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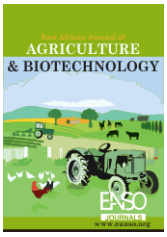

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Original Article

Socioeconomic Factors Influencing Uptake of Coffee Production Recommended Practices in Kichwamba and Kirugu Sub-Counties Rubirizi District, Uganda

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ABSTRACT

The study was on socioeconomic factors influencing the uptake of coffee production recommended practices in the Kichwamba and Kirugu Sub-counties of the Rubirizi district and was conducted in February 2021. Objectives were to identify the coffee production systems and practices used, identify the socioeconomic challenges associated with the uptake of recommended practices for coffee production, and identify the policy interventions to address the challenges associated with the use of recommended coffee practices. Farmers continue to register low coffee yields hence affecting their livelihoods and incomes and achieving maximum coffee production requires that farmers apply recommended practices since the quantity and quality of the crop rely on the practices used. A cross-sectional survey was conducted using simple random sampling and a total of 376 coffee farmers were sampled. Results indicated that Arabica coffee commonly grown has two major systems intercropping and mono-cropping. The coffee-recommended practices used were weeds control (23.7%), shading (21.5%), pruning (15.5%), fertiliser application (14.1%), pest and disease management (12.2%), water drainage management (6.6%), transplanting (4.0%), and seedbed preparation (2.7%). Statistically significant socioeconomic factors affecting the uptake of recommended practices for coffee were age [p=0.014], education level [p=0.002], labour [p=0.005], Farm size [p=0.001], farming experience [p=0.031], gender [p=0.031], land slope [p=0.048], un-accessibility to credit services [p=0.032], and plot ownership [p=0.049]. Policy interventions were farmer capacity building (35.1%), strengthening agricultural extension (23.7%), credit extension to the farmers (15.7%), re-visiting land reform policies (13.6%), and group formation (11.9%). The study concluded that coffee in the study area was grown under two production systems; intercropping and mono-cropping; the major coffee recommended practices used were; seedbed management, transplanting, pruning, shading, fertiliser application, weeds control, pest and disease

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management, and water drainage management. Socioeconomic factors like Education level, shortage of labour, farm size, experience in farming, gender, the slope of the land, un-accessibility of credit services, farmer age and plot ownership type were significant socioeconomic factors affecting uptake of recommended practices. Suggested policy interventions were re-visiting land reform policies, credit extension, capacity building, strengthening agricultural extension, and farmer group formation. More education and training for farmers, revisiting land policies, groups, associations and cooperative formation, and credit services extension are recommended.

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INTRODUCTION

Coffee (*Coffea spp*) is a genus of flowering plants in the family Rubiaceae. It is a shrub or small tree native to tropical, evergreen with multiple stems and smooth leaves and produces clusters of cream-white flowers and fruit commonly referred to as a berry which normally possesses two seeds and it is one of the most important cash crops across the world and a major source of export earnings in developing countries (Kandji & Verchot, 2014).

Globally, coffee is second only to crude oil as the most important internationally traded commodity in monetary value and Brazil is the largest producer and exporter of coffee, followed by Vietnam and Colombia (Igami, 2015). Despite its high global export earnings, coffee-producing countries, especially in Africa suffer a number of setbacks when it comes to coffee productivity and performance. The ever-changing environment coupled with compatible and unsustainable management practices affects performance, hence upsetting the overall production.

In Africa, Ethiopia is the largest producer of coffee but overall coffee yield in Africa is relatively little and fetches low prices compared to coffee from other continents (Minten et al., 2014). As a result, most coffee farmers get lower incomes from coffee sales which do not help them out of poverty. To boost production, African governments have adopted different management practices that can enhance coffee productivity, for-example agroforestry systems and other management practices have been approved to increase production while conserving a portion of the biodiversity that occurs in coffee farming systems. Such

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management practices balance the trade-offs between farmers' economic needs, ecosystem services, and biodiversity conservation (Hundera et al., 2013).

In Sub-Saharan Africa, coffee is a major cash crop and source of income for farmers (Adjognon, Liverpool-Tasie & Reardon, 2017). Despite its economic importance, the productivity of the crop is currently under threat posed by inappropriate management, declining soil fertility, pests, and diseases (Jassogne, Laderach & van Asten, 2013). Minimal use of recommended management practices contributes to low coffee performance hence affecting productivity (Kandagor, 2015). In coffee production, appropriate management practices are key if plant productivity must be achieved. Sustainable management involves the adoption of appropriate recommended land management practices that enables land users to maximise the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources (Batáry, BAldi, Kleijn & Tscharntke, 2011). There are various recommended management practices for crop survival and production, but Sub-Saharan African governments are still reluctant to invest in such technologies, perhaps due to high capital investments, lack of technical manpower, insufficient technology, overdependence on human labour and negative reception from the community (Amalu, 2002).

