

Exploring Crop Choices: Benefits, Challenges, and Rationale Among Rwandan Farmers

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Abstract

Farming decisions on crop choices are guided by different factors including natural conditions, household needs, traditions, stakeholder recommendations, and productivity. The best decision varies for each farmer based on specific circumstances. There are both benefits and challenges in farmers' crop growing experience. In Rwanda, agriculture employs 70% of the population, contributing 33% to the GDP across three main agricultural seasons. However, food and nutritional insecurity remain pressing issue affecting both human and economic progress. This study explored the rationale, benefits, and challenges of farmers' choices. This study used a qualitative descriptive approach, conducting six focus group discussions (FGDs) in each participating district. Each FGD comprised 10 participants, ensuring gender balance. Recruitment was facilitated by local community health workers (CHWs), with participants providing informed consent. Trained data collectors utilized voice recorders to collect the data. The researchers transcribed the data verbatim, anonymized the data, and translated the same data into English. Data analysis revealed four key themes: reasons for cultivation, factors influencing crop choice, farmers' livelihoods, and farming challenges. Findings highlight the need for holistic and context-specific solutions in Rwandan agricultural development, emphasizing stakeholder collaboration to support informed decision-making and sustainable agriculture.

Keywords: benefits, challenges, crops, exploration, farmers, Rwanda

1. Introduction

The Sustainable Development Goals (SDGs) encompass critical global issues, including eliminating poverty and hunger, health enhancement, climate action, and ecosystem preservation. Despite global efforts, challenges persist with approximately one in ten people worldwide still experience hunger, while one in three people experience food insecurity due to insufficient and unreliable access to food (ten Berge et al., 2019). Poverty plays a crucial role in driving hunger and malnutrition, leading to inadequate food access and malnutrition (Katona & Katona-Apte, 2008), which in turn, results in severe health repercussions and diminished productivity. Notably, malnutrition affects 149 million children globally, leading to stunting and wasting (Maniragaba et al., 2023). Extreme weather events exacerbate food insecurity, amplifying the urgency for SDGs driven solutions. Although the World Health Organization (WHO) committed to nine global health targets, including eradicating all forms of malnutrition by 2030 (Hasan et al., 2022), hunger affected approximately 783 million people in 2022, with significant proportions in sub-Saharan region (FAO et al., 2022). Population growth in this region exacerbates food demand, putting pressure on agricultural resources and hindering the adoption of sustainable farming practices (Van Ittersum et al., 2016).

Rwanda, aiming for economic transformation, relies heavily on agriculture, yet faces challenges due to limited, reliance on rainfed agriculture, and postharvest losses (Musabyemariya et al., 2018) (NISR, 2021b). Soil erosion, deforestation, and land degradation, further threaten productivity (Karamage et al., 2016). Government led initiatives like crop intensification programs seek to enhance productivity, but challenges persist including monocropping and harvest losses (MINAGRI, 2018).

Previous studies have highlighted the influence of factors on crop choices among Rwandan farmers including agroecological zones, market demand, profitability, government policies and local knowledge (Mugenzi et al., 2011; Nahayo et al., 2017). Additionally studies have examined the significance of specific crops within the Rwandan agricultural sector (Isaacs et al., 2016). The importance of climate resilience and adaptation in crop choices has gained attention given the impacts of climate change on agriculture (Clay & King, 2019). Programs including crop intensification program (CIP) have provided guidance and support to farmers in selecting suitable crops aligned with national agricultural strategies (MINAGRI, 2013; Nahayo et al., 2017). Further research should focus on a comprehensive exploration of crop choices among Rwandan farmers, delving into their benefits, challenges, and rationale. Understanding the specific decision-making processes, preferences, and relative importance of various factors in crop choice decisions is essential. Additionally, there is a need for economic analysis to compare different crop options in terms of profitability and income generation. Evaluating the long-term impacts of government policies and programs, on farmers' crop choices and agricultural practices is also imperative. Within this context, this study investigates farmers' crop cultivation experiences, focusing on the factors influencing crop choices, livelihood impacts, and agricultural challenges. By understanding these dynamics, the study aims to contribute insights into successful agricultural practices that address malnutrition and promote income growth, aligning with Rwanda's economic transformation objectives.

2. Study Methods

2.1 Study Design

A qualitative exploratory descriptive design was used for this study. The data were collected utilizing a focus group discussion (FGD) approach. This approach allowed for a thorough exploration of the factors influencing farmers' choices and their potential impact on livelihood.

2.2 Study Setting

The study was conducted in regions known for their significant agricultural potential in the western part of Rwanda, specifically within the districts of Nyamagabe, Karongi, and Nyabihu. These districts are also characterized by a notably higher incidence of undernutrition among children aged less than 5 years (NISR, 2021a). Having three different settings enhanced the comprehensiveness, reliability and applicability of findings hence this contributes to a more robust understanding of agricultural decision-making processes.

2.3 Study Population, Participant Selection, and Inclusion Criteria

All parents engaged in agriculture within the selected districts were eligible to participate in the study. However, a purposive sampling method was utilized to recruit 60 participants, 20 from each district, and half of which was either sex. The participants might be engaging in one of the suggested farming practices, including tea, Irish potato, or subsistence farming, and having an under five-year-old child at home. All the participants were aged above 21 years and able to communicate in Kinyarwanda (native language).

