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The Geographical Distance between Producers and Consumers of the Organic Street Markets: The Case of Belo Horizonte, Brazil

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Abstract: The organic street markets are considered a short food supply chain, and their importance gained new proportions since COVID-19 brought difficulties to the traditional supply chain. The organic street markets represent a place to sell the product for organic family farmers and an opportunity to obtain better quality and variety of organic products at a lower price. This work aimed to analyze the geographical distance from producers and consumers of organic street markets in Belo Horizonte, Brazil, identifying the organic street market characteristics that influence the organic consumers. The research methods used descriptive statistics, a chi-squared test, and the measurement of the geographical distance. Results allowed us to conclude the organic street markets with more producers attract more consumers and consumers willing to travel long distances. Additionally, the factors related to a street market location, product, and consumer behavior are associated. Finally, results indicated the location of organic street markets contributes to displacements by non-motorized modes. The results indicated that the organic street market characteristics can contribute to a sustainable, short, organic food supply chain in Belo Horizonte.

Keywords: organic food; short supply chain; organic street market; producers; consumers; spatial analysis

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1. Introduction

In 2019, the global organic market achieved EUR 96.7 billion in 186 countries with organic activities [1]. The United States, Germany, and France were the principal consumer markets, while India, Uganda, and Ethiopia concentrated most of the 2.8 million producers in 2018 [1]. Organic agriculture was cultivated in 71.5 million hectares [1]. The Brazilian organic food market rose 30% between 2019–2020, which amounted to USD 1.16 billion in 2020 [2]. The growth potential of the Brazilian consumer market motivated this research.

Organic products began as an alternative to industrial agriculture [3]. The concept of organic agriculture began in the 1920s as holistic product management [4]. Organic production is defined as an integrated system including cultural, biological, and mechanical practices to promote the foster cycling of resources, ecological balance, and conserve biodiversity [5]. Organic foods are grown and processed, addressing soil quality, animal raising practices, pest and weed control, and additives to enhance future generations' environmental quality. Organic production is a way to maintain the agricultural tradition, especially in traditional communities in Latina America, the Pacific, and Africa [3].

The organic food supply chain (OFSC) is considered a short food supply chain since it increases the benefits for producers and consumers and contributes to achieving sustainable agriculture [6,7]. A short food supply chain (SFSC) is measured by the geographical proximity between producers and consumers [8–10]. The SFSC characterization and

its benefits were provided by [7,8]. Tundys and Wisniewski [7] presented an extensive literature review related to SFSC and identified motivators, barriers, and drivers related to organic food. Paciarotti and Torregiani [8] discussed the concepts related to SFSC.

In SFSC, the producer keeps a higher selling price as the customer feels included in the production process [11]. The environmental benefits are related to less intensive agriculture, which preserves the environment, and fewer emissions due to the smaller distance between producer and consumer. The OFSC plays an essential role in the production process [7]. Figure 1 illustrates this supply chain.

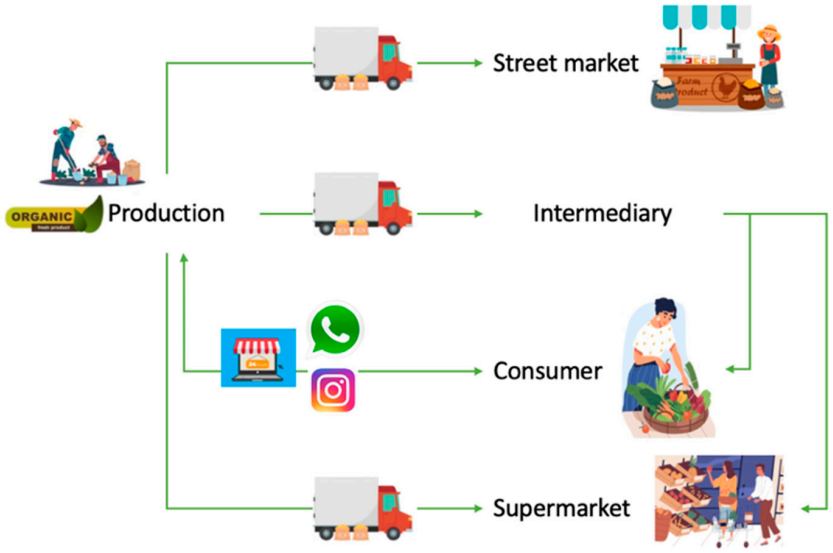

Figure 1. Organic food supply chain and its relationships.

