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Barriers to Smallholder Farmers in Production and Marketing of Wheat in Karatu District, North Tanzania

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Smallholder farmers are central to the development of the agriculture sector and they are crucial in contributing to the food security of the majority. Wheat is the fourth most consumed crop in Tanzania. However, the country's production is only 20% of the consumption demand regardless of the suitable resources for crop productivity. This study aimed to explore the main barriers to smallholder wheat production as the driver in securing national food security and economic development. More specifically, the objectives of this paper were to identify the challenges of Karatu smallholder farmers in the production and marketing of wheat, the extent of the wheat market and the factors that determine farmers' market decisions. Simple random sampling was used to select household respondents from five villages. The collected data from the field, households, and institutions was analyzed by using the Statistical Package for Social Sciences tool. Estimation of the average yields was done by considering the recorded harvest of farmers and weighing them to a randomly selected number of harvest units. Multinomial logistic regression was used to determine the level of influence of independent variables on wheat production and marketing by smallholder farmers. The paper derives a significant level of contribution of numerous variables to the farmers' production and marketing of wheat in the Karatu district. It was found that smallholder wheat production in Karatu is hindered by various challenges while capital and abiotic variables play the most roles. The findings revealed that the amount of yields was less than one tonne per hectare which indicates below average production. Low yields were a result of the intensity of production challenges and constraints. Additionally, wheat price advantage, capital support, and technical and market assurance emerge as the dominant influences on smallholder farmers' market participation. This paper provides useful information for economic development, specifically information for making relevant decisions on the use of scarce agricultural resources in wheat production and reformulation of agricultural development policies through updated wheat production and marketing information.

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INTRODUCTION

World population growth and technological developments have led to an increase in demand for agricultural products. WFP (2024) statistics have shown that there are more than 343 million people suffering from chronic hunger in the world, caused by conflicts (war), natural calamities, population growth and insufficient food production, most of the affected population is distributed in Africa. A glance at the 2015 International Community Sustainable Development Goals, which are set as 2030 targets, confirms that agriculture is significantly linked to a variety of other sectors within the development agenda, and measures in achieving hunger and poverty alleviation include tackling the challenges facing smallholder farmers in rural sub-Saharan Africa (Gupta & Vegelin, 2016).

The majority of the population in Sub-Saharan Africa are smallholder farmers scattered in rural areas where farming is the basic economic activity (Maletta, 2014). The intensity of agricultural production varies depending on the intensive resource supply and the interfaces of the other socioeconomic sectors particularly transport, water, energy, labour, and marketing channels (Poole, 2017).

According to the FAO (2023) database, wheat is listed as the major food crop globally with 750

million metric tons of production in 2017 from around 220 million hectares. The increase in demand for wheat has stimulated the tension to promote its production and supply. The wheat demand and supply chain is extremely unstable and can cause social unrest due to the growing global demand for wheat on the one side, and the difficulties challenging wheat production on the other, including climate rising cost of input, intensified biotic (pests and diseases) and abiotic (heat and drought) stresses (Tadesse et al., 2019).

Wheat is among the five most consumed crops in Tanzania together with maize, cassava and rice. Approximately 96,000 hectares are currently devoted to wheat production in the northern highlands of Kilimanjaro, Manyara and Arusha regions, and some southern highlands in Mbeya, Rukwa and Iringa, regions, with the capacity of producing roughly 100,000 million tons per year (Townsend & Mtaki, 2020). The total area used for wheat production in both the southern and northern highlands has been decreasing due to smallholder farmers withdrawing from the sector. The major withdrawal driving forces are climate change and poor support from the government to encourage further investment.

Although wheat makes up a pitiful 4% of Tanzanians' daily caloric intake, crop production,

demand and supply have significant and incredible implications for the country's economy (Townsend & Mtaki, 2020). The country is making efforts to boost local wheat production to ensure a sustainable and sufficient wheat supply to meet market demand. This is not an easy task due to the complicated challenges facing the sector. This study better explores the barriers to smallholder wheat production as the driver in securing the availability of food and economic improvement of livelihood in rural communities of Tanzania.

