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# WORKING PAPER SERIES

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**Acceptability of  
protein-enriched  
foods in a  
population  
sample of the  
region of Niassa,  
Mozambique: A  
Preliminary  
Insight**

A Working Paper by

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# ABSTRACT

Mozambique's Niassa province heavily relies on agriculture, facing nutritional challenges due to limited investment. This study examines dietary patterns and willingness to adopt protein-enriched foods among a representative sample. Additionally, this study seeks to understand the receptiveness of individuals towards incorporating protein-enriched foods into their diets.

A survey of 125 participants, using mailing lists and snowball sampling, found correlations between demographics and food preferences. Typically, participants have three to four meals daily, often purchasing from street markets. Their diet is maize flour-heavy, low in meat, fruits, dairy, and vegetables. However, there is awareness regarding protein-enriched foods, and willingness to try them.

In conclusion, the study suggests that even though there is a promising potential for the successful introduction of protein-enriched foods within this sampled population, more work needs to be done to fully gauge the nutritional needs of the broader population as well as the successful implementation of protein-enriched foods. This work suggests that the inclusion of protein enriched foods have potential to generate impactful change in Niassa province, contributing for SDG2 – Zero hunger.

## Key words:

Malnutrition | Mozambique | Niassa Province | Enriched Foods | Food Choices | Food Security

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## Contents

Introduction.....	2
Materials and Methods.....	6
Survey design/assessment.....	7
Survey respondents.....	7
Results analysis.....	8
Results and discussion.....	8
Conclusions.....	19
References .....	21

## Introduction

Malnutrition is a pervasive global issue, with undernutrition disproportionately affecting countries in the Global South (Dukhi, 2020, Siddiqui et al., 2020). Undernutrition can lead to a variety of complications, such as stunted growth and development of babies and young children, weakened immune systems, cognitive impairments, increased vulnerability to chronic diseases, hormonal imbalances, and reproductive health issues (Nigatu et al., 2021, Galler et al., 2021, Wells et al., 2020). Gender inequity in decision-making and access to nutritional food compounds these issues for girls and women, while harmful weaning customs and cultural beliefs, and food taboos can interfere with a woman's ability to make good nutritional decisions for herself when pregnant, lactating, and for her developing children (Lusambili et al., 2020). Malnutrition is further amplified by food insecurity, which is the result of a complex set of factors, including climate-related triggers. These impacts are expected to worsen, as climate change intensifies, affecting the agriculture sector (Banik, 2019). The United Nations' Sustainable Development Goal 2 (SDG 2) aims to achieve Zero Hunger by 2030. This includes ending hunger and ensuring that everyone has access to safe, nutritious, and sufficient food year-round. SDG 2 also focuses on creating sustainable food production systems, improving access to markets and economic opportunities, and promoting value addition and non-farm employment. To achieve these goals, it is essential not only to develop but also implement new food systems, especially in countries with limited food security (UN, 2023).

Agriculture is the economic mainstay of Mozambique, a country that has been historically prone to natural disasters such as floods and tropical cyclones. Due to its geographical location and extensive coastal line. Niassa Province, located in Northern Mozambique (Figure 1), is the largest yet most sparsely populated of the ten provinces outside of the capital Maputo. It has attracted little investment in comparison to other regions, despite the perceived potential of its agricultural sector, favourable climate, and fertile soils (Kronenburg García et al., 2022).

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However, most of the agricultural production in Niassa province is subsistence farming (Kronenburg García et al., 2022).

Traditionally, subsistence farming practices, highly dependent on rainfall patterns, consisted of shifting cultivation, and exploitation of river-basins but in more recent years there has been a focus on land sparing, by optimising high-tech, high-yield production on smaller land areas to allow for conservation of other land areas in their natural, more biologically rich, state (Mbanze et al., 2020). Land tenure is complex in Mozambique, although the 1997 Land Law legally formalises customary land use, though many of the processes are contested (Åkesson et al., 2009). Staple crops grown in Niassa include maize and tubers, while smallholder farmers typically raise local breeds of small ruminants, swine, and poultry for both household consumption and local meat market demand. Due to the presence of trypanosomiasis, a parasite transmitted by *Glossina austini* (tsetse fly), that causes sleeping sickness in both humans and animals, cattle rearing is difficult in Niassa (Rodrigues et al., 2017, Ofiço et al., 2022). Widespread poverty and limited access to essential services such as healthcare, education, markets, and infrastructure impact the population of Niassa (Ali 2020, Muianga 2022). Furthermore, the security incidents caused by terrorist attacks in the neighboring province of Cabo Delgado are expected to intensify severe food insecurity in Niassa due to population displacement from Cabo Delgado Province (OCHA, 2023). Niassa presents significant levels of malnutrition particularly among children under five years old. Over 50% of children in Niassa Province suffer from stunting, which not only affects physical development but also has long- term implications for health, education, and well-being (Cane et al., 2019, Picolo et al., 2019). For these reasons, it is urgent to think of strategies to struggle with these problems of food shortage. Enriched foods are being reported as strategies to minimize the nutritional needs in Africa (Birol et al., 2015, Talsma et al., 2017).



