



Nourishing the peripheries: examining weekly food markets and access to nutritious foods in rapidly growing urban settings – insights from Dar es Salaam, Tanzania

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ABSTRACT

Rapid urbanization and population growth in Sub-Saharan African cities exacerbate challenges in the availability and accessibility of nutritious foods for urban households, particularly in the underserved peripheries of fast-expanding urban areas. Although alternative food retail solutions, such as weekly food markets (WFMs), have emerged to address these issues, their contribution to urban food systems and to food access in rapidly expanding peripheries remains insufficiently examined. This paper examines the role of WFMs in providing nutritious foods, using the case of peripheral wards in Dar es Salaam, Tanzania. Data from 506 buyers and 381 vendors across 31 WFMs in five municipalities are analyzed through spatial, statistical, and qualitative methods. Results reveal adequate food diversity in WFMs in peripheral wards of Dar es Salaam. These markets comprise of a diverse vendor base and operate during convenient hours. Despite constraints in sanitation, waste management, and formal infrastructure, WFMs remain accessible due to their locations along major roads, facilitating access from residential and workplace areas. They also serve as key sources of nutritious foods at prices perceived as affordable, with informal pricing practices supporting low-income households. These findings demonstrate that WFMs function as primary food access points in underserved urban peripheries, while their temporary and informally governed status limits infrastructure investment and integration into formal planning frameworks. Policy efforts should prioritize integrating WFMs into urban planning and strengthening basic market infrastructure.

Introduction

Achieving sustainable food and nutrition security remains a central policy challenge in Sub-Saharan Africa (SSA) [1], where rapid population growth and urbanization are reshaping urban food systems [2]. Projections indicate that SSA's population will reach 2.51 billion by 2050, with 60% living in urban areas, and the region hosting 15 mega-cities [3–6]. Much of this expansion occurs through outward spatial growth into peripheral wards, areas often characterized by weaker infrastructure and uneven service provision. Such patterns alter the structure and complexity of urban food systems [7] and intensify constraints on access to nutritious foods, particularly in peripheral neighborhoods that are geographically distant, economically less dense, and underserved [8–12].

Within these contexts, WFMs have emerged as important retail spaces in peripheral urban wards. These markets are periodic, in which small-scale vendors sell food directly to consumers at designated public locations, typically under local authority authorization [13]. The broader literature shows that the urban retail food environment plays a decisive role in shaping food and nutrition security [14,15]. Consequently, access to nutritious foods is influenced by interrelated factors, including availability, prices, vendor and product characteristics, and individual-level constraints such as affordability and accessibility [16–19]. In SSA, where many households rely more on local markets and small shops than supermarkets, such market spaces remain central to food provision [20]. Yet the specific structure and functioning of WFMs in urban peripheries, particularly in relation to their spatial organization, accessibility, vendor practices, and governance, remain

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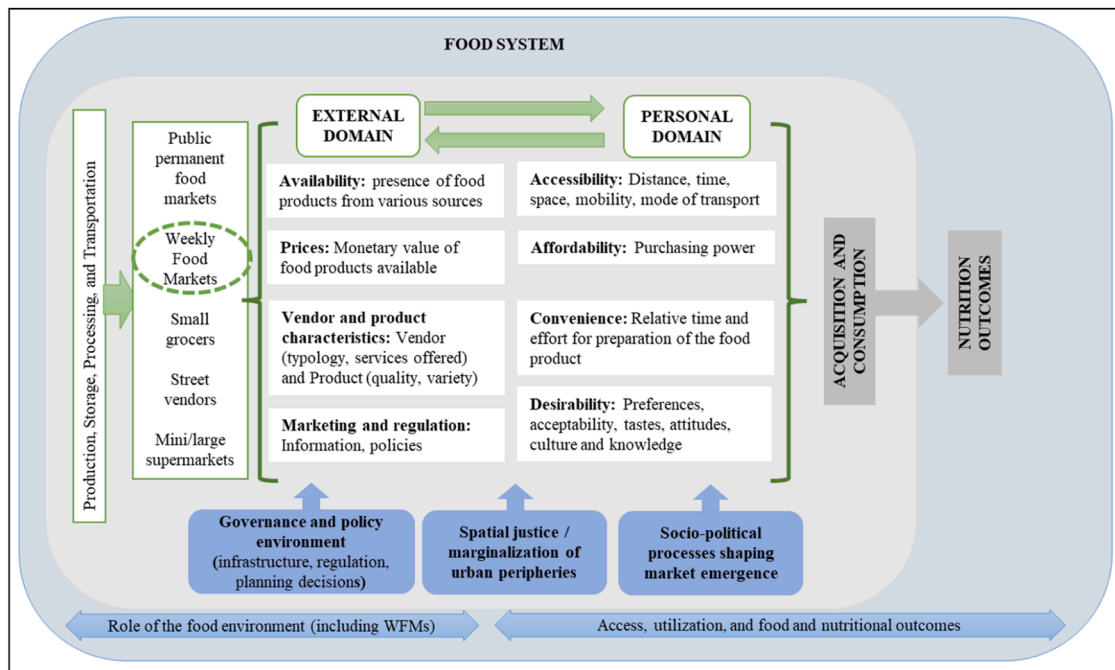


Fig. 1. Food environment (as an interface within the wider food system) and interactions shaping food acquisition, consumption, and ultimately nutritional outcomes, integrated with insights from Urban Political Ecology (adapted from [19,40]).

underexamined. Consequently, WFMs in urban areas are often neglected in urban planning and policy discussions despite their practical relevance in underserved areas.

In light of the above, this paper examines the role of WFMs in enhancing access to nutritious foods in urban peripheral wards, using the case study of Dar es Salaam, Tanzania. As the country's fastest-growing city, Dar es Salaam faces rapid spatial expansion and persistent food insecurity, especially in infrastructure-constrained peripheries [21,22]. Many households depend on alternative retail formats such as street vendors, local food stalls, and WFMs to meet daily food needs [7]. The analysis focuses on how WFMs shape key dimensions of the food environment (availability, affordability, accessibility, vendor and product characteristics, and desirability) and, in doing so, addresses a gap in empirical evidence on peripheral food markets. By situating WFMs within the broader urban food system, this paper contributes to debates on market regulation, infrastructure development, and food security in rapidly urbanizing SSA cities.

The remainder of the paper is structured as follows. Section Two reviews literature on the urban retail food environment and its implications for access to nutritious foods. Section Three outlines the methodology. Section Four presents the findings on WFMs in Dar es Salaam. Section Five discusses these findings in relation to existing literature, and Section Six concludes.

