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INVESTIGATING FOOD SECURITY STATUS OF RWANDAN SUBSISTENCE, IRISH POTATO, AND TEA FARMERS

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ABSTRACT

Global food insecurity has increased, affecting approximately 2.37 billion people, with Rwanda facing significant challenges 30% of its population is food insecure. This study employs a quantitative descriptive methodology to assess food security among farmers in Karongi, Nyabihu, and Nyamagabe districts. Participants included farmers growing food crops, cash crops, and exporting tea, all with children under five. Community Health Workers facilitated recruitment, and data were collected using a standardized questionnaire via mobile phones. Analysis was performed using SPSS v 25, applying descriptive statistics and bivariate analysis was conducted, with statistical significance set at a threshold of $P < 0.05$. Findings indicate that overall food security in the surveyed regions is 6.40%. Subsistence farmers show the lowest food security at 3.30%, while tea farmers exhibit most food security at 8.40%, with Irish potato farmers at 7.40%. The study highlights significant associations between household characteristics, farming practices, and food security status. The results highlight the significance of crop selection in affecting food security. Export crops like tea yield higher food security compared to cash crops and subsistence farming. Policymakers should consider these findings in food security strategies, promoting export crop cultivation to enhance food security. Additionally, understanding the interplay of crop selection, regional disparities, and economic conditions is essential for addressing food security challenges in Rwanda.

Key terms: Food security, district, households, Rwanda.
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INTRODUCTION

Food security is a critical global issue, particularly in areas where agriculture is the main source of food and livelihood. According to the World Health Organization (WHO), food security exists when every individual consistently has access to adequate, safe, and nutritious food that meets their dietary requirements and preferences, supporting an active and healthy lifestyle(FAO, IFAD, UNICEF, 2023). However, food insecurity remains a persistent issue in Sub-Saharan Africa, where about one third of the population is undernourished (FAO, 2022). The factors contributing to food insecurity are multifaceted and can include economic, social, and environmental influences. In particular, climatic conditions, including repeated droughts,

poverty, and limited access to agricultural land exacerbate the condition of food insecurity making rural areas especially vulnerable.

According to estimates by the Food and Agriculture Organization (FAO), nearly one billion people globally experience chronic malnutrition, with the majority residing in developing regions, particularly in Asia and Sub-Saharan Africa (Boliko, 2019).Significant regional disparities in food security are evident, as populations in Sub-Saharan Africa consume considerably less food compared to the global average, reflecting the severe challenges faced in achieving adequate nutrition. This emphasizes the need for holistic interventions that not only increase food production but also integrate social protection measures, healthcare, education, and sustainable agricultural practices to ensure equitable access to nutritious food (FAO, IFAD, UNICEF, 2023). The percentage of the world's population living in developing nations has grown from 66% in 1950 to 83% in 2022, and is projected to reach 86% by 2050 (FAO, 2018) Despite advancements, 767 million people continue to live in extreme poverty, with half located in Sub-Saharan Africa, where small-scale farming remains the dominant livelihood (Samkelisiwe & N.S., 2021). To secure future food supply, global food production needs to increase by at least 70%, as Sub-Saharan Africa remains one of the regions most severely impacted by food insecurity(FAO, 2018).

