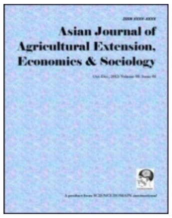

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Factors Affecting Technical Efficiency of Passion Fruit Producers in the Kenya Highlands

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Authors' contributions

This research was part of author CK's MSc thesis. Authors IM and MM were his thesis advisors. All authors contributed to the current form of the manuscript.

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ABSTRACT

The importance of passion fruit in livelihood improvement has been a key driver among rural households production participation in Kenya. The frequency of harvest and income flows compared to other farm enterprises in the fruit growing regions has been high. However, the productivity of the fruit remains low; an indicator of low technical efficiency. Using a semi-structured questionnaire, cross sectional data from 123 randomly selected passion fruit producers was used in the study to assess factors that contribute to purple passion fruit production efficiency in the Kenyan highlands. The study established a mean technical efficiency of 58.66%. Orchard age, credit amount used, non-passion fruit income and County variables significantly and positively influenced TE at 5% level. The level of education, extension advice use frequency and market access positively and significantly influenced technical efficiency at 10% level. In order to amend the current efficiency status upwards, passion fruit producers and support institutions should incorporate innovative measures towards resource use efficiency for increased productivity.

Keywords: Factors; efficiency; purple passion fruit; smallholder.

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1. INTRODUCTION

Like most developing countries, agriculture remains the mainstay of the Kenyan economy. In 2010, 26% direct and 25% indirect contribution of agriculture to the Kenya's GDP was recorded. The livelihoods of most rural dwellers depend on subsistence small scale farming which is rainfall fed. Majority of the farmers engage in low market value cropping which is dictated by the staple food requirements in Kenya (maize). The agriculture sector is a major informal employer (70%) in rural areas and also offers 18% in formal employment [1,2].

In Kenya, the horticultural sub-sector has increasingly become attractive due to the high market value of horticultural crops locally and internationally. Horticultural crops ranges from fruits, vegetables to flowers, the later being the leader in production due to huge export markets across the globe [2,3]. Approximately 80% of horticultural producers are smallholder in Kenya. Horticulture food crop production offers the best alternative for augmented food self-sufficiency because they are mostly early maturing, nutritious, offer employment and a source of income [4,5].

Over the last decade, horticultural fruit crops like passion fruit farming have attracted investment from high number of farmers due to their high market value, establishment of new (Kevian, Kasarani Fresh, Sunny, Premier Foods, Valley Orchard and Retief processors) and expansion of existing (Coca Cola and Delmonte) large scale beverage factories that use local fruits for juice extraction, expanding export markets [6] and increasing numbers of health conscious consumers [7]. However, the fruit productivity remains low at an average of 8 ton ha^{-1} compared to a potential of 24 ton ha^{-1}; an indicator of low technical efficiency.

The fruit is mostly produced by smallholder farmers on farms measuring from 0.10 to 0.81 hectares [8,9]. Passion fruit can be used as quick avenues of improving farmers livelihoods since they realize high yields more regularly since it is in production for at least 6 months (two 3 months seasons and harvested weekly) annually (in Kenya) which ensures frequent flow of income. The regular income flow promotes mixed farming enterprises monetary inter-dependence thus diversification. This also makes it a suitable enterprise for smallholder farmers who are resource constrained. Evidence from developing countries indicates that smallholder farmers face numerous challenges in utilization of available resources which affect their efficiency and productivity [10].

The influence on technical efficiency on passion fruit production was unclear in Kenya thus necessitating this study. Therefore, the study seeks to identify factors responsible for the current level of technical efficiency which has contributed to low productivity.

2. A CRITICAL REVIEW OF TECHNICAL EFFICIENCY STUDIES

Most recently [11] in the study of common bean productivity and efficiency in Uganda employed stochastic frontier model. Technical efficiency ranged from 0.91 to 85% and a mean of 48%. In this study age, farming experience, distance to the market, extension service and group membership significantly influenced TE. The researcher took a different approach from the norm on credit assessment where he assessed credit amount used rather than access to credit. Amount of credit used influenced TE negatively in this study. However, in assessing extension service the traditional aspect was taken by evaluation of access of extension service rather than use.