In Uganda, coffee is a cash crop, and Uganda ranks second in Africa after Ethiopia. Agriculture contributes 22.6% of the Gross Domestic Product and 90% of foreign exchange earnings (Diao & Pratt, 2007). Coffee is currently dominating the agricultural sector in Uganda as a source of income in terms of exports. The crops are the main source of livelihood for a large portion of the population. Specifically, coffee is the major export crop in Uganda employing over 3.5 million families through coffee-related activities (Diao & Pratt, 2007). Arabica coffee production systems are concentrated and intensive in highland areas. These regions account for 40% of the total coffee volume produced in Uganda (Jassogne, Laderach & van Asten, 2013). Production in Uganda is however under threat from a combination of constraints including poor management practices and declining soil fertility (Jassogne et al., 2012). These factors trap the smallholder coffee farmers who depend on the crop for their livelihoods in a vicious circle of low incomes and poverty. In addition, many soils are degraded due to the intense cultivation and erosion arising from high population densities and the overexploitation of natural resources (Munyuli, 2010)

The use of appropriate land use practices is therefore paramount in mitigating the effects of such shortcomings. These include fertiliser application, and agroforestry, a traditional management practice which improves adaptability through the simultaneous production of food, fodder, and firewood (Jassogne, Laderach & van Asten, 2013). Appropriate management practices (such as agroforestry, fertiliser application, weeding, pruning, pest and disease control) have the potential to buffer against current climate variability risks due to their ability to provide ecosystem services. The major goal of recommended management practices therefore has been to develop economically viable agroecological systems and to enhance the quality of the environment for coffee crop performance (Mugisha and Alobo, 2012). Uganda has remained very minimal due to a number of unknown social, economic, and institutional factors.

In the Rubirizi district, coffee farming helps farmers generate income through the marketing of coffee. Coffee farming has been promoted as part of the strategies for poverty alleviation through income generation (Ministry of Agriculture, Animal Industry and Fisheries, 2010). It is a major source of farmers' income in the district, and it has helped in poverty reduction across the district (Mugagga & Buyinza, 2013). To increase coffee productivity in

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the area, a number of management practices have been promoted by National Agricultural Research Organization (NARO), but they have not been fully embraced by the majority of farmers causing stagnation in the coffee yields (Ministry of Agriculture, Animal Industry and Fisheries, 2010)

Specific Objectives

- To identify the coffee production systems and practices used by farmers in Kichwamba and Kirugu sub-counties.
- To identify the socioeconomic challenges associated with the uptake of recommended practices for coffee production in Kichwamba and Kirugu sub-counties.
- To identify the policy interventions to address the challenges associated with the use of recommended coffee management practices in the area.

Problem Statement

Coffee is one of the most important cash crops in Uganda and a major source of income for many smallholder farmers. Achieving maximum production and productivity requires that farmers apply proper management practices since the quantity and quality of the crop rely on the management practices used (Jassogne et al., 2013). Rubirizi is one of the districts where coffee is grown in Uganda. The crop plays a critical role in poverty alleviation by boosting farmers' income (Mugisha & Alobo, 2012). To boost productivity in the area, the government through National Agricultural Research Organization (NARO), promoted a number of management practices aimed at doubling coffee production. However, farmers continue to register low coffee yields (average harvest of 0.5 kg of Fairly Average Quality per tree instead of 2-4 kg) hence affecting their livelihoods and incomes (MAAIF, 2010). Efforts to promote the right management practices to enhance productivity have remained futile as farmers have continued relying on traditional unsuitable practices, which yield poorly (Mugagga & Buyinza, 2013). Studies done in other areas linked the use of management practices to socioeconomic factors like land size, labour availability, access to credit and extension information (Allan et al., 2015). It remains unclear whether these very factors apply to the current study area, given that no empirical study has been conducted on the phenomena. The current study was conducted to fill the gap and hence delved into the factors limiting farmers' utilisation of recommended management practices for improved coffee productivity in the area.

MATERIALS AND METHODS

Research Design

The study employed a descriptive cross-sectional survey that used quantitative techniques for data collection. A survey is a means of gathering information about the characteristics, actions, and opinions of a group of people referred to as the population (Creswell, 2013). It describes data and characteristics of a population and phenomenon being studied. The descriptive survey design helped to answer the questions like who, what, where, and how to describe the phenomenon in the study. This design was appropriate for the study because it enabled sufficient data to be collected at one point in time from a sample which is selected to describe a larger population of coffee farmers. Qualitative approaches were used to collect and analyse views and opinions from key informants, while the quantitative approach involved the use of quantifiable methods to capture and analyse quantifiable information generated using a questionnaire. This enabled the researcher to draw from their respective strengths and gain a more comprehensive insight that informed both theory and practice.

Area of Study

The study was conducted in Kichwamba and Kirugu sub-counties, Rubirizi District. Rubirizi District is bordered by Kasese District to the north, Kamwenge

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District to the northeast, Ibanda District to the east, Buhweju District to the southeast, Bushenyi District to the south, Rukungiri District to the southwest and the Democratic Republic of the Congo to the west. The district headquarters at Rubirizi is located approximately 90 kilometres (56 mi) by road northwest of Mbarara, the largest city in the Ankole sub-region. The coordinates of the district are: 00 16S, 30 06E. Agriculture is the mainstay of the district's economy. The fertile soils and good climate have allowed adequate production of food crops for home consumption and cash crops for sale. However, because the district is located on mountainous terrain, bringing the produce to market remains a challenge and a constraint to increased production.

The main economic activity is small-scale subsistence agriculture with food crops like rice, maise, sweet potatoes, bananas, millet, cassava and cash crops like coffee and cotton (NAADS, 2004). The sub-counties selected are one of the leading producers of coffee in the district and two varieties of coffee (Arabica and Robusta) are grown. Rubirizi district is also one of the beneficiaries of the national coffee replanting programme by UCDA that has targeted reviving the coffee sub-sector. The district has many small-scale coffee factories that are used by coffee traders to hull their coffee, sort and grade and finally sell it to exporters. Agriculture is the mainstay of the district's economy. The fertile soils and good climate have allowed adequate production of cash crops like coffee for sale.