Rwanda, a predominantly agricultural country, faces significant food security challenges. With about 89% of rural households engaged in small-scale farming, the country is highly depended on agriculture, yet susceptible to environmental risks such as soil erosion, floods and droughts (Maniraho, 2021) These environmental constraints, coupled with rapid population growth and shrinking agricultural land, have contributed to food insecurity in the country. Despite the widespread application of anti-erosive measures, Rwanda continues to experience significant soil loss. The country, with a population of around 13 million, has two main agricultural seasons and a third season in wetlands, offering a diverse ecology across 12 livelihood zones(Devereux et al., 2019),though food purchasing remains common in poorer households(Maniraho et al., 2021). Recent estimates indicate that 48.7 % of the rural population and 22.1% of the urban population are still food and nutrition insecure(Lokuruka, 2016). Rwanda's poverty rate of 38.2% reflects the substantial economic challenges faced by a significant portion of the population. These challenges impact various aspects of life, including access to education, healthcare, and basic necessities, which in turn affect food security. Nearly one-fifth of the population experiences food insecurity, posing a critical issue for meeting the nutritional needs of vulnerable groups, such as children and pregnant women. Food insecurity not only contributes to malnutrition but also exacerbates health disparities, particularly among these groups, leading to long-term consequences for physical and cognitive development. Tackling this challenge is essential for enhancing the well-being and economic resilience of households in Rwanda. Food insecurity and malnutrition, especially among children and pregnant women, continue to be pressing concerns. Approximately 33% of children in Rwanda,aged under five years suffer from stunting, a sign of chronic malnutrition that can lead to long-lasting impacts on their physical and cognitive growth(Ahishakiye, 2020; NISR, 2020) Addressing such issues requires targeted interventions to improve agricultural productivity, ensure equitable distribution of resources, and enhance food security policies. Given this

situation, this paper focuses on investigating food security in Rwanda's subsistence, Irish potato and tea farming practices, aiming to understand the factors contributing to food security in these agricultural sectors and propose solutions for improving food security and livelihoods.

METHODS

Study design

This cross-sectional research was conducted in 2022 in Rwanda's western region, specifically targeting three districts selected through purposive sampling. These districts were chosen due to their notably high rates of malnutrition, particularly among children under five, as identified by the Ministry of Health(NISR, 2014b).

Study area

The research was carried out in three districts: Nyamagabe (Southern Province), and Karongi and Nyabihu (Western Province).

Karongi district, predominantly reliant on subsistence farming, spans 980 sq. km with a population of 333,713 (493 inhabitants per sq. km)(NISR, 2015). Four sectors—Gishyita, Mubuga, Murundi, and Twumba—were selected from the district's 13 sectors. Karongi is also among the districts with the highest levels of undernutrition (National Institute of Statistics of Rwanda(National Institute of Statistics of Rwanda (NISR), 2021).

Nyabihu district known for its Irish potato farming, spans 537.7 sq. km with 294,740 inhabitants (548 inhabitants per sq. km) Its fertile, mountainous terrain faces erosion risks, with rainfall averaging 1400 mm annually the study covered four out of 12 sectors which are Bigogwe, Jenda, Kintobo, and Mukamira(National Institute of Statistics of Rwanda, 2011).

Nyamagabe district, purposively selected for growing tea as a cash crop, has a population of 341,491 (161 219 males and 180 272 females) who live in 76,489 households(NISR, 2021). Its high altitudes (up to 3,000 meters) and forests cover (44.8%) contribute to a temperate climate characterized by rainfall ranging from 1,300 mm and temperatures between11^0C to 18^0C(NISR, 2012; Nyamagabe, 2013) Four sectors namely Kibilizi, Kitabi, Uwinkingi, and Tare hosted the study (National Institute of Statistics of Rwanda (NISR), 2021).

Population, sample calculation and Sampling process

A multistage sampling technique was employed to select districts, sectors, villages, and participating households(Bapat, 2017) The cluster sampling method was used to select districts based on the main farming practice. Three clusters have emerged: Nyamagabe Cluster, where participants were recruited mainly for growing tea crops, the Subsistence farming cluster in the Karongi district, and the Irish potato cluster in the Nyabihu district. The villages have been selected using computer-based random selection. The total number of participating households was calculated using the Taro Yamane formula(Singh & Masuku, 2013)and each selected village was to contribute with an equal number of approximately four households having (1) a child aged less than five years and (2) doing agriculture in accordance with selected farming practices. These criteria helped to ensure the inclusion of participants whose agricultural practices and child rearing might directly influence food security and nutrition outcomes. The

community health worker has provided a list of such households to the enumerators, and systematic sampling has been used to determine the participating households. The research participants were finally caretakers for less than five years-old children within the selected households.

