The influence of urban spatial characteristics on food insecurity among the low-income households: The case of Naivasha town, Kenya

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https://doi.org/10.51867/ajernet.6.3.39

ABSTRACT

Food insecurity (FI) exists when people do not have secure access to enough amounts of food that is safe and nutritious to enhance normal growth and development and an active and healthy life. Globally, FI prevalence of 25.5% is experienced in towns. FI is prevalent in Kenyan towns too. For example, food insecurity prevalence of up to 86% has been reported in Thika town. The measurement of FI in urban areas is done using rural-oriented approaches thus overlooking critical urban challenges and systemic drivers. One major challenge of the current food insecurity metrics is to overlook spatial variations within urban areas. The influence of spatial characteristics on FI is therefore poorly understood and is unavailable in Naivasha town. The purpose of this study was to examine how urban spatial characteristics influence food insecurity in Naivasha town, Kenya. The research was anchored in the sector theory of urban growth. A quantitative cross-sectional survey design was employed, targeting low-income households from six residential locations in Naivasha town. Using a multistage sampling technique, a total of 390 households were selected from the target population of 117,633. Data was collected through a pretested structured questionnaire and analysed using Kruskal-Wallis H test and multivariable logistic regression with SPSS version 26. Kruskal-Wallis H test results showed that perceived food utilization was significantly (p=0.00) different among the residential areas studied but that was not the case with household food insecurity access score. Regression analysis revealed unavailability of open markets significantly predicted household food insecurity access prevalence (p=0.04), while supermarket unavailability (p=0.039) and time to the food sources (p=0.049) significantly predicted perceived food utilization. These findings indicate that FI in Naivasha is influenced by the spatial characteristics of the town. Recommendations include improving access to open markets which are a significant source of food.

Keywords: Food Insecurity, Households, Naivasha Town, Spatial Characteristics, Urban

I. INTRODUCTION

Two billion people worldwide were reported to be food insecure in 2019 before the outbreak of Covid 19, and the figure has continued rising to the recently estimated 2.33 billion people (Food and Agricultural Organization [FAO] et al., 2024). This is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). This definition has four dimensions of food security. They are food availability, accessibility, utilization and stability (Clapp et al., 2022). Food insecurity is therefore a situation that might be caused by lack of availability of food, inadequacy of purchasing power, inadequate distribution, or insufficient use of food at the household level (FAO et al., 2018).

Food insecurity occurs in the rural areas as well as the urban areas, though at varying magnitude (FAO et al., 2024). Until the first decade of the twenty first century, the urban areas were overlooked in the global food insecurity discourse (Crush & Frayne, 2011). They were discussed alongside the rural areas with the assumption that they are similar. However, urban areas have specific dynamics and cross-scale linkages requiring considerations in understanding the dimensions of food insecurity. Left unattended and receiving subtle attention, the problem of food insecurity will continue getting worse owing to the rapid growth in urban areas.

Tadros et al. (2020) reported that global urban population will grow by 13% between 2018 and the year 2050. Sub-Saharan Africa is reported to have the highest urban growth rate spurred by high rates of natural increase, rural to urban migration, and the fact of having had the lowest level of urbanization in the past (Tadros et al., 2020). The Eastern Africa region is the subregion with the highest rate of urbanization. It is projected to grow by more than five times by 2050 (United Nations [UN], 2018). UN-habitat (2020) projects that the urban population in Kenya of 14.975 million in 2020, will have increased to 18.372 million by 2025.

Globally, secondary towns account for a higher share of the urban population compared to primary cities (UN-Habitat & United Nations Children's Fund [UNICEF], 2020). In Sub-Saharan Africa, the population living in secondary towns is 54% of the total urban population (Riley & Crush, 2023). Most of the secondary towns are characterized by limited basic infrastructure and social facilities and services. The rapid population growth from rural to urban migration constrains the resources even more. This limitation of the infrastructure and basic amenities is primarily experienced in the peri-urban/peripheral residential locations. This is where most of the new entrants to the urban areas settle (United Nations, 2017). These limitations have a direct influence on the food environment and eventually, food insecurity prevalence. Riley and Crush (2023) attest to this reality by reporting there being every indication that secondary cities are habitat for households facing severe food insecurity compared to those living in the primate cities.

In urban Kenya, a food insecurity prevalence of 35% has been recorded in the informal settlements of Korogocho and Viwandani in Nairobi (Mutisya et al., 2016). Owuor (2018) reported cases of up to 70% of the households experiencing food insecurity in the same city. These two studies indicate the situation in the primate city of Kenya. In another study conducted in Kisumu, the third largest city in Kenya, Omondi et al. (2017) reported food insecurity of up to 95% among the residents living in the city. The same authors reported food insecurity prevalence of 86% among the residents in the industrial secondary town of Thika.

Literature search has not yielded any records for food insecurity in the secondary town of Naivasha. However, a study conducted in the rural Lake Naivasha basin where Naivasha town is located reported food insecurity of 59.5% in a location adjacent to the town (Sassi & Zuchinni, 2018). This study by Sassi and Zuchinni (2018), strongly indicates food insecurity might be prevalent in Naivasha town.

According to Haysom and Tawodzera (2018, p. 117), "Despite the fact that the world has become increasingly urbanised, and the developing world in particular is experiencing its own urban transition, changes in food security measurement remain predominantly informed by a rural understanding of food security. In instances where urban measurement has taken place, rural-oriented measurement approaches have been adopted, thus overlooking critical urban challenges and systemic drivers."

One such challenge, is the tendency of current food insecurity metrics to overlook spatial variations within urban areas (Blekking et al., 2020). Yet, Andreasen et al. (2017) emphasize that infrastructure disparities between neighbourhoods near central business districts and those on the urban periphery influence local food environments and food insecurity. For example, Peyton et al. (2015) observed that supermarkets are more commonly found in high-income residential areas, while low-income neighbourhoods tend to rely more on informal food sources. These variations suggest that the household's proximity to food sources, such as supermarkets, open markets, means of transport and transport cost to these sources may affect their food insecurity status.