One of the major studies done in Kenya on measuring technical efficiency was on maize by [12]. The study involved high, medium and low potential areas where there were differing technical efficiency levels within and across the areas. Management practices and socio-economic characteristics were assessed on their influence on technical efficiency. Purchase of hybrid seeds, tractor use, school years and high potential variables positively and significantly influenced technical efficiency of farmers. However, the findings lacked the assessment of cost implication on technical efficiency as in the case of [13]. This would have boosted the literature on technical efficiency in relation to cost implication which is still limited.

In assessing technical efficiency in resource use among potato farmers in Nyandarua-Kenya, [13] estimated TE at 67%. The researcher employed stochastic frontier analysis. Education, access to extension services, access to credit and membership in farmer groups were found to significantly influence technical efficiency. The study addressed the cost implication of technical efficiency improvement. However, it lacked a robust assessment of extension services effect where the researcher addressed the aspect of access to extension rather than use. Extension access was a weaker measure compared to extension service use; access may not translate to use. In the study of agricultural extension in Ethiopia through a gender and governance lens [14] noted that effective extension services would ideally translate to a certain extent to farmers adopting new farming practices, growing new crops, or adopting inputs they didn't previously use. Therefore, the aspect of actual use of extension services supersedes access.

On the other hand [15] in a study on wheat in Uasin Gishu Kenya using Stochastic Frontier Analysis (SFA) found that small scale farmers were technically more efficient than their large scale counterparts. They scored TE of 88 and 86%, respectively. Access to credit was found to significantly influence TE. However, the study lacked an aspect of actual use of credit. The assessment of access to credit presented a limited and unreliable measure of influence of TE. The 'access' characteristic was weaker than the 'use' aspect because access does not translate into greater use of credit services [16].

In Uganda [17] employed SFA to measure the technical efficiency of banana production of smallholders. The researchers assessed banana productivity through emphasis of soil fertility and labour. In the study, rent and remittances were found to influence TE negatively. These results were contradictory to those of [18] where the expectations would mainly be that payment of rent and or remittances would make a banana producer to have increased access to the required resources to aid farming thus improved productivity and technical efficiency.

In China, [18] undertook a study to assess the effect of land rental market participation, land tenure contracts and off-farm employment on the TE in rice production in the rural areas. The TE scores ranged from 36 to 97% with a mean of 82%, [18] found that farmers that rented land were more technically efficient than those who owned or had contracted plots. These findings were consistent with [18] in the study of smallholder banana producers in Uganda.

In the study of pig farming in Greece, [19] argued that increasing the TE of a farm meant less input usage, lower production costs and ultimately, higher returns, which he cited as the driving force for most farmers in adoption of an enterprise. However, this may not be entirely the case since efficient management by a farmer is crucial in increasing efficiency. In the same way, Galanopoulos' notion of increasing technical efficiency could be achieved through better management practices thus optimal input usage rather than lesser usage which would lower production costs and eventually increase profit margins.

In the study of food crop production in West Africa, [20] estimated technical efficiency at 68%. The TE scores ranged from 2 to 90%. Age, education, credit, crop diversification and extension significantly influenced technical efficiency. A rare aspect in measurement and influence of technical efficiency was taken where crop diversification was found to influence TE negatively. However, the study assessed access to extension services rather than extension services use frequency.

Technical efficiency has also been employed in Micro-finance where their impact on micro-enterprises was assessed in Cape Coast by [21]. Age of an enterprise was found to influence technical efficiency negatively. Business experience, level of education and credit variables were found to influence TE positively. Hairdressers, dressmakers and wood-processors had 76, 83 and 89% TE respectively. A surprising outcome was observed in age and business experience which had a negative and positive effect on TE respectively. This was rather unusual in some way because having specialized in a micro-enterprise for a long time meant the owner had higher business experience and at the same time older. Therefore, the two variables would have at least had a similar influence on TE scores which the authors failed to explain.

