Farmers' Information Literacy and Productivity Performance of Smallholder Horticulture in a Highland Zone, Kenya

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors collaboratively designed, implemented the study and wrote the manuscript. Both authors read and approved the final manuscript.

Article Information

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ABSTRACT

The horticulture sub-sector contributes substantially to the Kenyan economy, but smallholder productivity is low. This study investigated the role of information literacy on smallholder horticultural productivity performance in a lower highland zone of Belgut Sub-county, Kericho County, Kenya. The study used descriptive cross-sectional survey design. Data were collected between January and April 2019. Smallholder horticulture farmers who previously participated in a program; NALEP, in Belgut Sub-county were purposely selected and interviewed. Data was collected from 31 respondents through face-to-face household interviews using pre-tested semi-structured interview schedules and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics were utilized to document the farmers' information sources. Associations between attributes were analyzed by running Goodman and Kruskals' gamma and Somers' d. Findings indicated that the smallholder horticulture farmers obtained horticultural information mostly from the public extension, but also from private companies, NGOs/FBOs, mass media, and other farmers. Farmers' level of formal education, organizational skills, accounting, and farming skills; as indicators of information literacy, showed moderate strength of relationship with

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productivity and profitability (Gamma = 0.200 to 0.563) but showed mixed strength with horticultural produce quality (Gamma = 0.138 to 0.948).Somers delta showed similar patterns (Somers d = 0.089 to 0.684). When the four indicators of information literacy were amalgamated into an information literacy score, there was evidence of a moderate strength monotonic relationship between information literacy and performance as measured by the Spearman rank correlation; r_s (29) = .571, *P* = .001.The study concludes that farmers obtain horticultural information from diverse sources. Information literacy contributes to the productivity and profitability of smallholder horticulture. Capacity building of the farmers on information literacy is recommended.

ABBREVIATIONS

FBO   : Faith-Based Organization
ICT   : Information Communication and Technology
IL   : Information Literacy
NALEP   : National Agriculture and Livestock Extension Program
NGO   : Non-Governmental Organization

1. INTRODUCTION

Agriculture is one of the most important sectors worldwide; both in developed and developing countries. It plays a vital role in the socio-economic development of many countries globally [1]. In Kenya, the sector contributes 51 percent of Kenya's GDP and accounts for 60 percent of employment and 65 percent of exports [2]. Smallholder farmers dominate the sector with farms of between 0.2 and 3 hectares. These smallholder farms account for 78 percent of total agricultural production and 70 percent of commercial production [3]. The horticulture sub-sector of agriculture similarly contributes largely to the Kenyan economy through wealth creation, poverty alleviation, and gender equity in rural areas [4]. The sub-sector is second to tourism in regard to foreign exchange earnings and employs about 2.5 million people in both formal and informal setups [5]. It has been argued that the dependence on agriculture by a large proportion of the Kenyan population underscores a need for the enhancement of agricultural productivity [6]. Such productivity enhancement may require enhanced access to agricultural information among smallholder farmers.

The agricultural information and its access enable stakeholders in the farming system to make informed decisions towards increasing agricultural productivity [7]. Kenya's devolution process in governance as envisaged in the constitution of Kenya (2010) requires every County to identify and support growth stimulators in their jurisdictions [8]. The main sources of agricultural information for farmers in Kenya include; public, private for-profit, and private nonprofit organizations [9]. However, reports suggest that farmers' preference for any source is influenced by such factors as age, group membership, household size, land size, and ownership of mobile phones [9]. Despite the existence of various sources of agricultural information, a small proportion of smallholder farmers are accessing and utilizing it. The inadequate access to agricultural information has been cited a cause for low agricultural production, food insecurity, and poor livelihoods [8]. Based on this, extension agents are expected to ensure that the smallholder farmers can identify, access, and utilize the information on modern farming methods. This is important for agricultural information literacy.