**Figure 1 - Map of the Study Area (source D-Maps.com)**

Enriched foods, are products fortified with essential macro or micronutrients that may be lacking in the diet or have been removed during the food processing. They are a well-established feature of the food security response landscape in Sub-Saharan Africa. Scott-Smith (2015) contends that four factors have been central to the longevity and attractiveness of this foods since the 1960's. Following WW2 there was a search for compact food stuffs in the form of powder, as a response to food shortages. A second factor was the emergence of a highly modernist approach to food production and nutrition, more based in new technologies and a more individualised nutritional understanding. A third factor was a strong focus on the notion of a 'global protein gap', and a fourth factor was the need to dispose of agricultural food surpluses.

Some of the most common enriched food types include grains, dairy products, breakfast cereals, beverages, breads and bakery products (Vishwakarma et al., 2022). Introducing enriched foods into food insecure regions of the Global South has shown to holds great promise

in combating malnutrition (Ahmed et al., 2022, Kiran et al., 2022, Olsen et al., 2020). However, several challenges must be addressed. Understandably, cultural preferences and dietary habits entrenched within communities may resist changes in food consumption patterns. Additionally, the cost of enriched foods could prove prohibitive in low-income contexts. Furthermore, the local population might lack awareness and understanding regarding the benefits of enriched foods (Timpanaro et al., 2020).

Introducing enriched foods to a population predominantly impoverished and reliant on local produce and trade necessitates a careful evaluation of its success. Scott-Smith (2015) suggests finding more participatory, locally appropriate, and culturally sensitive options. With limited education and resources, accepting and adopting these foods may face significant challenges. Cultural preferences, affordability, and awareness are pivotal in determining their effectiveness (Timpanaro et al., 2020, Ronoh et al., 2024, Alphonse et al., 2020). Assessing the impact requires a comprehensive understanding of local dietary habits, economic constraints, and nutritional needs. Community engagement, targeted education programs, and collaboration with local stakeholders are also essential to navigate these complexities and ensure the successful integration of fortified foods into the diet of such populations (Picolo et al., 2019, Sridhar et al., 2023). To date, little research has been published on locally sourced or Mozambican sourced ingredients or by-products.

The primary objective of this investigation is to assess the current dietary inclinations prevalent among a demographically representative subset of the Niassa Province population. Concurrently, it aims to gauge the willingness of individuals within this demographic to integrate enriched food items into their dietary routines. Furthermore, this study seeks to establish correlations between food preferences and various socioeconomic factors such as economic status, age, and gender. By doing so, the research aims to target the enriched food products catered specifically to the dietary needs and preferences of the Niassa Province population.

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## Materials and Methods

### *Survey design/assessment*

The survey was designed in Microsoft Forms (MS Forms 2024) and incorporated both attitudinal (food preferences, shopping preferences, knowledge about enriched foods...) and demographic data (age, income, sex...). Posteriorly to the construction of the survey, it was sent to 10% of the expected respondent number (100) for feedback and validation.

The protocol and the procedures for obtaining informed consent were followed by the latest revised SETU Ethics in Research Policy and Procedures document approved by the Governing Body and the Academic Council (SETU, June 2021).

### Survey respondents

An online voluntary and anonymous questionnaire was developed in Portuguese (see appendix 1). Respondents were recruited through university mailing lists and the questionnaire was distributed to students and staff of the University Rovuma in the Niassa campus, using the snowball method of sampling. The data collection period spanned 11th March and 22nd March 2024.

During the data collection period, the researchers were available to answer any questions from the participants by phone, message, or email.

The questionnaire was completed by 125 participants (56.8% male, 41.6% female, 1.6% prefer not to say) with 69% having children under five in the family. Of these, 38.4% belonging to the age group 18 to 25 years old, 31.2% belonging to the age group 26 to 35 years old, 19.2% belonging to the age group 36 to 45 years old, 8.8% belonging to the age group 46 to 55 years old, 2.4% belonging to the age group more than 55 years old. 69% of the respondents state to have children under five years old in the family. The monthly income of respondents is described in table 1.