An analysis of technical efficiency of rice farms in Nigeria applied Trans-log stochastic frontier production function [22]. The TE scores ranged from 30 to 98% and a mean of 87% was established. The study deviated from the common assessment of socioeconomic factors in the influence of TE. The researcher looked at a rather new aspect of technical efficiency in using traditional methods to frighten birds. Traditional methods used by farmers were found to influence technical efficiency positively.

3. METHODOLOGY

3.1 Theoretical Model

Stochastic frontier analysis (SFA) is basically an extension of the production function. As pioneers of SFA provides a candid explanation of the model [23, 24].

Suppose a producer has a production function $f(X_i, \beta)$, then in an ideal world the ith farm would produce:

$$y_i = f(X_i, \beta) \quad (1)$$

However, since this is not the case in the real world SFA provides a leeway in realization that each farm produces less than its potential due to inefficiency. Therefore, a farmer is likely to produce:

$$y_i = f(X_i, \beta)\mu_i \quad (2)$$

Where μ_i is the level of inefficiency of farm i (ranges 0-1). This implies that if μ_i=1 a farm is fully efficient that is attaining optimal output. On the other hand, if μ_i<1 the farm is attaining less output than its optimal using its current production technology. The inefficiencies encountered by a farmer in the production process are attributable to the farmer management and technology used in production. Therefore, technical inefficiency is entirely within farmer's control.

Further, in the real world, agricultural production is faced by constraints such as climatic conditions, insect pests and diseases thus variability in production. Additionally, accuracy of data gathered from small scale farmers depends on the farmer's recall capability which SFA modeling factors in [25]. These would be generally referred to as random shocks.

Essentially, μ is a component of ε (error term) thus ε-μ would result to the random shocks experienced in agricultural production that is the other component of the error term. This can be statistically represented as *v*. On this breadth by including the random shocks in a production function, then it will be of the form

$$y_i = f(X_i, \beta\ )\varepsilon_i \quad (3)$$

Or upon εi decomposition:

$$y_i = f(X_i, \beta)\mu_i\ exp\ v_i \quad (4)$$

Keeping in mind the effects of heteroscedasticity, the variables are in turn transformed into natural logarithms to ensure validity and reliability. Therefore the SFA model would be:

$$lny_i = \ln\{f(X_i, \beta)\} + \ln\ \mu_i + \ v_i \quad (5)$$

3.2 Data Sources and Sampling

A semi structured questionnaire was used for data collection among passion fruit farmers in Embu, Meru and Uasin Gishu Counties, Kenya. The data collected included passion fruit production and household socio-demographic characteristics. A total of 123 randomly selected passion fruit farmers were personally interviewed; 22 in Embu, 53 in Meru and 48 farmers in Uasin Gishu County. This was achieved through multistage sampling combining purposive sampling in identifying counties and districts, simple random sampling for administrative divisions and systematic random sampling for selecting passion fruit farmers. Cross-sectional data was used for the study; 1 year ranging from May 2011 to June 2012.

3.3 Empirical Model Specification

For this study either the Data Envelopment Analysis (DEA) method or Stochastic Frontier Analysis (SFA) could have been used. However, since the DEA does not take into account the importance aspect of variability in agricultural production and accuracy of data provided by smallholder farmers in the real world, SFA was adopted. The SFA simultaneously takes into account the random shocks and the inefficiency component in estimating a frontier function unlike DEA which assumes that all the deviations from the frontier are due to inefficiency [25]. The Stochastic Frontier as proposed by [23] was used for the study (model 6).

$$y_i = f(x; \beta)\varepsilon_i \quad (6)$$

Where i=1, 2… N, y is the output, x are inputs and ε (error term) = v_i-μ_i, *v* being the symmetric error and μ is the one sided error (technical inefficiency).

The Cobb Douglas functional form of the stochastic frontier was employed because of its simplicity and appropriateness in computation and interpretation. The Translog functional form could also have been used but suffers from multi-collinearity and degrees-of-freedom problems.