The sample size was determined using Taro Yamane's (1973) formula: $n = N / 1 + N(e)^2$, where "n" is the sample size, "N" represents the total population of farmers in Rwanda, and the margin of error is 0.05. An additional 10% was included to account for non-responses (Singh & Masuku, 2013). A total of 439 households participated, consisting of 154 tea farmers, 150 subsistence farmers, and 135 Irish potato farmers, proportionally distributed based on the farmer population in each district.(NISR, 2014a).

Data collection tool

The data collection tool was a questionnaire adapted from previously validated instruments used in prior studies(Coates et al., 2013; González et al., 2008). Using Cob collect, the questionnaire was digitalized and uploaded onto tablets. A pilot test was conducted to ensure proper functionality and clarity, facilitating accurate and reliable data collection. This measurement aims to assess households' food security status using the Household Food Insecurity Access Scale (HFIAS)(Coates et al., 2013), and provided by the Food and Nutrition Technical Assistance Communities (FANTA) project. The HFIAS is specifically designed to evaluate the level of food insecurity a household has experienced over a four-week period (30 days on average). The tool consists of nine occurrence-related questions, each aimed at capturing whether certain food insecurity conditions have occurred in the household during this period(Coates et al., 2013). For instance, respondents are asked if they worried about not having enough food, or if members of the household had to eat fewer meals due to lack of resources. These questions are followed by frequency-of-occurrence sub-questions, which assess how often the reported condition occurred: "Rarely" (once or twice), "Sometimes" (three to ten times), or "Often" (more than ten times) during the past 30 days. To calculate the food insecurity score, the responses to these frequency-of-occurrence questions are coded as follows: 0 for "No" occurrence, 1 for "Rarely,", 2 for "Sometimes, "and 3 for "Often." For instance, if the answer to an occurrence question is "No" (i.e., no food insecurity occurred), the related frequency question is automatically coded as 0. The sum of all nine frequency scores results in a total HFIAS score, with a maximum possible score of 27, indicating that the household experienced severe food insecurity ("Often" for all nine items). Conversely, the minimum score is 0, reflecting no reported instances of food insecurity. To enhance the precision, households' categories were created based on FANTA recommendations(Coates et al., 2013). Households were categorized into four distinct groups based on their total HFIAS score, household food insecurity categories were created based on the Fanta recommendations: 0-1: Food secure, 2-8; Mild food insecure, 9 -16: Moderately food insecure, and 17-27: Severely food insecure(Coates et al., 2013). Then the frequency and percentage calculations were applied to each category. Eventually, the three categories of food insecurity were merged and finally, only two categories, namely, food security and food insecurity remained. This allowed for a more streamlined interpretation of the results, reflecting the broader division between households that experience food insecurity and those that do not.Household wealth

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was assessed using Rwanda's Ubudehe socio-economic classification system(MINALOC, 2020), which groups households by income and living conditions into four categories. Category 1 represents the poorest households, with no stable income or assets, relying on government aid for basic needs like food and healthcare. Category 2 includes households with limited resources, owning small assets but struggling with larger expenses such as healthcare or education. Category 3 covers financially stable households with steady income from jobs or businesses, able to meet most needs. Category 4 represents wealthy households with significant assets and no need for government support

Data collectors and interviews

The enumerators were university graduates in the area of Human nutrition and dietetics. They were selected based on their competencies and have been trained on the objectives of the project, tools, and data collection process. They have also conducted piloting of the tool to ensure participants and enumerators understand it well. The enumerators provided information about the study to the under-five year's caregiver in each household. They then requested the participants to sign a consent form before the interviews started. Then, the child's caregiver participated in the interview by answering the questionnaire administered by one data collector. The selected households were interviewed face-to-face with structured questionnaires, carefully designed and pretested. The interviews took place in the household under the CHW's guidance to recognize the selected households. The data were recorded using an electronic tablet, and later after completing the daily surveys, the enumerator uploaded the data to facilitate access by the data manager.

