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Adoption of Sustainable Agricultural Practices: A Case of Coffee Farmers In Central Uganda

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Abstract

This paper examines sustainable agricultural practices (SAPs) in Mukono District, Central Uganda. However, sustainable food security production is an inevitable pillar toward environmental conservation and efficient rural livelihoods. Nevertheless, there is a need for robust capacity building and a change of generational perspectives toward agriculture. This research examines the adoption of SAPs among coffee farmers in Uganda. It focused on socio-economic and environmental factors leading to the adoption of SAPs among coffee farmers.

The methodology used was a descriptive research design. Questionnaires and an interview guide were used for data collection from 60 respondents—three extension workers and 57 coffee farmers of Mukono district—who were randomly selected and data was analyzed using SPSS software.

The study showed that land ownership has a direct influence on the adoption of SAPs. It was also found that 58% of the coffee farmers who participated in the study have between 5–10 acres of land. Additionally, these results indicate that the perception of soil fertility benefits and rainfall precipitation promotes the adoption of SAPs. However, land size and ownership are determinant factors for the adoption of SAPs. In addition to various programs by associations and cooperatives, through non-governmental organizations and government-led initiatives, to offer technical and financial support along with capacity building, it is recommended that such programs prioritize more incentives for land access. This will improve land ownership problems, space to apply farming innovative technologies, and capacity building in order to enhance SAP adoption and hence improve livelihood.

Keywords: Sustainable agriculture practices, Socio-economic factors, Environmental conservation, Rural Livelihoods, Coffee farmers; Mukono

Adoption de pratiques agricoles durables : Un cas de producteurs de café Dans le centre de l'Ouganda

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Résumé

Cet article examine les pratiques agricoles durables (PAS) dans le district de Mukono, au centre de l'Ouganda. Cependant, une production durable pour la sécurité alimentaire constitue un pilier inévitable de la conservation de l'environnement et de moyens de subsistance ruraux efficaces. Néanmoins, un solide renforcement des capacités et un changement de perspective générationnelle à l'égard de l'agriculture sont nécessaires. Cette recherche examine l'adoption des PAS parmi les producteurs de café en Ouganda. Il s'est concentré sur les facteurs socio-économiques et environnementaux conduisant à l'adoption des PAS par les producteurs de café.

La méthodologie utilisée était un plan de recherche descriptif. Des questionnaires et un guide d'entretien ont été utilisés pour la collecte de données auprès de 60 personnes interrogées – trois agents de vulgarisation et 57 producteurs de café du district de Mukono – qui ont été sélectionnées au hasard et les données ont été analysées à l'aide du logiciel SPSS.

L'étude a montré que la propriété foncière a une influence directe sur l'adoption des PAS. Il a également été constaté que 58 % des producteurs de café ayant participé à l'étude possèdent entre 5 et 10 acres de terre. De plus, ces résultats indiquent que la perception des bénéfices en matière de fertilité des sols et des précipitations favorise l'adoption des PAS. Cependant, la taille et la propriété des terres sont des facteurs déterminants pour l'adoption des PAS. En plus des divers programmes menés par des associations et des coopératives, par le biais d'organisations non gouvernementales et d'initiatives dirigées par le gouvernement, pour offrir un soutien technique et financier ainsi que le renforcement des capacités, il est recommandé que ces programmes donnent la priorité à davantage d'incitations à l'accès à la terre. Cela améliorera les problèmes de propriété foncière, l'espace pour appliquer des technologies agricoles innovantes et le renforcement des capacités afin de renforcer l'adoption du PAS et donc d'améliorer les moyens de subsistance.

Mots clés : Pratiques agricoles durables, Facteurs socio-économiques, Conservation de l'environnement, Moyens de subsistance ruraux, Producteurs de café ; Moukono

1.0 Introduction

Food insecurity is significantly more widespread in East Africa compared to other global regions. The presence of climate change and its related fluctuations play a crucial role in contributing to food insecurity within this area (Gebre, 2021).

In addition, demand for agricultural raw materials has increased for industries such as beer brewing and fuel. Although increasing crop production in Sub-Saharan Africa is a target for most countries, continuous decline in the quality of production factors especially soil fertility remains a challenge for most smallholder farmers.