## Monthly family income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 8500 MT (approx. 133 US dollars)	48	38.4	39.3	39.3
	between 8501 and 15000 (133 to 235 US dollars)	26	20.8	21.3	60.7
	between 15001 and 35000 (235 US to 548 dollars)	24	19.2	19.7	80.3
	between 35001 and 50000 (548 US to 782 dollars)	17	13.6	13.9	94.3
	between 50001 and 65000 (782 US to 1017 dollars)	5	4.0	4.1	98.4
	more than 65000 (more than 1017 US dollars)	2	1.6	1.6	100.0
	Total System	122	97.6	100.0	
Missing		3	2.4		
Total		125	100.0		

**Table 1 – Frequency table of all respondents to the survey on food habits (sample population of the region of Niassa, Mozambique)**

## Results analysis

The software SPSS (IBM SPSS Statistics (Version 28)) was used for the statistical analysis. A Pearson correlation test for parametric data was used to test for significant association between

variables. A Pearson's value over 0.25 is classified as strong, over 0.15 is moderate, and lower was considered a weak correlation. A 5% level of significance ( $P < 0.05$ ) or 1% significance level was used according to the data presented in Table 2.

## Results and Discussion

In terms of demographics of the responders, it is important to notice that they were from both sexes, mostly young (with nearly 90% being less than 45 years old) and mostly linked with the university setting, suggesting well educated. In this context it is important to know that the results presented might not be represented of the full population of Niassa, Mozambique, that is considered a low-income region with an annual GNI per Capita of 440 US\$ (WBG, 2024).

To better understand the daily eating habits of the sample population the question "How many meals, in average, do you eat per day" was asked. The majority reported having typically 2 or 3 meals per day (35% and 50% respectively, Figure 2).

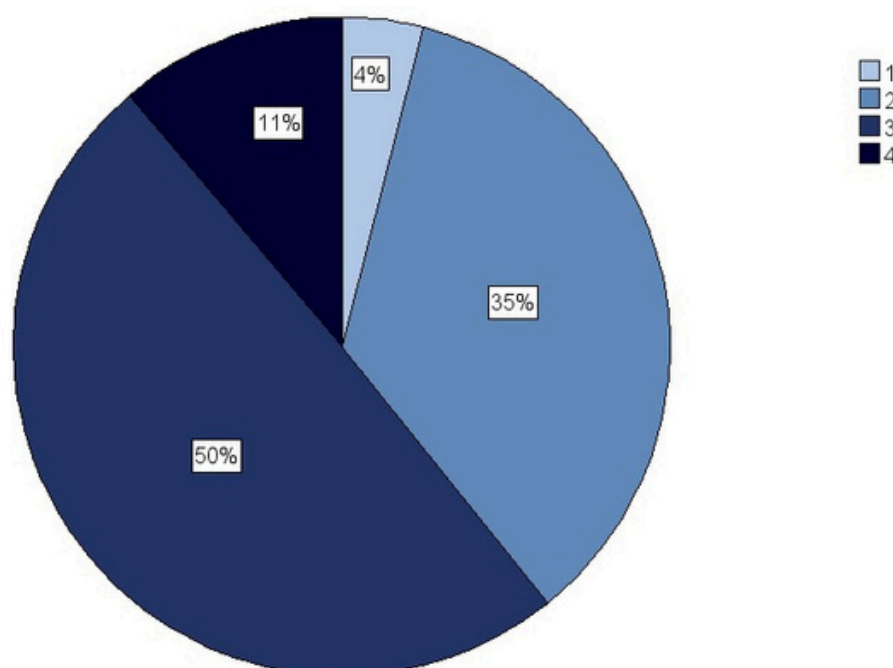
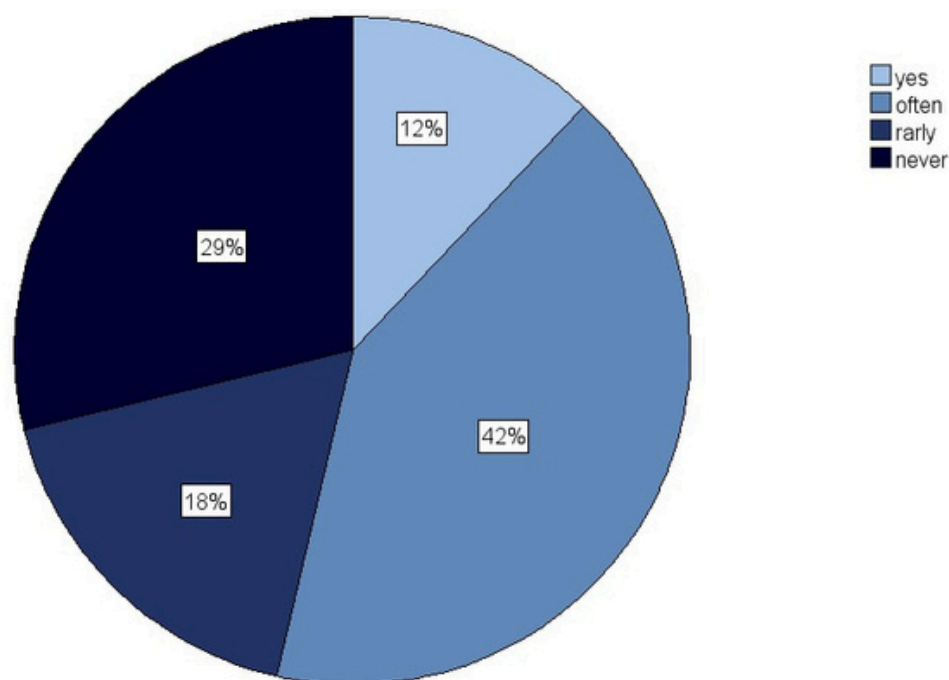