The first step of the OFSC occurs in the farms. In 2018, of 8 million hectares of organic agriculture in Latin America, 1.2 million hectares were cultivated in Brazil (0.4% of total agriculture land), with 23,381 producers, mostly family farmers (75%) [1,4,12]. Figure 2 shows the spatial distribution of organic producers in Brazil.

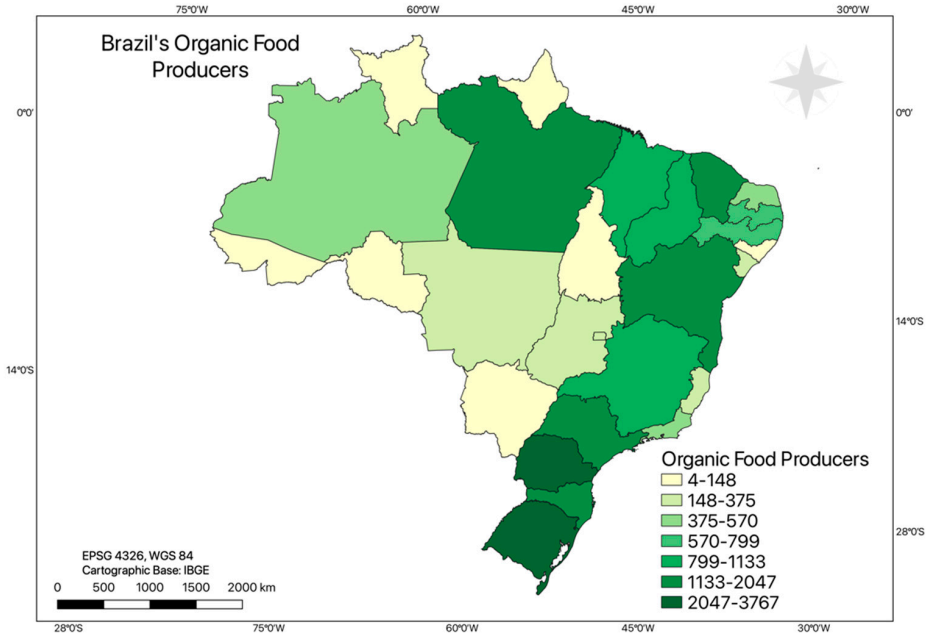

Figure 2. Organic producers in Brazil [12].

Since the production occurs in farms, the types of distribution channels for producers of organic products in Brazil are: (1) customers go to the production site; (2) street market and organic street market, with the difference between them being the latter one sells organic products and the first does not; (3) the producer or an intermediary delivers the organic products to the customers' homes; (4) organic products are acquired by programs, such as Fome Zero, that offer a 30% discount to buy local products; and (5) organic products are selling in groceries and supermarket [13]. According to Paciarotti and Torregiani [8], logistics is a challenge to improve the SFSC performance.

Brazilian supermarket chains, such as Carrefour and Pão de Açúcar Group, are responsible for popularizing organic products in Brazil [3,14]. Supermarket chains trade directly with small farmers and cooperatives, and their target is upper- and middle-class urban consumers willing to purchase overpriced organic groceries [14]. In another, e-commerce reduced the distance between the farmers and consumers, offering organic foods delivered at home. This marketing channel has increased mainly during the COVID-19 pandemic, increasing sales by digital applications, social networks, or e-commerce. Some examples of digital applications in Brazil are Orgânico do Chico, Orgânica Brasil, Raizs, and Clube Orgânico.

Due to the quality, productivity, and low cost required by supermarket chains [15], the street market is the way to offer organic food direct to customers, the most traditional distribution channel [3]. Brazilian Institute of Consumer (IDEC) [16] identified 846 organic street markets in a collaborative platform to provide "real food" during the pandemic. The concentration of organic street markets is shown in Figure 3.