Traditional systems of soil fertility management such as fallowing were prevalent in most Sub-Saharan African countries between the 1950s–1960s (Ebanyat et al., 2010). However, these extensive soil fertility management practices have almost disappeared due to high population pressure on arable land (Ojiem et al., 2014). In most Asian countries, intensification has resulted in improved productivity, while most parts of Sub-Saharan Africa are experiencing low crop yields and productivity. This is because, before colonialism, crop yields in Sub-Saharan-Africa were largely dependent on traditional farming practices, exhibiting modest outputs due to limited technological advancements. However, the post-colonial period witnessed increased agricultural modernization, leading to improved crop yields. Nevertheless, challenges like farming space, soil degradation, climate change, and resource constraints persist, impacting overall productivity. Despite advancements, the region still grapples with ensuring consistent and sustainable crop yield levels (Block, 1994).

Fuglie & Rada (2013), reported that the increase in agricultural productivity in Sub-Saharan Africa from the early 1980s to 2008 was due to an expansion in arable land. However, growth in cropping intensity remained below 1.0% throughout this period. The lack of incentives for smallholder farmers to intensify crop production through fertilizer use is mainly due to the high cost and limited access to credit (Woniala & Nyombi, 2014).

The adoption of SAPs may provide sustainable alternatives to major factors influencing productivity and efficiency. The justification of this alternative is that SAP encompasses farming methods and techniques that give precedence to the well-being of the environment, society, and economy. Their objective is to boost productivity while reducing detrimental effects on ecosystems, natural resources, and communities. SAPs encompass strategies like (a) organic agriculture, (b) agroforestry, (c) crop rotation, (d) integrated pest control, (e) efficient water management, (f) soil preservation, and (g) the promotion of biodiversity. The overarching aim is to ensure enduring food security, sustain ecosystem vitality, counteract the impacts of climate change, and bolster the livelihoods of farmers and communities (Kassie et al., 2013).

The adoption of SAPs in smallholder farms is determined by various factors. These factors can lead to considerable variation in the demand for agricultural products. They include the educational status of the farmer, cultivated land size, maximum economic yield, returns per unit of land, and the impacts of SAPs on the yield level (Assefa Gashaw et al., 2018).

In Uganda, the growth of market-oriented agriculture has raised optimism for agricultural development. Recent literature on soil fertility in Uganda indicates that soils within the smallholder farms are experiencing negative nutrient balances (Turinawe et al., 2015). During the period 1961–2007, yield increases for crop production were through expansion of acreage under cultivation, but due to increasing population this is no longer possible. A large proportion of

crop farmers in Uganda (95%) are smallholder farmers who do not apply optimal quantities of fertilizer in their crop production (Apanovich & Mazur, 2018). The adoption of SAPs by coffee farmers calls for other innovative approaches for maintaining soil fertility to reduce the impact of climate change.

SAPs take a more integrated approach to improve agricultural sustainability in general. Additionally, they improve soil and water conservation, soil fertility management, pest management, and waste management (Ganpat et al., 2014). Such combinations are multi-functional and promote (a) long-term soil fertility, (b) increased farm productivity, (c) resource conservation, (d) environmental maintenance, (e) food safety, and (f) worker health and safety. Despite the attractions and, indeed, the monetary incentives often presented to farmers, the adoption of SAPs is still low. Thorough research has been devoted to deducing other determinants underlying the adoption of SAPs (Kersting & Wollni, 2012; Läpple & Kelley, 2013).

However, Unagwu et al. (2013) argue that due to the poor nutrient capacity of the soil and the usual difficulties with unfavorable climate and weather in recent years, SAPs help to improve the situation. Similarly, SAPs are the only practical way to provide enough plant nutrients to restore Africa's nutrient-depleted soils and guarantee equitable food distribution.

In Kenya, most farms fail to make sufficient soil fertility replenishment investments, resulting in declining soil fertility, low returns to agricultural investment, decreased food security, and high food prices. For this reason, the full potential of improved crop varieties is compromised by soil infertility. Crop production in the region is strongly limited by soil nitrogen (N), phosphorus (P), and available potassium (K). The gap can be reduced through the adoption of SAPs (Musa & Odera, 2015).

In Uganda, the coffee yields are 573.3 kg/ha for traditional Robusta and 505 kg/ha for improved farmers. These figures are far below the expected yield of 1,080 kg/ha and 841 kg/ha for recommended farmers (Zziwa et al., 2017). The low yields could be improved by soil reconditioning using fallow land practice. Unfortunately, this is no longer a viable option in Mukono District because of land scarcity attributed to rapid population growth. With coffee being the major cash crop in the district, there is an urgent need to determine the appropriate and optimal strategy for improving the yield of coffee. This study, therefore, seeks to establish feasible and sustainable agricultural practices that will increase coffee productivity in the Mukono district.