In line with this challenge, information on the influence of the spatial variations on low-income household's food insecurity status within Naivasha town is missing. This study aimed to address this knowledge gap by analysing six residential locations with varying distances from the central business district and varied characteristics. The focus was on four spatial access factors: transport cost, transport time to food sources, availability of supermarkets, and open markets. The study assessed whether these factors can predict the households' food accessibility and perceived food utilization. Additionally, the study compared the households' food accessibility and perceived food utilization among the six residential locations.

1.1 Research Objective

The objective of the study was to examine the influence of urban spatial characteristics on food insecurity in Naivasha, a secondary town in Kenya.

1.2 Research Question

Does the residential location of a household within Naivasha town influence its food insecurity status?

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Sector Theory of Urban Growth

Sector theory of urban growth was developed in 1939 by Homer Hoyt. This theory hypothesizes that cities develop and grow by radiating outwards from the centre in form of sectors. This development is said not to skip at random but rather follows a definite path in one or more sectors of the city. Once a sector is established, it tends to retain that specific character for long distances, as the sector is extended through the processes of the city's growth (Hoyt, 1939). Secondly, distinct sectors are influenced by transport routes starting from the centre and spreading outside. Thirdly, the boundaries of the sectors are delineated by the transport routes and other natural features like rivers, mountains, or lakes.

Hoyt described various components that would influence the residential sectors. These components are the central business district (CBD) which is at the very centre, the wholesale and light manufacturing zone which adjoins the CBD but does not entirely encircle it, and the heavy manufacturing zone, which forms a sector radiating out from the centre. The other component of the city and important to this study, is the residential sector, described as the low – class, middle-class and the high-class residential areas (Hoyt, 1939). This theory is important to this study in explaining the anticipated variation of food environment existing between and among the residential localities of a city.

The pattern of development and growth of Naivasha town seems to create a gradient in relation to the subject of the study. While the three residential areas of Kihoto, Site/Kabati and Industrial area are adjacent to the CBD, it is not the case with the Kayole, Karagita and DCK, the other three areas chosen for the study. The later three residential locations are also at varying distance from the CBD. The distance from the CBD to the residential area may therefore have an influence on the food environment of the said residential area. Hoyt described the CBD as the sector performing the commercial function of the city. True to this and as observed in Naivasha, the major supermarkets and open fresh market are situated in the CBD, and these are major sources of food. This translates to easier access to these sources by the three residential areas closest to the CBD, perhaps as compared to those further from the CBD. Easier access is important in providing fresh food, a wider range of food, cheaper food and the most preferred foods. Also, the closer that a residential area is to the CBD may have an influence on infrastructure and other social services that would all influence food utilization dimension of food insecurity (Andreasen et al., 2017).

2.2 Empirical Review

Secondary towns have different forms, arising from functions, geography, and economies. Development of secondary towns have been categorized into three major types. The first category is the subnational secondary towns which are by far the most common type of secondary towns. They serve as subnational administrative capitals, transport hubs, large manufacturing, or natural resource industry centres. The second typology of development is the metropolitan secondary town clusters which are as a result of the process of devolution and deindustrialization, brought about by manufacturing businesses relocation and other services like the back-office that are moved to new industrial areas, where there is room for expansion, on city edges. Last are the corridor secondary towns- which develop along trade or economic corridors and act as new growth poles. Naivasha, the study location is a corridor type secondary town. The genesis of many of these types of towns is market centres or small subnational government administrative capitals (Roberts, 2014).

The second and third typology of secondary towns development mostly make them to be inhabited by migrants who are pulled from the rural areas or from smaller towns in search of better livelihoods, education opportunities or even living with relations (Andreasen et al., 2017), thus making them develop rapidly. This rapid development and growth in population requires the new people coming into the towns to be settled and provided with basic human needs, especially housing and other infrastructural services. These residential locations, and though not only for the new migrants, but also for others desiring to leave the town centre or the residential locations near to the town centre for various reasons, settle on the edges of the towns where land for settlement is cheaper and where the new residential houses are more modern and spacious. The development of these new residential locations is not accompanied by other infrastructural developments hence leading to an infrastructural gradient among the residential locations in a town. This gradient could even exist between new residential locations, but more so between the old and the new and upcoming residential locations. The existence of infrastructural differences that are important to food insecurity like electricity and tapped water have been reported among residential locations in the same city (Andreasen et al., 2017). This is where those near the central business district are more endowed than those that are further out. Such variations are then a possibility of influencing the food security dimensions of availability, accessibility and utilization and overall, the food environment.

Another salient feature of secondary towns that may have an impact on the residential location and the related effects is the ceaseless growth that continues to take place. A significant growth rate of up to four folds in total build-up and urban areas in a span of a decade has been reported in a secondary town (Korah et al., 2023). Such growth, and indeed as reported by the Korah et al. (2023) is accommodated by the expansion of the town to the former peri urban areas. This is anticipated to further compound the problem of important infrastructure deficit, but also the accessibility of the central business district which is more endowed with a better food environment. Important to the ceaseless growth of the secondary towns is the rate of growth of such towns that are in the same nation or even within the same region in a country. Some towns grow very first compared to others and therefore information applicable to one town may not be applicable to another. A good example is the case of Northern region of Ghana where Korah et al. (2023) have reported varying rate of growth in terms of total build-up and total urban area in two secondary towns, where one grew four folds in a decade while the second town recorded a twofold growth in two decades. It would be expected for a town that has a very rapid rate of growth to have more challenges in food security compared to the other.

Supermarkets are an important source of food stuff (Peyton et al., 2015; Kaiser et al., 2019; Ma et al, 2017; Aparecida et al., 2018). However, their distribution varies with residential locations (Peyton et al., 2015). They are more

common in high income residential locations and less common in low-income residential locations. In contrast the low-income residential locations have more informal food sources. The reason behind this observation is that food purchase and use strategies are influenced by opportunities for households to reach food retailers, which is dependent on their locations, pricing, packaging, credit arrangements, operating hours and the types of food sold. In summary, supermarkets are unable or fail to duplicate the benefits offered by food retailers (Battersby & Watson, 2018). It is therefore imminent that the location of a household in a town might have an influence on food insecurity, and more so on physical availability of the desired foods.

