Journal of Innovative Agriculture and Social Development

journal homepage: https://rdpublishers.com/journals/index.php/jiasd

Article

Evaluation of the effect of farmers' experience on optimization of coffee yields in Chuka Sub-County, Tharaka Nithi County, Kenya

David Mwangi Kihoro[1,*], Geofrey Kingori Gathungu[2], Moses Gachoka Wainaina[1], and Vicky Nyambura Wairimu[3]

ggathungu@chuka.ac.ke[2]

[1] Department of Agricultural Economics, Agribusiness Agricultural Education, Chuka University, P. O Box 109-60400, Chuka, Kenya

[2] Department of Plant Sciences, Chuka University, P. O Box 109-60400, Chuka, Kenya

[3] Department of Environmental Sciences and Resources Development, Chuka University, P. O Box 109-60400, Chuka, Kenya

ARTICLE INFORMATION

Article history:

Received 27 March, 2022

Received in revised form 25 May, 2022

Accepted on 29 May, 2022

**Corresponding author:*

Kihoro David M.

davidkihoro.12@gmail.com

ABSTRACT

Many farmers in the coffee-growing areas are determined to maintain production despite the challenges associated with the sector. Despite the efforts made by National and County governments to maximize coffee production in terms of quantity and quality, yields have shown a downward trend. The study's objective was to assess the factors affecting farmers' experience optimizing coffee production in Chuka Sub-County, Kenya. Variables such as the years of coffee farming, the number of trainings attended, and the number of journals read on coffee production were evaluated. Proportional stratified random sampling was used to select a sample of 150 respondents from a population of 7,428 coffee farmers from ten cooperatives in the Chuka Sub-County, where each cooperative was treated as a stratum. The Chi- square test was used to establish an association between the effects of farmers' experience and optimization of coffee yield. The logit model also found the relationship between farmer experience and coffee yield optimization. Farmers' knowledge had a chi-square mean of 60.3%, indicating that it significantly affected coffee optimization. Out of the three factors evaluated, the few numbers of the training attended had a positive association with a chi-square of 36.643. The few years of coffee farming had chi-square values of 33.714, while the number of journals reads had a chi-square value of 24.21. The study also established that the number of years of coffee farming and the training attended positively and significantly affected yield optimization, while the number of articles read negatively and significantly affected optimization. Therefore, the research recommends that coffee farmers practice coffee farming for many years and increase training attendance to optimize coffee production.

Keywords: Coffee; farmers experience; optimization of production; yield

1. Introduction

Coffee is a major foreign exchange contributor in most producing countries (Schmitt & Perfecto, 2021). About 80 nations in the tropics, with more than 125 million people living in developing countries, depend on coffee for their livelihoods. Ogutu *et al*. (2022) noted that total export earnings of coffee have a positive and significant economic growth and Gross Domestic Product for most countries producing the commodity. *Coffea arabica* L and *C. canephora* Pierre are the two essential coffee varieties in producing countries. Utrilla-Catalan *et al.* (2022) stated that most coffee-producing countries are experiencing rapid loss associated with a lack of farmers' experience in optimizing coffee production. Coffee is the second most marketable trade agricultural product after horticultural products accounting for about 17.1 billion USD in the crop year 2015/2016 export (Lachenmeier *et al.,* 2022). South American, Asian, and African countries have been leading coffee producers worldwide for many years (Wahyudi *et al*., 2020). However, there has been a decline in coffee production from different major producers due to a lack of farm experience, which results in low productivity of the sector in terms of quality and quantity of coffee produced.

Famer's experience influences the knowledge on factors affecting production, such as changing climate that results in a higher incidence of either increased rainfall or drought and increased incidence of pests and disease. Farmers' experience improves production technology adoption, such as improved land management, crop varieties, and agronomic practices (García *et al.*, 2020). The major coffee-producing countries in Africa include Cote d'Ivoire, Tanzania, Madagascar, Uganda, Burundi, and Kenya, which export the commodity in raw form, thereby fetching low prices (Maundu & Karugu, 2018). However, research has established that a country like Ethiopia has been at the forefront of encouraging coffee farmers to boost their productivity through local cash crop processing using simple farm equipment (Nyamwamu, 2018). The process facilitates farmers' experience as they are in a position to learn different production processes to increase the quality of their coffee.