Target Population

The target population is the entire group a researcher is interested in or the group about which the researcher wishes to draw conclusions (Amin, 2005). The study population included coffee farmers, local leaders, and agricultural extension workers. Farmers were considered for their role in coffee production, while key informants like local leaders and extension workers were considered for their closeness to the farmers and besides, they were part of the group that implemented agricultural policies in the area.

Sample Size Determination

The study sample size was calculated using the standard statistical formula (Yamane, 1973). This is after having known the number of respondents participating in coffee production from the Agricultural Officer's office in Kichwamba SubCounty. The sample size was calculated as follows:

$$n = \frac{N}{(1 + N * e^2)}$$

Where n = sample size, N = population size (obtained from Agricultural Officer database, e = sampling error to determine the sample size

From the Agricultural Officer database, the total number of coffee farmers in Kichwamba Sub County was 6,362 farmers. Therefore, applying the Yamane formula and using e=0.05.

$$n = \frac{6362}{(1 + 6362 * 0.05^2)}$$

The sample size (n) was 376.33 ≈ 376

A sample of 376 coffee farmers was used for the study

Sampling Procedure and Technique

A multi-stage sampling procedure employing simple random and purposive sampling techniques was employed to arrive at the required number of respondents. Kichwamba and Kirugu sub-counties had a total number of 10 parishes and 24 villages. Of the 10 parishes in the two sub-counties, 2 parishes from each sub-county were randomly selected to make four (4) parishes in total. Out of the four parishes selected, 2 villages were randomly selected using a piece of paper containing the names

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of the villages. A total of 8 villages were selected. The researcher with the help of the village chairman got a list of all registered coffee farmers from each selected village with the aim of getting the required number of respondents at the village level. A total of 47 respondents were randomly selected from each of the eight villages to get a total of 376 respondents. Key informants including two local leaders, 1 District Agricultural Officer, and one agricultural extension worker were selected with purposive sampling.

Research Instruments

The study used self-administered questionnaires with (closed and open-ended questions), observation, and interview guides to collect primary data.

Questionnaires

A self-administered questionnaire with both closed and open-ended questions was designed, translated into the local language, and then used to collect data from coffee farmers. This method allowed a selected number of respondents to answer questions related to the study phenomenon. The answered questions were in line with the study objectives. The data collected was in relation to the following;

- Socio-demographic characteristics like sex, age, education level, occupation, level of household income, household size, farm size, access to markets, access to credit and access to extension services, and decision making.
- Production characteristics like; the type of coffee, quantities and costs of inputs used such as seed planted, land under cultivation of the coffee, coffee production systems, management practices, pesticides, fertilisers, output harvested, and quantity sold plus the prices.
- Socioeconomic factors affecting farmers' use of different recommended management practices for coffee production and performance in the study area.
- Community and policy interventions for sustainable coffee production in the area.

Interview Guide

Interviews were conducted using an interview schedule that was administered by key informants. This involved oral or vocal questioning, where the researcher became the interviewer, and the respondents were interviewees. The interview schedule constituted both open and closed-ended questions. Interviews were preferred because the majority of the key informants were busy with their work schedules. The interviews were used widely to supplement and extend the researchers' knowledge about individual (s) thoughts, feelings, and behaviours. This method was suitable for capturing data on such groups of people.

Direct Observation

The observation method is a method of data collection in which the situation of interest is watched and the relevant facts, actions, and behaviours are recorded (Kawulich, 005). During interview sessions, the researcher observed critically the agroecological farming practices being applied. Additionally, farmers were visited to assess the technology or combination of technologies used in coffee production. This helped the researcher to capture actual data through assessment. The observation method further helped the researcher to identify the challenges faced by farmers during the use of different management coffee practices.

Data Analysis

Analytical Methods for Quantitative Data

The data collected was coded, entered, and cleaned using the excel computer program. A summary of descriptive statistics (percentages, means, standard deviations and t-statistics) was generated. Data was then transferred to Statistical Package for Social Scientists (SPSS) version 22.0, in which logistic analyses were carried out.

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Objective one was to assess the coffee production systems and management practices used by farmers in the area. Descriptive statistics of coffee production systems and management practices were generated using frequency counts and percentages.

Objective two was to identify the socioeconomic factors affecting farmers' use of different recommended management practices for coffee production and performance in the study area. This was achieved using the logistic model. This is because not all farmers have faced 100% of the factors. Thus, the dependent variable is dichotomous that is 1 for those experiencing the factors and 0 for those not experiencing

This study employed a generalised binary logistic model and specified as follows;

$$\text{Log} \quad (1\text{-}p) = a + b_1X_1 + b_2X_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + b_nX_n + e$$

Where, p = is the probability of success, α = is the coefficient on the constant term, bi = is the coefficient(s)on the independent variable(s), xi = is the independent variable(s), *e* = is the error term

Objective three was to identify interventions for addressing socioeconomic impediments to the use of management practices for sustainable coffee production in the area. Descriptive statistics of community and policy interventions were generated and presented using frequency counts and percentages.

Ethical Considerations

The free and informed consent of each individual participant was obtained at the start of the study. Respondents read an informed consent form that explained; the purpose of the study, what participation in the study involved, how confidentiality and anonymity would be maintained, and the right to refuse to participate in the study or to withdraw from the study without any penalty, the benefits, and risks of participating in the study. Study participants were not required to undergo any invasive procedures. Personal/sensitive issues were explored when a good relationship was established with the informant. The research team were urged and required to respect the culture of the respondents during the data collection process. Confidentiality and anonymity were maintained by the use of code numbers on the questionnaire other than names. The information obtained was only used for the purposes of this study.