Conceptualizing the food retail environment in urban peripheries

Food environments shape dietary practices and nutrition outcomes by mediating the interaction between food systems and households [23, 24]. They include physical, economic, policy, and sociocultural factors that influence food choice [18] and are affected by socioeconomic status, spatial location, and cultural norms [16,17]. In urban peripheries, these mediating factors are particularly pronounced due to limited infrastructure, low economic density, and distance from commercial centers [10].

Retail systems in SSA are diverse, encompassing small grocers, street vendors, supermarkets, and public markets [16,25]. Public markets operate as permanent facilities or periodic markets in authorized spaces

[26,27]. While periodic markets can support dietary diversity and affordability, they face constraints such as price volatility, limited infrastructure, and low consumer purchasing power [15]. Informal retail outlets also raise concerns regarding food safety and quality, which are intensified in peripheral settlements with limited transport, storage, and public investment [9,28,29].

Access to nutritious foods, defined as those providing essential nutrients while limiting harmful components [30], depends on both market characteristics and household conditions. In Tanzania, adherence to national dietary guidelines across six food groups [31] is influenced by agricultural production, supply chain efficiency, regulatory frameworks, and infrastructure for perishables [27,32,33]. Household purchasing power and cultural preferences further shape dietary choices [34,35].

This paper uses Turner et al.'s (2018) food environment framework, which separates external factors such as availability, prices, vendor and product characteristics, and regulation from personal factors including accessibility, affordability, convenience, and desirability (Fig. 1). WFMs show how these factors interact in peripheral areas. Externally, they provide fresh, locally sourced produce, often with flexible pricing through bargaining, and foods that meet local cultural preferences [36–39]. Internally, their location near residences or transport nodes improves convenience, while social connections reinforce desirability. Formal food safety and nutritional information are limited, with transactions relying on trust and local knowledge [1]. These dynamics show how market-level characteristics both reflect and respond to local social and spatial conditions.

To understand how these dynamics are shaped by broader structural conditions, the analysis draws on Urban Political Ecology (UPE), which emphasizes that urban socio-ecological systems result from political, economic, and institutional decisions, which determine the allocation of infrastructure, services, and regulatory attention [40,41]. In Dar es Salaam and other SSA cities, informal and semi-formal markets often emerge in areas neglected by formal planning, reflecting uneven investment and governance priorities. These conditions affect where markets are located, access to transport and sanitation, and the environment in which they operate. Combining the food environment framework with UPE provides a way to understand how retail structures, household constraints, and governance interact to shape access to



Fig. 2. Map of Dar es Salaam City, Tanzania, with its five Municipalities showing the built-up areas.

nutritious foods in rapidly urbanizing peripheral areas.

Context: Dar es Salaam, Tanzania

Dar es Salaam, Tanzania’s largest and most economically dynamic city, covers about 1393 square kilometers and had an estimated population of 5.4 million in 2022, representing 8.7% of the national total [22]. It serves as the country’s primary trade and distribution hub, receiving agricultural produce from across Tanzania [42]. Administratively, the city is divided into five municipalities, namely Ilala, Temeke, Kinondoni, Ubungo, and Kigamboni, which differ in population and administrative structure, with Ilala being the most populous (36 wards; 458,000 residents) and Kigamboni the smallest (9 wards; 91,000) [22].

As one of Africa’s fastest-growing cities, Dar es Salaam has an annual

population growth rate of 5.6% and an 8% yearly expansion of built-up areas. This growth pressures land, infrastructure, and public services, especially in peripheral wards, which house roughly 37% of the population [22]. These areas are often marked by informal land use, unplanned settlements, and limited access to essential services, including permanent food markets [21,43]. Although the Dar es Salaam City Master Plan 2016–2036 sets standards for local markets and commercial spaces [44], enforcement depends largely on municipal authorities responsible for land-use control, market allocation, licensing, and day-to-day management of trading spaces. In practice, limited serviced market sites, fragmented responsibilities across municipal departments, and uneven enforcement practices have allowed informal and periodic trading spaces to expand, particularly in peripheral areas. This reflects both governance gaps and the political tolerance of informal livelihoods,

Table 1
Summary of key methodological elements.

Item	Description/ Source/ Tool
Study area	Five municipalities of Dar es Salaam, including core and peripheral wards; field survey (2023)
Data sources	GPS field data, Landsat imagery, 2022 National Population and Housing Census, surveys, direct observation, key informant interviews
Markets surveyed	31 WFMs; purposive inclusion of all identified WFMs
Buyer sample size	n = 506; structured questionnaire administered using KoboToolbox
Vendor sample size	n = 381; structured questionnaire administered using KoboToolbox
Observational data	Full vendor coverage per market using a structured food-item checklist by food group; KoboToolbox-based observation tool
Food classification (International)	12 food groups (cereals, tubers, vegetables, fruits, meat, eggs, fish, legumes, milk products, oils, sweets, spices); FAO (2018)
Food classification (National)	6 food groups (cereals, starchy roots, tubers, plantains and green bananas; vegetables; fruits; pulses, nuts and oil seeds; animal-source foods; and healthy fats and oils.); Tanzania Mainland Food-Based Dietary Guidelines [31]
Spatial analysis tools	GPS coordinates, Landsat imagery, and buffer analysis (5 km and 10 km zones); ArcGIS Pro
Statistical software	Data cleaning and descriptive statistics; Stata
Non-parametric test	Kruskal–Wallis test for differences in median Likert responses across municipalities; Stata
Visualization tools	Dot plots of Likert-scale responses; R software

given the role such activities play in employment and household food access [10,21,42,43].

Consistent with patterns observed in other rapidly urbanizing SSA cities, many households in peripheral neighborhoods rely on informal and alternative food sources, such as small grocers, mobile vendors, and WFMs, to meet daily dietary needs [7]. Food vendors in these areas typically operate under more precarious and poorly supported conditions than those in better-served inner-city areas [45], highlighting the importance of WFMs for local food access.

Materials and methods

Study area, markets, and data

The study was conducted across all five municipalities of Dar es Salaam (Fig. 2), including core and peripheral wards, to capture variation in infrastructure, population density, and food retail options. Dar es Salaam is suitable for examining WFMs' role in providing access to nutritious foods, particularly in peripheral wards, which often lack formal markets and face infrastructure constraints [21,43]. The coexistence of WFMs with other informal and formal food sources allows analysis of how residents navigate food environments amid rapid urban growth [7,42].

Data were collected using multiple sources (Table 1). Market locations were mapped with GPS and supplemented by Landsat imagery and the 2022 National Census to determine proximity to residential zones. Observational data documented the availability and diversity of nutritious foods, guided by FAO (2018) and Tanzania's Food-Based Dietary Guidelines [31] (Table 1). Structured and semi-structured questionnaires collected socio-demographic and economic information from vendors and buyers. All instruments were pre-tested and administered using CAPI via KoboToolbox. Key informant interviews with market administrators, city planners, and officials complemented primary data, providing insights into WFM operations and governance.