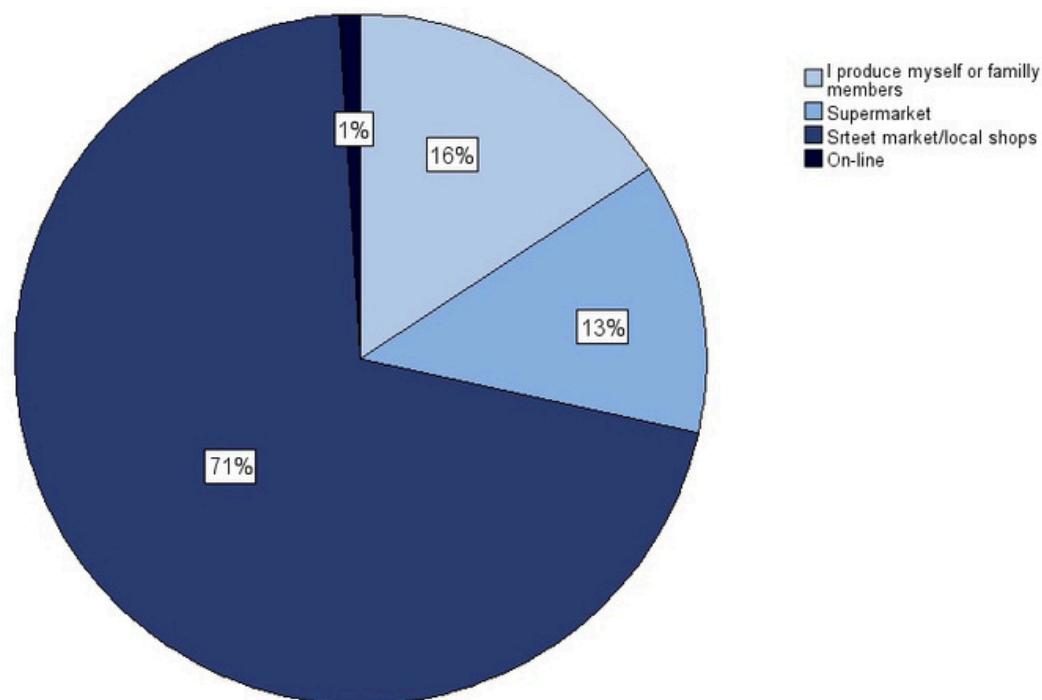
Figure 2- Answer to the question "How many meals, in average, do you eat per day?" N=125.

Although this aligns with reports stating that, on average, people in African countries typically eat three times a day (Raimundo and Pendleton, 2016, Tschirley and Weber, 1994), the number of meals per day by itself is not the best indicator of food security, and it has to be put in perspective of the quality of the meals (Leroy et al., 2015). Additionally, there is a positive correlation (Pearson Correlation = 0.251) between number of meals eaten by day and age group, with younger age groups consuming more meals per day compared to older age groups (Table 2). There is also a positive correlation (Pearson Correlation = 0.291) between monthly income and meal frequency. Individuals with higher incomes tend to have more meals per day compared to those with lower incomes within the sample population (Table 2). Furthermore, there's a slight but observable correlation (Pearson Correlation = -0.191) between sex and meal frequency, as females tend to consume more meals on average per day than males (see Table 2). These correlations are probably linked with access to food being different between age groups, monthly income, and possibly, to a lesser extent, to sex (Pawlak and Kołodziejczak, 2020, Gebre, 2021). While there are no restaurants, canteens, or food vendors on the university campus, the university is located a very short distance from markets and a large town. Proximity to markets and proximity to paved roads might help shape the frequency of meals. This would suggest that the respondents acquire their meals off campus, either in their homes or in the local town.



**Figure 3- Answer to the question "Do any of them include "snacks" such as biscuits, crackers, bars, dry foods?" N=125.**

Between meals, fortified snacks have been reported as a beneficial option to enhance nutritional intake, particularly in malnourished elderly populations, hospitalized individuals, and young children (Iannotti et al., 2016, Gall et al., 1998, Mills et al., 2018). Therefore, it was important to assess whether the surveyed population incorporates snacks into their dietary habits. To the question "Do any of [the meals] include snacks such as biscuits, crackers, bars, dry foods, etc?", more than half of the sample population answered "yes" or "often" (12% and 42% respectively, Figure 3). There is also a correlation between Age, Sex and Monthly income and the inclusion of snack or not in the diet (Table 2). Younger age groups reported eating fewer snacks than older groups, men report to include more snacks than woman in their diets and groups with lower income include more snack type foods in their diet. The fact that man eat less at home then woman may have had an influence in these data.

