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EXPLORING THE BENEFITS, CHALLENGES, AND RATIONALE BEHIND GROWING CROPS OF CHOICE AMONG FARMERS IN RWANDA

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ABSTRACT

Farming decisions about crop choices are influenced by natural conditions, household needs, family traditions, stakeholder recommendations, and crop productivity. The best decision varies for each farmer based on the specific circumstances. In Rwanda, where agriculture employs 70% of the population and contributes 33% to GDP, the sector operates across three seasons. Despite these conditions, food and nutritional insecurity remain significant issues affecting both human and economic progress. This study explored the rationale, benefits, and challenges of farmers' crop choices. This study employed a qualitative descriptive approach. Six Focus Group Discussions (FGDs) were conducted, with two sessions per district. Each FGD included 10 participants and lasted one hour, maintaining gender balance. Local community health workers (CHWs) facilitated recruitment, and participants gave informed consent. Trained data collectors used voice recorders for data collection. Researchers transcribed, anonymized, and translated the data into English, then coded and analysed it to generate themes and categories.Farmers grow diverse crops for income, export, and household consumption, influenced by soil, climate, inherited knowledge, and stakeholder advice. Agriculture sustains their livelihoods through nutrition and financial stability. However, they face challenges like pests, input access, climate change, and soil-crop incompatibility. These findings call for holistic and context-specific solutions to agricultural development in Rwanda. Stakeholders should work together to support farmers in making informed choices and promoting sustainable and profitable agriculture.

Keywords: Benefits, Challenges, Crops, Exploration, Farmers, Rwanda

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1. INTRODUCTION

The Sustainable Development Goals (SDGs) encompass critical global issues, including eliminating poverty (SDG 1) and hunger (SDG 2), improving health (SDG 3), implementing climate action (SDG 13), and preserving land (SDG 15) and water ecosystems (SDG 14).

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Unfortunately, a recent report highlights substantial challenges in achieving these goals, as 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 essential nutrient deficiencies (Katona & Katona-Apte, 2008). Malnutrition can lead to severe health consequences, including stunting, wasting, micronutrient deficiencies, and weakened immune systems, impacting productivity and education. Eliminating malnutrition could reduce disease rates by as much as 32% (Katona & Katona-Apte, 2008), nonetheless, the prevalence of stunting persists significantly, affecting 149 million children under five years old globally (Maniragaba et al., 2023). Extreme weather events like droughts and floods, exacerbated by climate change, worsen food insecurity, making it imperative to implement solutions driven by the SDGs.

In 2015, the World Health Organization (WHO) committed to nine global health targets, including eradicating all forms of malnutrition by 2030 (Hasan et al., 2022). However, in 2022, hunger affected approximately 783 million people with undernutrition, affecting nearly 10% of the population globally and 23.2% of the population in the sub-Saharan region (FAO et al., 2022). The sub-Saharan region faces a significant rise in food demand attributed to swift population expansion which is estimated to be 2.5 times greater by 2050 (Van Ittersum et al., 2016). This also hinders progress in adopting vital agricultural technologies and sustainable farming practices, which are essential for ensuring food security and proper nutrition.

Rwanda aims to attain middle income status by 2035 and high-income status by 2050 as part of its economic transformation objectives (Marina & Daniela, 2020). These goals are heavily reliant on agriculture, which contributes 33% to GDP and employs 70% of the workforce (Musabyemariya et al., 2018). Despite these substantial contributions, economic transformation, food security, and proper nutrition are challenging due to limited land holdings, constrained use of modern inputs, dependence on rainfed agriculture, and insufficient irrigation facilities (Bucagu et al., 2014; NISR, 2021a). Rwanda's diverse agricultural seasons offer cultivation opportunities (WBG, 2021), but soil erosion and landslides are significant issues. The country loses approximately 595 million tons of soil annually (Karamage et al., 2017). Additionally, harvest and postharvest challenges result in a 30% yield loss and worsening food insecurity (MINAGRI, 2018). Rapid population growth leads to deforestation and land degradation, and when combined with the farming system, deforestation contributes to low productivity (MINAGRI, 2018).