Agricultural Information Literacy (IL) has been explained by authors as a set of skills and competencies for identifying, accessing, and utilizing agricultural information for enhanced agricultural productivity [10]. A study conducted in China by [11] on agricultural IL of farmers shows that farmers lacked skills in identifying the sources of information they preferred. The same study also noted that access to information had a significant and positive relationship with enhanced agricultural productivity. A similar study by [12] revealed that the overall information literacy of the new generation farmers was relatively weak. The lack of knowledge deterred them from mastering and utilizing modern information tools, preventing their realization of agriculture informatization.

Despite the importance of horticulture and availability of various sources of agricultural information in the study area, farmers have not exploited their potential in productivity due to a low level of information literacy. The information that farmers seek from various sources culminates in such skills as; farming skills, organizational skills, and record-keeping or accounting skills. The level of farmers' education is also thought to add to the skills required by horticultural farmers [12]. These skills which are possessed by farmers differently are treated as indicators of information literacy in this study.

The purpose of the study was to investigate the role of information literacy on smallholder productivity and profitability in a highland of Kericho County, Kenya. The study objectives were; to investigate sources of information for smallholder horticulture farmers and establish the relationship between information literacy on the one hand with productivity, profitability and produce quality of smallholder horticulture farmers on the other. The concept of Information literacy in the study was measured through the farmers' level of formal education, organizational skills, record- keeping/accounting skills and farming skills as proxy indicators for the farmers' information literacy. The outcome variable of productivity performance was based on three indicators; productivity, profitability, and quality of the horticultural produce.

Productivity: Horticultural productivity was measured based on the output per unit of land. The interviewees were asked to self-assess their performance on a scale of 1 to 3; low, medium, and high.

Profitability: Horticultural profitability was measured based on the estimated Gross margins per unit of land. The interviewees were asked to self-assess their performance on a scale of 1 to 3; low, medium, and high based on their records. This indicator represented their level of satisfaction with the profits attained during the last one year.

Produce quality: Produce quality was explained to the interviewees as the ability of the horticultural produce to meet the consumers' expectations. This indicator was treated as one of the proxies for productivity performance. It was measured on a three-point scale (low, medium, and high). The interviewees rated their horticultural produce accordingly.

2. METHODOLOGY

2.1 Study Site

This study was carried out in Belgut Sub-county. It is one of the six sub-counties in Kericho County (Fig. 1). The study area falls under a Lower Highland (LH$_2$) agro-ecological zone. This is a tea, horticulture, and dairy zone. It receives an annual rainfall of between 1150 and 1550mm and an average annual temperature of 18°C [13]. The area receives long rains from March to May and short rains from August to October every year. The mean altitude is 1650 meters above sea level. The major horticultural crops grown in the Sub County by smallholder farmers for farm income and consumption are; Bananas, pineapples, avocadoes, tomatoes, kales, and cabbages.