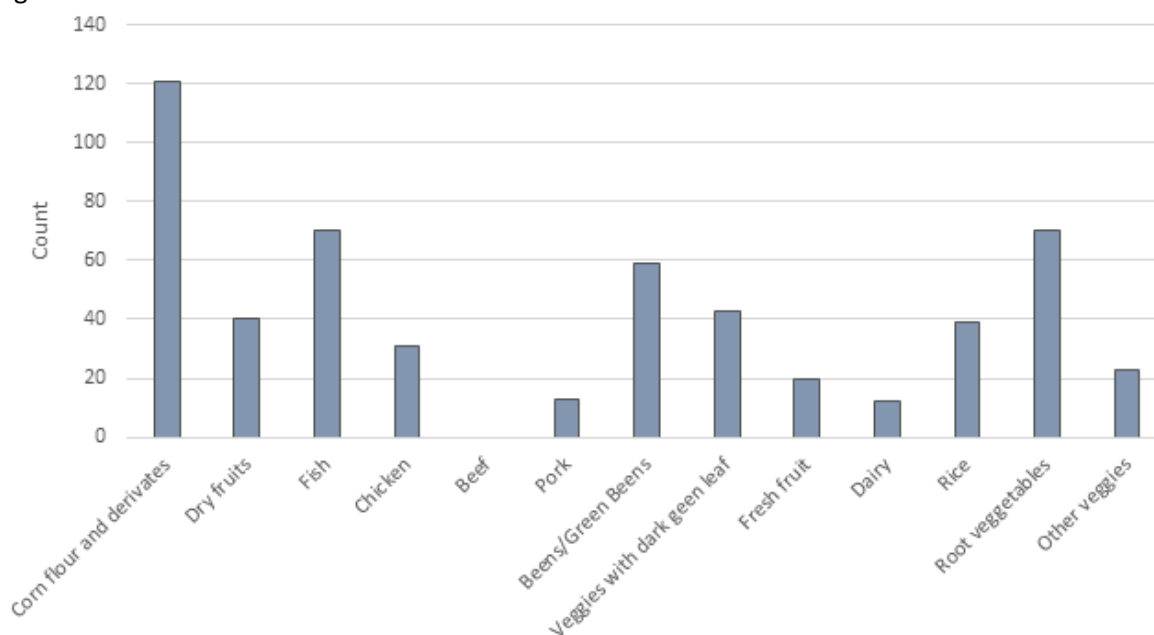


**Figure 4 - Answer to the question "Where do you buy your food?" N=101.**

The survey shows that the majority of respondents (71%) primarily purchase their food from street markets or local shops, with less than 1% opting for online purchases and only 13% favouring supermarkets (Figure 4). This data is essential in an era where online platforms are playing a significant role in introducing novel food products and marketing strategies for food globally. However, it is important to note that while some middle and high income countries supermarket and on-line shopping is preferred and the online platforms have had an increase, there might be more potential effectiveness of focusing efforts on markets and local shops for novel food distribution in Niassa at present. Local vendors may be preferred over internet retailers and supermarkets due to factors such as accessibility, provincial-level delivery options, and pricing (McCordic et al., 2022).

Furthermore, it's essential to highlight that 16% of respondents produce their food or trade among their community. This shows the importance of community involvement, especially in

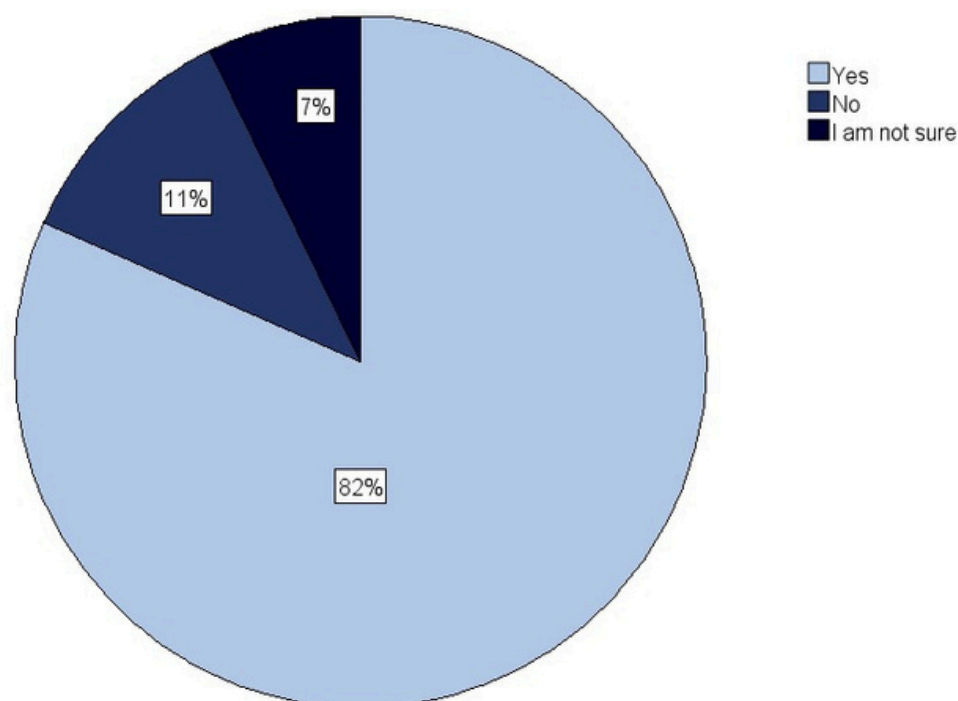
rural areas like Niassa, to facilitate meaningful shifts in food consumption habits. These foods included cereals, tubers and roots, vegetables, fruit, meat and dairy products, fish, and legumes.