In Kenya, coffee production is an essential enterprise that offers a considerable income to farmers and foreign exchange that improves living standards at the farm level. Moreover, coffee production in Kenya has increased GDP, tax generation, and job creation. The increase is attributed to a significant rise in the value of coffee from $ 105.67 million in 2013 to $ 215.97 million in 2017. Most Kenyans have not adopted the consumption of coffee, with only less than 2.5 percent of the commodity being locally consumed despite high productivity. According to Nyamwamu (2018), from 2018, the production has declined, with earnings going to as low as $16.6 million, hence pushing the ranking of coffee yields to the fourth position after commodities such as horticulture, tea, and tourism subsectors which may be affected farmers' experience. Lack of farmers' experience affects the producer's assessment of pests and mitigation of factors such as changes in climatic conditions, which determine the productivity of coffee. Coffee production in Kenya employs about 30 percent of the value chain and contributes to about 10% of the total exports from the agricultural sector (Cheruiyot, 2022). Maundu & Karugu (2018) postulated that Kenya has a high potential for producing quality coffee, despite the country being faced with low yields, which are associated with a lack of promotion for domestic consumption, overproduction in the world during the 1990s crisis, low prices, strict rules prohibiting trade, uprooting of the coffee crop and inaccessible credit facilities. In Kenya, coffee is grown in counties of Kiambu, Nyeri, Kirinyaga, Muranga, Meru, Embu, Machakos, Tharaka-Nithi, Makueni, Nandi, Trans Nzoia, Bungoma, Vihiga, Kakamega, Kisii, Nyamira, and Migori (Ogutu *et al.,* 2022).

In Chuka Sub-County, the coffee farmers face many challenges associated with a reduction in area under coffee coverage, low production, and low farmers' income. According to TNCG (2018), the cooperatives located in Chuka Sub-County collected about 88,000 kg of coffee. Out of the 88,000 kg, only 11,000 kg gets to the market, which is facilitated by the poor quality of the cherry. The poor performance of coffee has dire effects on the income and economy of the farmers' area and in the Chuka Sub-County. Nevertheless, the coffee farmers in Chuka Sub-County have indicated that the production of the commodity remains one of the significant agricultural subsectors in the provision of income for the farmers. Different key players in the coffee subsector have come up with various measures to improve production and quality through general production practices. However, general production at the farm level continues to decline, with most coffee farmers abandoning farming the crop. The farmers who have abandoned coffee production have turned to other sectors such as dairy farming, construction and building, and tea production. Whether a farmer's experience enhances optimization or non-optimization of coffee yield remains unclear in studies. Deserting the coffee sector through abandoning and uprooting the crop in Chuka sub-County will severely affect the livelihood and economy of farmers in the area. Kawada (2020), MacNairn (2018), and Nghiem *et al*. (2020) have done research on factors influencing the cost of production and marketing affecting the optimization of coffee production, but there exists limited information on the manner farmers' experience affecting the optimization of coffee yields. This article investigated factors contributing to farmers' experiences that affect coffee yield. Furthermore, the study focused on how the number of years of farming, training, and journals read about coffee optimization as the factors influencing farmers' experience.

2. Materials and Methods

2.1. Study area

Chuka Sub-County is located in Tharaka Nithi County, Kenya. The study was done in three wards, namely, Karingani, Mugwe, and Magumoni, in the Sub-County in a total area of 308 km^2. TNCG (2018) stated that the area comprises multiple topographical factors that interact with each other giving the Sub-County an average climate condition. The topographic factors include prevailing winds, latitude, altitude, and vegetable cover. The area's annual rainfall ranges between 1200 mm and 2200 mm, and the annual temperature changes between 14 ^{0}C and 30 ^{0}C, which is suitable for the production of various crops, including coffee. Similarly, Chuka Sub-County is characterized by the aspect of a stable radiation surplus climate. The soils in the study area are influenced by Icelandic volcanic soil around Mt Kenya, which are well-drained, well-weathered, deep, and high fertility, facilitating the production of many crops.

2.2. Research design

The study used a descriptive cross-sectional design for targeting coffee farmers in Chuka Sub-County. The survey accommodated the collection of quantitative and qualitative data. In addition, the research design was vital in offering the researcher an in-depth understanding of the farmer's experience within the time allocated for the field work without manipulating the parameters of the research. The descriptive cross-sectional design also facilitated giving detailed characteristics of the different farmers practicing coffee production in Chuka Sub-County. The study used primary and secondary data, where primary data was collected through structured interviews and questionnaires, while secondary data was obtained from the literature review, i.e., journals. The research and research assistants administered the questionnaires to the farmers in various coffee cooperatives, while structured interviews were used to gather data from various officials in cooperatives such as treasurers, secretaries and managers, and officials in the ministry of agriculture in Chuka Sub-County. The questionnaires sought to establish farmers' experience through the number of years of farming, the number of trainings attended, and the number of journals read.