The functional and distributional assumptions as well as the values of unknown coefficients (βs, δs, μ and v) were estimated using the maximum likelihood estimates method (MLE) in STATA which makes use of the specific distribution of the error term and is more efficient than OLS.

The SFA consist of two parts; the production frontier (models 7 and 8) and the inefficiency model (models 9 and 10).

$$\mathrm{LnY} = \mathrm{LnA} + \sum_{i=1}^{7} \mathrm{B_i LnX_i} + \mathrm{V} - \mu \quad (7)$$

Where Ln are natural logarithms, A and B are the unknown parameters for estimation.

$$\mathrm{LnY} = \beta_0 + \beta_1 \mathrm{lnnumberofseedlings} + \beta_2 \mathrm{lnfarmsize} + \beta_3 \mathrm{lnfertilizer} + \beta_4 \mathrm{lnmanure} + \beta_5 \mathrm{lnpesticides} + \beta_6 \mathrm{lnhiredlabour} + \beta_7 \mathrm{lnfamily\ labour} + (v - \mu) \quad (8)$$

$$\mu_i = \delta_0 + \sum_{i=1}^{14} \delta_i Z_i \quad (9)$$

$$\mu_i = \delta_0 + \delta_1 \mathrm{county} + \delta_2 \mathrm{gender} + \delta_3 \mathrm{age} + \delta_4 \mathrm{education}_4 + \delta_5 \mathrm{farming\ experience} + \delta_6 \mathrm{household\ size} + \delta_7 \mathrm{orchardage} + \delta_8 \mathrm{seedling\ source} + \delta_9 \mathrm{extension\ frequency} + \delta_{10} \mathrm{farmer\ group} + \delta_{11} \mathrm{market\ access} + \delta_{12} \mathrm{irrigation} + \delta_{13} \mathrm{credit\ amount\ used} + \delta_{14} \mathrm{nonpassion\ income} \quad (10)$$

4. RESULTS AND DISCUSSION

4.1 Descriptive Analysis

The descriptive results of passion fruit farmers from the study area were computed as shown in Table 1. Most of the farmers had relatively small passion fruit orchards averaging at 0.22 ha; ranging from 0.04-1.21 ha and the median was 0.16 ha.

An average yield of 1907 kg of purple passion fruit per farmer was recorded in the three counties. This was realized by cultivating 0.22 hectares, where an average of 464 seedlings, 58 kg of fertilizer, 3164 kg of manure, 6 kg of pesticides, 36.90 of hired and 57 family person-days were applied.

Most of the purple passion fruit farmers used seedlings from local nurseries. Seedlings from local and own sources were used by 53 and 39% farmers, respectively. Only 8% of the farmers planted seedlings sourced from research institutions. Of the total farmers, 34, 38 and 28% were youths (19-35), middle aged (36-50) and elderly (>50), respectively. Out of 123 farmers selected for this study 120 farmers (98%) had attained formal education. Out of these, 37% had attained primary, 46% secondary and 15% tertiary education. The passion fruit production participation in regard to gender constituted 73% men and 27% women.

The average household size was 5 members with a range of 1-14. The selected farmers had an average of 3.48 years experience of purple passion fruit farming, the least being 0.90 years while the highest was 20 years. The age of the orchards ranged from 0.90 to 5 years.

Approximately 41% of passion fruit producers used credit on their purple passion fruit orchards. The amount of credit used in purple passion fruit farming averaged Kshs. 8,573, the highest amount being Kshs. 100,000. The non-passion income ranged from Kshs. 2,000 to 700,000 with an average of Kshs. 194,122 per annum.

Out of the 123 farmers selected for the study, only 39% were members of passion fruit farmer groups. The study recorded an average frequency of 2 times that farmers received and used extension advice (from extension agents and trained farmers among others) on their purple passion fruit orchards per annum. Approximately 55% of the farmers irrigated their orchards.