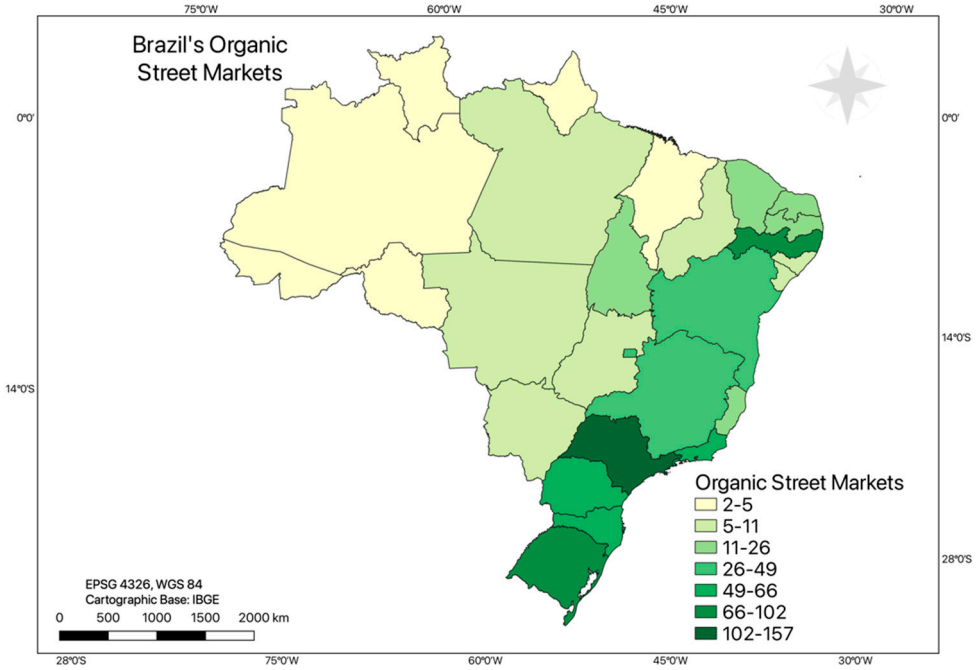

Figure 3. Organic street market in Brazil [17].

Brazil's organic food market was based initially on social ideology and opposed conventional farming until achieving a trending market [18]. Turra et al. [3] consolidated the studies about organic Brazilian profile from organic food consumers. Their profile was female, between 30–50 years old, with high education and diversified consumption habits. Reasons for the consumption of organic products by consumers were health, quality and taste of products, the environmental benefits, and lifestyle, among others [3,19–22]. On the other hand, the reasons not to purchase food were the absence of grocery, the perceived value, the lack of diversity, and the uncertainty about the certification [23]. In 2018, the average global per capita consumption was EUR 12.8. Switzerland (EUR 312),

Denmark (EUR 312), and Sweden (EUR 231) were the leading market consumers in the world. In Latin America, Brazil is the largest market consumer of organic products [1], where 19% of Brazilians consume organic products regularly. The per capita consumption was EUR 4 in 2018 [1]. In general, organic food consumers are loyal [20]. Through a meta-analysis of the literature, Massey et al. [24] identified the customers who focus their purchase experiences on the organic products' attributes such as health benefits, safety, environmental impacts, animal welfare, production practices, nutritional value, and quality of products. Additionally, the geographical proximity influences added value of products [25].

The literature related to the OFSC focused on sustainability [7,26,27], green supply chain [28], quality [29], critical factors of success [30], and logistics process [8]. Other usual topics in literature are the profile of producers [31] and consumers [3], consumer patterns and behavior [18,20,22,29,32–34], the producers' challenges [14], and marketing strategies [21]. Tundys and Wisniewski [7] analyzed the influence of organic food supply on the market profit.

From an extensive literature review, Paciarotti and Torregiani [8] identified the importance of sustainability strategies to improve SFSC. Moreover, the measure of distance between producers and consumers allows the identification of an OFSC [8], characterizing a local food system [35]. A local food system's limit distance is 250 km in Sweden [35] and 640 km in the US [36]. However, we did not identify a methodology to measure this distance. Still, the social distance, measured by the minimum number of actors between producers and consumers, can define an OFSC [8]. The local organic market's development supported by the community initiatives contributes to organic production [37].