2.3. Sampling and data collection

A total population of 7,428 coffee farmers in Chuka Sub-County was used. The study applied proportional stratified random sampling to acquire a sample of 153 coffee farmers, where 140 responded to the research tool. The study treated each coffee cooperative as a stratum to ease sampling in the three wards. In addition, simple random sampling was applied to obtain respondents from the ten coffee cooperatives (Kabuboni, Kiangondu, Muiru, Kirubia, Gitareni, Magumoni, Thuita, Mwangu, Rebate, and Ndagani) in Chuka Sub- County since the researcher was able to classify the coffee farmers as mutually homogeneous. The study applied Slovin's formula to establish the coffee farmers' strata sample size.
The study applied Slovin's formula to establish the coffee farmers' strata sample size.

$$n = N \div [1+N(e)^2] \quad (1)$$

Where; n= sample size; N= Population size, e= level of significance; hence,
$n= 7{,}428 \div [1+ 7{,}428(0.08)^2] = 153$

The questionnaires and structured interviews used captured various factors influencing farmer's experiences that affect coffee optimization in the study area. The structured interviews and questionnaires addressed factors within farmer's experience influencing optimal coffee production. This study sought help from Agricultural Extension Office in Chuka Sub-County to ensure validity. Furthermore, Cronbach Alpha was calculated where a value of 0.802 was obtained, indicating the items included in the questionnaire were worthy. The study followed the three essential principles of the fundamental assumption of ethics: respect, fidelity, and confidentiality. In this regard, all data collected was used solely for this proposed study with no reference to individuals. All secondary data sources were acknowledged and cited in the report.

2.4. Data analysis

The questionnaires and structured interviews used captured various factors influencing farmer's experiences that affect coffee optimization in the study area. The structured interviews and questionnaires addressed factors within farmer's experience influencing optimal coffee production. This study sought help from Agricultural Extension Office in Chuka Sub-County to ensure validity. Furthermore, Cronbach Alpha was calculated where a value of 0.802 was obtained, indicating the items included in the questionnaire were worthy. The study followed the three essential principles of the fundamental assumption of ethics: respect, fidelity, and confidentiality. In this regard, all data collected was used solely for this proposed study with no reference to individuals. All secondary data sources were acknowledged and cited in the report.

$$\square^2\square\square\square = \Sigma[(\square_{ij} - \square_{ij})^2/\,\square_{ij}] \text{ .... (2)}$$

Where O denotes the observed frequency while, E represents the expected frequency at column j and row □.

The Chi-square statistic was calculated to establish if it was less or greater than Chi-square tabulated. Adekpedjou *et al.* (2015) reported that if the values for the $\square^2$ calculated were less than the values for $\square^2$ tabulated, the null hypothesis should be rejected and vice versa. In addition, the Logit model was used to analyze the relationship between the variables and the optimization of coffee yield. The association's establishment was essential in establishing the variation that varies significantly between the optimizers and the non-optimizers of yield.

2.5. Logit model specification for optimization

A logit model was applied to deal with the farmer's experience in optimizing coffee yield. The study's dependent variable was optimization, which took the value of 1 or 0. The value for 1 denoted a coffee farmer who optimized yield through his farming experience, while the value for 0 indicated a farmer who did not. Optimizers of coffee yield were defined as farmers whose number of years of coffee farming, the number of trainings attended, and the number of journals reads in the cropping year 2016/2017 and 2017/2018 optimized coffee yield. The non- optimizers were defined as farmers who did not maximize their production in the given cropping season.

Thus, the study adopted the following simple regression model to determine the relationship between the farmer's experience and the optimization of coffee yield.

$$\square_i = \square_0 + \square_1\square_1 + \square_1 \text{ .... (3)}$$

Where;

$\square_i$ represents for optimization of coffee yield with the value of 1 for optimizers and 0 for non-optimizers

$\square_1$represents the farmer's experience, denoted by the number of years of farming, training attended, and journal read. $\square_1$ refers to a disturbance term with a mean of zero.

Equation (3) was a typical linear regression model, but because the dependent variable's optimization of coffee yield is binary, it results in a linear probability model (LPM). However, in applying the regression model, keeping in mind that the explained variable is optimization taking the values of 1 or 0, the usage of LPM poses some challenges. Hence, to overcome the challenges posed by the LPM, the study adopted the logit model recommended by Gujarati et al. (2004). The cumulative logistic probability for the coffee yield optimizers was represented by;

$$\square_i = \frac{1}{1+e-z} = \frac{e^2}{1+ez} \text{ .... (4)}$$

Where; $\square_i$ represents the probability that an i^{th} coffee farmer optimized yield, and Pi is assumed to be nonlinear related to Zi

$$\square_i = \square_0 + \square_1\square_1 + \ldots\ldots\ldots \square_n\square_n + \square_1 \ldots\ldots \text{ (5)}$$

Then, (1-P), the probability of the non-optimizers of coffee yield is presented as

$$1 - \square_i = \frac{1}{1+e-z} \text{ .... (6)}$$

Therefore, by dividing Equation (5) by Equation (6), the study was in a position to obtain the odd ratios in favour of optimization of coffee yields.