Observations were conducted to document the range and diversity of food items sold by vendors in each WFM. All vendors present during the survey day were included in the observation. Two enumerators recorded food items by food group using a structured checklist and cross-checked

entries for consistency. Observations took place over a full market day, starting around 14:00 when vendors had set up their produce, and typically lasted about 1.5 h per market. This procedure ensured full market coverage on the survey day rather than reliance on sub-sampling of stalls. Because observations were conducted during a single market day for each WFM, they primarily capture conditions present during the survey period and may not fully reflect temporal fluctuations in vendor activity and the availability of specific food items. However, the observations were intended to document the general composition and functioning of markets and were interpreted alongside survey and interview data.

In terms of sampling of markets and respondents, both probability and non-probability sampling techniques were used. First, 31 WFMs across five municipalities were identified, and a purposive decision was made to conduct data collection in all of them. Because vendor and buyer populations in informal markets are not formally registered, the underlying population size could not be determined in advance. Sample size targets were therefore guided by three established approaches: (i) minimum respondent thresholds for descriptive and multivariate analysis [46], which recommend at least 200–250 observations to ensure stable estimates and adequate statistical power; (ii) Green's (1991) rule-of-thumb, $N \geq 50 + 8k$, which provides a general lower bound when multiple variables or subgroup comparisons are considered (where k denotes the number of key explanatory factors examined) [47]; and (iii) Cochran's (1977) considerations for large or unknown populations, which offers a basis for approximating required sample sizes when population parameters are not precisely known [48]. The final sample comprised 381 vendors and 506 buyers. Buyers were stratified by gender (35% male, 65% female) to reflect women's dominant role in food markets [36]. Vendors were stratified similarly (45% male, 55% female) to cover all 12 FAO food groups [49]. Spatial distribution was ensured by dividing markets into sections and approaching every third or fourth respondent systematically.

Analytical methods

This paper employed spatial, quantitative, and qualitative methods to assess the distribution of WFMs, buyer perceptions, and factors associated with food access (Table 1). Spatial analysis used mapping and Geographic Information System (GIS) tools to examine the location and density of WFMs in relation to permanent food markets across the study area. Coordinates of all identified WFMs and permanent markets were collected through direct field surveys using KoboToolbox forms. These coordinates were compiled and organized into a geospatial database using ArcGIS Pro. The data were subsequently mapped to visualize the spatial distribution of both WFMs and permanent markets. Using the buffer tool in ArcGIS Pro, zones were created around the central business district to delineate areas within a 5 km and 10 km radius, enabling visualization of how WFMs are distributed within and beyond these buffer zones.

To analyze the external and personal domains of the food environment, descriptive statistics (means and proportions) were used to summarize key characteristics. Data collected via KoboToolbox were exported and cleaned in Stata to correct inconsistencies and handle missing values. Descriptive statistics were used to generate summary insights on buyers' perceptions of food availability, accessibility, affordability, and desirability within WFMs. In addition, descriptive analysis compiled and assessed the socio-demographic and economic characteristics of both buyers and vendors operating in the surveyed markets. Observational data on food items and vendor arrangements were used to assess the availability and diversity of food groups across WFMs and to complement survey-based findings on market characteristics and food access.

Buyer perceptions of WFMs' role in acquiring nutritious foods were measured using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), a standard tool for assessing attitudes [50]. Statements

Table 2
Descriptive statistics of buyers and vendors (selected) characteristics.

Variable	Measurement	Buyers (n = 506)	Vendors (n = 381)
<i>Individual demographic characteristics</i>			
Age	Years, mean (SD)	36.90 (11.10)	35.40 (10.20)
Male	1 = Male (%)	34.00	44.00
Married	1 = Yes (%)	56.00	35.00
Household head	1 = Yes (%)	58.00	71.60
<i>Household characteristics (buyers only)</i>			
Household size	Number of members, mean (SD)	4.46 (2.03)	–
Children under 5 in household	1 = Yes (%)	57.00	–
Health insurance member	1 = Yes (%)	49.00	–
<i>Education and economic activity</i>			
Education level	Categorical (%)		
– Primary school		22.13	58.27
– Secondary school		34.78	35.96
– Vocational training		10.47	1.57
– University		33.61	4.20
Main occupation (buyers only)	Categorical (%)		
– No occupation		13.04	–
– Employed		37.75	–
– Self-employed		49.21	–
Business as main occupation	1 = Yes (%)	–	89.00
<i>Vendor enterprise characteristics (vendors only)</i>			
Experience in current business	Years, mean (SD)	–	4.10 (3.60)
Number of WFMs operated	Count, mean (SD)	–	4.06 (1.91)
Business owned	1 = Yes (%)	–	86.00
Business registration status	Categorical (%)		
– Registered		–	29.00
– Not registered		–	71.00
Type of platform	Categorical (%)		
– On the ground		–	61.00
– On a table		–	33.00
– Other		–	6.00
Perceived conduciveness of the market environment for trade	1 = Conducive (%)	–	82.00
	0 = Not conducive (%)	–	18.00

covered vendor roles, healthy food availability, and market accessibility. Respondents rated each statement based on their experiences and perceptions of the markets they frequented. The Likert-scale responses were aggregated by municipality to allow for comparative analysis. Differences in median responses across municipalities were tested using the Kruskal-Wallis test [51]. To enhance interpretation, dot plots were generated in R Software, visually representing buyer perceptions. Because the visualizations are based on aggregated mean scores at the municipal level, they primarily reflect overall response tendencies and may obscure variation in individual perceptions within municipalities. Nevertheless, the aggregated scores remain useful for identifying broad comparative patterns across municipalities.

To assess the supply and acquisition of nutritious foods in WFMs, two complementary classification systems were applied. First, the FAO (2018) 12-food group system includes cereals, tubers, vegetables, fruits, meat, eggs, fish, legumes, milk products, oils, sweets, and spices. Second, the Tanzania Mainland Food-Based Dietary Guidelines [31] identify six food groups: cereals, starchy roots, tubers, plantains and green bananas; vegetables; fruits; pulses, nuts and oil seeds; animal-source foods; and healthy fats and oils. While the FAO system provides an international standard, the national guidelines reflect context-specific dietary priorities. Both classifications emphasize key macro- and micronutrients essential for a healthy diet and guided the structuring of survey questions and the classification of food items observed or reported during fieldwork. This integration ensured that both global

comparability and local relevance were maintained in the analysis of nutritious food supply and acquisition within WFMs.