Wheat farming in Tanzania particularly in the Karatu district is dominated by smallholder farming facing various barriers to its contribution to development and poverty reduction. Among other challenges, its production has been limited by poor mechanization, climatic stress and access to markets (Tumusiime & Matotay, 2014).

Measuring the efficiency and performance of agricultural production is useful for economic development; also, it provides important information for making relevant decisions on the use of scarce agricultural resources and in the reformulation of agricultural policies. Given the dynamic nature of social development, it is important to update information based on contemporary production. This research seeks to identify the barriers to smallholder farmers in the production of wheat and the level of production in the Karatu district.

LITERATURE REVIEW

Wheat plays a key role in the contribution of the diet to the world population. Wheat is scientifically called *Triticum aestivum*, belongs to the family *Poaceae* and is a self-pollinated cereal crop (Khan, 2019). Wheat provides food and a living for human populations in many poor and developing regions, and it is a major staple food crop highly consumed by the majority. Wheat is also an essential source of nutrition, accounting for 40% of per capita calorie intake and is the basic staple food and daily consumed in several sub-Saharan countries.

According to FAO (2023) statistical data, by 2022/2023 China was the largest wheat producer in the world with an annual average of 134 million tones production in every year since the 2018/2019 season. The other major wheat producer countries are India, Russia, the U.S.A, France Canada, Australia, Ukraine, Pakistan and Germany.

In Africa, consumption of wheat is increasing whereby the region spends over 12.75 billion US dollars annually for wheat import which is 15 percent of the total spending for total food import (OECD/FAO, 2021). In sub-Saharan Africa wheat production is dominated by a smallholder farming system in which most production is basically for household consumption and little surplus is set for the market (Tadesse et al., 2019; Dube, 2020; Silva et al., 2023)

Ethiopia, Africa's 3rd largest wheat-producing country, produces 5.7 million tons (Getahun & Muleta, 2022). Soil preparation, the use of pure seeds, the amount of irrigation, fertilizer, and pesticide applications are well-known elements that increase wheat yield. Markets, useful seed systems, and technological adoption are all essential for fostering an environment where farmers may increase wheat yield (Khan, 2019). In order to establish an environment where farmers may expand wheat production, it is equally vital to adopt technologies, effective seed systems, and markets (Silva et al., 2023).

FAO (2023) has reported that Tanzania is potentially capable of producing sufficient wheat to meet its consumption demand and export. However, it was reported by Townsend and Mtaki, (2020) that there was no increase in smallholder wheat production from 2018 to 2020 due to unfavourable weather conditions in the growing areas of northern highland Tanzania. Wheat production by smallholder farmers in Northern Tanzania is done under either mixed farming or demarcated small plots of farms.

Rural social well-being and economic conditions are reflected by performance in the smallholder agriculture sector. From previous studies (Birachi et al., 2011; Khoza, et al., 2019; Mayekiso, et al., 2017; Mmbengwa, 2012), the factors of smallholder farming decision can be categorized into three groups, first demographic factors such as gender, age, level of education, and household size. Second, institutional factors including land tenure system, training, information and access to market; and thirdly, environmental factors including climate change, environmental degradation and soil productivity.

In Oromia Ethiopia, the factors that were found to influence wheat production were land size, rainfall, pesticide, fertilizer, and temperature (Khan, 2019). Another study showed that determinants of wheat productivity were weather and soil quality in France; while in Hungary it was climate change and seasonal weather. In Hungary, wheat production positively corresponds to higher agrochemicals use while in France, additional days of labour positively correlate the amount of produce (Vigani et al., 2015). In Zarai, Pakistan main issues that led to low wheat output were low rainfall, the high price of chemical fertilizer, and the lack of availability of high-yielding types of seed (Khan, 2019). In Balochistan, a Province of Pakistan, the major challenges to wheat production level were climate change and the high price of technological inputs (Bajkani et al., 2019).

Mmbando et al., (2015); Kimaro and Towo (2015) and Boniphace, et al., (2015), carried out their research on Tanzania's smallholder farming and maintained that the status of the production is poor and mostly done by women for subsistence

purposes. They also found that the poor production level is affected by less concern of the farmers influenced by the unpredictable rainy season, cost of inputs, poor government support, predominant poor farming technology and lack of information and market assurance.