4.2 Stochastic Frontier Analysis: Factors Influencing Technical Efficiency

In the production frontier, the study established that number seedlings, passion fruit farm size, manure and hired labour had significant influence on passion fruit yields. On the other hand, the inefficiency model results showed that County, farming experience, orchard age, credit amount used and non-passion income variables were found to influence technical efficiency significantly at 5% significance level. Education, extension advice frequency and market access influenced TE significantly at 10% level (as shown in Table 2).

Table 1. Descriptive results of production, socioeconomic and institutional characteristics of the purple passion fruit farmers

Variables	Mean (p.a)	Std Dev	Minimum	Maximum
Output (kg)	1,906.94	5,216.17	2	48,000
Seedlings (number)	464.27	533.92	26	3,000
Passion farm size (ha)	0.22	0.52	0.04	1.21
Fertilizer (kg)	57.99	84.73	0	509
Manure (kg)	3,164.15	4,080.83	0	24,000
Pesticides (kg)	6.06	13.74	0	105
Hired labour (person-days)	36.9	69.52	0	525
Family labour (person-days)	56.72	75.80	0	580
Farming experience (years)	3.48	2.50	0.90	20
Household size (persons)	4.55	2.82	1	14
Credit used (kshs)	8,573.58	17,855.60	0	100,000
Age of the main orchard (years)	1.57	0.73	0.90	5
Extension frequency (times)	1.78	2.61	0	13
Market access (km)	3.05	4.07	0	18
Non-passion income (kshs)	194,122.20	121,071	2,000	700,000

The County variable which represented the region from which the farmers under the study practiced passion fruit farming positively influenced technical efficiency. In this study, farmers from Meru were more technically efficient than those from Uasin Gishu and Embu. Generally, this observation indicated that a farmer from Meru County was likely to be more technically efficient than a counterpart from another County. The findings were consistent with (see: [10,12]) who established that the region in which a farmer practiced farming had influence on TE in the studies of maize in Kenya and Tanzania respectively.

Negative influence of farming experience on technical efficiency meant that it reduced TE among the fruit producers. The results revealed that an increase of purple passion fruit farming experience by 1 year reduced technical efficiency levels by 4%. This means that farmers with more years of farming experience in purple passion fruit production were less technically efficient compared to the less experienced ones. This observation was inconsistent with [21] in their study of microfinance enterprises in the Cape Coast, [26] in the study of policy issues in technical efficiency of small scale farmers in Nigeria and [27] in the study of rose cut-flower in Oromia Ethiopia who found that previous accumulated experience in an enterprise increased technical efficiency. These findings among the small scale purple passion fruit farmers in Embu, Meru and Uasin Gishu Counties of Kenya could be attributed to frustrations and challenges (diseases, pests and marketing arrangements among others) experienced in the past by farmers in the fruit farming. Further, farmers could have employed the same management practices year after year in changing environments whereas the practices may no longer have been effective such as use of Sporekill^{TM} for control of diseases which has been found ineffective in passion fruit [28]. The "resistance to change" attitude could be rampant in pesticides application and disease management practices which changes regularly.

Education level positively influenced technical efficiency. This meant that farmers who attained an extra level of education would improve their technical efficiency by an average of 1.04%. Results on the education variable showed that farmers who attained at least primary education were more efficient than those with no formal education. The farmers who had primary, secondary and tertiary education scored almost equal TE levels. These results on the effect of education on TE were consistent with the findings of [29] in Arabica coffee study in Cameroon, [10] in smallholder maize productivity research in Tanzania, [13] in the study of technical efficiency in resource use among irish potato farmers in Nyandarua-Kenya and, [30] in rice production study in Vietnam. The positive influence of education on technical efficiency indicates a positive impact of increased human capital on productivity. Education may have increased farmers' awareness and decision making in relation to farming technology. Basic education may have set a basis for better use of inputs and general management of orchards. In addition, [31] in the study of yam production and technical efficiency in Nigeria and [27] in Ethiopia were in agreement with the findings. However, [15] in wheat study in Uasin Gishu District Kenya and [11] in common bean productivity study in Uganda found education level to be insignificant factor in influencing technical efficiency.