**Figure 5 - Answer to the question "Which of these foods do you eat every day?" N=125.**

The most consumed staple foods throughout the various provinces of Mozambique are maize followed by cassava and rice (Walker et al., 2006). Consistent with previous studies and the prevailing cropping system of Niassa province, nearly all respondents consume Maize meal (Xima) and porridge and its derivatives daily (121 respondents). Not surprisingly, given the agricultural landscape, none reported consuming beef daily, while only 12 respondents mentioned daily consumption of milk and dairy. Interestingly, twice as many respondents reported consuming dried fruits daily (40 respondents) compared to those who consume fresh fruits daily (20 respondents). Fish emerged as the primary animal protein source, with 70 respondents indicating daily consumption. This surpasses the combined daily consumption of chicken, beef, and pork (31, 0, and 13 respectively). Furthermore, root vegetables such as potato, cassava, yam and others are part of 70 respondents' daily diet. In contrast, vegetables with dark green leaves and other vegetables are consumed daily for less respondents (43 and

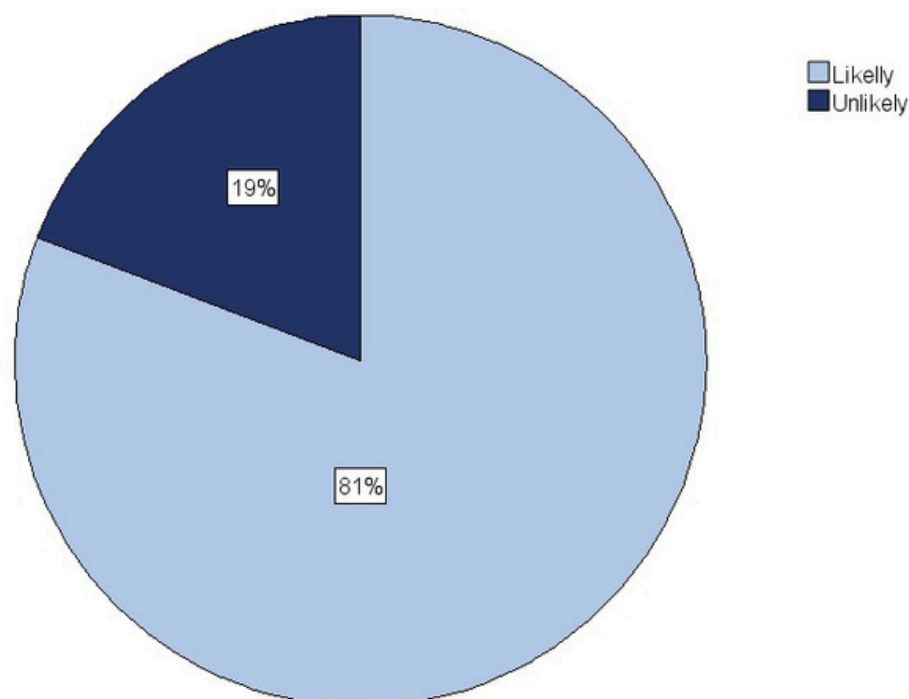
23 of the respondents, respectively, Figure 5). Beans and green beans are the most consumed pulses in the region (personal communication), but only about half of the respondents stated consuming them daily (60 respondents, Figure 5). Although these are a good source of quality protein, the fact that a portion of beans has significantly less amount of protein than a portion of meat or fish and that half of the responders mention not eating them every day suggests that the consumption of beans is not enough to compensate for the lack of consumption of other high protein sources. These findings suggest that there might be deficiencies among this adult population in terms of saturated fatty acids, polyunsaturated fatty acids, protein, fresh fruit, and vegetables (Khan and Bhutta, 2010). Future research should explore the frequency of food consumption and the portion sizes, particularly regarding fish and meat. Determining if these portions align with recommended intake levels for optimal health is essential.