METHODOLOGY

This study was carried out in Karatu which is an administrative district located in Tanzania. The district measures about 3300km² combining the agriculturally suitable land of 102573ha with a normal rainfall distribution which ranges from 300mm in lowland plains to 1200mm in highland areas (URT, 2016). Short rains season is around October to December and the long rains season is between March to June, with the wettest period in April and unpredictable storms. The mean annual temperature lies around 15°C to 24°C. This region was selected since its agro-climatic conditions favour wheat farming.

Data for this study was from primary sources such as questionnaires and interview schedules from smallholder farmers and local leaders. The sample size for the distribution of the questionnaire was determined using the formula recommended by Daniel (1999) from 48,345 households the formula gave 270 respondents. The respondents selected were from five villages which were Rhotia, Kilimatembo, Mtego wa Simba, Bonde la Faru and Silahamo. These villages were selected since they are the ones with the highest number of smallholder farmers. Table 1 shows the distribution of respondents across the 5 villages. Simple random sampling was used to distribute questionnaires to the respondents.

Table 1: Distribution of Respondents

Village	Number of respondents
Rhotia Village	Farmers - 27
Silahamo Village	Farmers - 64
Kambi ya Simba Village	Farmers - 59
Kilimatembo Village	Farmers - 104
Bonde la Faru Village	Farmers - 16

Data was analyzed using SPSS and presented in the form of tables. Determinant factors that influence smallholder market decisions were determined by Multinomial logistic regression because the dependent variable had more than two categories. The dependent variable was smallholder farmer marketing decision which was measured in a nominal scale of measurement such that 1=AMCOS, 2=non-AMCOS market outlets. While independent variables include Price variation (0=no, 1=Yes), Wheat production (hectare/kg), Farm distance (km), and Membership in Cooperative society.

RESULTS AND DISCUSSION

Social Demographic Profile of Farmers

The majority of the respondents have at least secondary education which suggests a potential inclination towards a more educated farming community, which may have implications for the adoption of advanced agricultural practices or engagement with modern technologies. The age distribution of farmers is noteworthy, with a substantial proportion falling within the 45-80 age range. The age distribution of farmers indicates that the highest percentage falls within the 45-80 age range. This raises concerns about the ageing of the agricultural workforce and underscores the need for strategies to attract and support younger individuals in farming. Understanding the dynamics of this age distribution is crucial for developing targeted interventions to sustain and rejuvenate the agricultural sector.

Household size emerges as a critical factor, with a clear majority of respondents having larger households (6-10 persons). This finding can inform resource allocation and support systems, acknowledging the potential impact of household dynamics on agricultural practices, decision-making, and overall resilience.

Farming experience and land size demonstrate a parallel distribution, highlighting that a significant portion of the surveyed farmers possess substantial

expertise and manage relatively larger land holdings. In terms of farming experience, a similar pattern is observed, with 67.0% having 6-15 years of experience, and additionally, land size distribution is also evenly split. This insight is crucial for tailoring extension services, as experienced farmers may benefit from more advanced guidance, while those with limited experience may require additional support and training.

The distribution of farm distance from home is indicative of the geographical spread of agricultural activities. Farm distance from home indicates that the majority of farms are located within 1-5 kilometres (84.4%), which suggests a concentration of agricultural practices in proximity to residential areas. This spatial insight can guide infrastructure development, such as transportation networks and market access, to optimize agricultural efficiency and economic returns.

Smallholder Wheat Production Level in Karatu District

The majority of respondents, constituting 66.3%, fall within the 0-999kg production range, indicating below-average wheat production as indicated in Table 2. This finding suggests a substantial portion of smallholder farmers in the district may face challenges or constraints that limit their wheat yield, as reflected in the lower end of the production spectrum. Several variables play a significant consequence in the quantity and quality of agricultural productivity. The factors can be basically categorized into environmental, biological and technological. According to research, initiatives aimed at reducing the negative effects of variables on agricultural produce, both in terms of quantity and quality, should take into account the crop type grown, farming land, the local climate and geographical characteristics of the location (Ngoune Liliane & Shelton Charles, 2020).