The relationship between the farmer's experience and optimization of coffee yield in the study was estimated through the logit model. The explained variable was transformed by taking the natural log of Equation 4, as shown below.

$$\square_i = \ln\left(\frac{\square_i}{1-\square_i}\right) = \square_i = \square_0 + \square_1\square_1 + \square_2\square_2 + \dots \square_n\square_n + \square_i \quad (7)$$

Where;

Li is the log of odds ratios, Zi ranges from –∞ to + ∞ , and Pi ranges between 0 and 1

In order to specify the Logit Model, the study adopted Menard's (2002) specification baseline as follows.

$$\square_i = \beta_0 + \beta_1\square\square\square\square + \beta_2 TRAIN + \beta_3 JOURNAL + \varepsilon i \quad (8)$$

Where;

Y_1 denotes the log odd ratios of optimization for the $\square^{it}$ coffee farmer, β_0 is the intercept, $\beta_1\square\square\square\square$ is the number of years a farmer has been in coffee production, β_2TRAIN is the number of trainings attended that pertains to coffee production, β_3JOURNAL is the number of journals read on coffee production, and εi is the disturbance term.

3. Results and Discussions

3.1. Coffee production

The quantity of coffee produced for the last two years was a significant factor in the study to establish the influence of farmers' experience. The findings of this study showed that the majority of the respondents in Chuka Sub-County, at 50%, produced between 300-399.9 kg per acre of coffee in the crop year 2016/2017. Similarly, in the crop year 2017/2018 majority, 47.9% of the research participants produced between 200-299.9 kg against about 2,300 kgs of coffee attained by other producing nations in the world. The findings showed a deterioration in coffee production in the crop year 2017/2018 compared to the crop year 2016/2017 (Table 1). Further probing revealed that the low coffee production experienced in the crop year 2017/2018 resulted from low rainfall compared to previous years. Rainfall distribution directly affects effective flowering, the prevalence of diseases, and the maturation of coffee cherries. The findings of this study concurred with (van Keulen & Kirchherr, 2021), who argued that low rainfall stresses the coffee bush, is likely to lower the optimization and result in poor quality and quantity of coffee beans. Likewise, the productivity of coffee changes with changes in rainfall, and the drought experienced in Chuka Sub-County in the crop year 2017/2018 affected the overall coffee plant health resulting in declined production.

Table 1. Coffee Production in the Crop year 2016/2017 and 2017/2018 per acre

Quantity (Kgs)	2016/2017		2017/2018	
	Frequency	%	Frequency	%
1-99.9	7	5	12	8.5
100-199.9	15	10.7	17	12.1
200-299.9	40	28.6	67	47.9
300-399.9	70	50	40	28.6
400 and above	8	5.7	4	2.9
Total	140	100	140	100

3.2. Effect of farmers' experience on optimization of coffee production

The study investigated whether the farmer's experience influences the optimization of coffee production. The farmer's experience will be determined by establishing the number of years a farmer has been practicing coffee farming, the number of trainings attended by a coffee farmer, and the number of journals or reading materials a respondent has read.

3.3. Number of years of coffee farming

The findings of the study indicated that the majority of the respondents (42%) had over 20 years, 27.1% had between 16-20 years,
17.8.1% had between 11-15 years, and 9.3% had between 6-10 years, while 2.9% had below five years of coffee farming (Table 2).

Table 2. Number of years of experience in coffee farming

Years	Frequency	Percentage
Below 5	4	2.9
6-10	13	9.3
11-15	25	17.8
16-20	38	27.1
Over 20	60	42.9
Total	140	100

The findings of this study are in agreement with those of Ullah *et al.* (2015) and Nyamwamu (2018), who stated that the majority of farmers had farming experience for more than 20 years and reported that the number of farming years correlates with the farmer's experience. Farmers with few years of coffee farming have low yields per bush hence low optimization of coffee production, which concurred with Ullah *et al.* (2015).

The study also sought to establish whether the coffee farmers had been attending training to boost their knowledge in optimizing coffee production, where a "Yes" response was used for attendance and “No" for not attending. According to the results, the majority of the respondents, 57.1%, had not attended a single training in the past two years compared to 42.9% who had participated in training on coffee production (Table 3).

Table 3. Coffee optimization training attendance

Training Attendance	F	Percentage
Yes	60	42.9
No	80	57.1
Total	140	100

The majority of the respondents had not attended training in the past two years. This may explain why the farmers in Chuka Sub-County are not attaining standard production of 2300 kg. This study concurs with the findings of Abdi-Soojeede (2018), Temple and Ziegler (2019), and Lyon *et al.* (2018), who reported that the majority of the farmers are less likely to attend the training have a low agricultural production compared to their counterparts. Further, the respondents who had attended the training were asked to indicate the number of training and the influence on the farmer's experience. The findings showed that most of the respondents, 45% attended between 11-20 training in a year. The results also showed that 25% of the respondents had participated in below 10 training, 16.7% attended between 21-30, while 13.3% attended above 30 training on coffee production in Chuka Sub-County (Table 4).

The findings of this study were in agreement with the results of Massimi (2017), who reported that most of the farmers were committed to other economic activities that limited the time scheduled for training.

