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Research Article

Pre-Harvesting and Harvesting Management Practices Affecting Coffee Quality in Kasaana Sub-County, Sheema District

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Abstract

The study focused on analyzing the effect of coffee pre-harvesting and harvesting management practices on coffee quality in Kasaana sub-county, Sheema district. It was guided by one objective which was to; establish coffee pre-harvest and harvest management practices that improve coffee quality. he study employed a cross-sectional research design. The study considered the sample size of 206 respondents. The study employed simple random sampling and purposive sampling to select categories of respondents. The study used questionnaires and interview guide to collect data. The data was analysed using SPSS version 22.0. The study concludes that both pre-harvest and harvest practices significantly improve coffee quality. Notably, harvesting method, pruning, and timing practices are the most impactful. The study recommends that, training programs should be intensified to educate farmers on the importance of selective handpicking of ripe cherries, as it has the greatest impact on coffee quality, local agricultural extension officers should support farmers with seasonal pruning calendars and demonstrations to encourage frequent and well timed pruning, which improves canopy health and productivity, awareness campaigns should be launched to emphasize harvesting only ripe cherries and avoiding strip picking and there is a need to constantly promote Integrated Pest Management (IPM) techniques among coffee farmers through farmer field schools and subsidies on eco-friendly pest control inputs.

Keywords

Pre-Harvesting, Management Practices, Coffee Quality

1. Introduction

Coffee is one of the most valuable agricultural commodities globally, contributing significantly to the livelihoods of millions of smallholder farmers, particularly in developing countries [10]. Its production plays a crucial role in economic growth and rural development, serving as a primary source of income for many households in regions such as Africa and Latin America [6].

The global coffee industry is characterized by diverse climates, altitudes, and cultivation practices [3]. Pre-harvesting and harvesting methods significantly influence the quality of coffee beans, affecting flavor, aroma, and overall market value. In recent years, there has been a growing recognition of the need to implement sustainable and precise practices to enhance coffee quality globally [15]. Coffee, one of the most

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globally traded commodities, plays a pivotal role in the economies of coffee-producing countries. Its quality largely influenced by pre-harvesting and harvesting management practices, is critical for the industry's sustainability and competitiveness on the international market [15].

In developed countries, there's a growing trend towards specialty coffee production, driven by consumer demand for unique flavor profiles and sustainable practices [8]. Countries like the United States, Japan, and Italy have vibrant coffee cultures with a strong emphasis on quality and innovation. For example, specialty coffee roasters in the United States often establish direct relationships with producers to ensure traceability and quality control throughout the supply chain [8]. Similarly, in Japan, where consumers have a discerning taste for high-quality coffee, there's a culture of continuous improvement in cultivation and processing practices to elevate coffee quality [19]. Italian coffee culture, characterized by its rich espresso tradition, exemplifies the meticulous attention to detail in every aspect of coffee production, from bean selection to brewing [4].

Africa is a key player in the coffee industry, with Ethiopia and Kenya renowned for producing high-quality Arabica coffee [18]. The impact of pre-harvesting and harvesting practices in African countries extends beyond economic considerations to cultural and social aspects [1]. Sustainable practices are increasingly emphasized to address challenges such as climate change and pests, ensuring the longevity of the African coffee industry on the global stage [1].

Different continents have unique climatic conditions, soil types, and coffee varieties. Understanding and tailoring pre-harvesting and harvesting practices to specific continental contexts is crucial for optimizing coffee quality [18]. For example, the conditions in South America might differ significantly from those in Africa, affecting coffee flavor profiles.

In Uganda, coffee is a vital cash crop and a significant contributor to the country's economy. The impact of pre-harvesting and harvesting practices on coffee quality is of paramount importance to Ugandan farmers. Recent studies highlight the need for improved agronomic practices, including proper ripeness assessment during harvesting and post-harvest processing, to enhance the quality of Ugandan coffee [15]. Uganda, located in East Africa, is a significant player in the global coffee industry. The country has a long history of coffee cultivation, and coffee production plays a crucial role in its economy. Uganda is known for producing both Arabica and Robusta coffee varieties, with Robusta being the dominant type. According to recent statistics, Uganda consistently ranks as one of the top coffee-producing countries in Africa, and coffee is a major export commodity [17]. The country's diverse agro-ecological zones provide suitable conditions for coffee cultivation, with regions like Bugisu, Mount Elgon, and Rwenzori being key coffee-producing areas.