Several initiatives aim to transition from subsistence to market-oriented agriculture in Rwanda. Notably, the government led Crop Intensification Program (CIP) established in 2007, emphasizes crop intensification and land consolidation for enhanced productivity and food security (Agrawal et al., 2021; Nahayo et al., 2017). The program emphasizes monocropping six major crops of maize, wheat, rice, Irish potato, beans and cassava, while offering vital resources to farmers (Kathiresan, 2011). Additionally, the Rwanda Agriculture and Animal Resources Development

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Board (RAB) leads agricultural research and extension efforts to disseminate improved farming techniques and technology to support farmers. Within the continuation of the research, this study aimed to investigate farmers' crop cultivation experiences based on personal preferences, seeking to understand the driving factors that influence farmers' choices of crops and how these choices impact their livelihoods. Moreover, the study will investigate the challenges farmers face in agriculture, with the ultimate goal of contributing insights into successful agricultural practices that can enable households to overcome malnutrition and attain significant income growth.

2. METHODOLOGY

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 Southern and 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 et al., 2020).

2.3. Study population, participant selection, and inclusion criteria

The study population consisted of farmers engaged in different types of farming practices in three districts of Rwanda: subsistence farming in Karongi district, Irish potato farming in Nyabihu district, and tea plantation farming in Nyamagabe district. A purposive sampling method was utilized to recruit 60 participants, with 20 participants selected from each district. The participants were chosen based on specific criteria: they had to be actively engaged in one of the three farming practices mentioned, have at least one child under the age of five, and be willing to participate in the study. In each district, the selection aimed to ensure gender balance, with 10 female and 10 male participants, forming two separate focus group discussions (FGDs) per district. Selection of potential participants was done by their leaders, who identified farmers meeting the inclusion criteria.

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

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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.

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 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.

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). 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 level one.

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.

Each statement received an indication code that could be used to differentiate it from other statements. This was made up of the district group of participants and the number of participants. An example could be KgF2, where kg stands for the district, F for females (and M for males), and 2 for the number of participants.

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 predominantly cultivated tea, export crops, food crops, and Irish potatoes.

3.2. Emerged themes

The themes identified from the analysis of FGDs is presented in Table 1 (See appendice).

3.1.1. First theme: Reasons for cultivation

Farmers have various crops, and none of them can grow one crop; however, some of them 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

3.1.1.1 Income and Profit

Cash crops are typically cultivated in substantial quantities for sale, often in urban markets. These plants 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 wheats, we can even sell some of the harvest. In addition, this is the same when we grow Irish potatoes".*

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NBM3 *"Briefly, we can get other foods and needs through the selling of our produce. We can buy what we don't grow. For example, if we grow wheat, we can sell a certain portion of the wheat to buy rice or maize flour. Shortly thereafter, you can buy what you do not produce to fulfil children's diverse food/nutrient needs. Sometimes you think about your children's proper nutrition, and you can buy some dry/small fish, cooking oil, salt, etc. All of these come from our sold harvest".*

NHF2 "Harvest *is of great importance; the sold harvest helps in school fees, payment for children and buying other food 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*".

3.1.1.2 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 main reason why we grow tea; in fact, Uhm! We were mobilized to grow the tea and later we have known its benefits. Once you grow tea, you can obtain a monthly income from its harvest., i.e., If you have a monthly harvest and plan to have every monthly income from its harvest to support your living, this monthly income from the tea harvest is the key influence on choosing the tea plantation. Uhm! This is because tea is very supportive in responding to monthly family needs; in the case where you urgently need money within the middle of the month, you can obtain it, as well as provide a chance to obtain either credit or food purchase on credit from the nearest shop. It is also easier for every tea farmer to receive medical insurance. No tea farmer was punished for medical insurance. This is the main factor that drives us to be highly involved in tea plantation/growth. Thank you very much!"*

NBM14 *"For these farmers, that you are seeing here, for example, tea cultivation represents a key pillar in our livelihood; through our cooperative, we supply the harvest, and when we are paid at the end of the month, the income helps us to buy things that we need at home".*

3.1.1.3 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.

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The **NBF5** *"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 meats after selling the harvest from the grown maize so that we can prepare a proper diet".*

KGF2 *"The main reason why we grow sweet potato and beans; it is they are the main food staples that we eat at home. We harvest and get what to feed the family and sell some of our harvests".*

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.

3.1.2.1 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 *"Those crops we've said are favorable and productive in a cold climate and our climate is cold, so those crops are grown in a hot climate and those grown in cold climates like those which match with our district climate".*

"Here, we normally grow different types of fruits depending on the soil characteristics of certain parts. We have been growing maize since the start of the TUBURA initiative. We have grown maize as well as beans, which were very productive except on some occasions due to climate change or other unfavorable conditions. These crops match our soil type".