**Figure 6 - Answer to the question "Have you heard about protein enriched foods?" N=125.**



To gauge the potential acceptability of a protein-enriched food product among the sample population, two questions were posed: "Have you heard about protein-enriched foods?" and "How likely would you be to purchase a protein-enriched food product?". A large majority of respondents (82%) indicated familiarity with protein-enriched foods (Figure 6), while 81% expressed their likelihood to purchase such a product (Figure 7).



**Figure 7 - Answer to the question "How likely would you be to purchase a protein enriched food product?" N=125.**

This shows the potential for acceptability of a protein-enriched food, should one be developed. This is of importance since, often, the development of novel foods does not have the impact envisaged due to a lack of acceptance (Siegrist and Hartmann, 2020). It is important to note, however, that due to the characteristics of the respondents (university educated students and adults) and the method (online survey), familiarity and understanding of protein-enriched foods could be expected to be different among community members and children.

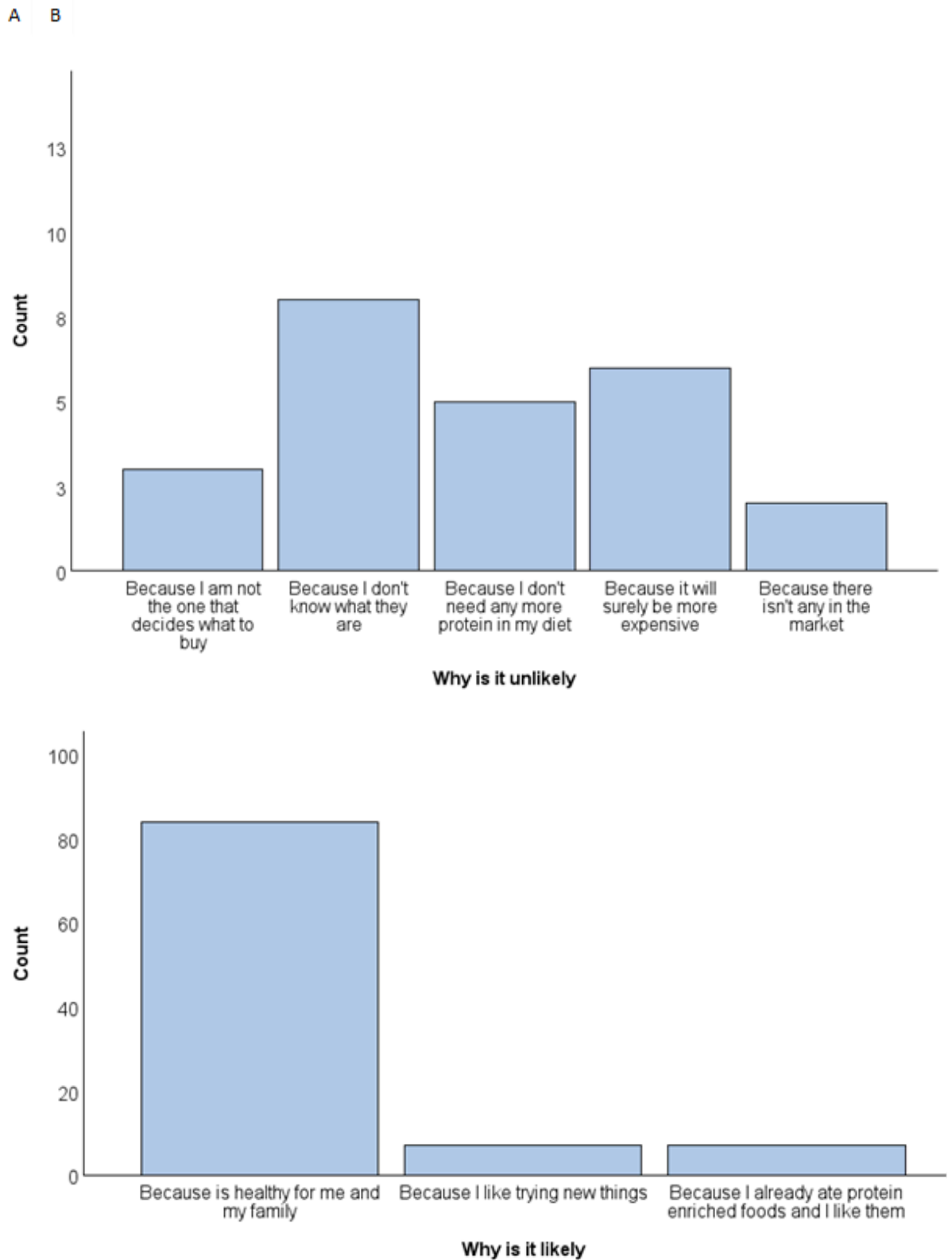


Figure 8 - Answer to the question "Why is it likely (A) / unlikely (B) to purchase a protein enriched food product?" N=125.