In general, the implementation of SAPs in Sub-Saharan Africa has exhibited encouraging outcomes concerning crop yields. However, in Mukono, the utilization of methods like agroforestry, crop rotation, and organic farming has improved soil well-being, water retention, and pest management. These approaches also encourage biodiversity and diminish environmental deterioration. Nevertheless, impediments like limited resource access, gaps in knowledge, and socio-economic restrictions impede the widespread adoption of SAPs. Instances of success illustrate amplified yields and heightened resilience, particularly among small-scale farmers. To maximize the potential of SAPs in advancing crop yields, the region requires comprehensive backing, technical support, access to farmland, and policy structures. This research seeks to answer the following questions: (a) What are the socio-economic factors for farmers' SAPs among coffee farmers, and (b) what are the environmental factors leading to the adoption of SAPs among coffee farmers?

2.0 Literature Review

2.1 Socio-economic Factors for Farmers' Adoption of SAPs Among Coffee Farmers

In addition to SAPs, there is a need for strong institutions and policy alignment that not only provide incentives, but also promote SAPs, as an alternative, to improve productivity and efficiency. It is important to mention that at the national level, Uganda has numerous and solidified cooperatives and associations such as The National Alliance of Agricultural Co-operatives in Uganda which co-ordinate market systems and offer cooperative services to its partners. Cooperatives and associations play pivotal roles in advancing the adoption of SAPs. They facilitate knowledge exchange, training, and resource sharing among farmers, promoting the implementation of eco-friendly methods such as organic farming, agroforestry, and efficient irrigation. By fostering collaboration, these entities enhance farmers' access to technical support, financing, and markets. Cooperatives and associations also advocate for policy changes and amplify the collective voice of farmers, strengthening the influence of SAPs in agricultural systems (Ferguson & Keep, 2011). Their collaborative efforts accelerate the transition toward sustainable practices, contributing to improved yields, minimized environmental impacts, and enhanced livelihoods for farming communities.

The application of SAPs involves a variety of farming techniques, including (a) alternating crops, (b) planting cover crops, (c) implementing integrated pest control, (d) enhancing soil well-being, (e) safeguarding resources, and (f) minimizing reliance on artificial inputs. All these benefits contribute to improving agricultural sustainability in general. They improve soil and water conservation, soil fertility management, pest management, and waste management (Ganpat et al., 2014). Such combinations are multi-functional and promote (a) long-term soil fertility, (b)increased farm productivity, (c) resource conservation, (d) environmental maintenance, (e) food safety, and (f) worker health and safety (Chatzimichael et al., 2014).

Age. According to Jones et al. (2006), youth in South Africa (<35 years) are less involved in farming even with the high unemployment rate (>70%). This is a concern that needs to be addressed by policymakers at a high-level as future agricultural productivity will be hampered if there is low involvement of youth in agriculture, who are often more likely to adopt innovative technologies (Kalcic et al., 2015). This is evident as the area of fallow land is increasing with time. The low involvement in farming by youth could be attributed to their emigration from rural to urban areas in search of better opportunities and lifestyles (Jones et al., 2006).

Previous studies have indicated that older farmers are less likely to adopt new sustainable practices and often rely on their indigenous knowledge to manage their farms (Tranter, 2011). However, their indigenous knowledge is becoming unreliable due to climate change and variability (Tomer et al., 2014). Therefore, the integration of indigenous knowledge and scientific agricultural management practices is key to the sustainable agricultural productivity of smallholder farmers.

Nevertheless, indigenous wisdom is a fluid concept that integrates historical and contemporary aspects (Sillitoe & Bicker, 2004). Implementing suitable policies could empower farmers to combine external components of SAPs with their traditional methods more effectively.

*Gender.*Cultural ideologies of men being superior to women have resulted in gender inequalities that have left most African women without land and not

involved in major decision-making at the household level, even after years of democracy (Atwell et al., 2009). In Ugandan rural settings, male superiority is apparent as men wield authority in decision-making, resource allocation, and societal norms, leading to women's marginalization, curtailed autonomy, and restricted prospects. In practice, women in rural communities can only acquire land from Traditional Authority if they are linked to a man through marriage or family bonds.

Gender consideration in technology development and dissemination is critical, such as those related to women's lack of control over production resources and social capital (e.g., land, attending meetings for new knowledge).

Additionally, there are existing gender differences: male-headed households have mobility, participate in different meetings, and have more exposure to information related to the adoption of SAPs by farmers—thus, the hypothesis that male-headed households have more access to SAPs than women (Yang et al., 2019).