Results

Sample characteristics of buyers and vendors in WFMs

Analysis of buyer characteristics (Table 2) indicates that WFMs attract household decision-makers, though other members also participate in purchasing. Women constitute the dominant group among buyers. The buyer population is relatively young, with a wide range of educational attainment. As is typical for most urban areas, household composition includes children under five and multiple members in the households. Buyers are largely economically active, combining formal employment and self-employment, and about half participate in health insurance schemes.

Vendor characteristics reveal a young and predominantly female workforce operating within WFMs. Educational attainment among vendors is concentrated at the secondary level or below. Most vendors report ownership of their business and operate across multiple markets, averaging four markets per week.

External food environments: food availability and vendor/product attributes in WFMs

Starting with food availability, the analysis of the 31 surveyed WFMs across the five municipalities indicates a generally high diversity of food items, reflecting broad availability of nutritious foods. Most markets offer products across the majority of the 12 FAO food groups. Vegetables, fruits, fish and seafood, roots and tubers, and pulses/legumes/nuts/seeds are present in nearly all WFMs, whereas meat/poultry, grains/cereals, milk products, and eggs exhibit more variation in availability. Applying the six food groups from the Tanzania Mainland Food-Based Dietary Guidelines [31] produces a similar pattern. Markets consistently provide cereals, starchy roots, tubers, plantains and green bananas; vegetables; fruits; and pulses, nuts and oil seeds. Animal-source foods and healthy fats and oils are less consistently available, being present in approximately half of the markets. These observations indicate that WFMs generally offer access to most core food groups, though the presence of certain categories remains uneven across the markets.

Buyer responses indicate a broadly positive perception of nutritious food availability within WFMs (Fig. 3[a]). Compared with other food outlets, WFMs are consistently rated highly for both diversity and sufficiency of available foods. Respondents perceive the variety of items offered as adequate to meet household needs, and the overall quantity of foods available is generally considered sufficient. These assessments highlight that buyers regard WFMs as reliable sources of diverse and nutritionally relevant food items.

Buyer assessments indicate that vendor and product characteristics play a central role in shaping access to foods and overall market functionality. When selecting where to purchase, buyers emphasize vendor diversity, service quality, convenient opening hours, and product freshness. Comparisons with other food outlets (Fig. 3[b]) show that WFMs are generally perceived as stronger in these aspects, with buyers expressing satisfaction regarding the quality and safety of food relative to alternative sources.

However, perceptions of the overall market environment, including product and vendor arrangement, cleanliness, and safety, are less uniformly positive. While many buyers rate WFMs favorably, mean scores for the overall market environment are lower than for other attributes, and experiences vary across municipalities, highlighting location-specific differences in market organization, sanitation, and congestion. These results indicate that, although WFMs perform well on vendor and product attributes, structural constraints in the trading environment remain a challenge. Vendor responses also (Table 2) complement buyer perceptions. While most vendors report that the market environment is

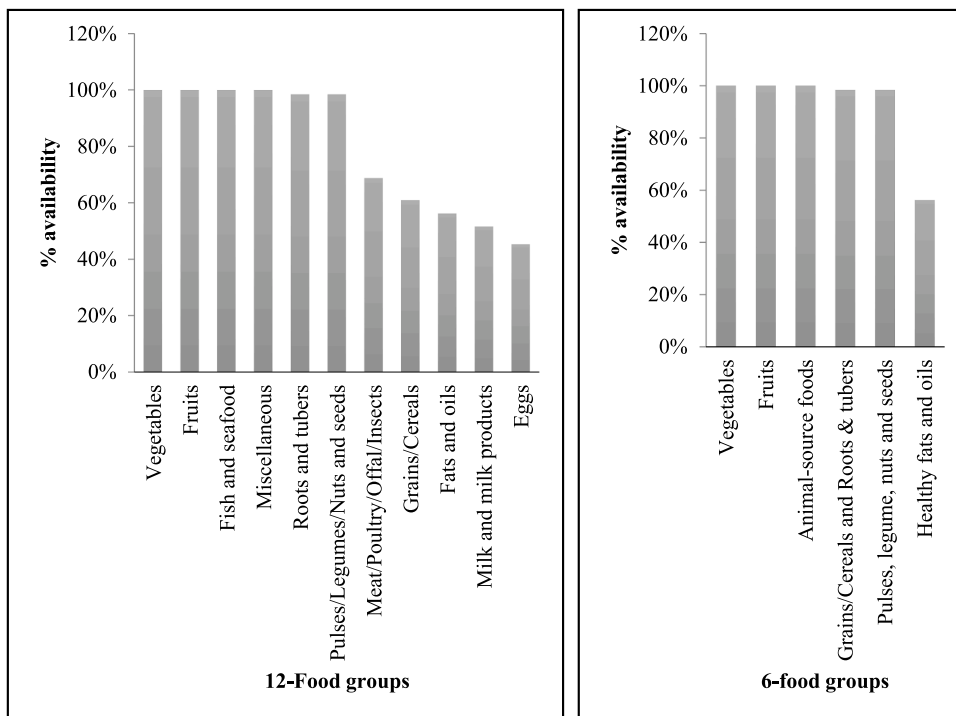


Fig. 3. Level of availability of specific food items per food group in the 31 surveyed WFMs.