The significance of the availability of open market on food insecurity cannot be underestimated. Open markets are observed to be a major source of fruits, vegetables, tubers, pulses and dry grains like rice, maize, sorghum and others. Duran et al. (2016) have observed the same in Sao Paulo, Brazil though in relation to their significance in the uptake of vegetables and fruits. Open markets are also an important source of the same foods to those that cannot access them directly. They act as the source of the different foods that are bought in bulk by retailers who then sell them in their neighbourhoods in the form of street vending, in Kiosks and in some shops.

Lack of access to these two sources of food (supermarket and open markets) would act as an important barrier to households experiencing food security. This is supported by Ma et al. (2017) who reported lack of transportation to the food source as increasing the chances of a household experiencing very low food security. The distance and consequently time taken to reach these food sources is also important. Food insecure households are observed to adopt a coping mechanism related to the cost of transport and distance to the food source. Kaiser et al. (2019) found that food insecure households were twice as likely to walk or live very close to the food store/source thus not incurring any transport cost. It is clear that availability of supermarkets and open markets coupled with the transport cost and the distance hence time spent to access them, could have a significant influence on food insecurity status of a household.

2.3 Conceptual Framework

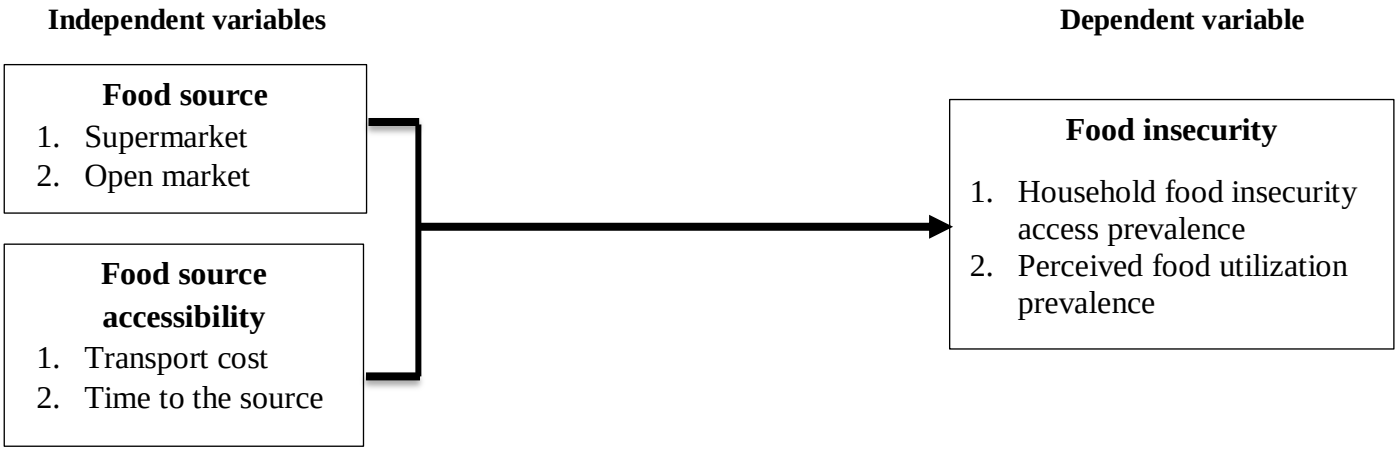

Figure 1
Conceptual Framework

2.4 Food Insecurity Measurement Indicators

2.4.1 Household Food Insecurity Access Scale

The Household Food Insecurity Access Scale (HFIAS), developed by Coates et al. (2007), uses a set of nine questions to measure the level and characteristics of food insecurity in households. It provides information on conditions and domains of food access, generates a household food insecurity score, and helps determine the prevalence of food insecurity within a population.

2.4.2 Perceived Food Utilisation

Perceived Food Utilisation (PFU) developed by Calloway et al. (2023) focuses on barriers to utilization of available food. The use of this method in the study involved five negatively worded reasons/barriers related to food preparation and storage that would inhibit food utilization. These were: don't have time to cook, requires much fuel to cook which I do not have, requires cooking equipment to cook which I do not have, requires special storage which is not available, and lack of water to prepare the food. Responses were scored as often true (score 2), sometimes true (score 1) and never true (score 0). A total score of zero suggested perfect utilisation, while a score of ten indicated significant underutilization.

III. METHODOLOGY

3.1 Research Design

The study adopted quantitative approach in a cross-sectional survey design. Primary data was collected from six low-income residential locations of Naivasha town. The town is located 92.8 kilometres northwest of Nairobi, with the main economic activity being floriculture and horticulture, which are big sources of employment for both locals and immigrants from other regions (Kuiper, 2019).

The target population for the study comprised low-income households residing in six residential locations within Naivasha town, from which a sample of 390 households was drawn. The sample size was determined using the formula by Krejcie and Morgan (1970) from Naivasha's total households' population of 117,633 (Kenya National Bureau of Statistics, 2019). Multistage sampling was utilised to select the sample. The study area was purposively stratified into six with each stratum representing a residential location. Using the google earth map of each stratum, map transects demarcating the sampling frame were made. Once the sampling frame block for each settlement was established, the main longitudinal roads on the sampling frame transects were used to form sampling clusters. The clusters were then numbered and five of them randomly selected. From the five selected clusters, 13 households per cluster were picked using a variation of random walk sampling technique adopted from Anand et al. (2019).

A pretested structured questionnaire was used to collect the data. The questionnaire was administered to the head of the household. A sampling interval of three households was maintained until all 13 households were interviewed leading to a sample of 65 per location. If the third household was ineligible or declined to be interviewed, the next household was picked. Data collection took place in August 2024 to September 2024.

3.2 Data Analysis

3.2.1 Effect of Residential Location on Food Insecurity

To confirm if HFIAS and PFU were significantly different among the six locations, data was tested for normality and homogeneity using Shapiro_Wilk test and Levene test respectively. Both the tests, and in both variables had a p value lower than the set value of $p \leq 0.05$. Therefore, the data did not fulfil the assumptions that are critical for a one-way ANOVA. To avoid the type one error due to these violations, the non-parametric Kruskal-Wallis H test was employed. However, to ensure that the violation of homogeneity of variance was mitigated for by the non-parametric test, both Brown-Forsythe and Welch test were carried out. These two tests of robustness gave results that were statistically similar to the ones of Kruskal-Wallis H test indicating effective mitigation.