Uganda's economy significantly benefits from coffee production, contributing substantially to the country's export revenue. Coffee is a major cash crop, providing income for numerous smallholder farmers and supporting livelihoods in both rural and urban areas. Coffee is a crucial export commodity for Uganda, accounting for a substantial portion of the country's foreign exchange earnings [12, 16].

Uganda's presence in the global coffee market enhances its competitiveness. The country's ability to produce both Arabica and Robusta varieties allows it to cater to diverse market preferences; Uganda's coffee industry plays a crucial role in maintaining the country's competitiveness in the global coffee market, offering a range of coffee varieties to meet consumer demands [10, 15]. National policies, regulations, and socio-economic factors contribute significantly to the coffee industry. Analyzing pre-harvesting and harvesting management practices at the national level helps identify broader patterns and challenges. National governments' support or lack thereof can influence the adoption of sustainable practices [10].

2. Problem Statement

The impact of pre-harvesting and harvesting practices on coffee quality is a critical concern, with a pressing need to bridge the gap between the ideal situation and the current reality [15]. Despite ongoing research, there remains a significant gap in understanding and implementing optimal practices at various geographical levels, leading to sub-optimal coffee quality and hindered sustainability.

In an ideal scenario, pre-harvesting and harvesting practices would be characterized by precision, sustainability, and alignment with local conditions. Farmers would adopt innovative and climate-smart techniques to maximize coffee quality, ensuring a consistent and high-value product on the global market [15].

However, the reality was far from the ideal. Many coffee-producing regions, including those in Africa and specifically in Uganda, continue to grapple with outdated practices, inadequate resources, and insufficient knowledge [1]. The result was a compromised coffee quality, impacting both the economic viability of farmers and the reputation of the global coffee industry [12].

What seemed to be lacking was a systematic approach to pre-harvesting and harvesting management practices in coffee production. There might be a dearth of research focusing specifically on the unique challenges and opportunities faced by coffee farmers in Kasaana sub-county. There might be limited access to training, resources, or extension services that could help farmers adopt more effective practices to enhance coffee quality and increase yields sustainably. This study aimed at filling this gap by conducting a comprehensive investigation into the pre-harvesting and harvesting management practices affecting coffee quality in Kasaana sub-county, Sheema District. By gathering empirical data through field surveys, interviews with study respondents, as this research sought to identify the most critical factors influencing coffee quality and develop evidence-based recommendations for improving pre-harvesting and harvesting practices.

3. Research Objectives

The general objective of the study was to; analyze the effect of coffee pre-harvesting and harvesting management practices on coffee quality in Sheema district. The specific objective was to; establish coffee pre-harvest and harvest management practices that improve coffee quality.

4. Justification of the Study

Coffee remains one of Uganda's most valuable export crops, contributing significantly to national revenue, employment, and household incomes, particularly in rural areas. Uganda is the largest exporter of coffee in Africa and ranks among the top ten coffee producers globally (Uganda Coffee Development Authority [17]. However, despite the country's high production volumes, the quality of Ugandan coffee has faced criticism in international markets due to inconsistent pre-harvesting and harvesting practices. These practices include early or late picking of coffee cherries, improper pest and disease control, poor shade management, and the use of unstandardized tools or techniques. All these issues significantly affect key coffee quality parameters such as bean size, moisture content, flavor, and aroma, which are crucial in determining market price and consumer preference [10]. Therefore, it becomes necessary to conduct a study focused on identifying and improving pre-harvest and harvest practices to enhance coffee quality in Uganda.