2.4 Data Collection and Instrument

A structured interview guide was formulated in alignment with the study objectives and existing literature to facilitate Focus Group Discussions (FGDs) (Plummer, 2017). The guide consisted of ten main topics applicable to all sessions and was tested before the research was implemented by conducting two FGDs of 4 people each in a different area than the study area. After this pilot session, the participants also commented on how they understood the guide questions. This has helped to refine the tool. Local community health workers (CHWs) in each district helped mobilize FGD participants. Sessions occurred in quiet rooms within local government administrative buildings. More probing options were provided to identify farmers' experience in growing crops of their choices. Therefore, the interview of this study was structured in main three sections including factors of choices, impacts of chosen crops and challenges experienced while implementing their choices. An in-depth face to face FGD method was opted for to enable farmers freely express their views.

The participants were told that a board with "Do not disturb" was hanging outside the room where the interview was being conducted. Participants were provided with information about the study's importance, objectives, and procedures during the debriefing sessions. Before starting the FGD, participants were invited to sign individual consent forms, and each participant was given a unique code number.

Each group consisted of 10 mothers or fathers, with two sessions held in each district. The duration of each FGD varied from 60 to 90 minutes, two trained research assistants conducted the data collection—one moderated the discussion, and the other took manual notes to supplement the voice recordings. The FGDs were conducted in Kinyarwanda, the participant's native language. The data collection procedure was consistent across the three settings.

2.5 Data Analysis

The audio recordings were transferred to the principal investigator's laptop, transcribed and translated by research assistants from the local language to English. The investigator did the analysis using qualitative content analysis (Lacey & Luff, 2009). To mask the identification of participants, each statement received an indication code indicating the district, FGD gender composition, and serial number of the participant, facilitating differentiation and organization of data (e.g., KGF2 represents a focus group discussion (FGD) conducted with female participants from district KG, with participant number 2). The four levels of coding were utilized to code the data in the following way:

Coding at Step One: The research investigators read the whole data line by line of each bunch of data. They then assigned codes to the content in the FGD sessions.

Coding at Step Two: The investigators reviewed and compared the coded data and then these were clustered by creating larger categories compared to those from step one coding.

Coding at Step Three: The investigators transformed the categories of codes into central themes that represent larger patterns and relationships between bunches of data having commonalities.

2.6 Ethical Considerations

The study obtained ethical approval from the University of Rwanda Institutional Review Board and approval from the National Institute of Statistics. Authorization to collect field data was granted by the Ministry of Local Governance. Participants were informed about the study's design, objectives, and importance and provided individual informed consent. To maintain anonymity, participants were assigned codes or pseudonyms. Participants were guaranteed confidentiality and anonymity, with assurance that their information would not be shared or linked to them. They were also informed of their rights including to withdraw from the study at any time.

2.7 Trustworthiness

The study maintained qualitative research principles, including credibility, dependability, confirmability, and transferability (Lacey & Luff, 2009; Tobin & Begley, 2004). Credibility was ensured by employing consistent questions, achieving data saturation in all interviews, and confirming the accuracy of the transcribed data with participants. Dependability was enhanced by describing the methodology and organizing the data into themes and Transferability was ensured by offering a detailed description of the study settings and context, facilitating replication by future researchers conducting similar studies.

3. Results

3.1 Demographics

Sixty farmers from three districts participated in six FGDs, with each district hosting two sessions—one for males and one for females. The female participants ranged in age from 24 to 59 years, while the male participants' ages varied from 27 to 68 years. Participants were predominantly cultivated tea as export crop, food crops (subsistence farming), and Irish potatoes.

3.2 Emerged Themes

Table 1. The themes identified from the analysis of FGDs

Research questions	Themes	Categories	Description or examples
What are the driving factors that influence farmers' choices of crops,	1. Reasons for cultivation	i. Income & Profit	Farmers prefer crops that can help them to make earnings and gains obtained from doing agriculture and selling farming products.
		ii. Export	This means a monthly regular income generated from growing export crops.
		iii. Household consumption	All types of crops are grown to provide food consumed at the household level.
	2. Factors influencing the choice of crops	i. Soil Climate	Environmental factors that significantly influence crop production, and agricultural practices.
		ii. Inheritance	Passing down of agricultural knowledge, practices, and assets from one generation to the next within farming families.
		iii. Stakeholders' recommendations	Farmers choose crops upon considering the advice or guidance provided by entities having a vested interest in the sector of agriculture.
How do these choices impact their livelihoods	3. Livelihood of Farmers	i. Family Nutrition	They choose crops that help the household to ensure all members of the family, children, women, and adults, receive the essential nutrients they need to maintain good health and wellbeing.
		ii. Financial support	They choose crops that when sold can provide monetary assistance to help farmers meet their financial needs or specific financial goals.
		iii. Self-financing	Farmers prefer crops that help to generate their own income or financial resources to support and sustain their agricultural operations without relying heavily on external sources.
What challenges do farmers face in agriculture	4. Challenges in choice of farming	i. Pests and diseases	This is the category of challenges that can lead to reduced crop yields, lower-quality produce, and increased production costs.
		ii. Accessing agricultural inputs	Accessing agricultural inputs is the process of obtaining and acquiring various essential resources and materials including seeds, fertilizers, pesticides, equipment, technology, and other resources necessary for farming management.
		iii. Climate change	This means various impacts of changing climatic conditions such as alterations in temperature and precipitation on agricultural practices and crop production patterns.
		iv. Soil and crop incompatibility	When the soil's characteristics and conditions are not suitable for the successful growth and development of a crop. The consequences are poor crop performance, reduced yields, and susceptibility to pests, diseases, and environmental stressors.