3.2.2 Regression Analysis

To conduct the binary logistic regression using the predictor variables, the food insecurity metric variables were reduced into binary criterion variables. Household food insecurity access, which is the primary criterion variable for household food insecurity access prevalence (HFIAP), and which is reported in ordinal scale consisting of four ranks, was reduced to a binary variable. This study adopted the method by Jonah and May (2020) who combined food secure and mildly food insecure; and moderately and severely food insecure to form the food secure and food insecure variables respectively.

The continuous variables perceived food utilization (PFU) was converted to a binary variable and labelled perceived food utilization prevalence (PFUP). This conversion was achieved by categorizing the households into two classifications based on the mean. A similar method has been used to convert household dietary diversity score to household dietary diversity prevalence (Jonah & May, 2020; Khumalo & Sibanda, 2019). The households falling below and above the mean of 6 were categorized as both low perceived utilization good perceived utilization respectively.

To understand the influence of residential location of the households on FI, binary multivariable logistic regression model was employed and predicted HFIAP and PFUP using the following equation.

$$\ln Y = \ln (Y/1\text{-}Y) = a + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

where: ln = natural logarithm, Y = dependent variable food insecurity (HFIAP and PFUP)1-Y = probability of being food insecure, a = value of Y when all values of predictors are zero, $\beta_{1\text{-}4}$ = coefficients of predictor variables, $X_{1\text{-}4}$ = are the predictor variables – Transport expense, availability of open market, availability of supermarket and distance to food source.

The goodness of fit for the regression models was tested using Hosmer and Lemershow test (Lomax & Hahs-Vaughn, 2013). The p value for accepting the beta coefficient of the models as statistically significant was set at $p \leq 0.05$. The research was licensed by the National Commission for Science Technology and Innovation license number - NACOSTI/P/24/36823. It was approved by St Paul's University Institutional Scientific & Ethics Review Committee - REF: SPU/155/2024.

IV. FINDINGS & DISCUSSION

4.1 Characteristics of the Study Population

The characteristics of the study population is indicative of households largely headed by males and married couples who have moderate level of education. The high proportion of internal migrants (75.6%) suggests movement to Naivasha driven by household heads seeking better employment opportunities, particularly in floriculture and horticulture sectors (Kuiper, 2019). This high proportion of internal migrants agrees with the observation by Tadros et al. (2020) of rural to urban migration being a driver of the rapid urbanization. The average age of household heads is youthful and thus aligns with secondary town population characteristics reported by UN-Habitat and UNICEF (2020). The monthly income falls within low-income boundaries as defined by the Kenya National Bureau of Statistics [KNBS] (2022), indicating an urban population predisposed to poverty and food insecurity vulnerabilities (table 1 and 2).

Table 1

Socio-Economic and Demographic Characteristics of the Household Heads

Variable	Frequency	Percent
Education		
Primary school and below	71	18.2
Secondary school	260	66.7
College and university education	59	15.1
Total	**390**	**100**
Marital status		
Single	126	32.3
spouse	264	67.7
Total	**390**	**100**
Household head		
Female	123	31.5
Male	267	68.5
Total	**390**	**100**
Sources of income		
Employment	208	53.3
Business	66	16.9
Casual labour	83	21.3
Employment and business	20	5.1
Others	13	3.7
Total	**390**	**100**
Asset wealth classification		
Poor	130	33.3
Middle	138	35.4
Wealthy	122	31.3
Total	**390**	**100**

n= 390

Table 2

Means and Standard Deviations of Household Socioeconomic Variables

Characteristic	Mean	Std Deviation
Age	34. 64	7.84
Household size	3.80	1.04
Transport cost to the food source	79.92	56.65
Time taken to the food source (minutes)	24.77	22.80
Monthly income	20,643.33	17,662.27
Weekly food expenditure	1124.42	747.01

n=390

4.2 Households' Food Insecurity Status

The results on HFIAP indicated that only 15% of the total households were food secure, with the rest (85%) being food insecure (table 3). It is apparent that 85% of the low-income households in Naivasha town are unable to economically access the preferred foods whose outcome is anxiety, uncertainty, and uptake of insufficient food quantity and quality. This does lead to some physical consequences for example going to sleep while hungry. This was more prevalent to 80% of the study population, which is what suffered between mildly and severely food insecurity.

Regarding PFUP, 39.0% of the households experienced poor perceived food utilization (food insecure) and 61% were classified to enjoy good perceived food utilization (food secure) (Table 3). Such findings have been stated by Calloway et al. (2023) who reported households as experiencing at least two barriers to desired food utilization, thus leading to food insecurity. Accordingly, one or a combination of the five barriers utilized in the study are upheld as the cause of the food insecurity in the 39% of the households.

Table 3

Households Food Insecurity Status

Food insecurity metric	Frequency	Percent
HFIAP		
Food secure	59	15
Food insecure	331	85
PFUP		
Good utilization	238	61
Poor utilization	152	39

n= 390

4.3 Sources of Purchased Food

The sampled households in Naivasha reported various sources from where they bought the food that they consumed. The leading sources of the food were Street vendors and shops and were visited by 90.5 and 90.3% respectively. Supermarket (58.7%), open market (34.4%) and Kiosks (17.4%) were not left out and their utilization followed in that order. Similar food sources have been reported in the study conducted in a wider area in Nairobi by Owuor (2018). However, a difference is observed between Naivasha and the findings in Nairobi in terms of the number of households using these food sources. As an example, street vendors are only used by 61.0% in Nairobi as opposed to 90.0% in Naivasha, but their growing importance is emphasized in Owuor's (2018) study. This then brings out the importance of time, in that a time difference of six years exists between these two studies, and the proportions using this food source might have grown (Figure 2)