This study is also strongly aligned with Uganda's long-term development goals, particularly Vision 2040, which envisions a transformation from subsistence agriculture to a modern and market-oriented farming system [13]. The vision emphasizes value addition, agricultural commercialization, and competitiveness in global markets. Since coffee is one of the strategic commodities identified under this vision, improving its quality through better agronomic practices supports this national transformation agenda. Similarly, this study will highlights agro-industrialization as a key programme to drive economic growth. One of the NDP III objectives is to increase the quality and market value of Uganda's agricultural products through improved research, extension services, and farmer training [13]. By examining the current pre-harvest and harvesting practices and identifying gaps, this study contributes valuable insights that can be integrated into extension programmes and policy frameworks for coffee sector development.

5. Significance of Study

The study will be significant to different stakeholders;

To farmers

Improved income and livelihood: Farmers stand to benefit significantly from the study's findings as it provides insights into optimizing pre-harvest and harvesting practices. By enhancing the quality of their coffee beans, farmers can command higher prices in the market, leading to increased income and improved livelihoods for themselves and their communities.

Sustainable practices: The research findings contribute to the development of sustainable agricultural practices, helping farmers reduce input costs, minimize environmental impact, and ensure the long-term viability of coffee cultivation. This is crucial for the continued success of coffee farming and the preservation of farming communities.

Competitive advantage: Understanding and implementing effective pre-harvest and harvesting practices can give farmers a competitive advantage in the global market. Farmers who produce high-quality coffee are more likely to attract premium buyers and establish long-term relationships with coffee roasters and retailers.

To policy makers/government

Economic development: The study's emphasis on improving the quality of coffee can contribute to the economic development of coffee-producing regions. Government policies that support and incentivize the adoption of best practices identified in the research can lead to increased revenue for farmers and overall economic growth.

Environmental sustainability; Policy makers can use the research findings to develop and implement environmentally sustainable agricultural policies. This includes promoting practices that reduce the ecological footprint of coffee cultivation, protect natural resources, and encourage biodiversity conservation.

International trade and reputation: A focus on quality improvement can enhance the reputation of a country's coffee industry on the international stage. Government support for quality-centric initiatives can boost exports, attract foreign investment, and strengthen the global competitiveness of the country's coffee sector.

To researchers

Scientific advancement: Researchers will benefit from the study by advancing scientific knowledge in agronomy and food science. The insights gained contribute to a deeper understanding of the complex interactions between agricultural practices and coffee quality, potentially leading to the discovery of new principles and techniques applicable beyond coffee cultivation.

Innovation and best practices: The study results will provide a foundation for the development of innovative and best practices in coffee cultivation. Researchers can build on this knowledge to explore new technologies, methods, and strategies that further enhance coffee quality, productivity, and sustainability.

Knowledge transfer: Researchers play a vital role in disseminating knowledge to farmers and industry stakeholders.

The study's findings can be used to develop extension programs, training materials, and workshops that transfer valuable insights to those on the ground, fostering the adoption of improved practices.

To student

The study findings will help the student to acquire his Master of Agriculture and Rural Innovations at Bishop Stuart University, since it is a requirement for his academic award.

6. Materials and Methods

The study was conducted in Kasaana Sub county, Sheema district, Uganda. Sheema District is situated in the south-western part of Uganda. The Western Region, where Sheema is located, is known for its diverse landscapes, including hills, valleys, and plains. The neighboring districts of Sheema District in the Western Region include, but are not limited to; Mbarara District, to the west of Sheema, Bushenyi District to the south of Sheema, Rwampara District to the south west and Buhweju District to the southeast, depending on specific boundaries. Kasaana Sub-county was chosen because it is leading in coffee farming in Sheema District, as this is attributed to its favorable climatic conditions, suitable soil types, or historical agricultural practices that make it conducive to coffee cultivation. The region's elevation, rainfall patterns, and temperature can influence the success of coffee farming.

The study adopted a descriptive cross-sectional survey to assess relationship between pre-harvest and harvest management practices and coffee quality. A descriptive cross-sectional survey design was a research method commonly used to gather information about a particular phenomenon or variable of interest from individuals within a population or sample at a specific moment [7]. In the context of studying pre-harvest and harvest management practices and coffee quality. How design was utilized during this study is explained below.