2.2 Research Design and Sampling

A descriptive cross-sectional survey design was used for the study. Belgut Sub-county was purposively selected for the study on information literacy in the horticulture sub-sector given the importance of the sector in the county and the proximity of the county to the county headquarters where demand for the horticultural produce is high. Farming is the major occupation of the majority of the residents of this County; hence, the need of bridging the information gap for these farmers is essential for enhanced productivity. Farmers who previously participated in a National Agriculture and Livestock Extension Program (NALEP) were targeted for study. The program had advocated for linkages between farmers and service providers. NALEP program was carried out in the 8 locations of Belgut Sub-county. The targeted areas were referred to as focal areas and in each focal area there were about 100 farmers [14]. For this study, one focal area was purposely selected among the 8 focal areas owing to its proximity to horticultural produce markets. One-third of the farmers in the selected focal area were randomly selected for the study. This formed a sample of 31 farmers. Proximity to a large horticultural produce market was thought to be an incentive for horticultural production in the study area.
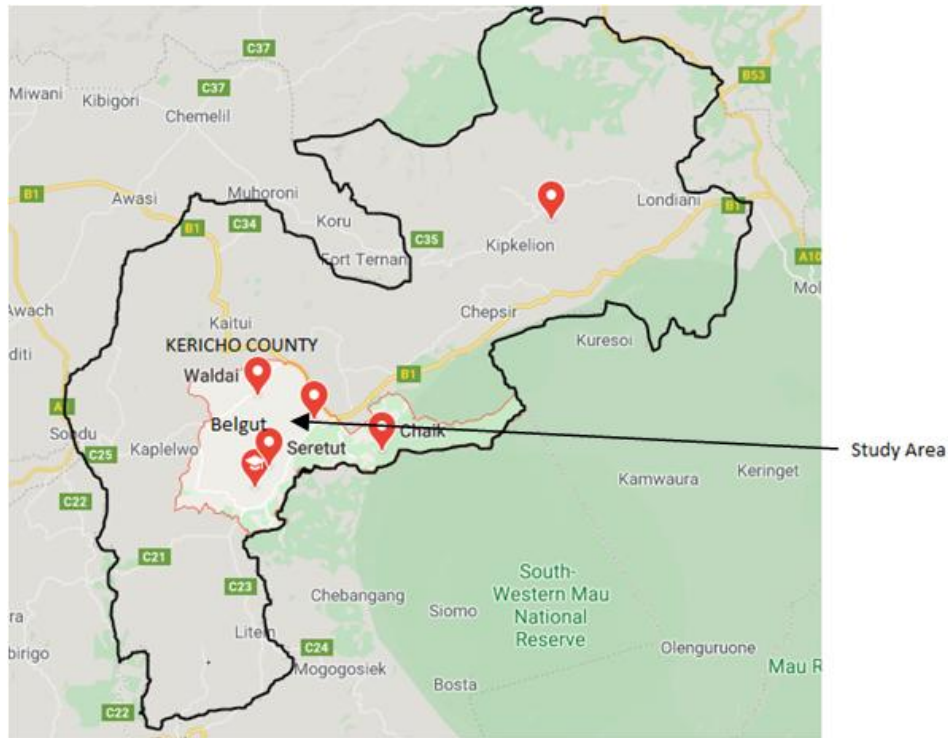
Fig. 1. Map of Kericho County, Kenya showing the study area
Source: Primary map from Google maps

2.3 Data Collection

Data were collected from the 31 respondents through face-to-face household interviews using a pre-tested semi-structured interview schedule. It was composed of questions that sought for answers from the respondents on their information literacy, sources of information, productivity, produce quality, and profitability of their horticultural enterprises. Information literacy was measured using some variables; level of formal education, organizational skills, record keeping/accounting skills, and farming skills. Productivity was measured based on the output per unit of land and profitability was measured based on the estimated Gross margins per unit of land, whereas quality was measured based on the ability of the horticultural produce to meet the consumers' expectations. All the variables, except sources of information, were rated on a scale of 1 to 3; low, medium, and high. The interviewers encountered challenges associated with differences in the levels of understanding among the smallholder horticulture farmers. In some cases the interviewers took long duration explaining the indicators to some interviewees to ensure they clearly understood the concepts.

2.4 Data Analysis

The categorical ordered data obtained from the interview schedules were subjected to tests for association using Goodman and Kruskals' gamma and Somers' delta. The two tests are recommended where the dependent and independent variables are ranked. Whereas Goodman and Kruskals' gamma reveals the strength of association between variables it does not distinguish between the independent and dependent variables since it is an asymmetric measure [15]. According to [16] the gamma coefficient is robust when the table dimension is small for relatively small sample sizes. The current study tabulates data on a small table dimension of 3-square for a sample of 31 participants. The Gamma coefficient is largely deemed the appropriate estimator for the association between the variables in this study. To assess the strength and degree of dependency of the dependent variables therefore a Somers' D analysis was run between the data sets on SPSS version 20 for windows. Since the Somers' Delta is an asymmetric measure of association, it provided a suitable measure of estimating the degree to which the presumed dependent variables of productivity, profitability,

and produce quality could be predicted based on the presumed independent variables. Further analysis for correlations was conducted using the Spearmans' rank correlation to establish if there was some monotonic relationship [17] between the ranked data sets on information literacy on the one hand and productivity performance on the other hand.