3.1.1 First Theme: Reasons for Cultivation

Farmers have various crops, and none of farmers can grow one crop only; however, some of the crops grown are given more value than others. There are underlying motivations and factors that drive farmers to engage in agricultural activities. Understanding the reasons for cultivation helps gain insights into the goals, priorities, and challenges that shape agricultural practices. Three main categories underscore the reasons for cultivation.

(1) Income and Profit

Cash crops are typically cultivated in substantial quantities for sale, often in urban markets. These crops are predominantly monocultured, although occasional intercropping may occur, with the primary crop designation reserved for cash crops. The cultivation of cash crops is characterized by the utilization of modern agricultural techniques, such as the application of fertilizers and pesticides, aimed at enhancing both yield and quality. Participants identify them in the following manner.

NBF9: *"They are very productive; for example, when we grow Irish potatoes, we get enough harvest, and when we grow wheat, we can even sell some of the harvest. In addition, this is the same when we grow Irish potatoes."*

NBM3: *"Briefly, by selling our produce, we can acquire other foods and necessities that we do not cultivate ourselves. For instance, if we cultivate wheat, we can sell a portion of it to purchase rice or maize flour. This allows us to diversify our children's dietary needs. Sometimes, we may consider additional nutritional requirements for our children and use the proceeds from our harvest to buy items such as dried or small fish, cooking oil, salt, and more."*

NHF2: *“The harvest holds immense significance as it not only contributes to covering school fees and children's expenses but also enables the purchase of additional food items for the family.”*

NBM8: *“The harvest from Irish potatoes is sold; then we can rear any cattle from that harvest sold. The remaining harvest feeds the family, and the cattle bought will provide the manure to keep the soil fertile and productive.”*

(2) Export

Export crops play a pivotal role in generating revenue for countries, stimulating economic growth, and fostering job opportunities. These crops are frequently cultivated as monocultures in substantial quantities, employing modern agricultural techniques, and often receiving government support. These crops are typically not intended for direct consumption by farmers due to their non-food nature. Farmers describe them as follows:

NBM2: *“The primary motivation behind our tea cultivation is multifaceted. Initially, we were encouraged to grow tea through mobilization efforts, and over time, we've come to appreciate its numerous benefits. One of the most compelling reasons to cultivate tea is the reliable monthly income it provides. For those who rely on a steady income to support their livelihoods, the consistent monthly harvests from tea serve as a dependable source of financial stability. This income not only fulfills immediate family needs but also offers flexibility during emergencies, enabling access to funds or credit for urgent expenses or purchases. Moreover, tea farming facilitates easy enrollment in medical insurance schemes, ensuring the health and well-being of farmers and their families without fear of penalty. The combination of financial security, accessibility to credit, and healthcare benefits makes tea cultivation an attractive option for us, driving our deep involvement in tea plantation activities. Thank you for your attention. Thank you very much!”*

NBM14: *“Tea cultivation stands as a vital pillar in the livelihoods of the farmers you see here. Through our cooperative, we supply the harvest, and the income we receive at the end of the month enables us to purchase essential items for our homes.”*

(3) Household Consumption

Staple crops serve as dependable sources of sustenance, particularly for farmers and local populations. They are typically cultivated under subsistence farming practices, often at low cost. One of their key attributes is their ability to be stored for extended periods, making them essential for ensuring food security. This category encompasses a wide range of crops, encompassing both staple and non-staple varieties, highlighting its crucial role in the overall food supply system.

The NBF5 cultivar: *“Vegetables, including green vegetables and carrots, are among the foods that are very important for fighting against malnutrition among children.”*

According to the NBM5: *“The benefits of growing tamarillos; malnourished children are recommended to take fruits. For the benefit of growing green vegetables, malnourished children are recommended to consume green leafy vegetables. That is the benefit of growing vegetables.”*

In the NBF10 treatment: *“When we grow maize, we sell it after harvesting. Then, we take the money we go to the market and buy other things we need so that we can feed the children well. We also buy other food needs that we don't grow like vegetables, beans, Irish and sweet potatoes, dry fishes, or sometimes meat after selling the harvest from the grown maize so that we can prepare a proper diet.”*

KGF2: *“We primarily cultivate sweet potatoes and beans because they serve as our main food staples at home. We harvest these crops to sustain our family's food needs and also sell a portion of our harvest for additional income.”*

3.1.2 Second Theme: Factors Influencing the Choice of Crops

Participants articulated a multitude of rationales underpinning their crop selection. These diverse motives have influenced farmers' decisions to cultivate crops they believe best respond to the underlying reasons for the choice.

(1) Soil and Climate

When crops align with the prevailing environmental conditions, they thrive and flourish robustly. They also exhibit resilience in the face of environmental challenges. In such circumstances, farmers gain access to dependable sources of sustenance, thereby mitigating hunger and malnutrition and making significant strides toward achieving food security. Participants articulated this phenomenon as follows:

NHM2: *"In our cold climate, crops that thrive in similar conditions are preferred for cultivation. Conversely, crops suited to hot climates are not as suitable here. We select crops that align with the climate of our district for optimal productivity."*

"Here, in our region, the choice of crop seeds to grow depends on the specific soil characteristics of different areas. Since the inception of the TUBURA initiative, we have consistently cultivated maize, which has proven successful. Additionally, beans have been a productive crop, though occasional challenges due to climate change or unfavorable conditions have been encountered. Our selection of crops is based on their compatibility with our soil type."