Health was provided as the main reason for purchasing a protein-enriched product by respondents who reported that they were likely to buy it. Respondents who reported that they were unlikely to buy protein-enriched foods mentioned a lack of understanding of what it is as the main reason, followed by cost concerns (Figure 8). This data shows that even though there is a good understanding of the health benefits of an increase of protein intake by the respondents, for a product like this to be developed and sold in this region, it would be beneficial not only to have an information campaign to educate the population about what protein enriched foods are. Moreover, taking into account this data together with the fact that nearly 40% of the sample population mentioned having a family monthly income of less than the minimum wage (8500 MT), it would be essential that the costs of any product developed and sold would be affordable (Scott-Smith, 2015).

**Table 2 - Correlations of the variables Age group, Sex, Monthly Family income, Meals per day, does any of them include snacks, did you hear of fortified foods and What is the likelihood of buying it by the Pearson Correlation. \* signifies a weak correlation and \*\* signifies a stronger correlation.**

		Correlations						
		Age group	Sex	Monthly family income	Meals per day	Does any of them include snacks	Did you hear of fortified foods	What is the likelihood of buying it
Age group	Pearson Correlation	1	-.304**	.401**	.251**	-.274**	-.075	-.102
	Sig. (2-tailed)		<.001	<.001	.005	.002	.406	.259
	N	125	125	122	125	125	125	125
Sex	Pearson Correlation	-.304**	1	-.018	-.191*	.189*	-.058	-.055
	Sig. (2-tailed)	<.001		.842	.033	.035	.518	.546
	N	125	125	122	125	125	125	125
Monthly family income	Pearson Correlation	.401**	-.018	1	.291**	-.233**	-.269**	-.148
	Sig. (2-tailed)	<.001	.842		.001	.010	.003	.104
	N	122	122	122	122	122	122	122

Meals per day	Pearson	.251**	-.191*	.291**	1	-.289**	-.359**	-.262**
	Correlation							
	Sig. (2-tailed)	.005	.033	.001		.001	<.001	.003
	N	125	125	122	125	125	125	125
Does any of them include snacks	Pearson	-.274**	.189*	-.233**	-.289**	1	.186*	.175
	Correlation							
	Sig. (2-tailed)	.002	.035	.010	.001		.038	.051
	N	125	125	122	125	125	125	125
Did you hear of fortified foods	Pearson	-.075	-.058	-.269**	-.359**	.186*	1	.311**
	Correlation							
	Sig. (2-tailed)	.406	.518	.003	<.001	.038		<.001
	N	125	125	122	125	125	125	125
What is the Likelihood of buying it	Pearson	-.102	-.055	-.148	-.262**	.175	.311**	1
	Correlation							
	Sig. (2-tailed)	.259	.546	.104	.003	.051	<.001	
	N	125	125	122	125	125	125	125

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

## Conclusions

The findings of this study show the significant alignment between the food choices observed in the studied group and those commonly reported in Mozambique. Furthermore, correlations were identified between food preferences and demographic characteristics, including Sex, Age, and Income levels, suggests that factors such as cultural background, socioeconomic status, and individual preferences play a crucial role in shaping dietary habits.

Additionally, the study shows a significant level of knowledge and receptiveness among participants toward trying protein-enriched and fortified foods. This indicates a potential willingness within the group tested to embrace new nutritional options that could address protein deficiencies. Moreover, the study underscores the importance of conducting more detailed and comprehensive analyses to understand food preferences and nutritional needs within the broader population of the Niassa province. This could involve employing qualitative research methodologies such as focus groups, individual interviews, and food diaries to gain deeper insights into dietary patterns and behaviours as well as assessment of food access, support, farming methods, among other political and cultural factors. Additionally, efforts should be made to ensure that the sample population is more representative, questioning children and older adults as well as stay-home mothers who often are responsible for the food purchase in the household, as well as people from the broader population, allowing for a more accurate depiction of broader dietary trends and preferences.

Furthermore, the study highlights the complexities of introducing new food products enriched with protein into the market. Beyond assessing consumer knowledge and willingness to try such products, considerations must also be given to factors such as affordability, preferred food formats, distribution channels, and market demand. Addressing these multifaceted issues is crucial for successfully integrating protein-enriched foods into the local food system. The

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present study suggests the potential for the successful implementation of protein-enriched foods in the region studied with a possibility of advancing towards the United Nations' SDG 2.

**Institutional Review Board Statement:** The questionnaire was online, voluntary, and anonymous in line with the ethical procedures of SETU and the University of Rovuma. A brief information sheet in Portuguese was attached to the questionnaire. During the data collection period, the researchers were available to answer any questions from the participants by phone, message, or email.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study

**Conflicts of Interest:** The authors declare no conflicts of interest.



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