The Spearman's rank correlation assesses for the monotonic relationship between variables and is an appropriate measure for both ordinal and continuous data.The rank correlation coefficient (r_s) is obtained by the formula;

$$r_s = 1 - \frac{6 \, \Sigma di^2}{n \, (n^2-1)},$$

where d_i is the difference between the ranks of the paired observations and n is the number of observations. The formula, however, applies only in cases where there are no ties in the ranks. In cases where there are ties in the ranks, the formula reverts to that used for Pearsons' correlation, but the ranks are used in the formula instead of the actual observations [17]. Thus the formula used where there are tied ranks reverts to;

$$r_s = \frac{\Sigma(Rxi-\overline{Rx})(Ryi-\overline{Ry})}{\sqrt{\Sigma(Rxi-\overline{Rx})^2 \Sigma(Ryi-\overline{Ry})^2}}$$

where Rx_i and Ry_i are the ranks of the paired observations x_i and y_i and Rx bar and Ry bar are the means for x and y respectively. The computation of the rank coefficients was performed using SPSS version 20 for Windows.

3. RESULTS AND DISCUSSION

3.1 Socio-Economics of Participants

Regarding chronological age, the participants were mostly aged between 20 to 30 years (51.6%) suggesting the horticultural enterprise in the locality was dominated by youth. Participants aged 31-40 years formed 19.4% of the participants, 41-50 were 16.1% and 51-60 years were 9.7%; 1% were under 20 years. 58.1% were males and 41.9% were females. All the respondents had a formal education. Among them 22.6% were educated to primary level, 48.4% to secondary level and 29% were post-secondary level graduates.

3.2 Main Sources of Horticulture Farming Information

The participating farmers were interviewed to elucidate their main sources of information for the practice of horticulture production. Five main sources of information were identified; the majority of the respondents relied on Extension services offered by Public Extension (35.5%). Another 22.6% of the interviewees relied on Extension services offered by Faith-based organizations (FBOs) and Non-Governmental Organizations (NGOs). 22.6% relied on other farmers for information, 16.1% relied on private companies involved in the marketing of farm inputs and those purchasing farm produce, while 3.2% relied on mass media (Table 1).

The findings in the current study are in line with those obtained by [8] which indicate that Kenyan farmers have a wide variety of information sources from which they can obtain agricultural information. The study further reveals that the public extension sector is the most utilized source of agricultural information. This contradicts the findings by [18], who found that in Pakistan, the majority of farmers (47.5%) ranked neighbor-friends-relatives and other farmers as the first source of information while only (10%) ranked agricultural extension staff as a first information source.

Table 1. Main source of horticultural information

Source	Frequency	Percent
Public Extension	11	35.5
Private Company	5	16.1
NGO/FBO	7	22.6
Mass Media	1	3.2
Fellow Famers	7	22.6
Total	31	100.0

Source: Survey Data, 2019

In another study conducted in Nigeria, [1] found that the larger percentage of the respondents used the radio more often than government agents since their services are restricted to a small number of farmers who were registered members of a group. These findings contradict the results in the current study, where only (3.2%) utilized the radio as a source of agricultural information. A study by [19] in India revealed that farmers perceived a lot of constraints in private extension services for fear of exploitation due to a lack of regulatory mechanisms from the government. Furthermore, Private for-profit service providers are concentrated in areas with households that are well off [8]. Private non-profit service providers are preferred by farmers but limited resources constrain their coverage. This current study contrasts the findings by [20] who found that 75.47% of the respondents had confidence in training programs done by NGOs on horticultural production in Murang'a County. The current finding in this study suggests that NALEP may have aided the interaction between public agricultural extension agents with the farmers; explaining why most farmers rated public extension services as their main source of agricultural information.

3.3 Formal Education and Productivity

Formal education in the current study was regarded as an indicator of information literacy. This proxy of information literacy was tested for association with productivity and profitability as reported by respondents. There was a moderate strength of association between the education levels of the participant with horticultural productivity (G =.384). When education levels were treated as an independent variable using the asymmetric Somers' D test there was still a moderate strength relationship; D = .238 and D = .251 for productivity and profitability respectively (Table 2). There was a weak association between the indicator with the quality of horticultural produce (G =.297, D = .178).