During this study design, researcher designed a survey instrument tailored to the research objectives. The instruments included questions covering various aspects of pre-harvest and harvest management practices, such as types of fertilizers used, pest management techniques, harvesting methods, processing procedures, and quality assessment criteria. Questions about demographic information and farm characteristics were also included to provide context to the data. This design was suitable for the study because conducting a cross-sectional survey was typically more efficient and cost-effective compared to other designs. Researcher collected data from a large sample of coffee farmers or farms relatively quickly and with fewer resources, making it feasible to study a broad range of management practices and quality outcomes.

Researcher also defined inclusion as smallholder coffee farmers aged 20 to 75 years, local leaders and agricultural extension agents in the study area and farmers who were not directly involved in coffee production, large scale coffee farmers and farmers aged above 80 were excluded from the study to delineate the boundaries of the study population and ensured that it aligned with the research objectives.

The study used formula by Slovin to calculate sample size for estimating proportions with a specified level of confidence and margin of error as given below [14]:

$n = Z_{\alpha/2}Pq/d^2$

$n = 1.96^2 \times 0.16 \times 0.84/0.05^2$

$= 3.8416 \times 0.16 \times 0.84/0.0025$

$= 0.\ 5163/0.0025$

n = 206 respondents

n is the required sample size.

Z is the Z-score corresponding to the desired level of confidence (usually taken from standard normal distribution tables, for a 95% confidence level, it's approximately 1.96).

p is the estimated proportion of the population with the characteristic of interest (coffee farmers, 16% (0.16), d - is the desired margin of error (0.05 for a 5% margin of error), q- proportion of the population with different characteristics 84% (0.84) and α– 0.05 (level of significance).

Simple random sampling is a straightforward method used to select a sample from a population in which each member of the population has an equal chance of being selected. This created a comprehensive list of all the coffee farmers or individuals involved in coffee production in Kasaana Sub-county. This list was obtained from agricultural records, local agricultural extension offices, or other relevant source. This used paper random method to select respondents from the population list. There were various ways to do this, such as using random number table. This method was applied in selecting coffee farmers because they were many and with similar adequate information about the study phenomenon. Simple random sampling was used to collect data from farmers because the target population was big and all members had similar characteristics. The researcher wrote names of all farmers on pieces of paper and folded these papers and put them in a basin or toss them on the ground.

Purposive sampling was also used to select respondents for a study on the relationship between pre-harvest and harvest management practices and coffee quality, and its rationale behind its use. This defined specific criteria that potential respondents must meet to be included in the study. These criteria could be based on characteristics such as geographic location, farm size, farming practices, or coffee quality outcomes. Researcher sought out coffee farmers who used harvest management practices, had experience with specialty coffee production and located in a particular area known for high-quality coffee production. Purposive sampling allowed researcher to target individuals or groups who possessed expertise or firsthand knowledge relevant to the research topic. By selecting respondents who had experience in offering technical information about coffee farming and are actively engaged in pre-harvest and harvest management practices, researcher gained valuable insights and perspectives that might not be accessible through random sampling methods.

The questionnaire was used with open-ended questions to allow respondents to provide detailed quantitative information about their pre-harvest and harvest management practices. These open-ended questions enabled researcher to gather rich, in-depth insights into the specific practices employed by coffee farmers. Following the open-ended questions, the questionnaire included closed-ended questions with predefined response options. These questions covered various aspects of pre-harvest and harvest management practices, such as the types of fertilizers used, the frequency of pesticide application, the timing of harvesting, and the methods of processing coffee beans (for example wet processing, dry processing). Closed-ended questions provided structured data that could be easily quantified and analyzed statistically.

The ethical clearance was obtained from Bishop Stuart University through Research Ethical committee.