KGF2 *"Of course, our soil matches with growing sweet potatoes and for sweet potatoes for those families with children they help in feeding them".*

3.1.2.2. 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

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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 *"They are all grown here. To my knowledge, we have inherited the crops that we have found our elders (parents and guardians) growing. Ultimately, TUBURA trained us about using agricultural inputs, for instance: maybe you had been growing maize in any such way, and now we can grow them in this such way using both any kind of fertilizer during plantation 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".*

3.1.2.3. 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 EjoHeza (Brighter Tomorrow-a saving scheme encouraging people to save for their future).

KGF4 "Before the *TUBURA intervention, we had been growing an unproductive variety of maize, and after-TUBURA provided an improved and productive variety of maize that is very productive in comparison to the variety that we had been growing before. The provision of other agricultural inputs, such as fertilizers, that we pay in instalments is also very helpful".*

NBF7 "*We harvest avocados when they are grown and are sold to the partners that The TUBURA have brought for us. They could first come to check the avocadoes through field visits prior, then they would come to buy our avocado harvest at a fair price. The maize harvest is normally used to feed the family, and others are processed into maize flour. We are no longer shopping for maize flour".*

According to the **NBF10, "***The other benefits of growing tea; we, rural area residents couldn't engage in the EJO HEZA initiative may be due to low financial capacity. However, we are in the EJO HEZA saving initiative because of the tea plantation. They also provide incentives/motivation awards, especially at every end of the year depending on the supplied kilograms".*

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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 channelled into investments, both in farming endeavours and nonfarm activities, fostering sustainable growth and prosperity.

3.1.3.1. *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 us talk about the tea: We sell our harvest for the tea, then after getting money; that money is very supportive of solving family issues. For maize, the plants were grown to feed the family and sell the remaining material. The same with the beans".*

NBM3 *"Our grown crops are simply supportive of proper and balanced diet preparation because we have kitchen gardens to grow vegetables; vegetables are essentially as a body-protecting food. Even kitchen garden preparation is very easy, as is its use in growing vegetables such as cabbage, carrots, and green vegetables without using a slightly larger surface area. If you can grow these vegetables, simply support the preparation of a proper and balanced diet. Irish and sweet potatoes and cassavas are energy-giving foods; however, they are not mostly very productive; rather, they are included in the crops that we grow, and before they are sold at the market, we first ensure our satisfaction and then we sell the remaining part. We also domesticate some cattle and hens for milk and meat. Thank you!"*

3.1.3.2. 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.

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NBM7 *"The harvest from Irish potatoes is sold; then we can rear any kind of cattle from that harvest sold. The remaining harvest feeds the family as well as works as manure to keep the soil fertile and productive. Harvest helps in school fee payments for children and food for the family".*

NBF7 *"The benefit of growing tea; it is that before, we could not be able to save in the EJO HEZA initiative due to low financial capacity. However, we are now able to save themselves in the EJO HEZA saving initiative because of the tea plantation. They also provide incentives/motivation awards, especially at every end of the year, depending on the kilograms of tea supplied. In case you urgently need money in the middle of the month, you can get it; as well as for loans or purchases of food with credit, medical insurance payments are simple for every tea farmer".*

NHM4 *"Here you can get 20 litres of banana juice, alcohol and you sell it and get six thousand because your child can't drink it, you can't drink it alone and leave your kid hungry so you sell and that six thousand you use it to buy porridge flour and other food stuff the kid needs for her to be healthy and from that you can at least take a bottle but knowing that the kid also got what to it".*

3.1.3.3. 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 labour and transportation. It can also lead to facilitating access to new farming technologies.

NBF8 *"The harvest of Irish potatoes is primarily used to feed the family. A small part is sold for savings through a community group savings scheme, and the remaining is kept as seeds for the next season. The same procedure was used for maize and wheat; one part of the harvest was used as family food, the other was sold, and the remaining part was kept as an input/seed for the next season. Selling is also important, as we have cattle that are also very supportive of providing organic manure. However, tea provides weekly harvests, and these plants are directly supplied to processing factories. Thank you!"*

KGM2 *"The benefit is that we keep seeds like beans because when they give yield, for example, here, we are able to get good harvests, one could harvest one big bag, three bags depending on the size of the land you cultivated; there are sometimes when you don't want to lose your seeds, at that time you go to buy what to eat in shops but you see that the seeds can yield more so you don't touch them but you keep them to be used for the next agriculture season, so you can sell juices to get other foods for eating then saving the seeds."*

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 some cattle that are also very supportive in our agricultural practices through providing organic manure."*

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3.1.4. Fourth theme: Challenges in the choice of farming

Agriculture is known as a challenging field. Approximately 90% of participants raised concerns about the challenges encountered in agriculture.