Table 4. Number of Trainings Attended and the Impact on Farmers

Training	Freq.	%	Impact of training on optimization		
			Yes (%)	No (%)	Impact (%)
Below 10	15	25	18.3	6.7	25
11-20	27	45	35	10	45
21-30	10	16.7	10	6.7	16.7
Above 30	8	13.3	5	8.3	13.3
Total	60	100	68.3	31.7	100

However, the findings contradict the report of Alessi (2017), who stated that most farmers attended any training prepared by government agencies and other NGOs due to the program's benefits. The respondents who attended the training were also asked to indicate whether the training had an impact. The results demonstrated that the majority of the respondents who attended training, 68.3% believed that it positively impacted the optimization of coffee production. Contrary, 31.7% of the respondents indicated that the training had no effect (Table 4). The study established that coffee farmers had access to three ways of training. In case a farmer attended training in the past two years, the knowledge acquired would be used in the subsequent year to optimize coffee production. The first was the cooperative society field day, conducted during the annual general meeting. As a means to increase competitiveness, the different societies also employ extension officers to train farmers at the farm level. Secondly, it was observed that the way through which farmers in Chuka Sub-County access training is through educational tours to the Coffee Research Institute in Ruiru, where they can visit as a group or individually.

The study findings concur with Ghimire (2017) and Mwende *et al.* (2017), who reported that farmers who attended training increased production as the training exposed them to many available production techniques, which are drivers of increased productivity. These researchers further stated that training is a crucial factor that assists farmers in incorporating technological tools and new scientific advancements into their farm operations. The finding of this study showed that training was essential in enhancing coffee farmers' operations. The result was in agreement with Davis (2020) and Alda (2020), who indicated that training enhances farmers' operation, which increases efficiency.

During the study, respondents were asked whether they read material related to coffee production to boost their knowledge of optimizing coffee production. This was done using a "Yes" response for reading and a "No" for not reading. It was observed that 87% of the respondents had not read a single article in the past two years, but 20% had read a journal on coffee production (Table 5). The findings concur with those of Biramo (2018) and Singh *et al.* (2019), in their research in Nigeria, who reported that farmers were reluctant to read journals due to poor reading practice as a result of vocabularies used and farmers who adopted the practice of journal reading had increased crop production.

Table 5. Coffee production journal reading

Journal Reading	Frequency	Percentage
Yes	28	20
No	112	80
Total	140	100

The respondents who had read journals were asked to state whether the process had an impact on their farming practice, whereby 82% of the respondents indicated that journal reading had a positive effect on coffee yields (Table 6). The results indicated that the majority of the respondents, 71.4%, had read below two journals on coffee production. 14.4% of the respondents had read between 3-5 journals, and 10.7% had read between 6-8 journals, while only 3.6% had read above eight journals. The results also showed that 82.1% of the respondents were positively impacted by the practice of journal reading that assisted in the optimization of coffee production from the journal they read, against 17.9% who did not find any positive impact. The findings concur with a report of Lencsés *et al*. (2014) and Singh & Dhadse (2021), who reported that the practice of journal reading impacts the farmers with valuable lessons acquired from many years of experience in the agricultural sector across the world. The findings concur with a report by Alda (2020), who argued that journal reading expands farmers' knowledge and makes them smarter in their production practices.

The practice of journal reading adds the depth of coffee farmers' knowledge, impacting their capability to make decisions and production choices. Therefore, the number of journals read was directly proportional to knowledge acquired in the optimization of coffee produced. The absence of the journals, especially after the introduction of the devolved government in 2013, reduced funds allocation to the ministry of agriculture, which purchased the articles.

Table 6: Number of journals read and impact on coffee production

No of Journals	Freq.	%	Impact of Journal Reading		
Read			Yes %	No %	Total Impact

					%
Below 2	20	71.4	57.1	14.3	71.4
3-5	4	14.3	10.7	3.6	14.3
6-8	3	10.7	10.7	0	10.7
Above 8	1	3.6	3.6	0	3.6
Total	28	100	82.1	17.9	100

3.4. Mean agreement of the different factors influencing farmers' experience

The study also sought to establish mean agreement of the factors influencing farmers' experience, thereby affecting the optimization of coffee production. Sixty percent (60.3%) of the coffee farmers affirmed that the few numbers of years of coffee farming, the number of trainings attended, and journal reading reduces the farmers' experience (Table 7). The results of this study showed that the number of trainings attended profoundly influences the coffee farmer's experience. The findings of this study are in agreement with the report of Zelaya *et al.* (2017), who reported that farmers who are engaged in farming practices for many years are in a position to have more knowledge on pruning, weeding, minimum tillage, land preparation, and fertilizer application rate.

Furthermore, the results of this study concur with the agreement of Alda (2020), who noted the number of journals read by a farmer is positively associated with the level of farmers' experience. The findings contradict an argument of Lencsés *et al.* (2014), who stated that the level of experience derived from the journals is facilitated by the type of journal read. A farmer's level of experience determines the coffee production's optimization level. Experienced farmers understand the different methods that can be applied in the management of the farm.