RESULTS PRESENTATION AND DISCUSSION

The Response Rate

All the 376 sampled respondents were accessed for data collection giving a 100% response rate. This response rate is above the minimum recommended response rate of 60% and hence the sample was adequate to provide findings that can be inference to the study population.

Socio-Demographic Characteristics of the Respondents

The study key socio-demographic characteristics profiled for the study included gender, marital status, source of livelihood, age, education level, number of people in the household and total land holdings.

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Table 1: Socio-Demographic Characteristics of the Respondents

Category		Frequency	Percent
Gender	Male	179	47.6
	Female	197	52.4
	Total	376	100.0
Age	15 below	34	9
	16 – 30	90	23.9
	31 – 45	178	47.3
	46 and above	74	19.7
	Total	376	100.0
Marital status	Married	203	54.0
	Not married	133	35.4
	Others	40	10.6
	Total	376	100.0
Education level	Not attended any formal education	34	9
	Primary	56	14.9
	Secondary	189	50.3
	University	45	11.9
	Others	52	13.9
	Total	376	100.0
Household size	1 – 5	127	33.7
	6 – 10	206	54.8
	10 and above	43	11.4
	Total	376	100.0
Source of income	Farming	201	53.5
	Salary	93	24.7
	Business	43	11.4
	Farming and Business	23	6.1
	Farming and Salary	16	4.3
	Total	376	100.0
Total size of land owned	Below 1 acre	57	15.2
	2 – 4 acres	127	33.8
	5 – 6 acres	159	42.3
	6 and above	33	8.7
	Total	376	100.0

This was aimed at capturing a picture of the number of men and women involved in coffee production in the area. Results show that 52.4% of the respondents were female and 47.6% male (see *Table 1*). The high number of women compared to men is reflected in the agricultural sector in Uganda, which is largely dominated by women than men.

The respondent's age was necessary because it determines the farmer's ownership of production resources, as well as influences production decisions, agricultural information-seeking behaviour, and capacity to access credit services. Results show that the majority (47.3%) of the respondents were aged 31 – 45, 23.9% were aged 16

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- 30 years, and 19.7% and 9% were aged above 46 and below 15 years, respectively. Those aged 6-10 formed the biggest proportion of the respondents (see *Table 1*).

The marital status of respondents was considered because it is very critical in the decision-making and adoption of production technologies and management practices. Responses on marital status were as shown in *Table 1*. *Table 1* indicates that 54% of the respondents were married, 35.4% were single, and 10.6% comprised those that were cohabiting, separated, and widowed.

The education level of the respondents was considered because it is very critical in technological adoption and use, production decision-making, and information-seeking behaviour of the farmers. According to the findings in table 4 above, those with secondary education (50.3%) formed the biggest part of the study, followed by 14.9% with primary, 13.9% with tertiary education, 11.9% university, while 9% had never attended school (see *Table 1*).

Household size influences labour availability for coffee production and other related activities. Household members are the main source of labour for different coffee production activities in the study area. Results indicate that more than half (54.8%) of the respondents were from a household of 6 – 10 members, 33.7% from a household of 1 – 5 members, while 11.4% were from a household of 10 members and above (see *Table 1*).

Household source of income was considered for the purposes of establishing the income levels which had an impact on the level of adoption of agricultural production technologies and management practices. According to the findings, more than a half (53.5%) of the respondents depended on agriculture for income, 24.7% relied on salary, 11.4% operated small-scale businesses for income, 6.1% relied on both farming and business while 4.3 depended on both faring and salary (see *Table 1*). Results indicate that 42.3% of the respondents owned 5 – 6 acres of land, 33.8% 2 – 4 acres, and 15.2% below an acre, whereas 8.7% owned 6 acres and above. The average land distribution was 5.3 acres (see *Table 1*).

Coffee Production Systems and Management Practices Used by Farmers

The results in *Table 2* indicate that 54% of the respondents were growing Arabic coffee, while 46% were growing Robusta coffee.

Table 2: Variety of coffee grown on the farm

Variety	Frequency	Percent
Arabica coffee	203	54.0
Robusta coffee	173	46.0
Total	376	100.0

According to the results in *Table 3*, 75.8% of the respondents practised intercropping, and 24.2% practised mono-cropping (pure stand).

Table 3: Coffee production systems

Production system	Frequency	Percent
Intercropping	285	75.8
Mono cropping (pure stand)	91	24.2
Total	376	100.0

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In terms of management practices applied, 23.7% of the respondents practised weed control, 21.5% shading, 15.2% pruning, 14.1% fertiliser application, 12.2% pest and disease management, 6.6% water drainage management, 4.0% practised transplanting while 2.7% seedbed management (see *Table 4*).