Formal education can be regarded as a process of learning in which literacy is the outcome. The learning itself means a process of developing ones' ability to understand and act in a more sophisticated way within a certain practice [21]. The current focus is on the practice of horticultural production. The findings in this study permit an argument that the information gained from schools has a role to play in solving problems associated with farming as evidenced by the moderate strength of the relationship

between schooling and productivity. It has been argued before that education entails the use of technical tools and the development of a way of thinking aimed at the consciously planned realization of interests [22]. Other studies have shown that education is important in improving agricultural productivity. Formal education opens the mind of the farmer to knowledge whereas non-formal education gives the farmer hands-on training. Informal education keeps the farmer abreast with changing innovations and ideas while allowing the farmer to share experience gained [12]. Moreover, formal education may enhance farm productivity directly by; improving the quality of labor, increasing the ability to adjust to disequilibria, and to successfully adopt innovations [23]. Furthermore, educated farmers can understand financial transactions and keep records, increasing the likelihood of obtaining credit [23]. This argument is in tandem with the current observation in which formal education has a positive role to play in horticultural productivity. It suggests that formal education may have aided knowledge and skills-seeking for productivity enhancement in the horticulture sub-sector.

3.4 Organizational Skills and Productivity

The participants were asked to rate their organization skills as a proxy for estimating their levels of information literacy in horticulture production. The indicator was explained by the interviewer consistently as the ability to use resources available in an effective way. This indicator was explained the same way by the enumerator to all the interviewees. Each interviewee rated the indicator on a scale of 1 to 3; representing low, medium and high.

The level of organizational skills was cross-tabulated with the levels of self-reported productivity levels (low, medium, and high). A test for correlations revealed that there was a moderate strength of the relationship between organizational skills reported and productivity (G = .283). When treated as an independent variable, organizational skills still moderately linked to productivity (D = .303) and profitability (D = .183). Organizational skills were moderately associated with produce quality (G = .478, D =.297). The results are similar to those obtained by [24] while studying drivers of productivity among smallholders from Pakistan's horticulture sector. They found that the bottom 10% of farmers needed to improve their technical efficiency by about 35% to catch up with the top 10% performing farmers.

These findings indicate that farmers could improve their farm productivity through better utilization of input resources if there are better education and training programs. Author [25] defines technical efficiency as the ability of the farmer to produce maximum output from a given level of inputs, whatever these inputs are. Author [24] asserts that excessive use of inputs for a given level of output or the production of less output from a given level of inputs results in technical inefficiency. Similarly, inappropriate use of the mix of inputs leads to allocative inefficiency. It has therefore been argued that the farm-level productivity can be improved by increasing the level of outputs with the same inputs or through changes in relative input and output prices. [26], further notes that growth in agricultural productivity depends on improved input use efficiency, among other factors. The current findings suggest that farmers' organizational skills aided the utilization of input resources; resulting in an increased horticultural productivity performance.

3.5 Record-Keeping/Accounting Skills and Productivity

The planning and tracking of a farm business are thought to influence productivity and profitability. For this purpose, record keeping is an important practice in agribusiness. The ability of a horticultural farmer to understand this practice and put it into use was used as an indicator of information literacy in good farm practice. The respondents were interviewed on their assessment of the level of record-keeping or accounting, ranging from low to medium and high. Record-keeping was explained by the interviewer as the practice of keeping documents on production inputs and outputs. After the explanation, the interviewees were asked to rate their levels; their ratings were classified as low, medium, or high. Since some farmers kept their records in their memory none of the respondents could be classified as having no records.