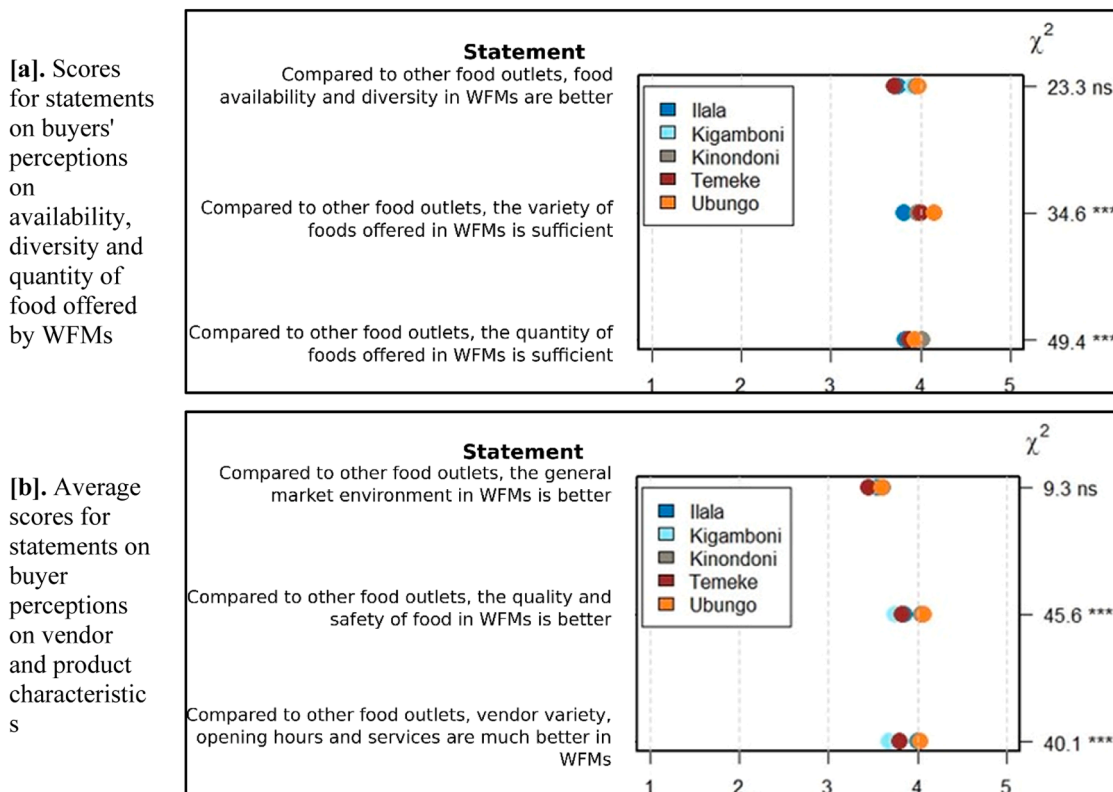


Fig. 4. [a-b]. Buyers' perspectives on food availability and vendor/product attributes in WFMs compared to other food outlets. Note: Each dot represents the mean Likert score (1 = strongly disagree, 5 = strongly agree) for respondents in that municipality. The secondary y-axis (right) displays the Kruskal-Wallis H-statistic, with asterisks denoting significance levels (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$) for differences across municipalities.

conducive to trade, a notable proportion indicate constraints or dissatisfaction. Observations and survey responses show that the majority arrange their produce directly on the ground, whereas approximately

one-third use tables or informal stalls. In addition, business formalization is limited: most vendors operate unregistered enterprises, with only a minority holding municipal registration. These findings reflect

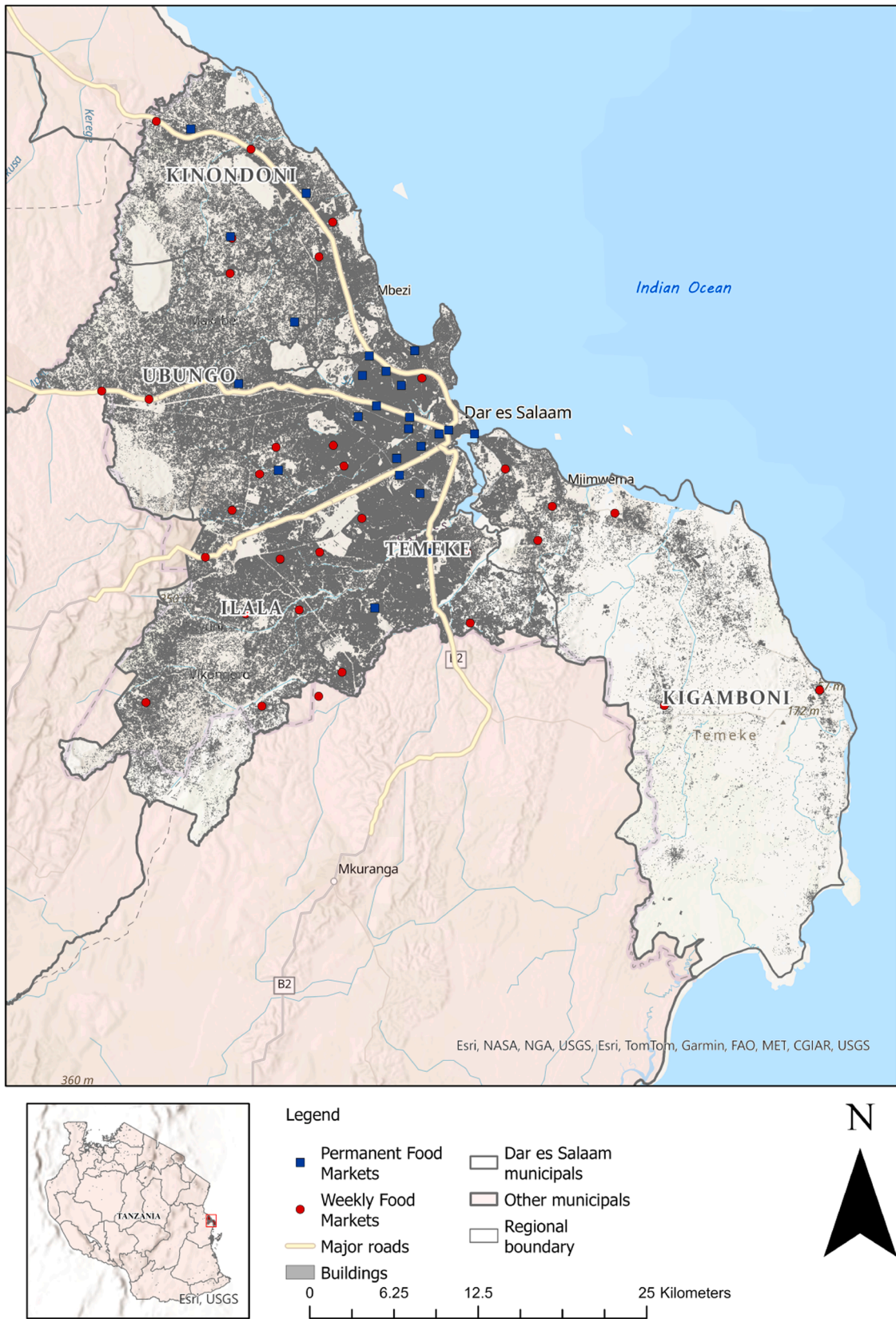


Fig. 5a. . Spatial distribution of WFMs and permanent markets in Dar es Salaam overlaid on built-up areas and human settlements.