Table 4: Management practices applied in coffee production

Practice	Frequency	Percent
Weed control	89	23.7
Shading	81	21.5
Pruning	57	15.2
Fertiliser application	53	14.1
Pest and disease management	46	12.2
Water drainage management	25	6.6
Transplanting	15	4.0
Seedbed management	10	2.7
Total	376	100.0

Socioeconomic Factors Affecting Farmers' Use of Recommended Management Practices

Table 5 shows a logistic regression output for the socioeconomic factors affecting farmers' use of recommended management practices. Adjusted odd ratios were calculated, and significant factors were interpreted at a 95% confidence interval and a 5% level of significance. Fourteen variables were hypothesised and among them, nine (9) factors remained significant and these included the Age of the farmer [AOR = 2.321, p=0.014], level of education of the household head [AOR = 1.919, p=0.002], Lack of labour [AOR = 0.850, p=0.005], Farm size [AOR = 1.930, p=0.001], farming experience [AOR = 1.104, p=0.031], Gender [AOR = 1.676, p=0.031], the slope of the land [AOR = 1.410, p=0.048], Un-accessibility to credit services [AOR = 1.221, p=0.032], Plot ownership type [AOR = 1.633, p=0.049].

Table 5: Parameter estimates for socioeconomic challenges associated with the utilisation of recommended practices for coffee production

	Challenges	Values	AOR	95% CI.	p-value
Model	Age bracket	15 below	1.290	0.370 - 4.499	0.690
		16 - 30	2.321	0.129 - 4.797	0.014
		31 – 45	0.991	(0.974 - 1.008)	0.294
		46 and above			
	Education	Never went to school	1.486	0.573 - 3.851	0.415
		Primary	0.749	0.263- 2.129	0.123
		Secondary	1.919	(0.870 - 3.970)	.002
		University	1.024	.952 - 3.101	0.529
		Others			
	Labour availability	Available	0.850	(0.757 - 0.954)	.005
		Not available			
	Farm size	Below 1 acre	0.786	0.334 - 1.306	0.341
		2 – 4 acres	1.950	0.761 - 2.496	0.133
		5 – 6 acres	1.930	(0.887 -2.976)	0.003
		6 and above			

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Challenges	Values	AOR	95% CI.	p-value
Experience	In years	1.104	(1.009 - 1.208)	0.031
Gender	Male	1.676	(1.048 - 2.682)	0.031
	Female	.	.	.
Religion	Catholic	0.364	(0.863 – 2.153)	0.183
	Protestant	1.009	(0.932 - 1.091)	0.435
	Muslim	0.156	(0.068 - 1.608)	0.864
	Others			
Culture		0.736	(0.468 – 1.158)	0.185
Access to extension	Yes	1.288	(0.609 - 2.720)	0.508
	No	.	.	.
The slope of the farm		1.410	(0.460 - 4.324)	0.048
Off-farm incomes	In shillings	1.488	(0.594 - 3.729)	0.397
Income status	High	0.761	(0.366 - 1.581)	0.464
	Low			
Access to credit	Have access	1.221	(0.539 - 2.763)	0.032
	Do not have			
Plot ownership type	Rented	1.633	(0.291- 2.378)	0.049
	Inherited	.622	(0.306 - 1.266)	0.191
	Purchase	.	.	.

a. The reference category is: no.
b. This parameter is set to zero because it is redundant.

Interventions to the Use of Management Practices for Sustainable Coffee Production

Results in *Table 6* highlight respondents' suggestions on the interventions for addressing the socioeconomic impediments to the use of management practices.

35.1% of the respondents mentioned community capacity building and developing the skills and knowledge of the farmers in different aspects of coffee management through training and education, 23.7% strengthening agricultural extension, 15.7% talked of credit extension, 13.6% changing land reforms to enable farmers to have access to more productive land while 11.9% mentioned of encouraging farmers to form groups to ease to access to inputs and credit services.

Table 6: Interventions for addressing the socioeconomic impediments to the use of management practices

Category	Frequency	Percent
Capacity building/ Skill and knowledge development	132	35.1
Strengthening agricultural extension	89	23.7
Credit extension	59	15.7
Land reform policies	51	13.6
Farmer group formation	45	11.9
Total	376	100.0

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DISCUSSION OF FINDINGS

Coffee Production Systems and Management Practices Used by Farmers

There were two coffee production systems used by the farmers in the study area, namely, mono-cropping (pure stand) and intercropping. Under the intercropping system, which is widely practised (78.8%), coffee was planted with crops or trees, also called agroforestry systems. Coffee was grown with perennial crops like banana and annual crops like beans, soya beans, and groundnuts to support household food security given the limited production space (land size) in the area and also grown with different types of trees to provide ecological benefits such as shading, breaking speeding winds, conserving the soils as well as recycling nutrients. Coffee farmers planted semi-permanent shade of leguminous shrubs such as calliandra, flamingia, and tephrosia between every fourth row of coffee and around the edges of the plantation. Permanent shade trees such as *Albizzia spp.* (migavu), *Ficus spp.* (Mutuba, Mucusu, Ekitooma), *Cordia africana* were planted at a spacing of 15 by 15 metres or 20 by 20 metres. This study finding is comparable to findings by Kawulich (2005) who mentioned that trees incorporated in agroecosystems provide a range of ecological advantages. Below ground, the roots of the trees penetrate the soil deeper than the roots of smaller plants which affects soil structure, nutrient recycling, and soil moisture conditions. Some of the trees can also benefit the agroecosystem by forming symbiotic relationships with *mycorrhiza*, which can increase nutrient uptake from the soil, and leguminous trees can contribute nitrogen to the system of which they are part. By absorbing nutrients from deep soil layers, trees can increase nutrient recycling and reduce the need for synthetic fertilising.