The head of the household in rural areas is the main decision-maker in household activities. Consequently, the level of education of the household head is supposed to play a role in adopting innovative technology. A case in point is Holden et al. (2010) who found that more educated households were more likely to adopt SAPs in Ethiopia. It is indicated that this is perhaps because education enhances the ability of individuals to analyze technical information associated with the use of such modern inputs.

Education. Low literacy levels in the region have an indirect impact on agricultural productivity as new technological advancements and information require a certain level of formal education and training (Jeong & Choi, 2020) Most SAPs are often presented in complex academic language, which makes it difficult for illiterate farmers to make use of them. Therefore, farmers with higher levels of formal education are likely to adopt new sustainable agricultural management practices. They can search, process, interpret, and respond to the latest information on SAPs much faster than their counterparts with no formal education or training. (Tomer & Locke, 2011).

Ownership of livestock. Low livestock ownership could hinder smallholder farmers from adopting SAPs such as the application of animal manure as an organic fertilizer to enhance soil fertility. Moreover, the low ownership of livestock could limit the use of livestock for draught power enabling smallholder farmers to animal-drawn planters for conservation tillage and easy transportation of farm inputs (Homann et al., (2008).

Extension services. Ahnström et al. (2009) noted that local extension officers often had contact with individual farmers during farmers' mass meetings. Moreover, access to extension services is highly skewed toward certain farmers over others (Lamba et al., 2020). The low outreach of the extension officers may be attributed to various factors such as low morale due to poor pay, shortages of staff, lack of resources, and poor use of resources. Most South African smallholder farmers prefer visits from local extension officers as their main source of information regarding SAPs, which are often presented in complex academic language and therefore difficult to use (Blackstock et al., 2010). Previous studies have reported that farmers who have access to excellent quality extension services are more likely to adopt SAPs (Ahnström et al. 2009). In contrast, a lack of technical information on how to effectively implement SAPs could limit the adoption of practices by smallholders.

Credit. Most credit institutions prefer lending money to farmers within economically active age groups and those who have proof of a reliable income stream (Beisland & Mersland, 2012). However, most smallholder farmers have no title deeds for their farms which hinders them from applying for loans to invest in their farms because of the lack of collateral. Additionally, improved access to credit from banks has the potential to improve the productivity of smallholder farmers and allow them to imitate the modern economic agricultural value chains. Therefore, access to credit allows farmers to have enough capital to overcome the financial constraints that hinder them from adopting SAPs, which require financial investment in expensive equipment and technology.

2.2 Environmental Factors Leading to the Adoption of SAPs Among Coffee Farmers.

Unagwu et al. (2013) argue that due to the poor nutrient capacity of the soil and the usual difficulties with unfavorable climate and weather in recent years, SAPs help to improve the situation. Similarly, Otunaiya et al. (2012) suggest that SAPs seem to be the only practical way to provide enough plant nutrients to restore Africa's nutrient-depleted soils and feed Africa's human population. Nevertheless, rainfall patterns and soil textures also influence the amount of nutrients available in the soil for plant intake.

Attaining improved food security and livelihoods of farmers in Sub-Saharan Africa through increased agricultural productivity will remain an illusion if the over-exploitation of soil for infrastructure development, construction, and so forth, is not controlled, as such activities affect framing productive land and reduce the available farming space. However, this situation can be reversed if farmers extensively adopt the use of recommended soil improvement strategies (Unagwu et al., 2013).

The yield of crops in general and cereal in particular is exceptionally low because of the insufficient utilization of improved technologies. For instance, the amount of fertilizer applied in the 2008–2009 cropping season was 423,000 tons. During the same period, the total area fertilized with fertilizer for all crops was about 29.6% of the total cultivated area in Ethiopia (Central Statistical Agency of Ethiopia, 2009). However, the extent of fertilizer use in Ugandan farming is influenced by factors such as crop choices, financial limitations, and product availability. Certain regions face restricted usage due to economic challenges and insufficient awareness, whereas areas with more resources tend to employ fertilizers more generously. Striking a harmony between optimizing fertilization for better yields and lessening environmental impact presents a complexity (Okoboi & Barungi, 2012). Government and non-governmental organization efforts and assistance initiatives aim to improve availability, educate farmers, and advocate for eco-friendly fertilizer methods, working toward responsible and efficient fertilizer application across Uganda's varied agricultural scenery.

3.0 Materials and Methods

3.1 Research Design and Population

Our study adopted a descriptive research design. Descriptive design was ideal for this study because the rationale of the methodology is to provide insights concerning specific thematic areas within a limited geographical scope and hence the ease and simplicity of conducting the study. According to Place et al. (2007), a descriptive research design determines and reports the way things are.