KGF2: *"Of course, Our soil is ideal for growing sweet potatoes, ensuring families can feed their children."*

(2) Inheritance

Participants highlighted the inheritance of choosing crops as a way through which they become aware of the growing crops that their ancestors have been growing. Farmers are more likely to grow crops that they are familiar with and that they know how to grow successfully. Participants expressed inheritance in the following statements:

NBF3: *"You can see our region is for growing Irish potatoes. A child from a family that grows Irish potatoes will grow the same crop of Irish potatoes when he becomes mature as he sees his parents growing the same."*

KGM1: *"All these crops are grown here. As far as I know, we have inherited the crops that our elders (parents and relatives) used to grow. Additionally, TUBURA has trained us in the use of agricultural inputs. For example, if you used to grow maize in a certain way, now we can cultivate it using various types of fertilizers during both planting and weeding."*

NBM9: *"I see that many people get land from their parents, although you can buy more if you have money, land, a variety of crops, and sometimes the way you manage soil comes from your elders. Like myself, most of the varieties of crops I have were also grown by my parents."*

(3) Stakeholders' Recommendations

The agricultural sector is a wide field where various stakeholders intervene for multiple purposes. Stakeholders can include farmers, consumers, traders, processors, retailers, government, and nongovernmental organizations (NGOs). They influence farmers in various ways, including by providing information related to markets of either inputs or harvests. They can offer financial incentives to grow certain crops and can even provide technical assistance to help farmers grow crops more efficiently. The next statements show the major areas of collaboration with stakeholders like TUBURA (Prosper-a company helping in accessing better inputs), and Ejo Heza (Brighter Tomorrow-a saving scheme encouraging people to save for their future).

KGF4: *"Prior to the TUBURA intervention, we cultivated an unproductive variety of maize. Following TUBURA's assistance, we received an improved and highly productive variety of maize surpassing the yield of our previous crop. Moreover, the availability of other agricultural inputs, including fertilizers, payable in instalments has proven invaluable."*

NBF7: *"We harvest avocados when they are ripe and sell them to the partners facilitated by TUBURA. These partners conduct field visits to assess the quality of the avocados before purchasing them at fair prices. As for maize, we primarily use the harvest to feed our families, while the surplus is processed into maize flour. Thanks to this, we no longer need to purchase maize flour."*

According to the NBF10: *"Among the additional advantages of cultivating tea, rural residents like us who couldn't participate in the EJO HEZA initiative previously may have faced constraints due to limited financial resources. However, our engagement in the EJO HEZA savings initiative has been made possible through tea cultivation. Furthermore, the program offers incentives and awards, particularly at the end of each year, based on the quantity of tea supplied."*

3.1.3 Third Theme: Livelihood of Farmers

Farmers are often referred to as the backbone of food systems and are primarily responsible for cultivating crops to sustain local communities. The selection of cultivated crops is highly important for farmers because cultivation directly affects their livelihoods. In addition to meeting the dietary needs of their communities, selling a portion of their harvest contributes to increased income and overall improvement in quality of life. These profits can further be channeled into investments, encompassing both in farming endeavors and nonfarm activities, fostering sustainable growth and prosperity.

(1) Family Nutrition

Household food security refers to having sufficient and nutritious food to maintain an active and healthy life. Subsistence farmers typically produce most of the food they need for their households, while larger farming investors prefer to obtain much of the household food needs from food markets. This is especially true when monoculture becomes the dominant agricultural practice.

KGF4: *“The harvest of these sweet potatoes is only for feeding the family, but I sell some portions sometimes depending on the occasion; on some occasions, they are very productive, and sometimes less productive depending on the season.”*

NBM6: *“Let's discuss our tea production: We sell our harvest and use the proceeds to address various family needs. As for maize and beans, we cultivate them primarily for household consumption, selling any surplus to supplement our income.”*

NBM3: *“Our cultivated crops play a vital role in maintaining a balanced diet. We also have our kitchen gardens where we grow nutritious vegetables these are important for their protective properties. The simplicity of managing these gardens allows for the cultivation of various vegetables like cabbage, carrots, and greens without requiring extensive space. These vegetables contribute significantly to having a balanced diet. While Irish and sweet potatoes, along with cassavas, provide essential energy, their productivity may vary. Nonetheless, they form part of our crop repertoire. We prioritize personal consumption before considering sales at the market. Additionally, we raise cattle for milk and chickens that can give eggs, they can as well give meat. Thank you for your attention.”*

(2) Financial Support

Farming is the primary source of income among farmers. Selling their harvest provides them with the money they need to buy clothing, shelter, and pay for education and health care. As living standards rise to meet sustainable development goals (SDGs), everyone will need to pay for health insurance, universal education, and other essential services. Farmers also report that farming helps them to pay for insurance, save money, and even purchase manure to boost crop production.