Similarly, some respondents practised a mono-cropping/pure stand system, which involved growing coffee as a single crop on one piece of farmland. This system was not widely practised (24.2%) as compared to the intercropping system (75.8%) because it requires large farm sizes to provide space for other resources like fuel/firewood and food security, there is no nutrient re-cycling and also reduced household income. This study finding is in line with Kandji and Verchot (2014), who argued while monoculture may increase coffee yields, it can potentially reduce the food available to feed the household and also growing the same coffee crop year after year depletes valuable soil nutrients that plants rely on and hence deficiency must be compensated for by using increasing amounts of appropriate fertiliser. Monoculture is highly susceptible to pests and diseases, requires intensive use of chemicals to control pests and diseases and weeds and limits optimum utilisation of land and the resultant farm revenue.

Weed control was the most management practice in the area and from the respondents and the extension worker, most farmers use mechanical methods like hoeing and slashing because it is traditional and easy to practice, and others use cultural methods like mulching and chemical control use of herbicides. In coffee, weeds cause several direct and/or indirect negative impacts, such as; reducing coffee bean/screen quality, reducing crop yield, increasing production costs, reducing irrigation efficiency, and serving as hosts and habitats for insect pests, disease-causing pathogens, nematodes, and rodents. This study finding is in line with Kawulich (2005) who argued that weed control is important in coffee production to avoid competition for moisture, nutrients, space, sunlight, and to minimise the spread of pests and disease and if weeding is neglected, coffee yields will be depressed and poor quality will result. Weeds can directly hinder coffee growth by competing for available resources and, in some cases, by releasing allelopathic or growth-suppressing chemicals.

Respondents reported shade provision as a management practice and they use different types of trees in coffee plantations such as *Albizzia spp.*

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(migavu), *Ficus spp.* (Mutuba, Mucusu, Ekitooma), *Cordia africana* and planted at a spacing of 15 by 15 metres or 20 by 20 metres. These provide benefits such as shading, breaking speeding winds, conserving the soils as well as recycling nutrients. This study finding is comparable to findings by MAAIF (2010) who argued that above-ground trees affect solar radiation and create a microclimate under its canopy, which can stabilise temperature conditions, which in turn increases humidity and limits evapotranspiration. Shade trees play a role in the efficient utilisation of nutrients by taking up leached nutrients that are outside the reach of the coffee tree root zone and returning these nutrients to the topsoil through litter fall and which also acts as mulch.

Another management practice in coffee production in Kirugu and Kichwamba Sub-County was pruning. This was done by removing unnecessary branches and unproductive wood to eliminate competition for nutrients hence allowing the tree to produce good crop yields year after year. This was done using hands because most farmers could not afford to buy pruning tools. Pruning also creates conditions that are less favourable to pests and disease infestation. This study finding concurs with Batáry et al. (2011) who recommended pruning as an essential task for maintaining strong and healthy coffee trees and creating well-structured, healthy trees that give good cherry yields but encouraged the use of pruning tools like pruning saw and secateurs during pruning.

According to the results, respondents identified pests and disease control as a coffee management practice. The most common coffee pests included Black Coffee Twig Borer (BCTB), Coffee Berry Borer (CBB), and Coffee Mealybug and common coffee diseases included Coffee Wilt Disease and Coffee Leaf Rust. Pests and diseases affect the health of the coffee plants, which further leads to quality deterioration, quantity loss, and eventually reduced economic returns to the farmer. Coffee farmers commonly use cultural methods like pruning and removal of diseased coffee trees, and some use chemicals/pesticides to control coffee pests and diseases. This study finding agrees with Lerouge et al. (2014) who argued that coffee pests and diseases could mainly be controlled by (i) chemical; (ii) cultural and (iii) biological. Cultural and agronomic practices have been the best approaches to deter the development and/or spread of pests and diseases. Timely application of pruning systems, weeding, shade control, drainage, and removing diseased trees and burning them on site and/or burying them have been important management practices.

Furthermore, Fertiliser application was another management practice reported by respondents in the area of study. The most commonly used type of fertiliser is inorganic like nitrogen (N), phosphorus (P) and potassium (K) which is accessed through local dealers. NPK is applied to increase plant height, root development, water use efficiency, bean weight, and highest efficiency. Despite being expensive in terms of purchase costs, farmers prefer inorganic fertilisers because of their accessibility compared to organic fertilisers. This study finding concurs with Ubos (2013) who argues that coffee quantity produced per unit area improves when soils are managed for optimum fertility. He further argued that Fertilizer application could increase yields of Robusta coffee from the average current of 1 metric tonne up to 3 metric tonnes of Fair Average Quality per hectare per year. Nitrogen is lost during leaching and phosphate is lost through fixation. Therefore, unless these nutrients are replaced, the quality of the coffee beans will be affected. Also, Van Asten et al. (2012) reported that in one of the major coffee-producing countries, Vietnam, the success to increased coffee production and productivity from less than 2 million bags in 1991 to about 30 million bags in 2017/18 has been due to prioritising the use of water, fertiliser, and variety.

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Socioeconomic Factors Affecting Farmer's Use of Recommended Management Practices

The study identified significant socioeconomic factors affecting the adoption of different recommended management practices for coffee production and performance in the study area. These included shortage of labour, education level of the household head, farm size, experience in coffee farming, gender, the slope of the farm, un-accessibility of credit services, age of the farmer and plot ownership type among the farmers.

Lack of labour was a significant factor limiting farmers' use of recommended coffee management practices at a 5% level. It was observed that households with limited labour had 0.8 times fewer chances of using the practices compared to those with labour. Labour is an important constraint in the adoption of new technologies, particularly those technologies that are labour-intensive. Labour availability was measured as the proportion of household members who contribute to farm work. This study finding was in line with findings by Lerouge et al. (2014), who stated that the proportion of household members available to provide labour positively influenced the adoption of soil fertility management practices. The number of household members who provide farm labour is positively associated with the probability of participating in soil fertility management practices.