This methodology also minimizes the risk of biases and helped maximize reliability. Additionally, it allows flexibility in terms of resources as well as avoiding the hardship of hunting for respondents more than once to produce a high response rate (Ivankova & Wingo, 2018). The study's target population was extension workers and coffee farmers of the Mukono district.

3.2 Sample Size and Sampling Techniques

This study utilized a sample of 60 respondents, including three extension workers and 57 coffee farmers from Mukono. Purposive and simple random sampling techniques were employed to select the respondents for the sample. Purposive sampling involves selecting individuals or groups based on their knowledge of a population and the study's purpose. This approach entails identifying and choosing proficient and well-informed individuals or groups who are familiar with the phenomenon of interest (Creswell et al., n.d.). In this method, we selected extension workers and local leaders as key informants because of their dependability and expertise in the topic. They were well-positioned to provide reliable and detailed information about the subject under investigation.

Simple random sampling is a method in which every element of the population has an equal chance of being selected for the sample (Etikan et al., 2016). This technique was employed to choose coffee farmers from various areas of the sub-county who took part in the study. The process involved randomly selecting coffee farmers who agreed to participate in the study until the desired sample size was reached. This approach ensured that each respondent had an equal and independent opportunity to be selected, thereby reducing bias.

3.3 Guided Questionnaire and Interviews

According to Hall & du Gay (1996), the questionnaire was chosen as the research instrument due to its ease of administration. We selected selected the questionnaire because of the level of literacy among the target study population, which facilitated the efficient collection of data. The questions were closed-ended, allowing for an easy and quick collection of necessary study information. This format also enabled respondents to provide swift answers while expressing their opinions freely. Furthermore, this instrument required less time, was cost-effective, and allowed for data collection from a large population within a short timeframe. Questionnaires were administered to coffee farmers to obtain firsthand information, thereby helping to prevent any potential biases.

Oral interviews were conducted to enable us to collect particular responses from local leaders. The results from the interviews were used to supplement the responses from questionnaires. Interviews were conducted based on an interview guide structured in line with the study objectives.

3.4 Data collection and Analysis

Reliability is a measure of (a) consistency, (b) precision, (c) repeatability, and (d) trustworthiness of research instruments (LeBel et al., 2018). Validity refers to the degree to which the results were truthful. It requires a research instrument—a questionnaire—to correctly measure the concepts under study. To determine the reliability of the instruments, we conducted a pre-test study with non-respondents—coffee farmers—in Mukono as shown in Figure 1 to determine if they could easily answer the questions in both the questionnaire and interview guide. The raw data from the questionnaires were coded, checked for errors, and then entered into SPSS software for analysis. Data were analyzed quantitatively using descriptive statistics like frequency counts and then

presented in comprehensive tables and charts showing the responses. For qualitative data, all collected data were sorted by checking for any errors, grouped into themes, and analyzed as postulated in the research objectives. Patterns and connections within and between categories were identified and data were interpreted by composing explanations and substantiating them using the respondents' open responses. Mukono district is a leading producer of Robusta coffee in Uganda. As per the 2002 national census, the population was approximately 423,100, with males constituting 49.8% and females 50.2%. During this period, the growth rate was approximately 2.7% yearly. By 2012, the population had increased to an estimated 551,000. In August 2014, the national population census and household survey recorded the district's residents as 596,804 (Wang et al., 2019).

Figure 1. Location and map of Uganda.

Map of Mukono district, Uganda adapted from (Seera, 2019).

4.0 Results and Discussion

4.1 Demographic Information

Gender, age bracket, marital status, and residential status of the respondents. Eighty-three percent of the respondents were men, compared to women (see Table 1). The majority of the respondents (53.3%) fell between the ages of 31