Smallholder and subsistence wheat growers are among the most vulnerable to climate change,

which has already led to decreasing crop yields in the region (Rowhani et al., 2011). About 86% of farmers declared that variation in precipitation and temperature influenced their yields consequently.

It is evidenced that the gap between the actual harvest and expected harvest is continuously widening seasonally ranging from 26 to 29 percent at the global level according to 2019 statistics (Tadesse et al., 2019). In Karatu, it was found that smallholder farmers harvest up to 0.5 tones per hectare while the national average harvest per hectare is 2 tones. This implies that wheat

production is poorly performing and it can be associated with various challenges.

Conversely, 33.7% of respondents fall within the 1000-1500kg production range, representing an above-average wheat production category. This subset of farmers demonstrates a more robust wheat production capacity, potentially influenced by factors such as efficient farming practices, access to resources, or effective management strategies. Understanding the characteristics and practices of this group could provide valuable insights for disseminating best practices and improving overall wheat production in the district.

Table 2: Smallholder wheat production level in Karatu district

Level of wheat production	Frequency	Percentage
0-999 (Below average)	179	66.3
1000-1500 (Above average)	91	33.7
Total	270	100

The data presented in Table 2 underscores the heterogeneity in smallholder wheat production within the Karatu district. This is the reason to call for strategic interventions to boost wheat production. Identifying and addressing the specific challenges faced by this group, such as limited access to resources, knowledge gaps, or environmental factors, can contribute to overall improvements in wheat production at the community level.

Barriers of Smallholder Farmers in Wheat Production

There are significant barriers faced by smallholder farmers in wheat production, providing a clear snapshot of the challenges encountered within this agricultural context. The most prevalent barrier, as indicated by 46.3% of respondents, is the lack of capital. Respondents term capital as a means of purchasing or renting farming land, purchasing seeds, pest and disease control chemicals and fertilizers, and affording farming machinery and labour services. Farmers' lack of capital has led to a paucity of modern agricultural skills, an inability to find appropriate financing solutions, and restricted

access to modern technology for the development and manufacturing of seeds, fertilizer, insecticides, and pesticides. Farmers in remote households tend to incur the high cost of production and marketing because the price of inputs is higher than in town centres. This underscores a critical financial constraint that hampers the ability of smallholder farmers to invest in necessary inputs, technology, and sustainable farming practices. Addressing this barrier may require targeted financial interventions, access to credit, or the development of alternative financing mechanisms and regulating timely availability and affordability of seeds, agrochemicals and fertilizers.

The second most frequently cited obstacle, with 43.0% of respondents highlighting it, is the limitation imposed by intercropping systems. When compared to sole-cropping, increased biodiversity in intercropping systems can boost the production, resilience, stability, and efficient utilization of resources of the intercropped crop (Ebrahimi et al., 2016). Wheat crop management and machinery harvesting systems in Karatu do not allow intercropping of other species on the same piece of

land. Due to limited farming land and the increasing demand for food crops, many farmers abandoned wheat production and opted for other crops that can be intercropped with other food crops (Aziz et al., 2015). The pieces of land used for wheat production are limited while others are set for food crops to meet family food demands. It was found that 89 percent of farmers produce their own food which is basically maize, beans, peas and cassava. Food crop production is done for domestic use and commercial purposes.

Insufficient farming land is identified by 10.7% of respondents as a significant barrier. This is in line with another study that also highlighted land size as an influencer of wheat production (Khan, 2019). While it ranks lower in frequency, the scarcity of land for cultivation remains a notable concern. Despite the sufficient and suitable land in the Karatu district, most of the arable land is reserved for the Ngorongoro conservation area and its buffer zone. However, due to emerging dangerous wild animals particularly elephants, wheat suitable land along the buffer zone is not utilized yet. The pieces of limited land for wheat in the villages are also affected by climate challenges, soil erosion, and infertility limiting productivity. This makes land suitable for wheat production insufficient and requires high investment for its production. Strategies to address this issue might involve land-use planning, promoting sustainable intensification practices, or exploring community-based approaches to optimize land utilization among smallholder farmers.