NBM7: *“We sell the harvest of Irish potatoes and the income serves to support various activities, including the access and support to cattle rearing. The surplus from the harvest provides food for the family. However, the other part of the income helps to get the fertilizer which maintains soil fertility and productivity. Additionally, the proceeds from the harvest assist in paying school fees for children and ensuring food security for the family.”*

NBF7: *“The advantage of cultivating tea lies in its transformative impact on our ability to participate in the EJO HEZA savings initiative. Previously hindered by limited financial capacity, our involvement is now feasible due to income generated from tea cultivation. Moreover, the management of tea companies offers incentives and rewards based on the quantity of tea supplied, enhancing motivation. Additionally, tea farming provides financial flexibility, enabling access to funds in emergencies without waiting the end of the month or facilitating purchases of food through credit. Furthermore, tea farmers can afford the payment of medical insurance without delay.”*

NHM4: *“Here, you can obtain a jerrycan of 20 liters of banana alcohol, which you can sell for six thousand [Rwandan francs]. Since neither you nor your child can consume it, you sell it to ensure your child's well-being. With the proceeds, you purchase porridge flour and other essential food items to maintain your child's health. After ensuring your child's needs are met, you may also indulge in a bottle yourself, knowing your child's welfare is secured.”*

(3) Self-Financing

The sustainability of farming relies on continued farming activities. Farmers use their usual work to finance this by obtaining seeds, fertilizers, and other agricultural inputs, including the cost of labor and transportation. It can also lead to facilitating access to new farming technologies.

NBF8: *“Regarding Irish potatoes: The harvest of Irish potatoes serves as the primary source of sustenance for our family. A portion is allocated for sale, contributing to savings through a community group savings scheme, while the remainder is preserved as seeds for the next planting season. This same practice is applied to maize and wheat; a portion is consumed by the family, another portion is sold, and the rest is retained for future planting. Selling is essential, as it also help to buy cattle that will also provide organic manure. Conversely, tea cultivation yields weekly harvests, directly supplied to processing factories. Thank you!”*

KGM2: *“The advantage lies in our practice of preserving seeds like beans. When they yield crops, as demonstrated here, the harvests can be substantial - ranging from one large bag to three bags, depending on the*

cultivated land's size. There are occasions when one hesitates to consume these seeds immediately, recognizing their potential for future yields. In such instances, instead of depleting the seed stock, individuals may opt to purchase food from shops while safeguarding the seeds for the upcoming agricultural season. Some may even sell produce like juices to acquire additional sustenance, all while ensuring the continuity of seed preservation for future cultivation."

The NBM4: *"The maize/corn harvest is very supportive; during the productive season, it provides enough harvest, and some portion of the harvest can be sold. This truly helps us to get inputs or buy some cattle that are also very supportive in our agricultural practices through providing organic manure."*

3.1.4 Fourth theme: Challenges in the Choice of Farming

Agriculture is known as a challenging field. These challenges are becoming increasingly complex. Farmers are dealing with many obstacles, including climate change, pests and diseases, market volatility, population growth, and limited resources. Approximately 90% of participants raised concerns about the challenges encountered in agriculture.

(1) Pests and Diseases

Currently, pests and diseases constitute a major threat to food security. They can damage crops and reduce yields, which can make it difficult for people to reach the recommended aspects of food security. When pests and diseases spread through agricultural fields, it becomes difficult to ensure their control, which contributes to increased losses.

NHM5: *"Irish potatoes undergo drying when affected by diseases and pests. As they emerge above the soil or reach the surface, they exhibit a yellowish-brown discoloration, failing to develop properly. Eventually, they perish and display a coloration similar to healthy growth, though their condition remains compromised. Locally, this phenomenon is referred to as "sembeshi" (Late blight, probably)."*

NGM9: *"Furthermore, the maize stalk borer poses another challenge in maize cultivation. After planting maize, it is susceptible to attacks by these borers. Occasionally, we encounter delays in the provision of pesticides, both initially and subsequently, to combat these pests. Consequently, this presents another obstacle in maize farming. Similarly, we have faced challenges with cassava cultivation, where pests have affected the crops."*

KGM3: *"We encountered challenges in cassava cultivation due to pest infestations."*

(2) Accessing Agricultural Inputs

Resources that farmers use to produce crops are highly valuable for maximizing production and meeting food security requirements. The availability of sufficient quality and quantity is key to food production. These may include consumable inputs (seeds, fertilizers, pesticides, water) and capital inputs such as machinery and land. Participants have described their challenges in the following terms:

NBF9: *"Another challenge arises with the acquisition of fertilizers (inputs); if they arrive late and coincide with the approaching end of the season, planting maize may be delayed. Consequently, the critical period when maize requires rain for optimal growth might overlap with the imminent cessation of rainfall. During such instances, we experience reduced yields."*

NBM10: *"Several challenges plague our agricultural practices, the most known among them being the soaring costs of agricultural inputs, particularly fertilizers. This exorbitant expense often results in insufficiency utilization of these inputs. Consequently, the increased cost may lead to the restricted or insufficient application of fertilizers, diminishing the cultivated land area as intended."*

KGF6: *"Regarding inputs, especially fertilizers or seeds, when they are not expensive or late, they may not reach our area because it is very far; or sometimes the crops we grow are not included in those that benefit from the subsidy."*

(3) Climate Change

Climate change denotes prolonged alterations in typical patterns impacting local or regional climates. It manifests through severe weather phenomena like droughts, floods, and heat waves, resulting in crop damage and diminished yields, thus hindering access to adequate food. Participants have encountered this experience, and now, they can reveal what climate change means in their farming experience.

The NBM11: *"In agriculture, we grapple with various challenges, including the impact of climate change. Heavy rainfall at times leads to diminished agricultural outputs, particularly affecting crops like beans and others."*

Conversely, there are instances of rainfall shortages during the agricultural season, further exacerbating our difficulties.”