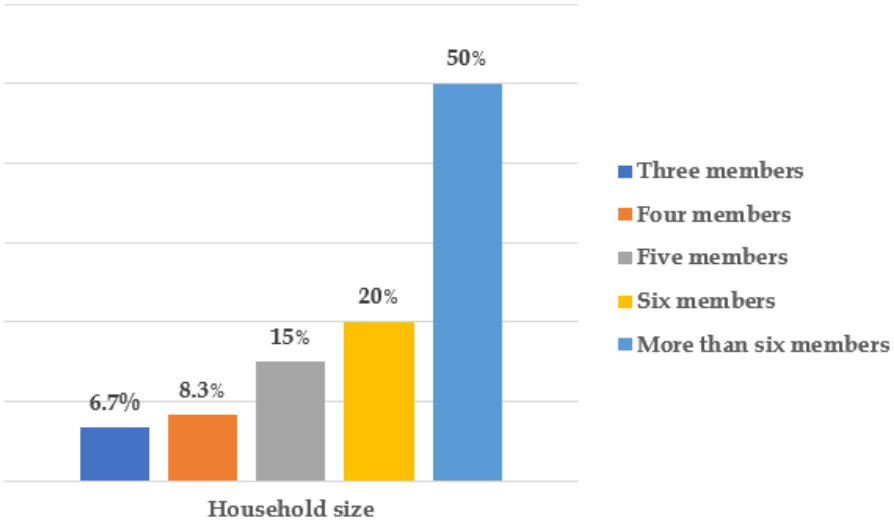
and 40 years. Additionally, the study found that most of the respondents were married, accounting for 90% of the total respondents, while a small percentage had been divorced, comprising 3.3%. Regarding their origins, the majority of respondents (78.3%) were natives of the area, with the remaining being migrants—people who migrated from the neighboring districts.

Table 1. *Percentage of the Respondents by Gender, Age Bracket, Marital Status, and Residential Status*

Response (n=60)	**Frequency**	**Percentage (%)**
Gender		
Male	50	83.3
Female	10	16.7
Age bracket		
20–30	8	13.3
31–40	32	53.3
Above 40	20	33.3
Marital status		
Single	4	6.7
Married	54	90
Divorced	2	3.3
Residential status		
Native	47	78.3
Migrant	13	21.7

Household size of the respondents. The findings in Figure 2 below, indicated that the majority of the respondents (50%) had more than six members in their family and the least had three members in their household.

Figure 2. Percentage of respondents by their household size.



4.2 Socio-economic Factors for Farmers' Adoption of SAPs Among Coffee Farmers in Mukono District

Land ownership and its influence on the adoption of SAPs. The study revealed that the majority (68.3%) of the respondents were landowners, whereas a smaller number were squatters (6.7%; seeTable 2). The results also indicated that land ownership influences the adoption of SAPs; 90% of the respondents stated that it does influence adoption, while 10% indicated that it does not.

Table 2. *Percentage of the Respondents Over Land Ownership and its Influence on the Adoption of SAPs*

Response (n=60)	**Percentage (%)**
Land ownership	
Landowner	68.3
Tenant	31.7
Squatter	6.7
Influence of land ownership and adoption of SAPs	
Yes	90
No	10

Size of farmland. The majority (58.3%) of the respondents said that they own between 5 to 10 acres and the minority (8.3%) of respondents own more than ten acres of land (see Table 3).

Table 3. *Percentage of the Respondents by Size of Farmland*

Size of farmland	**Frequency**	**Percentage (%)**
Less than 5 acres		33.3
5–10 acres		58.3
More than ten acres		8.3
Total	60	100

Farmers who apply SAPs all over the farmland. Table 4 indicates that the majority (78.3%) of farmers carry out SAPs all over the farmland and the remaining respondents do not.

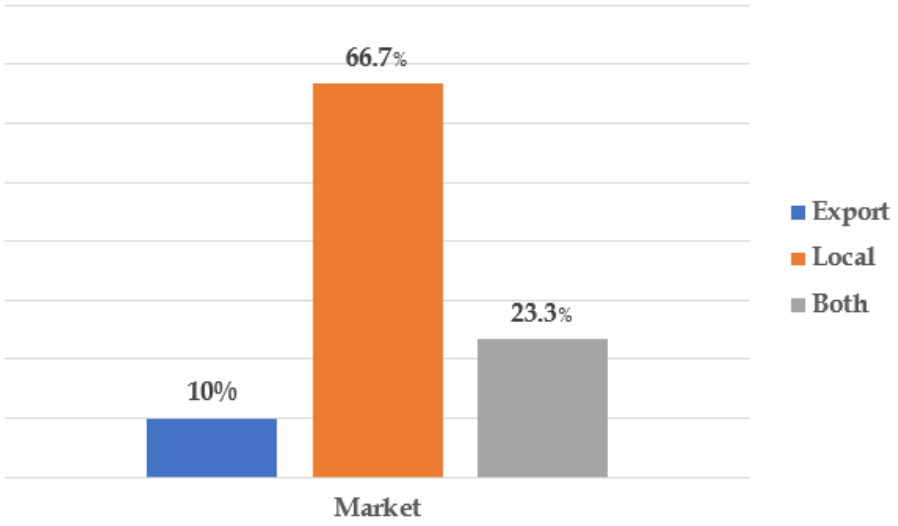
Table 4. *Farmers who Apply SAPs all Over the Farmland*

Response (n=60)	Frequency	Percentage (%)
Yes		78.3
No		21.7
Total	60	100

4.3 The Market Target for Farmers' Produce

Figure 3 below indicates that the majority (66.7%) of the respondents produce coffee for local market consumption whereas a minority (10%) produce it for export. Over the years, Uganda has developed a strong culture of coffee consumption and its derivatives especially chocolate-covered coffee beans, energy drinks, and so forth.