Respect for respondent's autonomy and dignity: Respondents had the right to make autonomous decisions about their participation in research, and their dignity and rights should be respected throughout the research process. This provided respondents with opportunities to withdraw from the study at any time, respect their autonomy in decision-making, and avoided any actions that might compromise their dignity.

Cultural sensitivity and respect: This recognized and respect cultural diversity, values, beliefs, and practices, ensuring that research activities are conducted in a culturally sensitive and inclusive manner. This was engaged with diverse communities in a respectful and culturally sensitive manner, adapt research protocols to reflect cultural norms, and incorporate diverse perspectives in research design and interpretation.

Informed consent: Participants were fully informed about the purpose, procedures, risks, and benefits of the research, and voluntarily consented to participate without coercion or undue influence. Researcher obtained written or verbal consent from participants before their involvement in the study, ensuring they understand their rights and responsibilities.

Privacy and confidentiality: Participants had the right to privacy, and their personal information should be kept confidential to the extent possible. Researcher took measures to protect participants' anonymity and confidentiality. Researcher anonymize data, stored data securely, and ensured that only authorized personnel have access to participants' information. Each participant was compensated five thousand shilling for his or her sacrificed time during data collection.

Qualitative data using content analysis was done which involves systematically examining audio data to identify patterns, themes, and meanings within the content. This clearly defined the objectives of research and formulate specific research questions that were addressed through content analysis. This helped to guide the analysis process and ensures that it remained focused and purposeful. Qualitative responses captured were presented through reporting results in form of verbatim statements.

Quantitative analysis using SPSS (Statistical Package for Social Sciences) involves a series of steps to manipulate data, run statistical tests, and interpret results. Data was entered into SPSS version 23.0 manually. Data was cleaned by checking for missing values, outliers, and errors. SPSS tools such as "Variable View" and "Data View" to inspect and edit data set. Inferential statistical techniques, such as correlation analysis or regression analysis, to examine the relationships between pre-harvest and harvesting practices and coffee quality was done. Data output was presented in form of tables.

7. Study Results

Table 1. *Demographic Characteristics of Respondents (n =206).*

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	142	68.9
	Female	64	31.1
Age	< 20 years	6	2.9
	20–25 years	17	8.3
	26–35 years	44	21.4
	36–45 years	53	25.7
	46–55 years	48	23.3
	56 and above	38	18.4
Education Level	No formal education	15	7.3
	Primary	63	30.6
	Secondary	79	38.4
	Diploma	28	13.6
	Bachelor's degree	15	7.3
	Other (for example vocational training)	6	2.9
Marital Status	Single	29	14.1
	Married	148	71.8
	Widowed	18	8.7
	Separated	11	5.3
Coffee Farm Size	Less than 1 acre	41	19.9
	1–3 acres	93	45.1
	3–5 acres	49	23.8
	More than 5 acres	23	11.2

Gender: A majority of the respondents (68.9%) were male and 31.1% were single, indicating that coffee farming in Kasaana Sub-county is male-dominated. This gender dominance could influence labor-intensive practices such as selective picking and pre-harvest sanitation, which are important for maintaining coffee quality.

Age: Most farmers fell within the 26–55 year age range (70.4%), representing an active working population. This age group is more likely to adopt improved pre-harvest and harvesting techniques such as proper pruning, pest control, and selective picking due to their physical capacity and awareness.

Education Level: A significant number of farmers had at least secondary education (38.4%), primary, 30.6%, diploma, 13.6%, and no formal education and others 7.3% respectively. Educated farmers are generally more aware of best practices for harvesting, such as avoiding strip picking and ensuring only ripe cherries are harvested, which contributes positively to coffee quality.

Marital Status: The majority (71.8%) were married, single 14.1%, divorced and separated 16% combined. An implication that married farmers have high family labor used commonly used on farms, supporting better management practices during harvesting seasons.

Farm Size: Most farms were between 1–3 acres (45.1%), followed by 23.8% who own 3-5 acres, 19.9% own less than an acre and 11.2% revealed more than 5 acres. The results imply that medium-scale farmers are often better positioned to manage coffee quality due to manageable farm size and access to basic resources, though they may still face challenges related to labor availability and mechanization.