Similarly, the level of education of the household head was significantly associated with the use of coffee-recommended management practices at a 5% level. Educated household heads had 1.9 times more chances of using recommended coffee management practices than the uneducated. This is because higher education gives farmers the ability to perceive, interpret, and respond to new information much faster than their counterparts with lower education hence educated farmers had more chances than the uneducated. These results were consistent with Kandji and Verchot (2014), who found education to be positively related to the adoption of soil and water conservation measures.

Furthermore, farm size had a significant influence on farmers' use of recommended coffee management practices at a 5% level of significance. Farmers with small plots had 1.9 times less likely to use management practices compared to those with large plots. This was because, with a large farm size of land, a farmer can still produce from different other crops even if a new practice did not perform well when applied to crops on a smaller portion of land on the farm. This study finding concurs with Charles, Munishi and Nzunda (2013), who stated that farm size could positively influence adoption because farmers with large farm sizes of land can experiment with new technologies on a portion of land without worrying about endangering the family food security. In addition, the benefits from the large-scale adoption of new technologies are absolutely large for larger farms.

The experience of the farmer was also a significant factor associated with the use of recommended coffee management practices in Kirugu and Kichwamba Sub Counties at a 5% level of significance. It was observed that farmers with experience in farming in years were 1.1 times more likely to use the recommended management practices in coffee production. This is because longer farming experience implies accumulated farming knowledge and skill, which contribute to adoption. Many studies supported this argument; for example, Vandermeer, Perfecto and Philpott (2010) found the mean farming experience difference between adopters and the non-adopters is statistically significant

A positive and significant relationship was observed between gender and the use of recommended coffee management practices at a 5% level of significance. It was observed that men, compared to women, are 1.6 times more likely to use coffee management practices because males easily access resources, especially land. This study finding concurs with

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Mugagga and Buyinza (2013), who showed that male-headed households in developing countries have higher access to resources and information that give them greater capacity to adopt. Using binary logit to determine farmer participation in new technologies, results indicated that male-headed households had a higher probability of adopting than women due to their high likelihood of access to requisite resources and information.

The slope of the land had a significant relationship with the farmer's decision to use recommended management practices at a 5% level of significance. Farmers with coffee plantations located on steep slopes were 1.4 times more likely to adopt management practices compared to those with plots located on gentle slopes. This is because steep slopes experience more erosion and run-offs than gentle slopes and hence this increases the chances of adopting control mechanisms compared to gentle slopes. This finding is comparable to findings by Hundera et al. (2013) who, in their study, multinomial logit results showed that the likelihood of households choosing to practice conservation declined with the perceived slope of the farm. This reflected the fact that plots with steeper slopes are more prone to soil erosion which necessitates the adoption of farming techniques.

Furthermore, the lack of credit services was a significant challenge associated with the use of coffee management practices for coffee production in the area of study at a 5% level of significance. It was observed that farmers who did not have access to credit services were 1.2 times less likely to use the practices and vice vasa. Given the nature of the agriculture sector in the area, many financial institutions do not normally give out loans to farmers for fear of the associated risks. A few that are willing to give loans to farmers have complicated loan terms which most farmers may not satisfy like security, payback period etc. This lack of credit therefore limits farmers' capacity to invest in practices and technology. This study finding agrees with Vandermeer, Perfecto and Philpott (2010), who argued that coffee management involves more use of inputs which has great cost implications. Credit is very much useful for purchasing inputs such as improved seeds and other inputs. Hence, access to credit is expected to influence the effectiveness of coffee management practices positively on the dependent variables. Mugagga and Buyinza (2013). also stated that borrowing money is one of the most expensive ventures in Uganda, with interest rates hardly going below 25% per annum, while informal money lenders (such as VSLAs) charge exorbitant rates of not less than 10% per month.

The age of the farmer was a challenge associated with the use of coffee-recommended management practices at a 5% level of significance. Farmers of ages 16-30 were 2.3 times more likely to up-take coffee recommended management practices than those ages below 16 and above 30. This is because older farmers are rigid in adopting new technologies. Perhaps this is because of investing several years in particular practices, which makes them unwilling to take risks by trying out completely new farming methods. This study finding agrees with Hundera et al. (2013), who argued that age is negatively associated with farmer participation in new technology.

From the study, plot ownership type was a significant factor limiting farmers' use of recommended management practices at a 5% level of significance. It showed that farmers with rented plots were 1.6 times less likely to use practices than those who inherited or purchased their own plots. This is because one to invest in long-term management practices needs a long period of access and use of land. However, there was no observed difference in the use of practices between farmers who inherited and those that purchased their own plots. This study finding concurs with Allan et al. (2015), who revealed that plot ownership is a proxy measure for assured land access, and this has a positive impact on the decision to adopt conservation tillage methods. Ownership of land

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increases the assurance of future access to returns on investments.

In general, the earlier stated null hypothesis that there was no significant association between the nine (9) factors (Age of the household head, Education, Labour availability, Farm size, Experience, Gender, Slope of the farm, Un-accessibility of credit services and plot ownership type) and use recommended coffee management practices was rejected.