Table 7: Mean agreement on a scale of 1-5

Factors	Mean 1-5 points	%age	F
The few numbers of years of coffee farming reduce farmers' experience	2.99	59.7	140
The few numbers of training attended reduce farmers' experience in coffee production	3.16	63.2	140
The few numbers of journals read reduces the farmers' experience in coffee production.	2.90	58	140
Total Mean	3.07	60.3	

3.5. Mean Chi-square Coefficients for the Factors Influencing Farmers' Experience in Optimization of Coffee Production

Furthermore, this study sought to determine the association between the number of years of farming, the attendance of training, and the number of journals reads with farmers' experience. The three variables were ranked to establish the means and standard deviations. The findings showed that out of the three factors evaluated, the few numbers of the training attended had the highest association with a chi-square of 36.643 (M=3.12, SD=1.10). The few numbers of years of coffee farming had chi-square values of 33.714 (M=2.99, SD=1.116), while the number of the journal read had a chi-square value of 24.21 (M=2.90, SD= 1.10) (see Table 8). The study's results indicated that increasing the number of trainings increases the optimization of coffee production. The findings concurred with those of Alda (2020), who reported that the farmer's Similarly, the study's findings agree with those of Alessi (2017), who indicated that the number of farming affects farmers' experience. The number of years of farming is essential in determining diseases, pests, and the best timing for weeding, spraying, and harvesting the produce.

The study results were presented using maximum likelihood estimation in Table 9.

The Table shows the parameter estimates (coefficients) and the marginal effects accompanied by the robust standard errors. The study's findings indicated that the model was reasonably fit, as demonstrated by low Wald chi (24) and log pseudo-likelihood -118.34 (Table 9). The Wald χ^2 65.81 (P=0.00) indicated that the three explanatory variables under investigation influenced the probability of optimization of coffee yields in the Chuka Sub-County. Also, the logit model correctly classified the respondents into optimizers and non-optimizers, indicated by a level of 85.23% correct prediction.

Table 8. Chi-square Coefficients for the Factors Influencing Farmer's Experience

Farmers' Experience	Factor	Score
The few numbers of years of coffee farming reduce farmers' experience	Chi-square Value	24.21
	Mean	2.986
	SD	1.1752
	Df	2
The few numbers of training attended reduce farmers' experience in coffee production	Chi-square Value	36.643
	Mean	3.1570
	SD	1.1012
	Df	2
The few numbers of journals read reduces the farmers' experience in coffee production	Chi-square Value	33.714

experience is affected by the number of trainings attended. Battista *et al*. (2016) suggested the number of years of farming, training attended, and journal reading.

Mean	2.900
SD	1.1013
Df	2

The study indicated that coffee yield optimization was mostly done by farmers who had been in the farming practice for many years. The study's findings indicated that the number of years a coffee farmer had was significant at 10% (Table 9). The results of this study were in agreement with Ullah *et al.* (2015), who stated that farmers who have had many years of farming are in a position to develop new production practices that improve production. However, the study's findings contradict the work of Nyamwamu (2018), who noted that the number of years of farming does not influence a farmer's experience; hence, they cannot translate to optimization. The study found that the number of training that a coffee farmer attended had a positive and significant relationship with the optimization of coffee yield.

Variables	Coef	Robust Std.Err.	dy/dx	Delta Method Std Err
No of Years of Farming	0.0128	0.033	0.001	0.003
Below 5 (yes=1)	2.308	1.581	0.326	0.218
5-10 years (yes=1)	2.143	1.355	0.301	0.189
Over 10 years (yes=1)	2.190	1.243	0.320*	0.187
No Trainings Attended	0.0127	0.021	0.002	0.004
Below 10 Trainings (yes=1)	0.225	0.584	0.032	0.081
10-20 Trainings	0.243	0.451	0.035	0.064
Above 20 Trainings (yes=1)	1.750	0.387	0.248***	0.052
No journal Read	0.0288	0.031	0.002	0.003
Below 2 (yes=1)	-0.983	0.413	-0.131**	0.051
2-8 (yes=1)	-0.005	0.002	-0.001***	0.002
Above 8 (yes=1)	-0.100	0.003	0.0001	0.001
Number of Obvs	140	Prob>chi2		0.000
Log pseudo-likelihood	-118.34	Pseudo R2		0.317
Correctly predicted	85.23%	Wald chi (24)		65.81

The farmers who had more than 10 training attendances were likely to optimize coffee production by 24.8% at ($p<0.01$) level of significance (Table 9). This suggested that attending training would improve access to information from peers and agricultural experts and understand and analyze production techniques that can improve optimization better than those who attended less. The findings of this study concurred with Ghimire (2017) and Mwende *et al.* (2017), who argued that more training could enhance the farmers' capacity to acquire, process, and utilize data and information obtained from various agricultural trainers. Similarly, more training enhances the capability of individual farmers to find ways to manage their farm enterprise. The study found that the number of journals read was negatively significant to the likelihood of optimization. Similarly, Lencsés *et al.* (2014) also reported a negative and significant relationship between journal readings and production. The findings of this study indicated that an additional unit of the journal a farmer read resulted in a decline in the optimization of coffee yield (Table 9).