Data analysis

The data analysis began by downloading the data set from Kobo collect into an Excel sheet where it was checked for completeness. After ensuring the dataset was complete, it was imported into SPSS Version 25 for coding and analysis. Descriptive statistics were generated, providing frequencies and percentages to summarize key variables. Bivariate analysis was also conducted using the chi-square test or Fisher exact test where appropriate to examine potential associations between variables. The significance level for all tests was set at $P = 0.05$. However, the analysis did not reveal any statistically significant associations between the variables under investigation.

RESULTS

This section presents the household food security status across different districts, and also examines the associations between food security status and the studied variables.

Food security by district

The following figure shows the levels of food security and food insecurity across three studied districts. Food insecurity is prevalent with Karongi showing 96.7%, Nyabihu 92.6%, and Nyamagabe 91.6%, contributing to overall food insecurity rate of 93.6%. Food security remains very low, with Karongi reporting 3.3%, Nyabihu 7.4%, and Nyamagabe 8.4%, leading to a total food security rate of 6.4% (Fig.1)

Relationship between household characteristics and Food security status

The table 1 summarizes the relationship between various household characteristics and food security status, showing the distribution of households categorized as food secure and food insecure. The households headed by males show a food security rate of 6.5% compared to 5.6% for female-headed households. However, food insecurity is slightly higher among male-headed households at 93.5% versus 94.4% for female-headed households. In terms of marital status, households where partners live together exhibit a food security rate of 5.9%, while households without partners show a higher rate of 9.8%. Education appears to influence food security, with households where members have primary education showing the highest food security rate at 8.3%, compared to 3.9% for those with no education and 2.7% for secondary education. Regarding wealth categories (Ubudehe)(MINALOC, 2020), the second category has the highest food security prevalence, with 6.9%, followed by category 1 at 8.3%. Financial aspects also play a role, as households whose members participate in a tontine scheme show a higher food security rate of 7.4%, and those with at least one member owning a bank account demonstrate a food security rate of 7.9%. When considering the number of children under five years of age, households with one child show a food security rate of 6.6%. Larger households (more than seven members) show a food security rate of 10.9%, and households with members engaged in casual labor have a higher food security prevalence at 7.8%.

Association between farming practices and Food security categories

Table 2 shows that food security was higher among farmers owning land with a percentage of 6.9% (16), those without woodland have 6.6% (19), and those with livestock have 5.5%, (17). It was higher in households that sell produce with 6.8% (24) and those with kitchen gardens 6.4% (23) or fruit trees with 7.3% (17). However, food security was lower in households using farming agreements with 10.2% (5), growing fortified crops with 6.2% (4), and participating in training with 8.7% (6). It was higher in those using chemical fertilizers with 6.3% (24) or organic manure with 6.2% (26). Households with mothers participating in decision-making have 8.3% (6) or taking loans show 1.9% (2) had lower food security, while cooperative membership did not affect food security.

DISCUSSION

This study investigated the food security across three districts, each with distinct farming practice. Figure 1 illustrates the prevalence of food security and insecurity in these areas. In Karongi district, where subsistence farming dominates, only 3.3% of households were food secure, highlighting widespread food insecurity. In Nyabihu district, which focuses on Irish potato cash crop farming, 7.4% of households were food secure, while 92.6% were insecure. Nyamagabe, an export-oriented tea farming district, showed 8.4% food security and 91.6% insecurity. These findings align with a study in Burundi, where tea farming improved food security among smallholder farmers by supplementing their income (Bitama et al., 2020). Nyamagabe, with export farming, exhibited the highest food security, followed by Nyabihu, with Karongi trailing. Authors like Archterbosch, suggests that cash crops stimulate agricultural innovations and enhance food security by generating capital for investment and institutional growth(Achterbosch et al., 2014) . Factors such as markets access, infrastructure,