Pretty et al. [38] estimated and evaluated scenarios considering the production and transportation costs of farm foods in the UK. The authors pointed out a sustainable production and transportation system could reduce food costs. A sharing economy could be a pathway to the sustainable development of OFSC [27]. According to Asian et al. [27], sharing an economy enables sharing services, facilities, and products in an online platform. During the COVID-19 epidemic, the authors observed sharing economy services offering organic products by online platform or social applications to increase the coverage during the lockdown. Asian et al. [27] demonstrated improvements in producers' competitiveness by forming a sharing-economy agricultural cooperative, proposing a mathematical model for decision makers.

Tundys and Rzeczycki [7] identified the basis for a green OFSC. Sazvar et al. [26] developed a multi-objective linear mathematical model to minimize the total cost, lower GHG emissions, and maximzse social health to identify a sustainable supply chain, reducing the deterioration of the organic product.

A lack of theoretical foundation for the short organic food supply chain was indicated as a research gap by [7]. The analysis of the geographical proximity between producers and consumers was suggested by [7,8]. Considering these research opportunities, this paper analyzed the geographical distance between producers and consumers of organic street markets in Belo Horizonte, Brazil, identifying the organic street market characteristics that influence the organic consumers. The analysis was based on four research hypotheses: (1) more producers in the organic street markets will have the potential to attract more consumers; (2) more producers in the organic street markets have the potential to attract consumers willing to travel long distances; (3) factors related to a street market location, product, and consumer behavior are associated; and (4) the location of organic street markets contributes to displacements by non-motorized modes.

We did not identify the use of spatial techniques to analyze producers' and consumers' geographical distance in the literature review. Moreover, the measures reported in the literature were not based on a research method. Thus, our research method intended to contribute to this gap.

The increasing organic market in Brazil, at affordable prices, create opportunities for organic street markets. Understanding the supply chain of organic street markets could

attract more organic producers and reach more customers, spreading the influence area of organic street markets. The short organic food supply chain that could enhance quality food in a pandemic crisis, such as COVID-19, is an opportunity to provide technical solutions for this supply chain, as suggested by [39]. Results could contribute to a technical overview of the short organic food supply chain in Belo Horizonte, Brazil.

2. Data and Research Method

Considering the proposed research hypotheses, we provided data from a questionnaire and face-to-face survey. Table 1 shows its structure. The questions were simple, and the survey was not extensive to obtain the maximum number of respondents. We focused our research on producers and consumers to analyze the short organic food supply chain. Additionally, we selected four from the 18 organic street markets in Belo Horizonte for our analysis (more details are presented in the Results section). Face-to-face interviews were conducted with producers and consumers in each organic street market. We interviewed 389 consumers and all sellers (52).

Table 1. Structure of the questionnaire.

Stakeholder	Information	
Producer or seller	Place of organic street market (Belvedere, São Bento, UFMG, Terra Viva) Producer or seller Location of the farm (open question) Family farm (yes/no) (only for producers) Type of organic products (open question) Transportation mode (private car, truck, public transportation, walk) Travel time (open question) Transportation cost (open question)	
Consumer	Place of organic street market (Belvedere, São Bento, UFMG, Terra Viva) Type of organic products (open question) Type of organic consumer (ecological, health, or occasional consumer) Transportation mode (private car, truck, public transportation, walk) Travel time (open question) Zip-code (open question) Age (open question)	
	Factors related to street market location (Likert 5-scale)	Location of the street market Accessibility of the street market
	Factors related to the product (Likert 5-scale)	Quality of products Price of products Variety of products
	Factors of consumer behavior (Likert 5-scale)	Environmental concern Taste of products Health reasons

The research method had two steps: (1) profile of producers, consumers, and consumer behavior analysis and (2) producers' and consumers' geographic distribution, described in the below sections.

2.1. Profile of Producers, Consumers, and Consumer Behavior Analysis

Descriptive statistics were used to describe the profile of producers and consumers. We compared our results with other surveys related to organic consumers. Additionally, the chi-squared test was conducted to evaluate the relation between the organic street market, products, and consumer behavior. The last analysis allowed us to evaluate the research hypothesis' factors that are related to a street market location, product, and consumer behavior are associated (hypothesis 3).