3. 1.4.1. Pests and diseases

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 get dried. When they grow above the soil or at the top, they change colour to yellowish brown without growing normally; they die and change colour to those which grow normally, but in reality, they are not; they call them sembeshi"* (Late blight, probably).

NGM9 *"Also maize stalk borer is another challenge in maize; where after cultivating maize they are attacked by the borer, and sometimes we are not provided with pesticides early as well as their later supply to fight against these pests. Therefore, this is another challenge".*

KGM3 *"We used to have challenges when growing cassava where they were affected by pests."*

3.1.4.2. 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 is getting fertilizers (inputs); if they reach us late and then you find that the season is about to end and maize needs rain to grow, so there is time we delay growing them and find that the rain is about to stop in critical time when they are about to grow well; so, in that time, we don't get enough* yield".

NBM10 *"Some of the challenges that we experience in our agricultural practices; the agricultural inputs/fertilizers are currently expensive; this leads to insufficient use of inputs. An increased cost of inputs may lead to limited or insufficient use of fertilizers, leading to a decrease in the amount of intended land for cultivation."*

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".*

3.1.4.3. 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,

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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 means in their life.

NBM11 *"Challenges we face in agriculture include climate change; sometimes heavy rain causes decreased agricultural outputs, for instance, in beans and others, and sometimes, there is a shortage of rain during the agricultural season".*

KGF5 *"We also experience too much sunshine, sometimes disasters or hazards; there can be landslides due to too much heavy rainfall".*

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 fail to get water to drink".*

3.1.4.4. 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 contains too much acid. This is also another challenge because, when we look at it, it is not fitting well".*

***NB*M6** *"The crops we actually grow are very difficult; sometimes we grow one crop, and when you do it twice or many times, the harvest is not good, as the fertilizers and manure are expensive, and the soil nutrients have depleted".*

NBF9 "*Another challenge that we can meet is that we grow beans, but we have this problem: when they are growing and reach the top, they don't have or get the beans; they start to get dry, and we ask ourselves; is it the problem of soil? Is this the problem of fertilizers? We say that maybe it's the problem of soil or the seed beans that we grew have the problem!".*

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

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from agricultural endeavours, 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

In examining the factors influencing crop choices among participants, a diverse range of motivations emerged that shape farmers' decisions. These include environmental suitability, cultural inheritance, and recommendations from stakeholders such as agricultural programs and savings initiatives. Farmers prioritize crops that thrive in their local soil and climate conditions, ensuring reliable food sources despite environmental challenges (Habarurema & Steiner, 1997; Nyirahabimana & Uwimana, 2017; Rushemuka et al., 2014). Additionally, cultural practices and inherited knowledge play a pivotal role, influencing farmers to continue growing crops passed down through generations. Moreover, stakeholders' interventions, such as improved crop varieties and market incentives, significantly impact crop selection and agricultural practices, fostering sustainable farming and economic resilience within the community. 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).

Participants in the study emphasized the influence of inherited knowledge and practices in their crop selection process, continuing agricultural traditions passed down through generations (NBF3, KGM1, NBM9). This intergenerational transfer of knowledge is integral to their farming decisions, supported by initiatives like TUBURA, which blend modern techniques with traditional methods (KGM1). As Inheritance involves the transfer of resources across generations (Žutinić & Grgić, 2010). This study's findings align with research on inherited resources in agriculture, including farmland, skills, and crop choices, highlighting their role in ensuring agricultural continuity and resilience (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

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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 *EjoHez*a (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 others' 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. Additionally, households often establish kitchen gardens to cultivate seasonal vegetables, which 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, 2021b). 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 farmers' capacity, improved infrastructure, and the promotion of agricultural exports.

Choosing to cultivate specific crops also enables farmers to finance their ongoing farming endeavours. It grants them 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.