government policies, and climate conditions also influence food security in market-oriented farming (Ahmed et al., 2017), whereas subsistence farmers face financial barriers(Shrestha & Nepal, 2016). Overall, food insecurity was prevalent, consistent with findings in Ethiopia, where 62% of households were food insecure (Aliber & Hart, 2007). Addressing this requires promoting agricultural diversification(Dodd et al., 2020), particularly in subsistence farming. Cash crops, like Irish potatoes, should complement rather than replace food crops to balance the income generation and food production(Aliber & Hart, 2007). Export crops can improve food security by enhancing access to international markets(Rubhara et al., 2020).

The study's analysis of household characteristics and food security reveals key insights into the factors affecting food security in Rwanda, as summarized in table 1. Although the difference in food security between male and female headed households is minimal and not statistically significant (P=0.755), female-headed households tend to experience greater food insecurity, which aligns with research on gender disparities in resource access and decision-making.(Silvestri et al., 2015) Empowering women could improve food security. This finding supports study findings, which noted that despite women's dominance in agricultural labor, lower productivity leads to higher food insecurity(Aliber & Hart, 2007). Marital status also plays a role, with households having a partner showing better food security (P=0.287), echoing findings that married couples experience lower food insecurity compared to single-mother households(Sharma, 2022).

Age of the household head was not significantly linked to food security (P=0.642), though older household heads, as noted in a Brazilian study, often face food insecurity due to social inequalities(Kareem & Muhammad, 2024). Education level, while not strongly correlated (P=0.093), is associated with better food security, with primary-educated heads faring better than those without education, reflecting findings on education’s role in food production and management(Kareem & Muhammad, 2024). Wealthier households showed improved food security, though not significantly (P=0.658), diverging from Mark and Brent’s findings, which showed 23% food insecurity among higher-income households (Mark & Brent, 2002), This suggests that economic factors alone do not determine food security, and resource access and knowledge are crucial.Financial inclusion, through tontines and bank accounts, correlates with improved food security (P=0.1 and 0.127, respectively), supporting research on the positive impact of savings mechanisms (Hirvonen et al., 2024). Household size and the number of under-five children did not show significant associations (P=0.779 and P=0.24), although larger families may face resource distribution challenges(Awoke et al., 2022). The lack of additional income sources among respondents further highlights the need for targeted interventions (Hirvonen et al., 2024)to enhance economic opportunities and food security. While some characteristics relate to food security, addressing it in Rwanda requires comprehensive strategies involving economic, social, and educational initiatives.

The findings in Table 2 explore the relationship between farming characteristics and food security. There is no statistically significant difference in food security between households that own land and those that lease or use public land (P=0.606), suggesting that land ownership may not be a key determinant of food security in Rwanda. Similarly, woodland ownership does not significantly influence food security (P=0.836), supporting findings in Kenya that land

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markets do not fully address food security goals(Hirvonen et al., 2024). Livestock ownership shows a slight but insignificant difference in food security (P=0.223), indicating it may not be a decisive factor(Hirvonen et al., 2024). The sale of farm produce also shows no significant impact on food security (P=0.465), suggesting random variations rather than a direct link. Households with farming agreements show slightly better food security, though not statistically significant (P=0.245), possibly indicating stability in agricultural practices(Ciza et al., 2021) Kitchen gardens and fruit trees are associated with better food security, though not statistically significant (P=0.959 and P=0.417, respectively) however authors have found that found kitchen gardens significantly improve household food security and nutrition in Rwanda (Habimana & Muhawenayo, 2023).