An analysis for correlation revealed a moderate strength of relationship between record-keeping on the one hand and productivity and profitability on the other; G = .308 and .563 respectively. When treated as an independent variable, record-keeping could aid the prediction of productivity and profitability by about 41.9% or .419 (Table 1). Record-keeping was strongly associated with produce quality (*G* =.948, *D* =.684). The findings of this study are in line with those of [27] who found that majority of the

poultry farmers (52%) rated themselves as moderate in the practice of record-keeping, 44% as a high, while 4% represented farmers who kept the lowest number of farm records. The relationship between record-keeping and productivity in the current study is supported by [28], who argues that there is a need for SME to keep proper records to enhance their profitability and continuity. Good record-keeping enables business firms to plan properly and also to curtail misappropriations of resources [29]. Author [30], noted that poor record-keeping or non-availability of financial records have consequences of mismanagement of resources and poor cash management.

The opinion offered by [31], similarly asserts that the major benefit of keeping a proper record is to know the performance of the business. Author [28] also found that the majority of farmers (96%) in his study area kept production records. These high percentages suggest that most commercially-oriented farmers are more concerned about the productivity of their farm business. According to [29], the majority of the farmers (95%) kept financial records for tracking financial performance. These show the importance farmers attach to their financial needs. However, researches conducted in Zambia, Tanzania, Uganda, Namibia, Swaziland, Malawi, Ghana, and Kenya by [32] and [33] revealed that small-scale farmers rarely keep a record of their farm business. Author [32] noted that the lack of sensitization on the importance of farm record-keeping on the performance of farm businesses by extension agents or enumerators is a constraint of keeping farm records. An association between record-keeping and productivity in the current study may be attributed to a commercial-orientation of the farmers who keep records for purposes of informing their decisions towards performance improvement.

3.6 Farming Skills and Productivity

Skills in farm operations were treated as an indicator of information literacy. Skills are regarded as the ability to carry out a task with the relevant expertise. In the current study farming skills were explained to the interviewees as the ability to carry out horticultural farm practices well. After explaining the indicator clearly to the horticulture farmers, they were asked to assess themselves on a 3-point scale; low, medium, or high. This indicator of farming skills was cross-tabulated with productivity, profitability, and quality of produce. The cross-tabulation analysis

revealed a moderate strength relationship with productivity and profitability (Table 1), but the association between farming skills and produce quality was very weak (*G* = .138, *D* =.089).

Author [34] defines farming skills as all activities undertaken to acquire knowledge, attitudes, and capacities to enable efficient and effective agricultural production/farming. The relationship between farming skills and productivity in the current study is supported by [35], who found a positive impact of rice production training on rice yields in both irrigated and rain-fed areas in Ghana, Mozambique, Senegal, Tanzania, and Uganda. The authors assert that the processing of agricultural products, packaging, and marketing of those products as well as application development using ICT to improve management of production requires a skilled individual. A study in Pakistan by [24] revealed that the majority of smallholder farmers were poor in the best practices due to technical inefficiency. It implied that education and training programs were required to improve smallholders' farming skills. In the same study, access to media and technology such as TV/radio and mobile phones were found to have a positive impact on the uptake of innovation practices, which resulted in higher productivity and profitability. The findings suggest that those farmers who interacted regularly with extension agents and other sources of agricultural information had gained various farming skills resulting in higher horticultural productivity. The study finding implies existence of a strong link between farmers' gained-skills and the productivity of the horticultural enterprise.

3.7 Data Amalgamation into Information Literacy Score

The information literacy levels as indicated by the four variables of formal education, organizational skills, record keeping, and horticulture farming skills was summarized as one interval scale measure. Each of the four indicators had a maximum score of 3 and a minimum score of

1.When the four indicators were summed up, it gave a minimum score of 4 and a maximum possible score of 12 for each participant. These scores which ranged from 4 to 12 were treated as a self-reported score for the individual on Horticultural Information Literacy (IL). The IL score was subjected to correlation analysis with productivity performance using Spearman's' rank correlation.