2.2. Producers' and Consumers' Geographic Distribution

The hypotheses ((1) more producers in the organic street markets will have the potential to attract more consumers), (2) more producers in the organic street markets have the potential to attract consumers willing to travel long distances), and (3) the location of organic street markets contributes to displacements by non-motorised modes) were evaluated by geographic distribution analysis. We used the Measuring Geographic Distributions toolset in ArcGIS [40], which supports answering the following questions. (1) Where is the data set center? (2) What is the data set orientation? (3) How dispersed is the data set? The tools used in this analysis are described in Table 2.

Table 2. Tools used to measure the geographic distribution of the dataset.

Tool	Description
Central Feature	Identify the most central feature in the dataset. The centroid is computed using the weighted mean centre of all feature parts. The distance method used was Euclidean distance.
Directional Distribution (Standard Deviational Ellipse)	Creates standard deviational ellipses or ellipsoids to summarise the spatial characteristics of geographic features: central tendency, dispersion, and directional trends.
Mean Center	Identifies the geographic centre for a set of features. It is the average X and Y coordinates of all features.
Median Center	Identifies the location that minimises the Euclidean distance from all features in a dataset by an iterative algorithm. It measures the central tendency not influenced by outlier's data.
Standard Distance	Measures the degree to which features are concentrated or dispersed around the geometric mean centre

The influence of the organic street market was analyzed from five distance buffers and expected walking time, as shown in Table 3. The expected walking time was obtained in the Google Maps App and represents walking conditions.

Table 3. Distance Buffer.

Distance Buffer	Walking Time (min) [1]
500 m	6
1000 m	12
1500 m	18
2000 m	24
2500 m	30

[1] 5 km/h.

The buffers were created by using the *v.buffer* tool in the software QGIS. The attending neighborhoods by each buffer were obtained by using the "join attributes by location" tool. We evaluated the hypothesis (4) (the location of organic street markets contributes to displacements by non-motorized modes) by walking time, presented in Table 3.

3. Results

There are 18 organic street markets in Belo Horizonte [16]. We selected four organic streets market (Figure 4), in which the selection of criteria was spatial dispersion in Belo Horizonte and the street market importance.

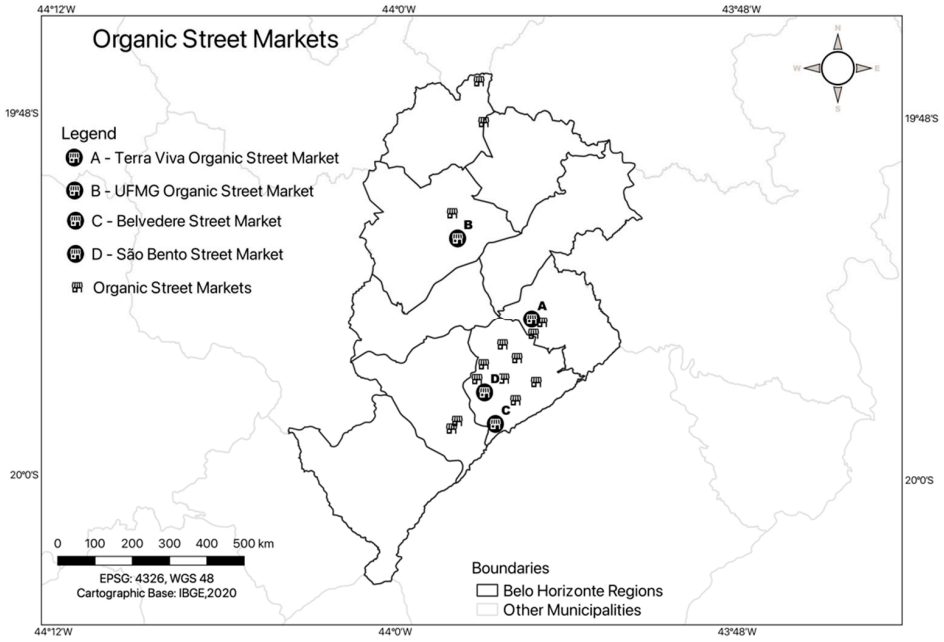

Figure 4. Organic street markets in Belo Horizonte [16].