Growing fortified crops such as beans and sweet potatoes shows no significant difference in food security (P=0.936), contrasting with the following studies in Tanzania and Malawi respectively that highlight the positive impact of biofortified crops on food security and child health (Girard et al., 2021; Joy et al., 2022)The lack of impact in this study may be due to limited training and seed accessibility. Training in farming shows no significant effect on food security (P=0.391), though previous studies have shown that it improves yields and incomes(Haile et al., 2022). Fertilizer use (chemicals and manure) does not significantly affect food security (P=0.832 and P=0.401), although it contributes to crop yields and agricultural sustainability(Polyxeni et al., 2016). However, overuse can have negative environmental and health consequences. Mother's involvement in farm decision-making is associated with better food security (P=0.433), reflecting the importance of inclusive planning(Nain & Kumar, 2010). Similarly, membership in farmers' cooperatives suggests a positive but not statistically significant impact on food security (P=0.072), aligning with studies on cooperatives' role in enhancing income and community development(Tefera et al., 2017). A statistically significant association is found between bank loans and food security (P=0.03), with households that have taken loans showing lower food security. This suggests the need to further investigate loan terms and their impact on food security(Adetiloye, 2012).

CONCLUSION

This study aimed to describe food security among farmers growing export crops, cash crops, and food crops in subsistence farming. The findings suggest that the choice of crops to grow in because of responding to food security needs matters as the type of crops being grown has an impact on food security. Farmers growing export crops such as tea in Nyamagabe seem to have higher food security levels compared to those growing cash crops like Irish potato in Nyabihu and those practicing subsistence farming in Karongi This implies that promoting certain types of crops in specific regions could improve food security. There are also farmers engaged in export crop cultivation, these might have more stable incomes, which can contribute to food security. On the other hand, those relying on cash crops or subsistence farming may face greater food security challenges due to income fluctuations. Policymakers may need to consider the role of agriculture and crop choice in food security strategies. Encouraging the cultivation of export crops, where feasible, could be part of a broader food security policy. As some variables have been found associated to food security, this shows that food security is influenced by a complex interplay of factors including crop choice, regional disparities, and economic

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conditions. These findings can inform policies and strategies aimed at improving food security in specific areas and among different types of farmers.

Data availability

The dataset is available on request

Conflict of interests

The authors declare no conflicts of interest

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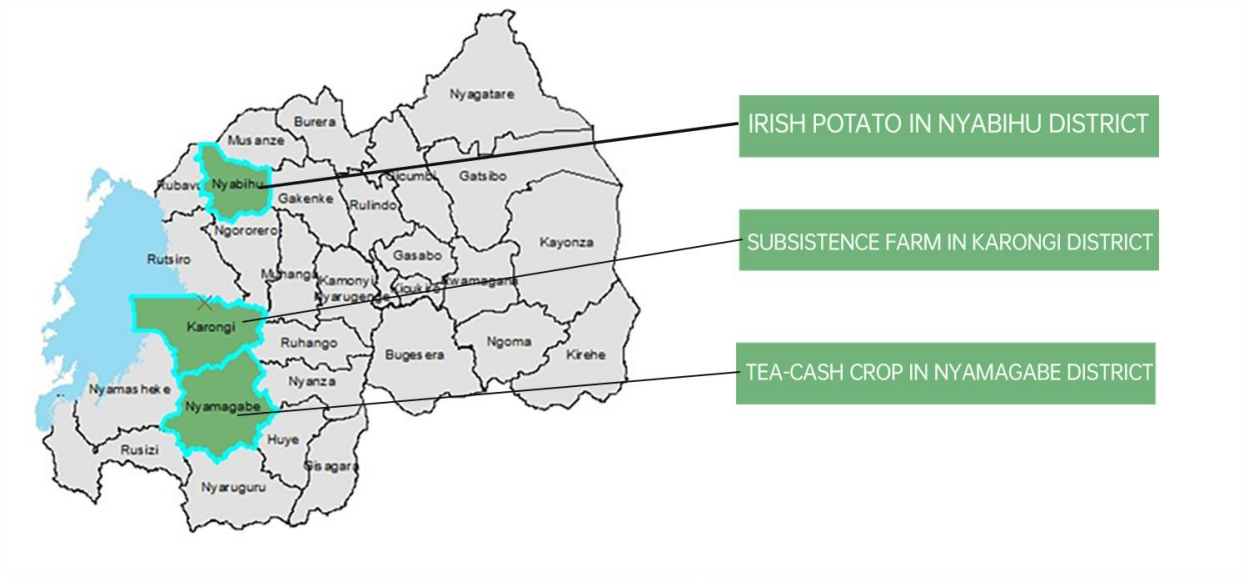