Table 2. *Multi-linear regression output on pre-harvest practices that improve coffee quality.*

Variable	Unstandardized Coefficient (B)	Std. Error	Standardized Coefficient (Beta)	t-value	p-value
(Constant)	59.380	2.013	—	29.50	0.000
Soil fertility management	3.875	0.942	0.322	4.11	0.000
Pest & disease Control	2.945	1.017	0.244	2.90	0.004
Shade management	2.613	0.901	0.218	2.90	0.004
Pruning practices	1.832	0.866	0.153	2.12	0.035
Irrigation/water management	2.157	0.877	0.174	2.46	0.015

A *p-value less than or equal to 0.05* means the effect is *statistically significant* that is; the variable *has a real influence* on the dependent variable (coffee quality).

(Constant = 59.38): The baseline coffee quality score is *59.38* when all practices are absent or poorly applied.

Soil Fertility Management (B = 3.875, β = 0.322, p < 0.001):

This is *highly significant*. The impact of soil fertility efforts on coffee quality is real and not due to chance. This practice *strongly improves coffee quality*.

For each unit increase in effort (for example., moving from no fertilizer to organic + inorganic), coffee quality increases by *3.88 points.*

Pest & Disease Control (B = 2.945, β = 0.244, p = 0.004): This is *statistically significant practice*. Pest control practices significantly improve coffee quality. The result is reliable and should be adopted by farmers. A one-unit improvement leads to a *2.95 points* increase in coffee quality.

Shade management (B = 2.613, β = 0.218, p = 0.004):

This is *highly significant*. The impact of soil fertility efforts on coffee quality is real and not due to chance. This practice *strongly improves coffee quality*.

Proper shade improves microclimate, promoting slow, quality cherry development. An implication that this boosts sugar content and flavor richness.

Pruning Practices (B = 1.832, β = 0.153, p = 0.035): *Significant but weaker* than others. It still contributes positively to quality, but the evidence is less strong. Proper pruning improves light penetration and uniform cherry ripening.

Irrigation/Water management (B = 2.157, β = 0.174, p = 0.015):

Statistically significant indicating reliable evidence that watering practices improve coffee quality. This also contributes to coffee quality by ensuring consistent growth and avoiding drought stress during cherry development.

Table 3. *Regression out on harvest management practices that improve coffee quality.*

Variable	Unstandardized Coefficient (B)	Std. Error	Standardized Beta	t-value	p-value
Constant	4.210	0.456	-	9.23	0.000***

Variable	Unstandardized Coefficient (B)	Std. Error	Standardized Beta	t-value	p-value
Selective harvesting	1.275	0.212	0.412	6.01	0.000***
Strip picking	-0.478	0.197	-0.162	-2.43	0.016**
Handpicking	0.653	0.188	0.289	3.47	0.001***
Harvesting at optimal ripeness	1.012	0.231	0.384	4.38	0.000***
Timely transport after harvest	0.544	0.202	0.216	2.69	0.003***
Use of clean harvesting tools	0.389	0.195	0.172	1.99	0.048*

Significance codes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Selective harvesting (B = 1.275, p = 0.000***):

Strong positive and significant impact on coffee quality. Farmers using selective harvesting gain 1.28 points more in quality score. This implies selective picking of only ripe cherries ensures better cup quality.

Strip picking (B = -0.478, p = 0.016**):

Negative and significant. Strip picking reduces coffee quality by ~0.48 points. This implies non-selective bulk harvesting introduces unripe or overripe cherries, degrading quality.

Handpicking (B = 0.653, p = 0.001***):

Positively and significantly impacts coffee quality. manual picking offers careful selection compared to mechanical methods.

Harvesting at optimal cherry ripeness (B = 1.012, p = 0.000***):

Strong positive effect. Ensures cherries are fully mature with best flavor profile, improving the quality.

Timely transport after harvest (B = 0.544, p = 0.003***):

Significant positive impact. Reduces post-harvest fermentation or mold risk, hence maintaining coffee bean quality.