KGF5: *“We also contend with excessive sunshine and occasional disasters or hazards, such as landslides triggered by heavy rainfall.”*

The NHM6: *“drought may take a longer time, and in that period, there is no rain. The crops do not grow well, and there is no way of irrigating, as we are not able to buy the machine. Even the animals we rear fail to get water to drink.”*

(4) Soil and Crop Incompatibility

Soil and crop incompatibility refers to the inability of a crop to grow well on some soils. This can be caused by soil factors, including texture, drainage, acidity, and soil nutrient content. It affects people’s food security in terms of crop yields, crop susceptibility to diseases and pests, and/or increased costs while trying to prevent and fight such challenges. The following are the testimonies of the participants.

KGM4: *“Moreover, our land suffers from excessive acidity, posing yet another challenge. Upon looking at it, it becomes evident that the soil acidity levels are not conducive for plant optimal growth.”*

NBM 6: *“The cultivation of our chosen crops presents challenges. Despite repeated attempts, achieving satisfactory yields proves elusive. This difficulty is exacerbated by the high costs of fertilizers and manure, coupled with the depletion of soil nutrients.”*

NBF9: *“Another challenge we encounter is related to bean cultivation. A perplexing issue arises when bean plants fail to produce beans upon reaching maturity; instead, they wither prematurely. This dilemma prompts us to question whether the issue lies with the soil quality or the effectiveness of fertilizers. It's plausible that either the soil composition or the quality of the seed beans used for cultivation may be contributing factors!”*

4. Discussion

This study explored the benefits, challenges, and rationale behind growing crops of choice among farmers in Rwanda. It utilized a descriptive qualitative approach and conducted focus group discussions (FGDs) to capture farmers’ perspectives.

4.1 Reasons for Cultivation

Farmers cultivate a wide range of crops in their respective regions. The choice of crops is influenced by several factors, with key policies playing a significant role in shaping the transition from subsistence farming to market-oriented agriculture. Income pertains to the revenue derived from agricultural endeavors, encompassing the sale of crops, livestock, and associated goods. Many people around the globe rely on farming as the primary source of income, whether it is subsistence or large commercial agriculture. The farmers sell Irish potatoes and wheat, among others. Income helps individuals access other important foodstuffs required at home, as it also contributes to responding to other needs, including paying children’s school fees and acquiring other farm resources, such as cattle. These findings align with those of the study by (Giller et al., 2021). Profit represents the surplus or financial gain obtained from agricultural operations after deducting all costs and expenses associated with production, such as labour, materials, equipment, land, and overhead expenses (Blank, 2018). This is an indicator of the financial viability and sustainability of an agricultural enterprise; it remains as important as reinvestment, expansion, and long-term success in the farming industry. The profit motive extends beyond the farm gate with opportunities to add value to agricultural products and capture additional income in the supply chain (Blank, 2018). Agriculture offers opportunities for diversified income streams, as many farmers engage in mixed farming, cultivating a variety of crops, which is also important for mitigating risks and generating income throughout the year (Blank, 2018). Moreover, agriculture is essential for economic development because it provides employment and income opportunities for rural communities (Hall et al., 2017).

Exporting as a reason for doing agriculture means that farmers prefer cultivating specific crops with the primary intent of selling them in international markets. This focus is driven by the desire to generate revenue and foreign exchange earnings, contribute to economic growth, and access a broader range of markets beyond domestic consumption. In our study area, large quantities of crops, such as tea, were grown in the Nyamagabe district, while coffee and pyrethrum were also found in substantial quantities in the Karongi and Nyabihu districts, respectively. These crops serve as sources of foreign exchange and could contribute to national economic growth. In addition to direct income from exporting the harvest, this type of agriculture is known to offer large amounts of seasonal employment directly and indirectly in rural areas (Hall et al., 2017). It also attracts foreign investment and allows for technology transfer as a joint venture between multinational corporations and local farmers (Remeikiene et al.,

2018). Agriculture exports benefit from support from government policies, including incentives and subsidies; however, such support is associated with challenges such as price volatility, mostly due to international trade tensions.

With respect to household consumption, agriculture provides sustenance and livelihoods for countless communities. Its significant production portion is primarily geared toward household consumption, which is one of the fundamental reasons farmers engage in agriculture (Giller et al., 2021). Farmers grow staple crops such as sweet potato and beans or high nutritional value crops such as vegetables or fruits. They can even sell staples such as maize to use the income for buying what is not grown at home. This self-reliance on homegrown produce ensures a consistent and affordable source of nourishment. In regions with unreliable access to markets, limited purchasing ability, or vulnerable food supply chains, household agriculture serves as a critical safety net against food shortages and crises (Giller et al., 2021). Agriculture ensures households access diverse, fresh, and nutritionally rich foods, promotes self-sufficiency, and empowers families to take control of their nutritional needs.

4.2 Factors Influencing the Choice of Crops.

Farmers may face a crucial decision on what crops to cultivate. The choices they make can have far-reaching consequences not only for their own livelihoods but also for the broader agricultural landscape. Exploring factors such as soil and climate inheritance and stakeholder recommendations are critical for both agricultural practices and the global food system.

Soil and climate are significant determinants guiding farmers in their choice of crops. The soil type directly affects nutrient availability, and each crop has unique soil requirements. Research findings reveal that maize, beans, and vegetables thrive in volcanic soils, whereas tea prospers at higher altitudes and in well-drained marshes. These findings align with those of studies by Nyirahabimana and Uwimana (2017) and soil classification research (Habarurema & Steiner, 1997; Rushemuka et al., 2014), which have facilitated regional categorization of crops based on Rwandan farming priorities. Soil also plays a role in crop susceptibility to erosion (Getnet & Mulu, 2021) and water retention, which are vital for normal crop growth (Easton & Bock, 2016).