4. Conclusion

The study's findings revealed that the number of years of schooling, training attended, and journal read have a significant effect on farmers' experience that influences optimization of coffee production. The study also found that the level of farming experience is one of the biggest challenges that farmers face today as agriculture is changing drastically. Farmers need to undergo thorough training. The fact that many farmers have few years of coffee farming negatively affects optimization. If the coffee farmers are to boost their farming experience, they have to embrace the training and produce the crop for a long time. Provision of training improves farmers' production skills that, in the long run, improve the farming experience. Similarly, the study established that most farmers did not attend the training. The stakeholders in the coffee sector should invest in ensuring that the material offered to farmers during the training is relevant. Furthermore, farmers should also be trained on the proper utilization of inputs such as fertilizers and the control of pests. Coffee cooperatives can start the capacity building of the farmers through programs that ensure good coffee agricultural practices, such as peer agriculture. However, the study established that the number of journals read does not influence farmers' experience. Finally, the policymakers should promote farmers' experience, which will be essential in adopting new technologies and practices at the farm level.

Conflict of Interest

Authors declare no conflict of interest.

References

Adekpedjou, A., De Mel, W., & Zamba, G. (2015). Data Dependent Cells Chi-Square Test with Recurrent Events. *Scandinavian Journal of Statistics*, *42*(4), 1045-1064. https://doi.org/10.1111/sjos.12150

Alda, M. (2020). Sustainable Agriculture and Farmers Choices Among Short Term Efficiency and Preserving the Future. *Academicus International Scientific Journal*, *21*, 89-100. https://doi:10.7336/academicus.2020.21.08

Alessi, S. (2017). Teaching Farmers about Fertilisation: Ali Saysel's Research on Improving Farmers' Decision-making. *Systems Research and Behavioral Science*, *34*(4), 440-443. https://doi: 10.1002/sres.2467

Battista, F., Fino, D., & Mancini, G. (2016). Optimisation of biogas production from coffee production waste. *Bioresource Technology*, *200*, 884-890. https://doi: 10.1016/j.biortech.2015.11.020

Biramo, G. (2018). The Role of Integrated Nutrient Management System for Improving Crop Yield and Enhancing Soil Fertility under Small Holder Farmers in Sub-Saharan Africa: A Review Article. *Modern Concepts & Developments in Agronomy*, *2*(5). https://doi: 10.31031/mcda.2018.02.000547

Davis, K. (2020). Embedding your work in theoretical frameworks of agricultural education and extension. *The Journal of Agricultural Education and Extension*, *26*(5), 421-422. https://doi.org/10.1080/1389224x.2020.1806454

Davis, K. (2020). Embedding your work in theoretical frameworks of agricultural education and extension. *The Journal of Agricultural Education and Extension*, *26*(5), 421-422. https://doi.org/10.1080/1389224x.2020.1806454

García, I. F., Lecina, S., Ruiz-Sánchez, M. C., Vera, J., Conejero, W., Conesa, M.R., Domínguez, A., Pardo, J. J., Léllis, B. C., & P. Montesinos. (2020). Trends and Challenges in Irrigation Scheduling in the Semi-Arid Area of Spain. Water, 12, 785; https://doi:10.3390/w12030785

Ghimire, R. (2017). Extension Professionals Preparedness for Demand-Driven Agriculture Extension Services in Nepal. *Journal of Extension Systems*, *33*(01). https://doi.org/10.18765/jes.v33i01.10580

Gujarati, D. N., Bernier, B., & Bernier, B. (2004). *Econométrie* (pp. 17-5). Brussels: De Boeck.

Kawada, T. (2020). Coffee consumption and extreme longevity: a risk assessment. *Aging Clinical and Experimental Research*. https://doi.org/10.1007/s40520-020-01569-1

Cheruiyot, J. K. (2022). Farmers' Information-inputs and their Sway on Coffee Productivity in the West of Rift, Kenya. *Journal of Applied Life Sciences International*, 1-14. https://doi.org/10.9734/jalsi/2022/v25i230282

Lachenmeier, D., Schwarz, S., Rieke-Zapp, J., Cantergiani, E., Rawel, H., & Martín-Cabrejas, M. et al. (2021). Coffee By-Products as Sustainable Novel Foods: Report of the 2nd International Electronic Conference on Foods—"Future Foods and Food Technologies for a Sustainable World". *Foods*, *11*(1), 3. https://doi.org/10.3390/foods11010003

Lencsés, E., Takács, I., & Takács-György, K. (2014). Farmers' Perception of Precision Farming Technology among Hungarian Farmers. *Sustainability*, *6*(12), 8452-8465. https://doi: 10.3390/su6128452

Lyon, S., Mutersbaugh, T., & Worthen, H. (2018). Constructing the female coffee farmer: Do corporate smart-economic initiatives promote gender equity within agricultural value chains? *Economic Anthropology*, *6*(1), 34-47. https://doi: 10.1002/sea2.12129.