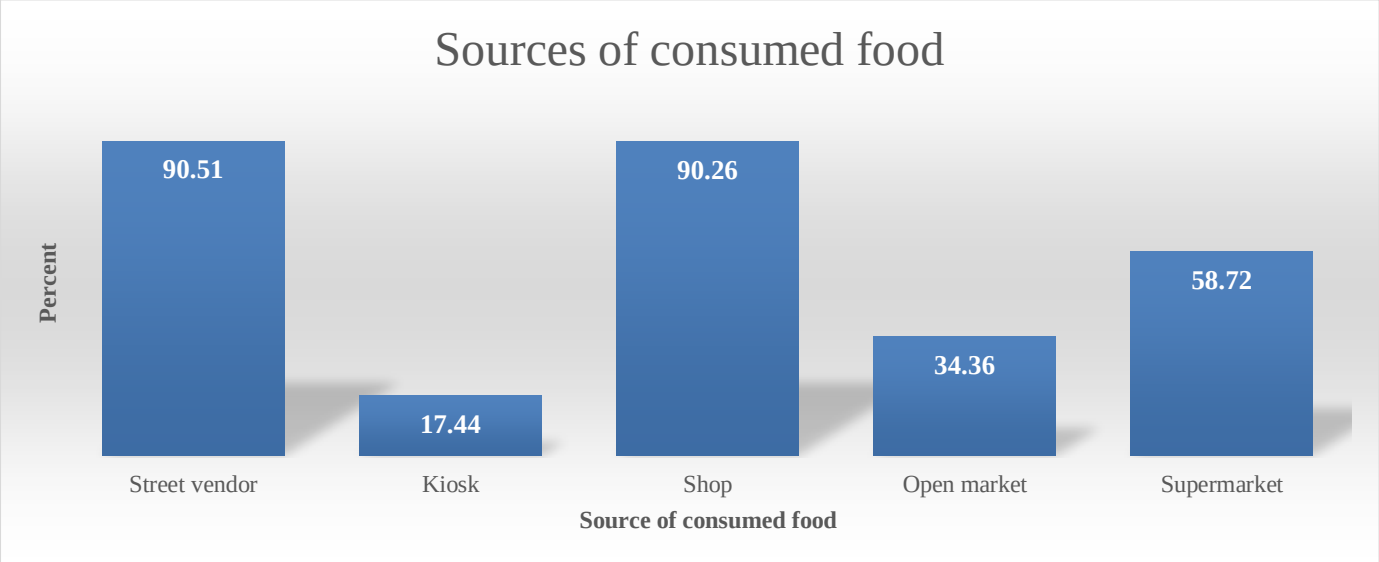

Figure 2

The Source of the Foods Consumed by the Households

4.4 Means of Transport to the Food Source

The households employed various means of transport to access the sources of the bought food. The main was walking which was practiced by almost every household except 1.0%. On accessing the sources that needed another

means of transport other than walking, 26.2% households had to use public means. Own transport was only available to a minority 4.4%, while assistance to reach the source through getting a lift (assistance) was only by less than 0.3% of the households (Figure 3). Walking which was the predominant means of accessing the food source has been associated with food insecurity. Food insecure households live near the food source to avoid incurring transport related expenditure (Kaiser et al., 2019). Consequently, the high proportion of households walking to the food source can be related to the high level of access based food insecurity.

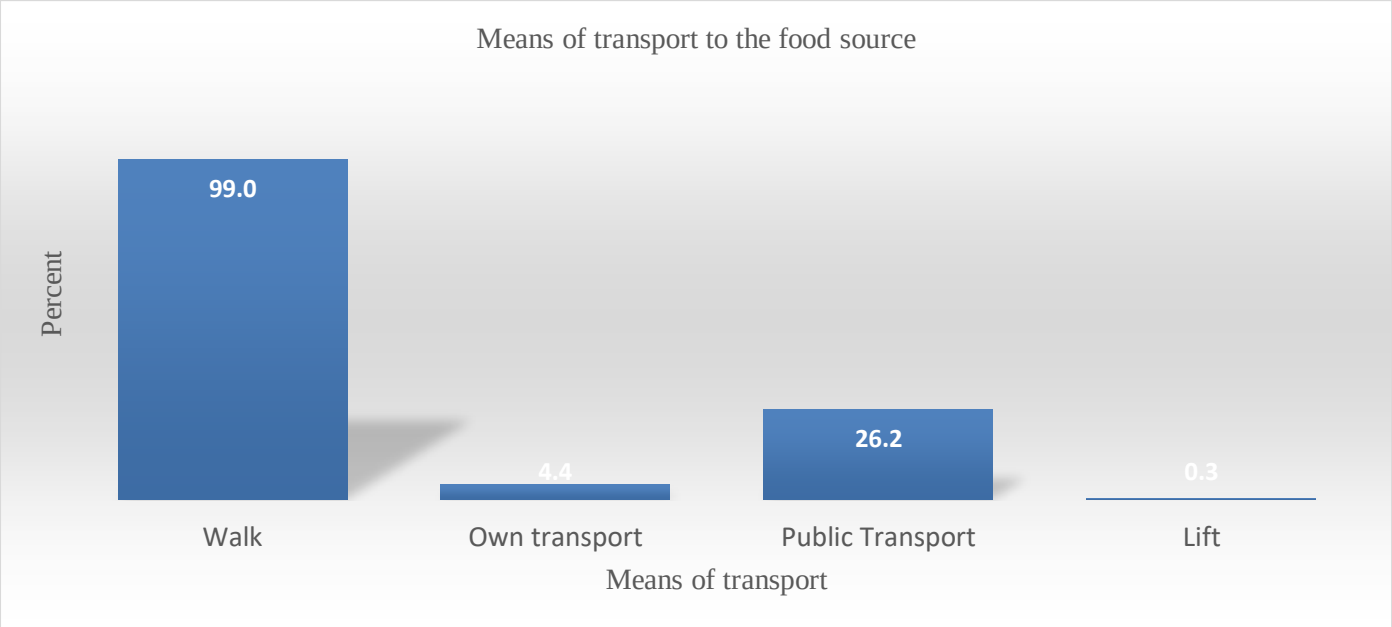

Figure 3
The Means of Transport Employed by Households in Accessing Food

4.5 Inferential Statistics

4.5.1 Effect of Residential Location on Food insecurity

Kruskal-Wallis H test revealed there was no statistically significant χ^2 (5, 390) = 12.99, p = 0.07 effect of residential location of the household on food insecurity when measured using the HFIAS metric (Table 4). These results on residential location not being a significant influencer of food insecurity in terms of economic accessibility of food agree with the findings of Alam et al. (2016). This finding can be associated with the deficiency in the ability of the households to buy food that meet all the nine conditions contained in the HFIAS measure, due to the low income of the household heads.