Map1: Study area

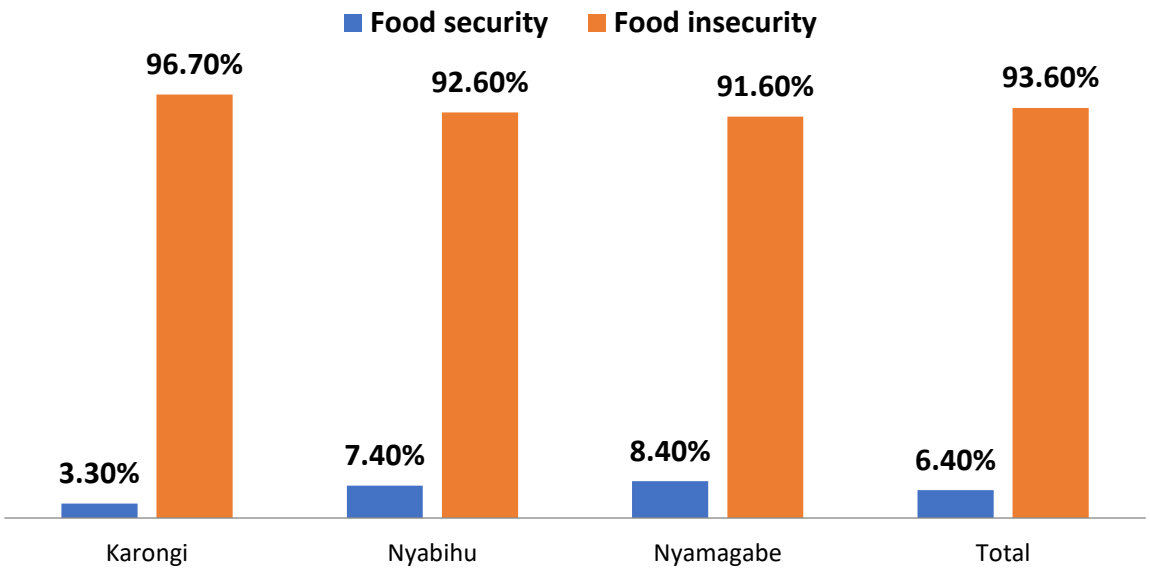

Figure 1: Food security by district

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Table 1: Relationship between household characteristics and food security categories

Characteristics	Foodsecure n (%)	Food insecure n (%)	Total n (%)	P-value
Sex				**0.755**
Male	24(6.5)	343(93.5)	367(100)	
Female	4(5.6)	68(94.4)	72(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Marital Status				**0.287**
With partner	23(5.9)	365(94.1)	388(100)	
Without Partner	5(9.8)	46(90.2)	51(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Household head age				**0.642**
Less than 30	5(7.4)	63(92.6)	68(100)	
30-39	13(7)	173(93)	186(100)	
40-59	10(6.1)	154(93.9)	164(100)	
60 and above	0(0)	21(100)	21(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Education level				**0.093**
No education	2(3.9)	49(96.1)	51(100)	
Primary education	23(8.3)	254(91.7)	277(100)	
Secondary education	3(2.7)	108(97.3)	111(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Wealth category**				**0.658***
Category 1	3(8.3)	33(91.7)	36(100)	
Category 2	15(6.9)	202(93.1)	217(100)	
Category 3	10(5.4)	175(94.6)	185(100)	
Category 4	0(0)	1(100)	1(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Belonging to a tontine				**0.1**
No	3(2.9)	100(97.1)	103(100)	
Yes	25(7.4)	311(92.6)	336(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Own bank account				**0.127**
No	8(4.3)	178(95.7)	186(100)	
Yes	20(7.9)	233(92.1)	253(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Number of under five years children				**0.779**
1	23(6.6)	326(93.4)	349(100)	
2	4(5.0)	76(95.0)	80(100)	
3	1(10.0)	9(90.0)	10(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Household size				**0.24**
Small size (<4)	10(6.3)	148(93.7)	158(100)	