Based on the observed value of the coefficient as computed from SPSS, the information literacy had a moderate strength association with productivity performance; $r_s(29)$ =.571, *P* = .001. This finding suggests that the four indicators of information literacy used in this study could explain a significant proportion of the performance of smallholder horticulture. A graphical representation (Fig. 2) similarly indicates that there is a monotonic relationship, but indicates the presence of outliers within the middle scorers; those with a mean score of about 7. The outliers may be attributed to exceptional cases. The Spearman correlation, unlike the Pearson correlation coefficient, does not require the assumption of normality [36]. The spearman correlation coefficient; r_s (29) =.571, *P* =.001, suggests that the information literacy score was a good predictor of the productivity of the smallholder farmers. According to Hopkins (1997) as cited by [37] such an effect which lies between .5 and .7 is regarded as a 'large' effect size. The large effect size therefore suggests a strong evidence of the monotonic relationship between information literacy and performance as measured by the Spearman's rank correlation (r_s (29) = .571, *P* = 0.001).

The current findings contradict those of [10], who found that there was no significant association between IL and enhanced agricultural productivity among the paddy farmers in Sri Lanka. However, he found a significant relationship between accesses to information and enhanced agricultural productivity. Author [38] highlighted the importance of information literacy towards the optimization of

Table 2. Gamma and somers' D coefficients between predictors and performance indicators

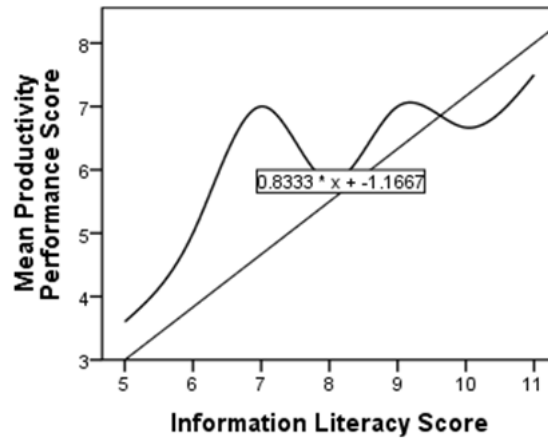| Indicator variable	Productivity		Profitability		Quality	
	Gamma	Delta	Gamma	Delta	Gamma	Delta
Formal Education	.371	.238	.384	.251	.297	.178
Organizational Skills	.458	.303	.283	.183	.478	.297
Record-Keeping skills	.308	.200	.563	.419	.948	.684
Farming Skills	.326	.211	.403	.258	.138	.089

Source: Survey Data, 2019

Fig. 2. Productivity performance by information literacy score
Source: Survey Data, 2019

farming activities among farmers in Nigeria. A study by [39] on the factors affecting productivity and profitability of vegetables in Swaziland, noted that the level of education had a positive relationship with profitability and was significant at a 1% significance level. The results indicated that with an additional year of education, profitability would increase by 0.304. Author [40] asserts that education helps to unlock the natural talents of vegetable farmers and inherent enterprising qualities. In the present study there is some evidence that farmers with better formal education, organization skills, record-keeping and farming skills had higher horticultural productivity. This implies that information literacy is a significant input in the enhancement of horticultural productivity.

4. CONCLUSION

The study concludes that horticultural farmers obtain information from a wide range of sources. The farmers obtained horticultural information from the public extension, private companies, NGO/FBO, mass media, and other farmers. Agricultural information literacy contributes to the productivity, profitability, and produce quality from smallholder horticultural farms. Information literacy had a positive influence on horticultural productivity, profitability, and produce quality. This study is of importance to the farmers, extension agents, and policymakers. It is recommended that the County government makes a deliberate effort to invest in the information literacy system and provide support for horticulture sub-sector public extension service and other service providers to improve on the information literacy among the smallholder

horticulture farmers. There is a need to strengthen the extension services to train the farmers on identification, access, selection, and utilization of horticultural information from a variety of available sources to optimize horti-cultural productivity. An effective Horticultural information literacy system will support the entire horticultural value chain in the highland zones of Kenya which have a high potential for horticultural production. Further research is recommended to investigate the farmers' characteristics influencing the seeking, selection and utilization of horticultural information in the study area.

CONSENT

Individual consent was sought from the respondents before the administration of the data collection instruments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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