Figure 3: A market target for farmers' produce.



4.4 Socio-economic Factors for Farmers' Adoption of SAPs Among Coffee Farmers

The results shown in Table 5 indicate that the majority (88.3%) of respondents with low household income assets must adopt SAPs, while a minority (11.6%) disagreed. Furthermore, the results revealed that the availability of labor encourages farmers to adopt SAPs in coffee farming, with 76.6% in agreement and only 1.7% in disagreement, while 21.7% strongly disagreed. The study also found that the education level has facilitated the adoption of SAPs in coffee farming practices, as indicated by 83.3% of the respondents, while the remaining respondents disagreed.

The study revealed that land ownership influences the adoption of SAPs. This suggests that crop farmers who own their land have the choice to use fertilizer on either the entire farmland or a portion of it. This finding is consistent with Kalcic et al. (2015), who used oxen ownership as a proxy for wealth and found a positive correlation with the adoption of SAPs.

Over 63% of the coffee farmers who participated in the study have between 5–10 acres of land. This implies that they have enough land that can allow them to adopt SAPs. According to Kinuthia & Mabaya (2017), the potential benefits from the adoption of new technologies are larger in the absolute sense for large farmers. This finding is related to Ketema & Bauer (2011), who found that land size is positively related to the adoption of SAPs. As land size increases, it encourages investment through improving costs related to its application, thus improving economies of scale with time.

Table 5. *Socio-economic Factors for Farmers' Adoption of SAPs Among Coffee Farmers*

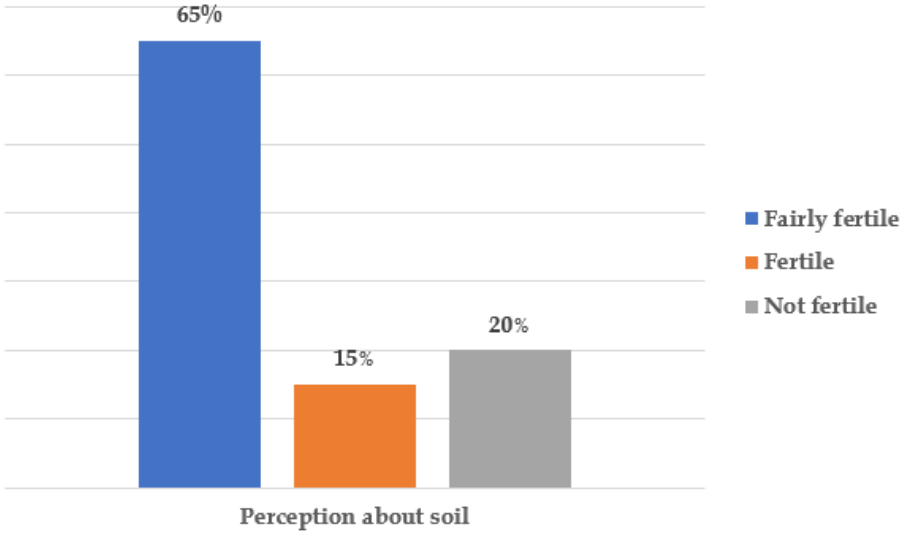
Socio-economic factors for the adoption of SAPs	**Response**	**Frequency**	**Percentage**
Having low household income–assets has made me adopt SAPs.	Strongly agree	38	63.3
	Agree	15	25
	Disagree	5	8.3
	Strongly disagree	2	3.3
	Total	60	100
The availability of labor makes me adopt SAPs in my coffee farming.	Strongly agree	26	43.3
	Agree	20	33.3
	Not sure	1	1.7
	Disagree	10	16.7
	Strongly disagree	3	5
	Total	60	100
My education level has enabled me to adopt SAPs in my coffee farming	Strongly agree	30	50
	Agree	20	33.3
	Disagree	10	16.7
	Total	60	100

Additionally, in Uganda, cooperatives are crucial in aiding small farmers to achieve economies of scale. Through combined efforts, these cooperatives allow joint acquisition of resources and knowledge, leading to cost-effective input procurement. They grant shared usage of equipment, infrastructure, and market access, thus boosting productivity. Members of these cooperatives gain strength in negotiating, ensuring equitable prices for their goods. Additionally, cooperatives provide training, technical support, and knowledge sharing, enhancing agricultural techniques. This collaborative strategy empowers Ugandan small-scale farmers to surmount individual constraints, optimize production, and enhance competitiveness in broader markets, ultimately promoting sustainable progress and elevating their quality of life.