On the other hand, residential location had a statistically significant χ^2 (5, 390) = 42.34, p = 0.00 effect on PFU (Table 4). The results agree with what the study had anticipated based on the expected infrastructural variations among the residential locations. Andreasen et al. (2017) have reported a variation in infrastructural development between residential locations within the same city, among them being electricity and water which could be important barriers to utilization of preferred foods even when they are physically and economically accessible.

Table 4
Results of the Kruskal-Wallis H Test for the Food Insecurity Dependent Variables

Variable	Total n	Test Statistic	Degrees of Freedom	Asymptotic Sig. (2-sided test)
HFIAS	390	12.99	5.00	0.07
PFU	390	42.34	5.00	0.00

The significance level is $\alpha \leq 0.05$.

4.5.2 The Influence of Residential Location on Household Food Insecurity Access Prevalence

Regarding suitability of the multivariable logistic regression model, good model fit for HFIAP was demonstrated by none statistically significant results on the Hosmer–Lemeshow test, $\chi 2$ (n=390) =7.131, df=7, p=0.415. When controlling availability of transport expense, availability of supermarket and time to the food source, only open market (OR=0.46, 95% CI [0.22–0.96], p=0.038) was a statistically significant predictor of HFIAP. The odds ratio for unavailability of open market suggests that the likelihood of a household being food secure as compared to being food insecure are reduced by 54% (Table 5).

Concerning transport cost which depicted a family having incurred some cost to get to the market, these results contrasted those of Ma et al., (2017) who found that a lack of transportation increased the chances of a household experiencing very low food security in terms of HFIAP. However, unlike with this study where the food environment of the households composed of both formal (shops, open market and supermarkets), and informal (Kiosks and street vendors sources), [classification borrowed from Peyton et al. (2015)], their study only focused on the formal food sources which indeed required transportation. Food insecure households have been shown to be twice as likely to walk or live very close to the food store/source (Kaiser et al., 2019). Such is necessitated by transport, distance and time to the food source challenge to low-income households that predispose them to food insecurity (Kaiser et al., 2019). Thus, walking and living close to the food source may have been the main reason why transport cost and time to the food source did not influence HFIAP in this study. Living a walking distance which means close to the food source may then be a deliberate choice made by the household heads to help escape food insecurity arising from time limitation and scarcity of transport resources.

Regarding supermarkets, several studies (Kaiser et al., 2019; Ma et al, 2017; Aparecida et al., 2018) have shown them to be an important source of food that can alleviate availability related food insecurity. However, the results of this study suggest otherwise, and this is in line with the observations by Peyton et al. (2015) in Cape Town South Africa, that even though supermarkets continue to penetrate the low-income communities, they are incompatible with the consumption of the poor households. This points to the importance of what they labelled informal food sources. Additionally, the use of supermarket by the poor households is less frequent, and the day to day purchasing of food are more regularly done from informal traders (Battersby & Watson, 2018), who are preferred over the supermarkets because they offer credit facilities to the households (Owuor, 2018 and Peyton et al., 2015).

The significance of the availability of open market on food insecurity based on HFIAP cannot be underestimated. The significant results of this study are like those by Duran et al. (2016). Open markets and as observed in the study are a major source of fruits, vegetables, tubers, pulses and dry grains like rice, maize, sorghum and others. Duran et al. (2016) observed the same in Sao Paulo, Brazil though in relation to their significance in the uptake of vegetables and fruits. Open market act as the source of the different foods that are bought in bulk by retailers who then sell them in their neighbourhoods in the form of street vending, in Kiosks and in some shops. The unavailability of the open markets may then end up making the low-income households to buy the food stuffs at a higher cost from the retailers, thus buying less quantity than they would prefer or substituting the preferred type and quality with the less preferred.

Table 5

Residential Location Determinants of Household Food Insecurity Access Prevalence among the Low-Income Households in Naivasha Town

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I .for EXP(B)	
							Lower	Upper
Transport cost (Non-incurrence)	-0.46	0.39	1.34	1.00	0.25	0.63	0.29	1.37
Supermarket (Not available)	0.53	0.32	2.74	1.00	0.10	1.69	0.91	3.16
Open market (Not available)	-0.77	0.37	4.29	1.00	0.04	0.46	0.22	0.96
Time to the food source	0.00	0.01	0.11	1.00	0.74	1.00	0.99	1.02
Constant	-1.45	0.44	10.88	1.00	0.00	0.23		

Source: Own research (2025)

*Note: estimates represent log odds of Food secure versus Food insecure

*Note: () denotes included category (nonreference)

4.5.3 The Influence of Residential Location on Perceived Food Utilization Prevalence

The good model fit for PFUP, was demonstrated by none statistically significant results on the Hosmer–Lemeshow test, $\chi 2$ (n=390) =10.896, df=7, p=0.143. When controlling availability of open market, incurrence of transport expense and the time to the food source, supermarket availability (OR=1.71, 95% CI [1.03–2.83], p=0.039) was statistically significant in predicting PFUP. Similarly, when controlling for open market availability, transport expense and availability of supermarket, time to the food source (OR=1.02, 95% CI [1.00–1.04], p=0.049) was statistically significant in predicting PFUP. Households without access to a supermarket had 1.71 times higher odds of reporting good food utilization compared to those with supermarket access, while for each unit increase in time spent reaching the food source, the odds of good perceived food utilization increased by 2% (table 6).