Due to climatic stress, several farmers have moved to maize, cassava and bean cropping. The delay of rainfall and under-average precipitation switched farmers to beans because they tend to produce better than wheat in low-rainfall climates. Karatu district wheat production has been yearly declining due to low yield experienced in the previous seasons. Farmers have been reducing the portions of land they used for wheat and switching to produce other climatic suitable and profitable crops instead. High variations in environmental characteristics have

been common in East African highlands wheat farms and are a great challenge in successful production and yield quantity (Tadesse et al., 2019). The same abiotic stress has been noticed in the Karatu district with a high degree of moisture and temperature variations. Researchers found that the wheat crop yield will decrease by 6 to 10 percent for every 1°C increase in temperature throughout the growing season (Asseng et al., 2015).

Marketing Extent of the Wheat Smallholder Farmers in Karatu District

Table 3 provides an insightful perspective on the marketing extent and decision-making factors by wheat smallholder farmers in Karatu district. The data is categorized into various dimensions, shedding light on the key elements influencing farmers' marketing choices and the factors guiding their decisions.

In terms of wheat price advantages, capital support, availability and access to input, technical support, and market assurance are identified as critical factors. Notably, technical support and market assurance emerge as the dominant influences, both reported by 41.5% of respondents. This suggests that smallholder farmers in Karatu district highly value support systems that enhance their technical know-how and provide assurance in the marketing process. Policymakers and stakeholders can leverage this information to tailor programs that focus on improving technical skills and creating reliable market mechanisms to bolster farmers' confidence in wheat production and marketing.

The distribution of market outlets reveals a diverse landscape, with AMCOS (Agricultural Marketing Cooperative Societies) and brokers being the most prevalent options. This diversity implies that farmers have various channels through which they can sell their wheat, fostering competition and potentially providing opportunities for negotiation. Understanding the dynamics of these market outlets can guide interventions to strengthen existing

systems and explore ways to expand market access for smallholder farmers.

The decision-making factors for choosing market outlets showcase that better prices and good conditions are the primary considerations for 41.9% and 45.6% of respondents, respectively. This insight emphasizes the economic and quality-driven motivations behind farmers' choices. Policymakers and market facilitators can use this information to design initiatives that address pricing mechanisms and ensure that market outlets maintain quality standards, thereby aligning with farmers' preferences.

Lastly, the presence of alternative options in the "Others" category, chosen by 7.0% of respondents,

underlines the importance of recognizing the diversity in farmers' preferences. Customized approaches to accommodate various choices can contribute to a more inclusive and supportive marketing environment.

Therefore, Table 3 provides a nuanced understanding of the marketing dynamics in the Karatu district, offering valuable insights for designing interventions that enhance technical capabilities, improve market assurance, and align with farmers' decision-making criteria, ultimately contributing to the sustainable development of smallholder wheat farming in the region.

Table 3: Marketing extent of the wheat smallholder farmers in Karatu district

Market extent	Frequency	Percentage
Wheat price advantages		
Capital support	19	7.0
availability and access to input	27	10.0
Technical support	112	41.5
Market assurance	112	41.5
Market outlets		
Brokers	106	39.3
AMCOS	110	40.7
Companies	20	7.4
Local markets	15	5.6
Others	19	7.0
Decision to market outlets		
Better price	113	41.9
Good condition	123	45.6
No alternatives	34	12.6

Factors Influencing Smallholder Market Decisions in Karatu District

Table 4 presents the results of a multinomial regression analysis aimed at identifying factors influencing smallholder farmers' market decisions in the Karatu district. The analysis considers various independent variables, with associated coefficients, standard errors, Wald statistics, degrees of freedom, significance levels, and odds ratios (Exp(B)). The intercept coefficient of -0.794, with a significance level of 0.044, indicates that the model's baseline

(when all other variables are zero) has a statistically significant effect on market decisions. The likelihood ratio test and goodness of fit statistics suggest that the model fits the data well, with a significant contribution to explaining the variation in the dependent variable. Examining specific variables, the coefficient for "Price variation= Not vary" is -0.342, though it is not statistically significant at the 0.05 level.