A number of policy interventions for addressing the socioeconomic impediments to the use of coffee management practices were suggested by respondents. 35.1% of the respondents suggested the need for community capacity building through training and education. Capacity building was recommended by respondents to develop the skills and knowledge of the farmers in different aspects of coffee management. This can be achieved through periodical hands-on training. Through hands-on training, farmers can be in a better position to acquire the necessary skills and knowledge required to apply and sustain production management practices and technologies. This study finding is comparable to findings by Mugisha and Alobo (2012), who revealed that building farmers' management and problem-solving capacity requires joint learning through practical work. This requires a shift from previous perceptions where farmers were seen mainly as 'adopters' or 'rejecters'' of technologies but as providers of knowledge and improved practices. Many studies have shown the ability of farmers to innovate and develop their own solutions to problems through FFSs, thereby being part of the innovation system rather than just recipients.

Furthermore, the respondent recommended the need to strengthen agricultural extension by the government through additional budget allocation to recruit Assistant Agricultural Officers so that rural farmers can fully access the extension advisory services on coffee-recommended management practices. For a long time, the Ugandan agricultural extension system has remained weak in terms of operations resulting from underfunding; the extension-to-farmer ratio in the area of study is high (1:1500), and the area of coverage for one extension worker Agricultural Officer (all Sub County) is big. As a result, farmers in most remote rural settings are unable to access extension services. This study finding concurs with Méndez et al. (2010) who indicated that the role of extension is to educate people to understand that they are an agent of change and can influence their communities by addressing their immediate problems through the application of acquired technology. The process of extension education is one of working with people and helping them by means of education to put to use useful knowledge that works for them.

The study indicated that 15.7% of the respondents recommended the provision of credit extension at a low-interest rate to farmers. Farmers need money to purchase inputs that are used in different activities on the farm such as mulches, herbicides, farm tools and hire labour to work on the farm. Lack of credit and high-interest rates limits farmers' capacity to invest in good management practices. This study finding agrees with Owolabi et al. (2011) who stated that cash is essential in hiring labour and purchasing farm inputs like seeds and animal manure.

Revising Land reform policies was also another policy intervention recommended by respondents for addressing the socioeconomic impediments to the use of coffee management practices in the area, as indicated by 13.6% of the respondents. This was to prohibit more fragmentation and sharing of land among family members. The majority of the farmers hold their land under customary tenure and this tenure mostly involves fragmentation of land into small plots among family members hence less investment in new technologies of management practices. This agrees with Van Asten et al. (2012) who argued that larger farm sizes are better initiated for the effectiveness of coffee management practices and farmers' uptake of new technology. In

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addition, Mwaniki (2014) argued that the benefits from the large-scale adoption of new technologies are absolutely large for larger farms.

The study findings further indicated that 11.9% of the respondents recommended the formation of farmer groups. Group formation promotes cohesion, knowledge sharing and farmers' access to inputs and financial capita hence being able to address some of the challenges that impair the use of recommended practices in coffee production. This study finding is comparable to findings by Mugwe (2014), who argued the impact of farmer group mobilisation on technology adoption: One of the factors that encourage farmers to work in collaborative marketing groups (CMG) is the sense of security by members of the CGM in adopting new innovations. Individual farmers do not feel isolated in taking risks associated with adopting new technologies, as the effect of adopting a particular innovation is felt by everyone in the group.

CONCLUSIONS

The study concluded that coffee in Kichwamba and Kirugu Sub counties was grown under two major production systems, that is, intercropping and mono-cropping (pure stand).

The study also concluded that the major coffee management practices used included; seedbed management, transplanting, pruning, shading, fertiliser application, weeds control, pest and disease management and water drainage management.

The study further concluded that there are significant socioeconomic factors affecting the adoption of different recommended management practices for coffee production and performance in the area, such as; the education level of the household head, shortage of labour, farm size, experience in coffee farming, gender, the slope of the farm, un-accessibility of credit services, age of the farmer and plot ownership type.

These could be addressed through suggested policy interventions like; re-visiting land reform policies, credit extension, capacity building/skill and knowledge development, strengthening agricultural extension and encouraging group formation among farmers.

Recommendations

Based on the study findings, the following recommendations were made in line with the study objectives.

- There is a need for more education and training for farmers on the recommended practices since education influences farmers' decision to adopt technologies by enhancing their ability to understand and utilise the practice through overall managerial ability. This would help them acquire a specific level of knowledge needed to use specific agricultural technologies. This was because a large number of the farmer were partially educated, which perhaps explained their lack of understanding of certain practices.
- Revisiting land policies is paramount if farmers in the area are to use recommended management technologies. Small-sized land was one of the reasons farmers failed to use recommended practices. Therefore increasing land size/area, stopping land fragmentation and promoting consolidation of land areas would mean that farmers have enough spaces/area to try new technologies/practices.
- Groups, associations, and cooperative formation should be encouraged. These farmers' associations ease farmers' access to support services like inputs, extension, and credit services.
- There is a need to support farmers through credit services. This can be achieved through establishing village SACCOs/banks and starting loan schemes for farmers' loans at a low-interest rate.

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- Farmers need to be educated on the best coffee production system and management practices to boost coffee production.
- There is a need for collaboration and cooperation among small-scale farmers and non-governmental organisations to deal with the socioeconomic factors limiting the use of recommended practices for coffee production.
- There is a need for more capacity building and external support. This can be achieved by providing agricultural advisory services
- There is a need to change the mindset and perceptions of the farmers towards the use of recommended practices. This can be achieved through organising educational training at sub-county and village levels.

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