Climate conditions are another crucial factor. Farmers select crops that can thrive in their region's weather. In Rwanda, for example, farmers opt for crops such as bananas and cassava, which are well suited to warm, humid climates (Moniruzzaman, 2015). Climate is pivotal in determining crop suitability for cultivation, authors highlight the effects of climate change on agriculture necessitate farmers' adaptation to mitigate these effects (Mikova et al., 2015). Most agricultural activities revolve around seasonal characteristics, leading farmers to choose crops based on available rainfall, as different crops have varying water needs (Kuradusenge et al., 2023).

Inheritance in agriculture involves the transfer of resources across generations (Žutinić & Grgić, 2010). This study's findings corroborate research that accounts for inherited resources in categories such as farmland, agricultural knowledge, skills, practices, farming perceptions, and crops (Saugeres, 2002). Inheritance ensures agricultural continuity and resilience, but it comes with challenges such as conflicts, debt, succession, planning issues, and resistance to new technologies (Bakry et al., 2021; Barnard & Calitz, 2011; Hu & Gill, 2021). Moreover, inheritance may favor male heirs, potentially exacerbating economic inequalities. For families engaged in farming with limited resources, agricultural inheritance can hinder the fulfilment of household needs and modern agricultural technology adoption (Alexandri et al., 2015).

Stakeholders or partners in agriculture, including the private sector, government institutions, and international organizations, play vital roles in supporting smallholder farmers in low-middle-income countries. They provide information, support, and incentives for adopting new crops and farming practices, influencing farmers' decisions to embrace modern and market-oriented agriculture (Vermeulen et al., 2012; Yami et al., 2019). Our findings confirm that farmers have received good seeds of maize and good avocado that are consistently sold to buyers. Private and government involvement in procuring inputs and linking farmers to markets, along with organizations such as *Ejo Heza* (brighter tomorrow) and *Tubura* (Prosper), further underscores the pivotal role of partnerships in influencing farmers' choices (Sheahan & Barrett, 2014).

4.3 The Livelihood of Farmers

Household food security and nutrition rely significantly on agriculture's essential role. For many families, agriculture is the primary source of sustenance, even for landless individuals who work on other farms (Maithya et al., 2015). These individuals also view agriculture as their primary means of survival, as their compensation may appear in the form of agricultural produce rather than cash, depending on their agreement with landowners.

Families typically cultivate a mix of export crops, cash crops, and food crops to secure food availability throughout the year. Crops do not mature simultaneously, allowing farmers to continuously access food. These diverse crops

serve various purposes; some provide sustenance, others generate income, and some serve as a fallback if cash income is delayed (Hashmiu et al., 2022). Most farmers cultivate multiple crops, with those growing cash crops such as tea or Irish potatoes also maintaining food crops such as maize, vegetables, and fruits, often alongside their main crop. Furthermore, households are encouraged to establish kitchen gardens cultivating seasonal vegetables that play a vital role in combating malnutrition, especially among children and mothers (Ahishakiye, 2020).

In many developing countries, agriculture serves as the primary income source for rural households. Similarly, agriculture sustains the livelihoods of around 70% of Rwanda's populace (NISR, 2021a). Farmers sell their crops to cooperatives, consumers, and companies, and the income generated contributes to raising living standards and touching foreign exchange reserves. The Rwandan government has implemented strategies to transform agriculture and alleviate poverty, including agricultural research and development, increased farmer capacity, improved infrastructure, and the promotion of agricultural exports.

Choosing to cultivate specific crops also enables farmers to finance their ongoing farming endeavors. It grants them with access to crucial resources like seeds and fertilizers (Kurdyś-Kujawska et al., 2021). Farmers frequently reserve a portion of their harvest for seed stock in the subsequent planting season. However, the quality of stored seeds plays a crucial role in determining success, as poor-quality seeds can lead to increased costs and risks. Moreover, higher yields from more productive crop varieties allow farmers to maximize their land's potential, leading to increased profits. These higher-yielding crops often require fewer resources, such as water and fertilizer, ultimately reducing production costs (Ali & Talukder, 2008). Additionally, in line with findings observed in diverse countries it is a well-established phenomenon that marketable crops that yield more profit attract buyers willing to pay a premium.

4.4 Challenges in the Choice of Farming

Farmers are laden with challenges that can intertwine and create a tapestry of issues that shape the way the agricultural landscape is managed.

Diseases and pests are significant challenges within the agricultural domain and are responsible for considerable losses and drastic reductions in yields, thereby negatively impacting food security (Kumar et al., 2018). Globally, it is estimated that pests and diseases cause annual losses ranging from 20% to 40%, despite the application of approximately two million tons of pesticides (Simantov, 1980). In Rwanda, this study revealed that pests and diseases, including cassava brown streak, potato late blight, and maize stalk borer (known as *Busseola fusca* Fuller), are prominent local threats to crop health. Moreover, these pests and diseases not only hinder export earnings and commercial development but also weaken food and nutritional security due to reduced production (Hardwick et al., 2019). Various strategies can be employed by farmers to prevent pests and diseases, with Integrated Pest Management (IPM) being highly recommended, as it encompasses a combination of cultural, biological, and chemical control methods (Stenberg, 2017). Nevertheless, the selection of the method relies on the specific characteristics and extent of the encountered issue (Stenberg, 2017). Thus, it is essential to enhance farmers' organizational capacity to enable them to utilize these methods effectively.