Perceived food utilization is a new metric developed by Calloway et al. (2023). It is observed that only the time and lack of water for cooking available food would act as a barrier to preferred food utilization. If the time taken to the food source especially in the absence of a faster mode of transport that would require incurring a cost is long enough to inhibit the household from cooking the most preferred and already available food, then the aspect of time becomes

important. Living near to the food source, and this may be elucidated by the fact that many households chose to live within a walking distance which agrees with the observation by Kaiser et al. (2019) and having a substitute for a food source may be such a factor.

This being the case, the aspect of incurring transport cost to save on time may not be important and thus the lack of significance of the same on PFUP in this study. Nonetheless, even if the food source is a walking distance, and one that does not require incurring a transport cost, the walking distance may vary significantly in terms of the time required to cover the distance. This appears to have been the case in this study. On separating the walking distance from the distance requiring a mode of transport attracting a cost from the data collected, the walking time ranged between 10 and 40 minutes to and from the food source. The difference of 30 minutes is quite significant when observed from the view of time required to prepare a meal.

The results of unavailability of a supermarket increasing the odds of good perceived food utilization were contrary to what was expected. Nevertheless, this should not be a surprise. Timperio et al. (2008) reported a higher consumption of vegetables by those living far away from a supermarket which could be interpreted to mean absence of a supermarket in the household's locality increased vegetables utilization. In addition, supermarkets have been reported as being incompatible with the consumption patterns of the poor people (Peyton et al., 2015). However, based on the items included in the PFU metric, time and special storage for the food stuff could be the main contributors of the negative relationship between the two. If time for cooking is a barrier to good food utilization, bringing the food stuff closer to the household may prove very beneficial by saving on time required to cover the long distance in accessing the supermarkets which was the case especially for three residential locations – DCK, Karagita and Kayole.

The preceding argument is supported by the result that time spent to the food source influenced perceived food utilization significantly. Also, the distance to the supermarket in relation to the time to be spent would inform buying food stuff in bulk, to reduce the frequency of visiting the market. However, the bulk food stuff and especially the highly perishable like fruits and vegetables would require storage/preservation facilities, but the low-income households may face the barrier of lack of the facilities. Thus, lack of a supermarket is expected to make the households turn to the informal market within their residential location. This would lead to saving on time for accessing the food source as well as enabling them to buy what is enough without requiring storage thus leading to good perceived food utilization.

The observation on PFUP not being statistically influenced by availability of open market, may be clarified by the storage, handling and preparation equipment factors of the metric. One of the findings of this work is the high food insecurity experienced as measured by economic accessibility (HFIAP). That being the case, the amount of fresh food stuff bought regardless of whether from the informal market or open market may not require storage and special handling thus not affecting the PFUP. Preparation equipment is not in any way related to the open market, while time required for cooking versus availability of open market is similar to the discussion under supermarkets.

Table 6

Residential Location Determinants of Perceived Food Utilization Prevalence among the Low-Income Households in Naivasha Town

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Transport cost (Non-incurrence)	-0.34	0.34	1.02	1.00	0.31	0.71	0.37	1.38
Supermarket (Not available)	0.54	0.26	4.27	1.00	0.04	1.71	1.03	2.83
Open Market (Not available)	0.24	0.29	0.68	1.00	0.41	1.27	0.72	2.24
Time to the food source	0.02	0.01	3.89	1.00	0.05	1.02	1.00	1.04
Constant	0.02	0.45	0.00	1.00	0.97	1.02		

Source: Own research (2025)

*Note: estimates represent log odds good perceived food utilization versus low perceived food insecure utilization

*Note: () denotes included category (nonreference)

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The objective of this study was to establish the influence of urban spatial characteristics on food insecurity. The residential location of households was employed to represent the spatial characteristics of Naivasha town. The study was able to establish the following. First, that only PFU was affected by the residential location and not HFIAS. Secondly, that open market unavailability, transport to the food source and supermarket unavailability are the spatial factors associated with urban household's food insecurity. It is thus concluded that urban spatial factors are important in influencing households' food insecurity status.

5.2 Recommendations

Based on these findings, it is recommended that local authorities and stakeholders prioritize improving physical access to food by establishing open markets closer to residential areas. This would reduce travel time and transport costs, thereby enhancing food accessibility. This intervention targeting the spatial constraints is essential in effectively reducing food insecurity in Naivasha's low-income households.

REFERENCES

Alam, M. M., Siwar, C., Wahid, A. N., & Talib, B. A. (2016). Food security and low-income households in the Malaysian East Coast economic region: An empirical analysis. *Review of Urban & Regional Development Studies*, *28*(1), 2-15.

Anand, S., Jagadeesh, K., Adelina, C., & Koduganti, J. (2019). Urban food insecurity and its determinants: A baseline study of Bengaluru. *Environment and Urbanization, 31*(2), 421–442.

Andreasen, M. H., Agergaard, J., Kiunsi, R. B., & Namangaya, A. H. (2017). Urban transformations, migration and residential mobility patterns in African secondary cities. *Geografisk Tidsskrift-Danish Journal of Geography*, 117(2), 93-104.

Aparecida B, C., Cabral-Miranda, W., & Constante Jaime, P. (2018). Urban food sources and the challenges of food availability according to the Brazilian dietary guidelines recommendations. *Sustainability*, *10*(12), 4643. https://doi.org/10.3390/su10124643

Battersby, J., & Watson, V. (2018). Addressing food security in African cities. *Nature Sustainability*, *1*(4), 153-155. https://doi.org/10.1038/s41893-018-0051-y

Blekking, J., Waldman, K., Tuholske, C., & Evans, T. (2020). Formal/informal employment and urban food security in Sub-Saharan Africa. *Applied Geography*, *114*, 102131.

Calloway, E. E., Carpenter, L. R., Gargano, T., Sharp, J. L., & Yaroch, A. L. (2023). New measures to assess the "Other" three pillars of food security–availability, utilization, and stability. *International Journal of Behavioral Nutrition and Physical Activity*, *20*(1), 51. https://doi.org/10.1186/s12966-023-01451-z

Clapp, J., Moseley, W. G., Burlingame, B., & Termine, P. (2022). The case for a six-dimensional food security framework. *Food Policy*, *106*, 102164. https://doi.org/10.1016/j.foodpol.2022.102164

Coates, J., Swindale, A., and Bilinsky, P. (2007). *Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide. Food and Nutrition Technical Assistance Project,* Academy for Educational Development, Washington DC.