MacNairn,I. (2018). Desk Study of Extension and Advisory Services. http://www.digitalgreen.org/wp-content/uploads/2017/09/DLEC-Rwanda_Desk-Study_revised_final.pdf.

Massimi, M. (2017). Importance of Field Extension Training for Farmers of Alfalfa (Medicago sativa L.) to Adopt Weed Control Techniques. *Asian Journal of Agricultural Extension, Economics & Sociology*, *20*(3), 1-7. https://doi: 10.9734/ajaees/2017/36789

Maundu, L. M & Karugu,. W. N. (2018). Financial Factors Affecting Coffee Production among Small Scale Farmers in Kiambu County. http://www.ijssit.com

Mwende, J., Wachira, M., & Amata, E. (2017). Effects of Credit Card Incentives on Consumer Borrowing in Kenya: A Case of Commercial Banks in Kenya. *International Journal of Academic Research in Economics and Management Sciences*, *6*(2). http://doi: 10.6007/ijarems/v6-i2/2784

Nghiem, T., Kono, Y. & S. J. Leisz. (2020). Crop Boom as a Trigger of Smallholder Livelihood and Land Use Transformations: The Case of Coffee Production in the Northern Mountain Region of Vietnam. Land, 9, 56; https://doi:10.3390/land9020056

Nyamwamu, P. (2018). Factors Affecting the Financial Performance of Small and Medium scale Chicken Farming Enterprises in Eldoret South Sub-County, Kenya. *SSRN Electronic Journal*. https://doi: 10.2139/ssrn.3102767

Ogutu, C., Cherono, S., Ntini, C., Wang, L., & Han, Y. (2022). Comprehensive analysis of quality characteristics in main commercial coffee varieties and wild Arabica in Kenya. *Food Chemistry: X*, *14*, 100294. https://doi.org/10.1016/j.fochx.2022.100294

Schmitt, L., & Perfecto, I. (2021). Coffee leaf litter decomposition: Short term home-field advantage in shaded coffee agro-ecosystems. *Applied Soil Ecology*, *161*, 103854. https://doi.org/10.1016/j.apsoil.2020.103854

Singh, A., & Dhadse, K. (2021). Economic evaluation of crop production in the Ganges region under climate change: A sustainable policy framework. *Journal of Cleaner Production*, *278*, 123413. https://doi.org/10.1016/j.jclepro.2020.123413

Singh, S., Singh, S., & Singh, D. (2019). Extent the Adoption of Organic Farming Practices by Farmers in Crop Production. *International Journal of Current Microbiology and Applied Sciences*, *8*(08), 2744-2747. http://doi: 10.20546/ijcmas.2019.808.316

Temple, J., and Ziegler, A. (2019). Gender Differences in Subjective and Physiological Responses to Caffeine and the Role of Steroid Hormones.

Tharaka Nithi County Government (TNCG). (2018). Transforming Tharaka Nithi*:* Unlocking the Great Potential. Development Plan CIDP 2018-2022

Ullah, A., Shah, S., Ali, A., Naz, R., Mahar, A., & Kalhoro, S. (2015). Factors Affecting the Adoption of Organic Farming in Peshawar-Pakistan. *Agricultural Sciences*, *06*(06), 587-593. http://doi : 10.4236/as.2015.66057

Utrilla-Catalan, R., Rodríguez-Rivero, R., Narvaez, V., Díaz-Barcos, V., Blanco, M., & Galeano, J. (2022). Growing Inequality in the Coffee Global Value Chain: A Complex Network Assessment. *Sustainability*, *14*(2), 672.

van Keulen, M., & Kirchherr, J. (2021). The implementation of the Circular Economy: Barriers and enablers in the coffee value chain. *Journal of Cleaner Production*, *281*, 125033. https://doi.org/10.1016/j.jclepro.2020.125033

Wahyudi, A., Wulandari, S., Aunillah, A, & J. C. Alouw. (2020). Sustainability certification as a pillar to promote Indonesian coffee competitiveness. 1st

International Conference on Sustainable Plantation (1st ICSP 2019), IOP Conf. Series: Earth and Environmental Science 418: 012009. https://doi:10.1088/1755-1315/418/1/012009

Zelaya, P., Harder, A., & Roberts, T. (2017). Small-Scale Farmers' Decision-Making for Crop Selection and Production Practices in Northern Haiti. Journal of International Agricultural and Extension Education, 24(2), 22-34. http://doi: 10.5191/jiaee.2017.24202