The findings showed that non-passion fruit income influence on technical efficiency was positive. This meant that if the farmer non passion fruit income increased by 1% then TE would improve by 2%. Therefore, farmers with alternative sources of income tended to be more technically efficient compared to those without. These results were in agreement with [10] findings in Tanzania. This implied that farmers with other income sources were able to finance the running of purple passion fruit farming which is a high capital consumer during the initial stages and later (after 9 months) pay back. The maintenance of the fruit orchard was ensured with alternative sources of income thus higher efficiency.

Due to limited credit access, other farmer income sources may have been used to raise money which they required as working capital. However, as noted by [10] in the long run this practice might not foster specialization leading to a negative impact on efficiency. Farmers would therefore be advised to undertake a trade-off farm enterprise assessment, take up those that they could adequately manage to avoid distraction and neglect of the purple passion fruit orchards upon diversification. However, [12] findings on Maize study in Kenya were in contradiction with the results, off-farm income was significant but had a negative influence on TE.

The study results showed the amount of credit used to have positively influenced technical efficiency. This implied that credit use increased technical efficiency. The results indicated that an increase by 1% in amount of credit used on purple passion fruit orchards would increase TE by 0.22%. Farmers who used credit in their purple passion fruit orchards were more technically efficient than those who did not. Most of the studies conducted previously tend to prefer assessing the effect of credit access rather than credit use on technical efficiency. Studies including [21] in micro-finance, [32] in rice production in Mwea-Kenya, [20] in food crop technical efficiency research in Nigeria, [15] in wheat and [13] in irish potatoes research in Kenya found out that access to credit had positive influence on technical efficiency. In this study, a different approach to assess credit on purple passion fruit orchards was adopted. Amount of credit used was employed since it represented a more realistic approach unlike access to credit with the base argument that you may have access to credit and not apply or even if accessed not use it [16] on an enterprise. Therefore, ‘access to credit’ presents a limited and an unrealistic approach as a measure of influence on technical efficiency. [11] also used the same approach although amount of credit borrowed for farming was not significant in common bean productivity. For this study, the higher technical efficiency recorded for credit users signify that the obligation to account for debt acquired could have pushed farmers to be more technically efficient. The indebted farmers could have felt the need to work harder in order to meet their debt obligation and also make a profit. Further, when debt is acquired in lump sum the farmer can more timely cater for the running expenses of purple passion fruit orchards thus increased efficiency.

Purple passion fruit orchard age variable results showed that it had a positive influence on technical efficiency. For every one additional orchard year technical efficiency would improve by 17%. The older orchards were more technically efficient than the younger ones. However, when the orchards attained the age of 4 years their technical efficiency started to decline. The results were consistent with the findings of [33] who established that the age of plantain (*Musa* spp.) affected its productivity. The results in this study could be explained by the increasing yields of purple passion fruits as the orchards grew older up to the age of 4 years where technical efficiency scores started to decline. Technical efficiency of the fruit farmers followed a sigmoid curve as the years advanced.

Best management practices may therefore be adopted to reduce the negative effect of age on production and productivity.

The frequency of extension advice positively influenced technical efficiency as had been hypothesized. The results meant that an increase of extension frequency by 1% would contribute to improvement of TE by 0.85%. The results indicated that the more frequent farmers received extension advice (provided by agricultural officers and trained farmers) on purple passion fruit farming the more efficient they were. The results were in contradiction with [34] findings in technical efficiency measure of wheat in Egypt

Table 2. The stochastic frontier model of purple passion fruit farmers in the Kenya highlands