Crush, J. S., & Frayne, G. B. (2011). Urban food insecurity and the new international food security agenda. *Development Southern Africa*, *28*(4), 527-544.

Duran, A. C., De Almeida, S. L., Maria do Rosario, D. O., & Jaime, P. C. (2016). The role of the local retail food environment in fruit, vegetable and sugar-sweetened beverage consumption in Brazil. *Public Health Nutrition*, *19*(6), 1093-1102. https://doi.org/10.1017/S1368980015001514

FAO. (1996). *World food summit: Rome declaration on world food security and world food summit plan of action*. FAO.

FAO, IFAD, UNICEF, WFP & WHO (2018). *The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition.* FAO. https://www.fao.org/3/I9553EN/i9553en.pdf

FAO, IFAD, UNICEF, WFP, & WHO. (2024). *The state of food security and nutrition in the world 2024 – Financing to end hunger, food insecurity and malnutrition in all its forms*. FAO. https://doi.org/10.4060/cd1254en

Habitat, U. N. (2020). *World Cities Report 2020: The value of sustainable urbanization*. Nairobi, Kenya.

Haysom, G., & Tawodzera, G. (2018). "Measurement drives diagnosis and response": Gaps in transferring food security assessment to the urban scale. *Food Policy*, *74*, 117-125.

Hoyt, H. (1939). The structure and growth of residential neighborhoods in American cities. US Government Printing Office.

Jonah, C. M., & May, J. D. (2020). The nexus between urbanization and food insecurity in South Africa: does the type of dwelling matter?. *International Journal of Urban Sustainable Development*, *12*(1), 1-13.

Kaiser, M. L., Carr, J. K., & Fontanella, S. (2019). A tale of two food environments: Differences in food availability and food shopping behaviors between food insecure and food secure households. *Journal of Hunger & Environmental Nutrition, 14*(3), 297–317.

Kenya National Bureau of Statistics. (2019). *2019 Kenya population and housing census*. https://www.knbs.or.ke/?wpdmpro=2019-kenya-population-and-housing-census-volume-i-population-by-county-and-sub-county

Kenya National Bureau of Statistics. (2022). *Economic survey 2022*. https://www.knbs.or.ke/wp-content/uploads/2022/05/2022-Economic-Survey1.pdf

Khumalo, N. Z., & Sibanda, M. (2019). Does urban and peri-urban agriculture contribute to household food security? An assessment of the food security status of households in Tongaat, eThekwini Municipality. *Sustainability*, *11*(4), 1082. https://doi.org/10.3390/su11041082

Korah, P. I., Jambadu, L., & Nunbogu, A. M. (2023). Mapping spatial and temporal dynamics in urban growth: The case of secondary cities in northern Ghana. *Journal of Urban Affairs*, *45*(3), 390-406.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, *30*(3), 607-610. https://doi.org/10.1177/001316447003000308

Kuiper, G. (2019). Agro-industrial Labour in Kenya: Cut Flower Farms and Migrant Workers' Settlements. Springer.

Lomax, R. G., & Hahs-Vaughn, D. L. (2013). Statistical Concepts-A Second Course. Routledge. https://doi.org/10.4324/9781315816685

Ma, X., Liese, A. D., Hibbert, J., Bell, B. A., Wilcox, S., & Sharpe, P. A. (2017). The association between food security and store-specific and overall food shopping behaviors. *Journal of the Academy of Nutrition and Dietetics*, *117*(12), 1931-1940.

Mutisya, M., Ngware, M. W., Kabiru, C. W., & Kandala, N. B. (2016). The effect of education on household food security in two informal urban settlements in Kenya: a longitudinal analysis. *Food Security*, *8*(4), 743-756.

Omondi, S. O., Oluoch-Kosura, W., & Jirström, M. (2017). The role of urban-based agriculture on food security: Kenyan case studies. *Geographical Research*, *55*(2), 231-241.

Owuor, S. (2018). *The state of household food security in Nairobi, Kenya.* Hungry Cities Partnership.

Peyton, S., Moseley, W., & Battersby, J. (2015). Implications of supermarket expansion on urban food security in Cape Town, South Africa. *African Geographical Review*, *34*(1), 36-54.

Riley, L., & Crush, J. (2023). Introduction: African secondary city food systems in context. In L. Riley & J. Crush (Eds.), *Transforming urban food systems in secondary cities in Africa* (pp. xx–xx). Palgrave Macmillan.

Roberts, B. H. (2014). Managing systems of secondary cities. http://www.citiesalliance.org/sites/citiesalliance.org/fles/1d%20%28i%29%20-%20Managing%20Systems%20of%20Secondary%20Cities%20Book_low_res.pdf

Sassi, M., & Zucchini, E. (2018). Food insecurity in the Rural Lake Naivasha Basin: Evidence and policy implications. NAF International Working Paper Series, *18*, 1-56.

Tadros, W., Naguib, S., Anna, W., Das Maitreyi, B., Nic, P., Severine, D. A. O., Cadavid, R. C., Goga, P., Terraza, S., Lakovits, H. C., Baeumler, C., Gapihan, A. E. N., & Treylane, A. (2020). *Demographic trends and urbanisation*. World Bank Group. http://documents.worldbank.org/curated/en/260581617988607640/Demographic-Trends-and-Urbanization

Timperio, A., Ball, K., Roberts, R., (2008). Children's fruit and vegetable intake: associations with the neighbourhood food environment. *Preventive Medicine*, *46* (4), 331–335.

United Nations Human Settlements Programme (UN-Habitat), & United Nations Children's Fund (UNICEF). (2020). *Analysis of multiple deprivations in secondary cities in sub-Saharan Africa*. UN-Habitat.

United Nations. (2017). Habitat III Regional Report Africa: *Transformational Housing and Sustainable Urban Development in Africa.* Nairobi.

United Nations. (2018). *World urbanization prospects: The 2018 revision, key facts*. https://esa.un.org/unpd/wup/Publications/Files/WUP2018-KeyFacts.pdf