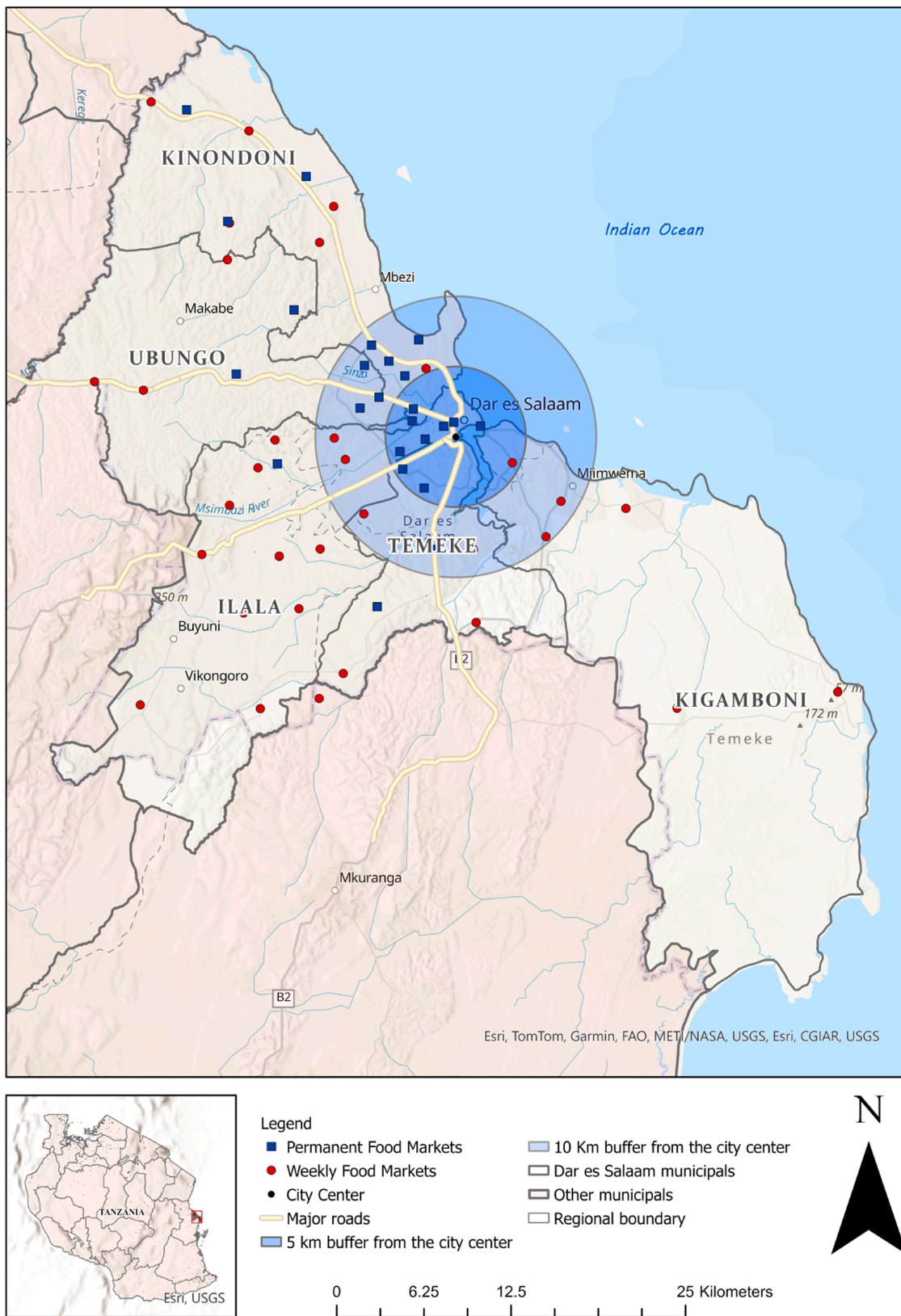


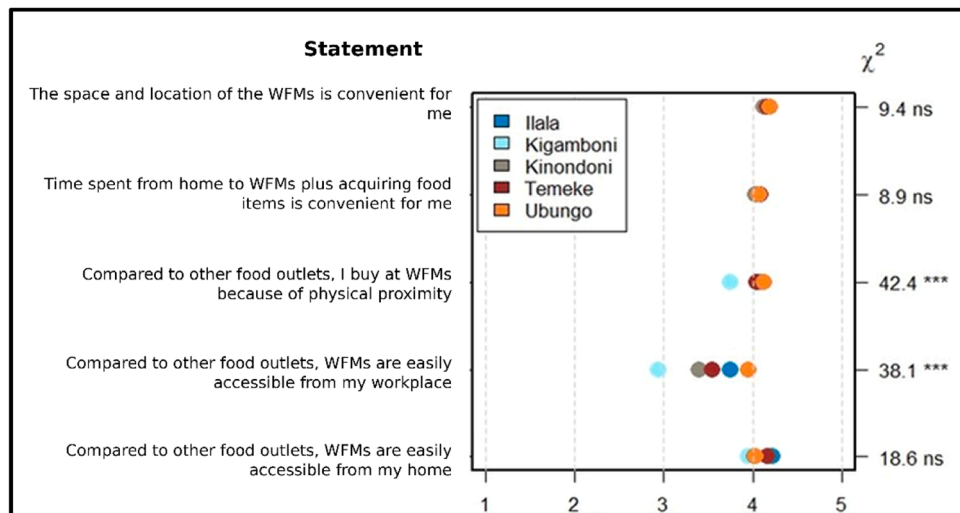
Fig. 5b. Spatial distribution of WFMs and permanent markets in Dar es Salaam along the urban core–periphery gradient.

variation in vendor practices, spatial arrangements, and levels of formalization across WFMs, highlighting heterogeneity in how markets function.

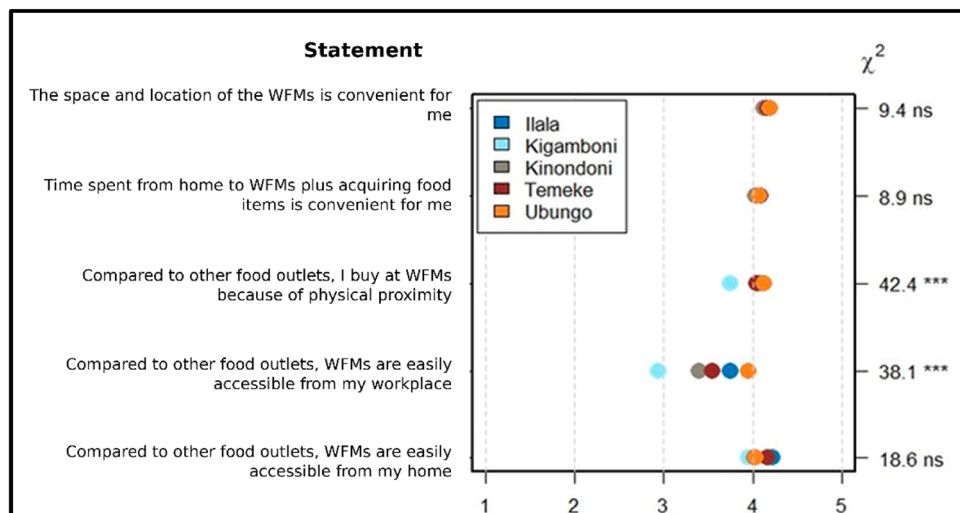
Personal food environments: accessibility, affordability, and desirability

Accessibility is a key dimension of food environments, and here we assess how the physical location and reachability of WFMs shape buyer

[a].
Average scores for statements on accessibility of WFM based on a Likert scale (1=strongly disagree, to 5=strongly agree).