Variable	Coefficient	Standard error	Z
Ln output (kg ha^{-1})			
Number of seedlings (number ha^{-1})	0.80	0.37	2.14**
Farm size under passion fruit (ha)	-1.15	0.45	-2.57***
Fertilizer (kg ha^{-1})	0.14	0.11	1.25
Manure (kg ha^{-1})	0.88	0.28	3.17***
Pesticide (kg ha^{-1})	-0.07	0.19	-0.36
Hired labour (person-days ha^{-1})	0.37	0.17	2.22**
Family labour (person-days ha^{-1})	-0.03	0.14	-0.22
_cons	-2.84	1.30	-2.19**
lnsig2v _cons	-1.85	0.58	-3.19***
lnsig2μ_cons	-0.59	0.43	-1.37
Variance parameters			
sigma_v	0.31**	0.04	
sigma_μ	0.75**	0.25	
sigma2	0.65**	0.20	
Lambda (λ)	2.42**	0.35	
Mean technical efficiency (overall)	58.66 %		
Technical inefficiency model			
County	-2.19	1.02	-2.15**
Gender	2.24	1.65	1.35
Age	0.74	0.73	1.01
Education	-1.04	0.56	-1.86*
Farming experience	4.30	1.84	2.33**
House hold size	0.84	1.37	0.61
Orchard age	-16.70	8.03	-2.08**
Seedling source	-1.62	1.04	-1.55
Extension frequency	-0.85	0.51	-1.67*
Farmer group	1.80	1.25	1.43
Market access	-1.75	1.05	-1.67*
Irrigation	-0.15	0.51	-0.29
Credit used	-0.22	0.07	-2.92**
Non-passion fruit income	-2.39	0.92	-2.59**
_cons	-0.16	5.66	-0.03

, ** and * significant at 10, 5 and 1 % significance level respectively*

who found that 2 or more extension visits influenced technical efficiency negatively. Most studies done in the past on technical efficiency have used a dummy (have access or no access) to assess extension rather than the extension advice use frequency. These studies included [32,20,11] whose access to extension findings were significant and had positive influence on technical efficiency. The results may imply that the more frequent farmers received and applied extension advice, the more informed and better they became in decisions making thus the need for frequent update in farming information due to changing requirements in farming systems.

5. CONCLUSION AND RECOMMENDATIONS

The study established that resource use in passion fruit production was not efficient in the Kenya Highlands. The study also found that socioeconomic and institutional factors such as education level, farming experience, extension advice, credit amount used, orchard age, market access, non passion income and region (county) were responsible for the low technical efficiency of 58.66% among the fruit producers.

The positive effect of extension advice frequency implies that enhancing small scale farmers' access to information will improve technical efficiency. Therefore, policy makers should focus on pioneering effective institutional arrangements that would enhance extension access by farmers through deployment of participatory methods such as lead-farmer model, use of group training approach; farmer-driven extension demand and or intensification in the use of the extensive mass media available in the regions that would supplement and complement the efforts of the few extension workers.

The positive influence of amount of credit used on technical efficiency provides a basis for provision and use of credit. The high initial capital consumption and running costs by purple passion fruit farming enterprise can be provided through credit where farmers are unable to raise the required funds. Such funds include pesticides costs in passion fruit farming cannot be postponed otherwise high losses are incurred. Therefore, credit access should be enhanced to increase use for those farmers who are unable to raise the cost involved in purple passion fruit farming. Formation of operational and services oriented passion farmer groups should be encouraged.

In consideration of the findings of this study, emphasis on at least primary schooling would have a huge impact of attaining higher efficiency levels in purple passion fruit production. However, since there are some farmers who have not acquired formal education and its impact is not immediate, the purple passion fruit stakeholders should focus on promoting best orchard management practices. Therefore, provision of non-formal agricultural education could supplement or complement formal education. This can be done through regular training of farmers, farmer forums and on-farm practical demonstrations. The education should range from input access and use and best orchard management practices (training of vines and pruning, weeding, disease management, manure/fertilizer application, watering, soil conservation and harvesting among others).

Non-passion fruit income positive influence on technical efficiency of small scale purple passion fruit farmers is an indicator of inter-dependence of farm enterprises. Due to limited credit access by farmers, other farmer income sources provide an avenue to raise money which they need as working capital for purple passion fruit farming. However, in the long run this practice might not foster specialization leading to a negative impact on efficiency. Farmers are therefore advised to diversify income sources to a level they can adequately manage.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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