This suggests that the variation in wheat prices may not significantly influence market decisions among smallholder farmers in the district. In contrast, "Wheat production=<1000 hectare/tonnes" has a significant positive effect on market decisions, with a coefficient of 1.118 and a p-value of 0.001. This indicates that farmers with wheat production below 1000 hectares/tonnes are more likely to make different market decisions compared to the reference category.

These results were consistent with Ahmed *et al.* (2016) who found that the quantity of crop harvested positively affects farmers' participation decisions in the market. The variables related to "Farm distance" and "Membership of AMCOS" do not show significant effects on market decisions, as their coefficients are not statistically different from zero. This implies that the distance of the farm from home and membership in

an Agricultural Marketing Cooperative Society (AMCOS) may not be critical determinants of market choices for smallholder farmers in this context. The pseudo-R-square values suggest a moderate level of explanatory power for the model, with Cox&Snell=0.075, Nagelkerke=0.100, and McFadden=0.056. The classification accuracy is reported at 61.5%, indicating that the model correctly predicts the market decisions for about 61.5% of the cases. Therefore, the multinomial regression analysis in Table 4 provides valuable insights into the factors influencing smallholder farmers' market decisions in the Karatu district. The statistically significant impact of wheat production levels on market decisions highlights the importance of focusing on interventions that enhance production capabilities to positively influence farmers' marketing choices.

Table 4: Multinomial regression results to determine factors that influence smallholder market decision in Karatu district

	B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
							Lower Bound	Upper Bound
Intercept	-0.794	0.395	4.040	1	0.044			
[Price variation= Not vary]	-0.342	0.256	1.784	1	0.182	0.710	0.430	1.173
[Price variation= Vary]	0			0				
[Wheat production=<1000 hectare/tonnes]	1.118	0.352	10.113	1	0.001	3.060	1.536	6.097
[Wheat production=1000-1500 hectare/tonnes]	0			0				
[Farm distance=1-5 Km]	0.118	0.475	0.061	1	0.804	1.125	0.443	2.853
[Farm distance= 6-10 Km]	0			0				
[Membership of AMCOS= No]	-0.136	0.255	0.282	1	0.596	0.873	0.529	1.441
[Membership of AMCOS= Yes]	0			0				

Key:

1. Likelihood ratio test: Model fitting criteria -2 log-likelihood=42.897, X²=20.921, df=4 and P-value=0.000
2. Goodness of Fit: Pearson: X²=4.872, df=7, P-value=0.676, Deviance: X²=5.339, df=7 and P-value=0.619
3. Pseudo R-square: Cox&Snell=0.075, Nagelkerke=0.100 and McFadden=0.056
4. Classification 61.5%

CONCLUSION

The findings of this paper contribute to a comprehensive understanding of the factors influencing wheat smallholder farmers' production and market decisions in the Karatu district. The analysis incorporated various socio-economic variables, and the results from the multinomial regression model shed light on the nuanced dynamics within the local agricultural context.

The significance of wheat production levels on market decisions underscores the pivotal role that production capacity plays in shaping farmers' choices. Smallholders with wheat production below 1000 hectares/tonnes are more likely to make distinct market decisions compared to their counterparts. However, the influence of price variation, farm distance, and membership in Agricultural Marketing Cooperative Societies (AMCOS) did not emerge as significant factors in determining production and market choices.

Implementing programs that provide technical support, training, and knowledge transfer could empower farmers to improve their production efficiencies, ultimately positively impacting their market choices. The paper identified the lack of capital as a prevalent barrier among smallholder farmers. Policymakers and financial institutions should collaborate to develop and implement accessible financial support mechanisms, including credit facilities and grants, to alleviate the financial constraints faced by farmers and enhance their capacity to invest in inputs and technologies.

The moderate explanatory power of the model suggests that additional factors, beyond those considered in this study, may contribute to the complexity of smallholder farmers' decision-making processes. Future research endeavours could explore these unexamined variables to provide a more holistic understanding of the intricacies involved in the market.

The barriers facing smallholder farmers in wheat production and marketing can be considered opportunities if the government decide to put

efforts to potentially promote production by investment in advanced technological practices in crop management, application of policies that favour accessibility and availability of inputs as well as to regulate and foster marketing services (Tadesse et al., 2019). However, the availability of fertile land and inputs are the key indicators of successful wheat production and marketing.

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