[b].
Average scores for statements on affordability of foods at WFM based on a Likert scale (1=strongly disagree, to 5=strongly agree).



[c].
Average scores for statements on desirability and purchase decisions at WFM based on a Likert scale (1=strongly disagree, to 5=strongly agree).

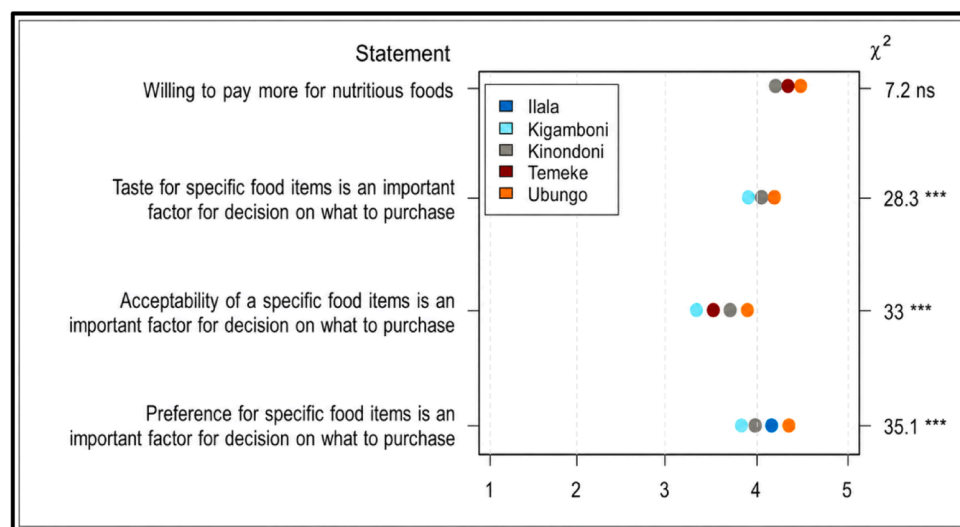


Fig. 6. [a-c]. Buyers' perspectives on accessibility, affordability and desirability aspects relating to WFM. Note: Each dot represents the mean Likert score (1 = strongly disagree, 5 = strongly agree) for respondents in that municipality. The secondary y-axis (right) displays the Kruskal-Wallis H-statistic, with asterisks denoting significance levels (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$) for differences across municipalities.

access. Results from spatial analysis (Fig. 4) show that the distribution of permanent food markets (blue dots) differs significantly from that of WFM (red dots). While permanent food markets are concentrated in the urban core (represented by the 5 km and 10 km radius buffers), WFM

are more dispersed beyond the 10 km radius, thereby being a common feature in the peripheral wards. Further, buyers were asked to compare WFM with other food outlets they normally buy from on several aspects of accessibility (Fig. 5[a]). Overall, perceptions of WFM accessibility

were positive. Ease of access from home and from work was rated favorably across municipalities, indicating generally high perceived convenience. Physical proximity received the highest ratings, showing that markets are generally located within a reasonable distance for buyers. Differences across municipalities were observed for this dimension, with Kigamboni showing a distinct pattern, reflecting its geographic characteristics as it is a peninsula with fewer roads and more dispersed settlements compared with other municipalities. Ratings for time efficiency, combining travel and purchasing duration, were positive, as were ratings for the convenience of market space and location, with minimal variation across municipalities.

Buyers were asked about value for money and whether prices at WFMs are reasonable compared to other outlets (Fig. 5[b]). The majority of buyers interviewed reported that value for money is important to them when deciding where to shop. Mean scores for price reasonableness and satisfaction with prices both averaged 4.0 across municipalities. Significant differences were observed across municipalities for both statements Fig. 5a, b

To understand whether preferences shape food choices at WFMs, buyers were asked to rate the importance of taste, acceptability, and preference for specific food items when deciding what to purchase (Fig. 5[c]). Responses indicate strong agreement across municipalities, with taste, acceptability, and preference consistently rated as highly important. Differences across municipalities were observed for all three attributes. Buyers were also asked whether they would be willing to pay more for nutritious foods compared to other outlets, and overall responses indicate a positive willingness across municipalities, with no notable variation. To complement stated preferences, observations of actual purchases on the day of the interview (Fig. 6) show that buyers typically select items from multiple food groups. Across municipalities, purchases generally covered most of the six food groups outlined in the Tanzania Mainland Food-Based Dietary Guidelines [31], namely: cereals, starchy roots, tubers, plantains and green bananas; vegetables; fruits; pulses, nuts and oil seeds; animal-source foods; and healthy fats and oils. In particular, cereals, starchy roots, tubers, plantains and green bananas; vegetables; fruits; and pulses, nuts and oil seeds emerged as the most commonly purchased food groups across municipalities. Variation is nevertheless apparent across municipalities, with some areas showing higher diversity in purchased food groups than others.

Discussion

Urban households rely substantially on the existing food retail environment for accessing food, as the majority do not produce their own food [26]. Food markets, both permanent and weekly, have been documented as key sources of food for urban residents in many SSA cities [37,52]. Our findings indicate that WFMs in Dar es Salaam's peripheral wards provide a wide variety of nutritious food options. Using the 6-food group classification per the Tanzania Mainland Food-Based Dietary Guidelines 2023, WFMs appear to offer sufficient variety and quantity of staple, vegetable, fruit, protein, dairy, and fat/oil items [31]. This positions WFMs as critical nodes within short food supply chains, linking local producers directly to consumers and supporting both household nutrition and local economic activity.

In comparison with other food retail outlets, existing literature suggests that open-air markets, including WFMs, perform more consistently in provisioning nutritious foods. Studies from SSA indicate that supermarkets and other formalized retail outlets are often associated with lower availability of healthy foods relative to traditional markets [19,53]. Our results extend these findings, showing that the diversity and freshness of products in WFMs reflect both vendor strategies and buyer expectations, particularly in peripheral neighborhoods where supermarkets are less accessible. Despite the observed diversity, certain nutritious foods, such as eggs and healthy oils, remain limited. These gaps highlight potential leverage points for targeted interventions that enhance the completeness of food supply without undermining the

informal market structures that support local livelihoods.