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4.3. 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 pose significant challenges in agriculture leading to substantial yield losses and thereby threatening food security (Kumar et al., 2018). Globally, these issues result in annual losses ranging from 20% to 40%, despite the extensive use of pesticides amounting to about two million tons (Sharma et al., 2019). In Rwanda, this study identified prominent local threats such as cassava brown streak, potato late blight, and maize stalk borer (Busseolafusca Fuller), which not only hinder export earnings and commercial growth but also undermine food and nutritional security by reducing crop yields (Hardwick et al., 2019). Various strategies, including Integrated Pest Management (IPM), are recommended to mitigate these challenges, integrating cultural, biological, and chemical control methods tailored to specific pest and disease issues (Stenberg, 2017). However, effective implementation of these strategies hinges on enhancing farmers' organizational capacity to deploy them optimally. Access to agricultural inputs presents another critical challenge. Delays in supply, high prices, and limited availability severely constrain agricultural production, particularly for small-scale farmers. Essential inputs such as seeds, fertilizers, pesticides, water, machinery, and labour are pivotal, requiring proficient management to ensure environmentally sustainable practices and increased yields. Our findings underscore that delays in input supply disrupt planting schedules, thereby affecting overall production outcomes (Stenberg, 2017). Additionally, elevated input costs influence input utilization rates (Liverpool-Tasie et al., 2017). Sustained high productivity demands timely access to all necessary inputs (Mpandeli & Maponya, 2014). Furthermore, the Covid-19 pandemic has exacerbated these challenges, disrupting global supply chains and exacerbating difficulties in accessing agricultural inputs in many countries (Hossain, 2020). Dependence on imported inputs without robust domestic strategies or international aid further complicates efforts to secure essential agricultural resources. Addressing these issues requires a comprehensive approach. Measures such as input subsidies, equitable input markets, enhanced training and extension services, and holistic support in areas like credit access, land tenure, and marketing are essential to bolstering farmers' productivity and ensuring 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

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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 (Schut 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. CONCLUSION AND RECOMMENDATIONS

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, pests, limited inputs, climate variability, and soil-crop mismatches are major challenges in Rwandan agriculture. Targeted interventions are crucial to enhance productivity and resilience. Implementing Integrated Pest Management (IPM) reduces pesticide use while protecting crops sustainably. Ensuring timely, affordable access to quality seeds, fertilizers, and pesticides through subsidies or improved markets boosts farmer capabilities. Promoting climate-smart practices like agroforestry and drought-resistant crops aids adaptation. Supporting soil conservation and diversified cropping systems mitigates mismatches and improves resilience. Strengthening extension services to disseminate modern techniques and policies that incentivize sustainable practices are essential.

Limitations

We acknowledge several limitations related to the heterogeneity of the study site selection. These practices represent a diverse range of farming practices, and while this diversity was intended to

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offer a thorough comprehension of the factors shaping farmers' decisions, it does introduce certain limitations. This study was context specific, and the findings may not be easily generalizable to other settings or populations. Focusing on description and exploration can make it challenging to draw broad conclusions. As a result of the discussion and interpretation of the researcher, researcher bias may have affected the way the data were collected, coded, and interpreted. Regarding the sample, it is evident that the number of FGDs conducted was limited, which hence impacted the diversification of perspectives and experiences represented in the study. The interpretative work is very complex and open to multiple challenging interpretations. Translating these FGDs into English poses difficulties in preserving their original context, including nuances, words, and emotions. Maintaining the integrity of the messages conveyed in the local language during translation is challenging, requiring bilingual translators proficient in both languages to ensure accuracy and fidelity.

This research is highly valuable because it promotes the adoption of qualitative methods in agriculture to allow a more in-depth exploration of subjects, including the emotions and sentiments of farmers. Qualitative research has the potential to fill critical gaps in the literature and provide valuable insights into the challenges and opportunities faced by the agricultural sector in Africa. To enhance the generalizability of the findings and broaden the scope of participants, future research should aim to include a diverse range of stakeholders, including farmers, agricultural extension agents, and policymakers. This broader inclusion of perspectives would contribute to a more comprehensive understanding of the challenges and opportunities confronting agriculture in developing countries.

Availability of Data

The authors hereby guarantee that the research data collected and analysed for this research project will be made available upon request to interested parties for transparency, advancing science and research. Ethical efforts will be made to protect the privacy and confidentiality of the participants and entities involved.

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APPENDICE

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	Soil & climate	Environmental factors that significantly influence crop production, and agricultural practices.
		Inheritance	Passing down of agricultural knowledge, practices, and assets from one generation to the next within farming families.
		Stakeholders' recommendation	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 and the benefits they derive from them	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	They choose crops that when sold can provide monetary assistance

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		support	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 of funding.
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, precipitation and 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.