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Medium size (4-7)	11(5.1)	206(94.9)	217(100)	
Large size (>7)	7(10.9)	57(89.1)	64(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Another Source of income				**0.777***
None	17(6.3)	253(93.7)	270(100)	
Casual labor	10(7.8)	119(92.2)	129(100)	
Crafts and arts	1(4.8)	20(95.2)	21(100)	
Salary/retirement	0(0.0)	19(100.0)	19(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	

*Fisher's exact test P-value, **Wealth category locally known as "Ubudehe Category"(MINALOC, 2020)

Table 2: Association between farming practices and food security status

Characteristics	Food Security n (%)	Food insecurity n (%)	Total	P-value
Ownership of farmland				**0.606**
Owned land	16(5.9)	255(94.1)	271(100)	
Other (leased, public etc…)	12(7.1)	156(92.9)	168(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Ownership of woodland				**0.836**
No	19(6.6)	271(93.4)	290(100)	
Yes	9(6.0)	140(94.0)	149(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Ownership of livestock				**0.223**
No	11(8.6)	117(91.4)	128(100)	
Yes	17(5.5)	294(94.5)	311(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Sells of Farm Produce				**0.465**
No	4(4.7)	82(95.3)	86(100)	
Yes	24(6.8)	329(93.2)	353(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Use of Farming agreement				**0.245**
No	23(5.9)	367(94.1)	390(100)	
Yes (written or not)	5(10.2)	44(89.8)	49(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Having kitchen garden				**0.959**
No	5(6.3)	75(93.8)	80(100)	
Yes	23(6.4)	336(93.6)	359(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Having fruit trees				**0.417**

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No	11(5.4)	194(94.6)	205(100)	
Yes	17(7.3)	217(92.7)	234(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Growing fortified crops (beans and sweet orange potato)				
No	24(6.4)	350(93.6)	374(100)	**0.936**
Yes	4(6.2)	6 1(93.8)	65(100)	
Total	*28(6.4)*	*411(43.6)*	*439(100)*	
Any member participated in farming training				**0.391**
No	22(5.9)	348(94.1)	370(100)	
Yes	6(8.7)	63(91.3)	69(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Use chemical fertilizers				**0.832**
No	4(7.0)	53(93.0)	57(100)	
Yes	24(6.3)	358(93.7)	382(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Use manure fertilizers				**0.401**
No	2(11.1)	16(88.9)	18(100)	
Yes	26(6.2)	395(93.8)	421(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Mothers participate in farm decision-making				**0.433***
No	22(6.0)	345(94.0)	367(100)	
Yes	6(8.3)	66(91.7)	72(100)	
Total	*28(6.4)*	*411(43.6)*	*439(100.0)*	
Household member belongs to the farmers' cooperative				**0.072**
No	14(4.9)	274(95.1)	288(100)	
Yes	14(9.3)	137(90.7)	151(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	
Has taken the bank loan				**0.03**
No	26(7.8)	307(92.2)	333(100)	
Yes	2(1.9)	104(98.1)	106(100)	
Total	*28(6.4)*	*411(93.6)*	*439(100)*	

*Fisher's exact test P-value