Vendor and product attributes further shape food access. Buyers in our study prioritize vendor variety, service quality, opening hours, market hygiene, and product freshness and safety. These preferences, often culturally mediated, underscore the role of social norms in reinforcing the reliance on WFMs; vendors' reputations and relationships with buyers support repeated market use and trust in food quality. Product characteristics such as freshness strongly influence purchasing decisions, particularly for fruits and vegetables, consistent with observations in other SSA contexts [37].

Affordability remains a critical determinant of food access. In low-income households, even modest increases in food prices can limit the ability to obtain diverse and nutrient-rich diets. Across SSA, there is evidence that transitioning from staple-dominated, low-nutrient diets to diets that meet recommended nutrient guidelines can be associated with increases in household food expenditures, often making such diets unaffordable for poorer populations [54]. However, buyers in WFMs perceive prices as reasonable, partly reflecting the role of informal market mechanisms, including negotiation and cultural norms of exchange [39]. Such market dynamics allow households to optimize dietary choices within constrained budgets, enhancing access to culturally appropriate, locally sourced foods. Evidence from Nigeria and Zambia also indicates that bargaining practices improve household purchasing power and enable consumption of more diverse diets [37,39].

Accessibility further differentiates WFMs from other outlets. Spatial analysis reveals that WFMs extend into peripheral wards, while permanent markets are concentrated in the urban core (Figure. 4). This distribution contributes to reduced travel burden for households in underserved areas and supports regular access to fresh, nutritious foods. Buyers' perceptions confirm that WFMs are accessible relative to other outlets (Fig. 5[a]), reinforcing the significance of spatially distributed informal markets for urban food security. Further, the growth and functioning of WFMs reflect broader patterns in urban governance and infrastructure. Peripheral WFMs often operate in temporary roadside spaces, constrained by inadequate municipal support and limited infrastructural investment [10,42]. This informal spatial organization, while adaptive, also limits the potential for standardized hygiene and safety practices, linking local governance capacities to nutritional outcomes [7,55,56]. In addition, infrastructure deficits and uneven planning enforcement contribute to heterogeneity in vendor operations, spatial arrangements, and the broader sustainability of these markets.

Our findings further indicate that WFMs are not merely transactional spaces but socially embedded institutions. In the SSA context, vendors and buyers are documented to maintain reciprocal relationships, grounded in trust, negotiation, and cultural familiarity, which shape consumption patterns [39]. Such interactions reinforce the preference for WFMs, support culturally appropriate diets, and contribute to social cohesion within urban communities. Overall, the evidence suggests that WFMs function as critical infrastructures for dietary diversity, food security, and local economic support. Traditional markets in SSA provide nutrient-rich, culturally aligned foods at lower costs than supermarkets [19,36,57,58]. Their role extends beyond immediate food provisioning to include local economic stimulation, support for short food supply chains, and contributions to more sustainable urban food systems. By supplying locally sourced fresh produce aligned with local diets, WFMs complement broader efforts to enhance nutrition and human well-being while maintaining environmental advantages over more centralized, supermarket-based systems [59].

Conclusions and policy implications

This paper assessed the role of WFMs in supplying nutritious foods in the peripheral wards of Dar es Salaam. The findings show that WFMs are a critical source of food in these areas. They provide a range of food groups consistent with national dietary guidelines and are widely regarded by buyers as accessible and reasonably priced. In wards where

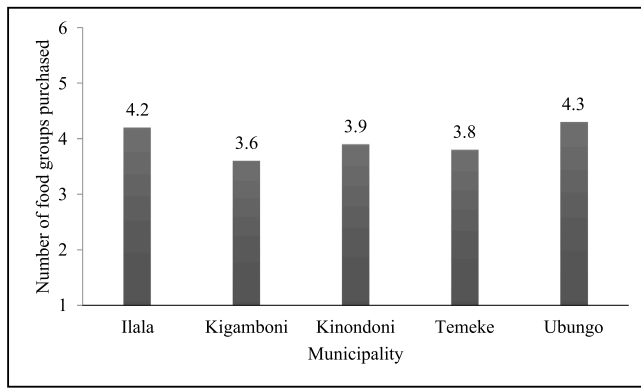


Fig. 7. Mean number of food groups purchased by buyers at WFMs on the day of the interview, based on direct observation (n = 506). Food groups are drawn from the Tanzania Mainland Food-Based Dietary Guidelines for a Healthy Population (2023).

permanent markets are limited and supermarket presence remains uneven, WFMs function as the main point of access to fresh produce and other nutrient-rich foods. Their proximity reduces travel time, and common pricing practices, including negotiation, support access for low-income households. However, the results also identify clear constraints. Some nutrient-dense food groups are not consistently available across markets. In addition, the temporary and informal character of WFMs limits the provision of infrastructure such as sanitation facilities, waste management systems, and appropriate vending spaces. These shortcomings affect the overall market environment and may influence food quality and safety. The evidence therefore indicates that while WFMs improve physical and economic access to food, their operating conditions may limit their effectiveness.

Three policy implications emerge from these findings. First, municipal planning frameworks should formally incorporate WFMs into urban land-use plans. The study shows that these markets already serve as primary food access points in peripheral wards, yet they often operate in undesignated roadside spaces. Allocating planned and serviced sites for WFMs would address spatial constraints identified in the results and provide a basis for basic infrastructure improvements. Second, investment should focus specifically on improving market conditions and addressing observed supply gaps. The findings highlight inconsistent availability of certain nutritious food groups and concerns about sanitation and the market environment. Targeted improvements in hygiene infrastructure, waste management, and mobile and modular vendor facilities, alongside measures that support more reliable supply of underrepresented foods, would respond directly to these weaknesses without undermining affordability. Third, regulatory approaches should clarify operational standards while maintaining the features that support access. The study demonstrates that negotiated pricing and close vendor-buyer relations contribute to affordability and continued reliance on WFMs. Clear guidelines on food safety, space allocation, and vendor practices can improve market conditions, provided they do not restrict the informal mechanisms that enable low-income households to access food.

Conclusively, WFMs play a decisive role in food provisioning in Dar es Salaam's urban peripheries. Strengthening their spatial integration, improving their operating conditions, and adopting proportionate regulatory oversight would address the specific constraints identified in this study while reinforcing their contribution to urban food security (Fig. 7).

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CRediT authorship contribution statement

Luitfred Kissoly: Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Claudio Ngassa:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Fatma Norman:** Writing – review & editing, Validation, Methodology, Formal analysis, Data curation. **Sabrina Rutatora:** Writing – review & editing, Visualization, Methodology, Data curation. **Angela Aluko:** Writing – review & editing, Validation, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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