Clean harvesting tools (B = 0.389, p = 0.048*):

Marginally significant positive effect. Prevents contamination during harvest, maintaining bean cleanliness and quality.

8. Discussion of Results

The study respondents revealed pest and disease control as part of pre-harvest management is moderately practiced in Kasaana. Farmers mainly use cultural practices like sanitation (removing fallen cherries and pruning infested branches), but chemical pesticides are less frequently used due to cost. The presence of Coffee Wilt Disease (CWD) and Leaf Rust has been reported, especially on unpruned or poorly managed trees. Integrated pest management (IPM) is increasingly promoted, Kasaana farmers rely more on indigenous knowledge and reactive measures. This finding can be compared with Avelino et al., who in their study noted that pre-harvest pest and disease control measures are essential to protect coffee cherries from damage [2].

The study results revealed that coffee is typically grown under rain-fed conditions, which exposes the crop to seasonal drought stress, especially during prolonged dry spells. However, a few progressive farmers with access to water practice, use manual irrigation during dry months. This supplemental irrigation, though minimal, helps maintain cherry development and reduce bean defects due to drought stress. This finding can be compared with DaMatta and Ramalho, who noted that adequate water supply is crucial for the development of coffee cherries. Controlled irrigation during dry periods and proper drainage to avoid water-logging are essential practices [5]. DaMatta and Ramalho, also explained that water stress at critical stages can adversely affect coffee bean development and compromise yield and quality [5].

The study results also revealed that selective harvesting through use of handpicking is one of the most critical determinants of coffee quality in Kasaana sub-county. Selective handpicking choosing only red, fully ripe cherries is widely practiced and has been positively correlated with superior quality and reduced fermentation defects. Farmers who pick cherries at peak maturity report better prices and consumer preference. This finding concurs with Illy and Viani, who emphasised that this practice is crucial for obtaining high-quality beans with desirable flavor characteristics [9]. Illy and Viani, further explained that this process is crucial for achieving the highest quality coffee beans because only fully ripe cherries possess the desired flavor compounds and characteristics and that over-ripe or underripe cherries can negatively impact the overall cup quality [9].

The results also indicate that decision of when to harvest cherries also affects coffee bean quality. Farmers who consider weather patterns, cherry ripeness, and market timing produce more desirable beans. In contrast, premature harvesting or harvesting after over-ripening leads to quality deterioration. This finding is consistent with Jaramillo-Botero who established that harvesting should be carried out when the cherries are fully ripe to ensure optimal flavor and aroma development [11]. Jaramillo-Botero further explained that delayed harvesting can lead to over-ripening and negatively impact the cup quality of the coffee and also emphasized importance of precise timing during harvest to maximize quality coffee cherries [11].

9. Conclusion

The study concludes that both pre-harvest and harvest practices significantly improve coffee quality. Notably, harvesting method, pruning, and timing practices are the most impactful.

10. Study Recommendations

Training programs should be intensified to educate farmers on the importance of selective handpicking of ripe cherries, as it has the greatest impact on coffee quality.

Local agricultural extension officers should support farmers with seasonal pruning calendars and demonstrations to encourage frequent and well timed pruning, which improves canopy health and productivity.

Awareness campaigns should be launched to emphasize harvesting only ripe cherries and avoiding strip picking. This will minimize defective beans and enhance flavor quality.

Extension workers should offer specific guidance on the right time and dosage of fertilizer application, particularly during flowering and berry development stages.

There is a need to constantly promote Integrated Pest Management (IPM) techniques among coffee farmers through farmer field schools and subsidies on eco-friendly pest control inputs.

Cooperatives and buyers should consider offering better prices for farmers who follow quality-improving practices, especially those practicing selective harvesting and timely input use.

Abbreviations

IPM	Integrated Pest Management
CWD	Coffee Wilt Disease
NDP	National Development Programme
SPSS	Statistical Package for Social Sciences

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Conflicts of Interest

The authors declare no conflicts of interest.

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