4.5 Environmental Factors Leading to the Adoption of SAPs Among Coffee Farmers

Perception about soil fertility status. The study found that the majority of the respondents (65%) said that their soils were fairly fertile. The rest said that it was either fertile and not fertile (see Figure 4).

Figure 4. Percentage of the respondents concerning perception about soil fertility status.



Perception of the influence of soil fertility status on the adoption of SAPs. Our study indicated that perception of soil fertility influences the adoption of SAPs as indicated by 56.7% of the respondents, this implies that the status of soil fertility makes coffee farmers adopt SAPs while 43.3% said that it does not influence them.

This finding aligns with Unagwu et al. (2013), who argued that due to the poor nutrient capacity of the soil and the challenges posed by unfavorable climate and weather in recent years, the adoption of SAPs has helped to improve the situation. This conclusion is also supported by Otunaiya et al. (2012), who propose that the adoption of SAPs appears to be the only practical approach to providing sufficient plant nutrients and restoring nutrient-depleted African soils. Moreover, many farms neglect adequate investments in soil fertility replenishment, leading to (a) declining soil fertility, (b) low agricultural investment returns, (c) reduced food security, and (d) elevated food prices. However, the adoption of SAPs stands as the practical means to supply adequate plant nutrients, restore depleted soils, and enhance food security.

However, agricultural rural extension plays a crucial part in promoting sustainable farming methods. Extension services share essential insights, methods, and new ideas with farmers, encouraging the use of environmentally friendly approaches. They offer advice on effective resource use, pest management, and soil health, leading to increased yields and less harm to the environment. These services also assist in accessing better seeds, technology, and market details, ultimately improving overall farm output and income. Through training and workshops, rural extension empowers farmers to wisely choose, adapt to shifts, and employ practices that support both the environment and economic growth, contributing to sustainable agriculture throughout the nation.

With solid rural extension services, research has suggested that the adoption of SAPs increases crop yield. This implies that the nutrients present in organic fertilizers can be absorbed by the plants. Additionally, farmers must implement the use of improved technology to maximize productivity and reduce waste, ensuring high-yield production.

The study also revealed that the rainfall pattern influences the adoption of SAPs. This implies that while SAPs can enhance soil nutrition, changes in rainfall patterns can have a negative impact on plant growth. According to Mustafa et al. (2011), in the Tigray region of Ethiopia, which comprises four zones, variations in rainfall patterns were observed across the different zones. Drought was dominant, and the level of rainfall received in all four zones was characterized by infrequent and low-level precipitation. These conditions have a detrimental effect on plant germination, even in the presence of fertile soils.

5.0 Conclusion

Mukono holds significant promise in adopting SAPs. Its varied agro-ecological regions provide chances for diverse crop growth and agroforestry. Involvement of the community and utilization of local wisdom can assist in embracing environmentally conscious methods. Established agricultural cooperatives aid in sharing resources and spreading knowledge. The fertile soil in the area allows for the application of organic farming techniques, reducing reliance on artificial inputs. Government backing and availability of educational initiatives can additionally encourage the integration of sustainable practices, resulting in increased productivity, resource preservation, and better farmer livelihoods in Mukono district.

However, the adoption of SAPs among coffee farmers is mainly influenced by farmland size and land ownership. Farmers who own large acres of land and wealth are fully able to adopt SAPs, to boost their production as compared to those who own small areas of land.

Of all the environmental factors influencing the adoption of SAPs by coffee farmers, low soil fertility, and low rainfall patterns are the major environmental factors that influence farmers' adoption of SAPs.

Farmers should work hard to accumulate assets, especially land. This will enable them to be able to use technology freely on their land without any hindrance since the study found that the land size of the farmers influences their adoption of SAPs.

Financial institutions should establish schemes to avail credits to farmers with low-interest rates and fewer restrictions in terms of collateral security because most farmers are limited to adopt modern farming practices due to limited funds.

Cooperatives and associations with strong rural extension services have a crucial role in promoting the adoption of sustainable farming methods. They enable the sharing of information, joint management of resources, and collective access to markets and technology. Through these cooperative initiatives, farmers are empowered to implement environmentally friendly practices, optimize resource utilization, and improve productivity, all while prioritizing environmental preservation.

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