Access to agricultural inputs is another fundamental challenge. Delays in supply, elevated prices, and limited availability impose major constraints on agricultural production, particularly for small-scale farmers. Key inputs include seeds, fertilizers, pesticides, water, machinery, labour, and land (Nabahungu & Visser, 2013). Farmers must also be sufficiently knowledgeable about resource management to ensure environmentally sound practices and increased yields. According to our findings, input supply delays affect the timing of planting, which subsequently affects the overall output. Higher input costs can influence the quantity of inputs used (Liverpool-Tasie et al., 2017). It is crucial to acknowledge that maintaining consistently high levels of production necessitates timely access to all required inputs (Mpandeli & Maponya, 2014). Moreover, the Covid-19 has caused disruptions in accessing agricultural inputs and supplies in numerous countries, further complicating preexisting issues. Certain nations heavily depend on imported farm inputs, in the absence of international aid and domestic effective strategies, countries encounter obstacles in acquiring the necessary agricultural inputs essential for maintaining productivity (Hossain, 2020). To address these issues, a holistic approach that may include input subsidies, fair input markets, training and extension services, and a focus on interconnected factors such as credit, land tenure systems, and marketing can help farmers improve productivity and food security (Schut et al., 2015).

Furthermore, climate-related challenges, such as changes in temperature, rainfall patterns, and soil moisture, significantly impact agriculture (Nkurunziza et al., 2023; Suranny et al., 2022). Participants in our study highlighted excessive sunshine, heavy rains, related hazards, and unexpected rain shortages as major causes of poor harvests. Climate change reduces food production, crop productivity, and threatens global agriculture, food security and nutrition (Kabubo-Mariara & Mulwa, 2019). Moreover, in Rwanda, landslides triggered by increased

rainfall have had severe negative impacts on farmers' livelihoods (Bizimana & Sonmez, 2015). Addressing climate-related challenges involves improving agricultural practices, such as planting drought-tolerant crops, efficiently irrigating, and utilizing cover crops for improved soil health. However, it is equally important to strengthen farmers' capacity to manage these challenges effectively. This entails providing accessible climate-smart agricultural education, constructing resilient infrastructure, establishing early warning system and fostering integration into regional or continental mitigation systems. Such measures enable farmers to enhance their adaptation to and mitigation of their detrimental impacts of climate change on their agricultural activities.

Incompatibility between soil conditions and crop requirements represent yet another major challenge for farmers. This occurs when soil conditions are unsuitable for supporting the growth of certain crops. Soil characteristics, including texture, drainage, acidity levels, and nutrient content, can all contribute to this incompatibility (Smita Tale & Ingole, 2015). For instance, beans are sensitive to acidic soil, while sorghum exhibits greater tolerance. Attempting to grow beans in acidic soil may result in stunted growth or crop failure (Soti et al., 2015). Farmers can address soil and crop incompatibility by selecting crops better suited to their specific soil conditions or by improving soil conditions through methods such as liming in acidic soils (Mustafa et al., 2011; Paradelo et al., 2015). However, it is essential to recognize that some farmers may lack access to the necessary resources or knowledge required to manage soil and crop compatibility effectively. Empowering them with the necessary skills and knowledge can significantly enhance crop yields.

5. Conclusions

This study sheds light on the factors influencing farmers' crop choices, the impact of these choices on their livelihoods, and the challenges they face. Farmers in Rwanda base their crop choices on soil and climate suitability, family traditions, household needs, and advice from agricultural partners. Diverse crop choices aim to ensure food security, generate income, and sustain continued farming. These decisions bolster household food security and economic resilience, implying the significance of policies that promote crops diversification. When farmers can generate income and secure their livelihoods, they are more inclined to stay in agriculture essentially for both food and economic prosperity.

However, challenges including pests, restricted access to inputs, climate variability, and soil crop mismatch pose significant obstacles to Rwandan agriculture. Addressing these challenges through targeted interventions and support can improve agricultural productivity and resilience. Agricultural extension services, research, and policies promoting climate smart practices are crucial for aiding farmers in adapting to evolving conditions and enhancing their livelihoods.

6. Limitations and Suggestions

The study acknowledges limitations due to the heterogeneity of the selected study sites, context specificity, limited sample, interpretation complexities and language translation issues. However, it emphasizes the value of qualitative research in agriculture for exploring subjects deeply and understanding farmers' emotions. To enhance generalizability. Future research should include diverse stakeholders in addition to farmers like extension agents and policy makers for a comprehensive understanding of agriculture in developing countries.

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Authors Contributions

The manuscript, led and corresponded by François Xavier Sunday, embodies a collaborative effort reflective of the diverse expertise and contributions of the authors. François Xavier Sunday spearheaded the study design, oversaw data collection, and ensured alignment with scientific and journal standards. Yvonne Uwineza, Ezechiel Ndahayo, and Irene Patrick Ishimwe meticulously drafted the manuscript, while Prof. Lakshmi Rajeswaran enhanced its robustness through revision. Dr. Maryse Umugwaneza provided invaluable advice and mentorship throughout the manuscript's development. All authors approved the final manuscript and agreed to share publication and recognition equally.

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No additional data are available.

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