The organic street market A takes place every Tuesday and Saturday, joining many organic producers. The organic market B is based on a solidarity economy, taking place inside the Federal University of Minas Gerais Campus. The organic street markets C and D have one seller. We interviewed 389 consumers and all sellers (52). Of the sellers, 94% are producers and 77% are family farms.

Figure 5 illustrates the location of producers, organic street markets, and consumers. Most producers came from cities near Belo Horizonte. However, the organic market B attracts producer and consumers from cities far away from this organic market, despite most of the customers living in Belo Horizonte. Using the extension MMQGIS to create hub-lines, we obtained data, presented in Table 4, to reinforce the information shown in Figure 5. Producers and consumers from the organic market B travel greater distances because of the university's broad coverage, attracting people from all over the city. Producers from organic street market A travel the smaller mean distance, and its consumers travel long distances because of its unique characteristics and variety of products. Organic C and D street markets have similar characteristics and have only one producer from a nearby Belo Horizonte municipality.

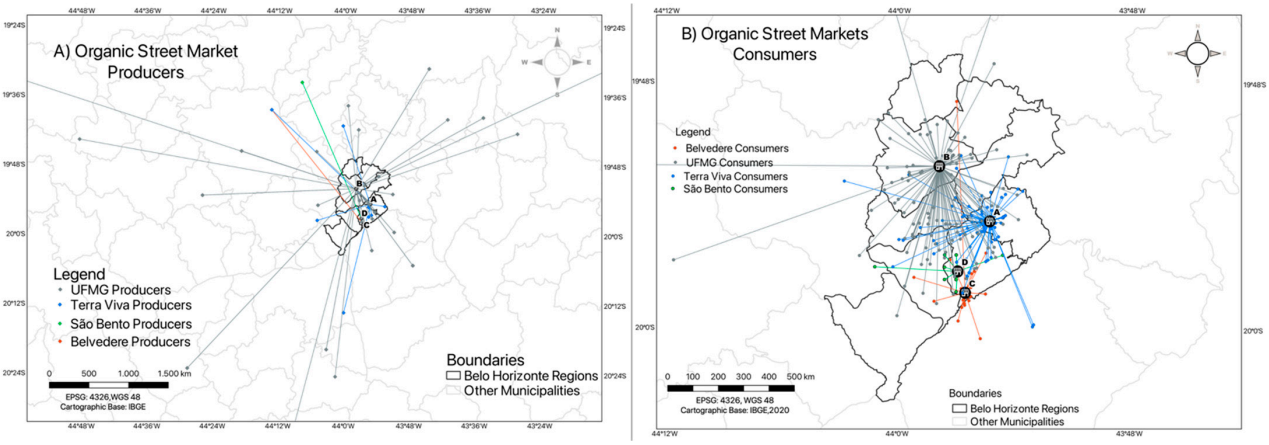

Figure 5. Location of producers and consumers concerning organic street markets.

Table 4. Mean distance (in kilometers) from producers and consumers.

Organic Street Market	Producers	Consumers
A	15.34	2.47
B	218.77	6.30
C	46.828	1.73
D	47.330	1.15

Table 5 presents producers' transportation mode and travel time: 61% use their car to transport organic products, and the most frequent travel time is between 31–60 min. We highlighted the travel time higher than 61 min for 33% and trucks for 27% of producers/sellers.

Table 5. Transportation mode and travel time from organic producers/sellers.

Transportation Mode	<30 min	31 until 60 min	60 until 120 min	>120 min	Total
Private car	86%	71%	43%	67%	60%
Light truck	-	25%	21%	33%	21%
Small truck	-	-	21%	-	6%
Public transportation	-	4%	14%	-	8%
Walking	14%	-	-	-	2%
Total	13%	46%	27%	6%	100%

The customers mostly were of ages between 21 to 50 years (60%), frequently buying organic products. Own car (46%), public transportation (28%), and walk (22%) were the transportation modes more frequently used to travel to organic street markets. A similar customer profile was also found in the literature [3]. Pinho et al. [41] found a biweekly purchase frequency of organic products between organic consumers.

Consumers more frequently buy fruits and vegetables (56%) in organic street markets (Table 6). A similar result was found in the literature [3,31]. Moreover, Padel and Foster [32] identified that the experience with buying an organic product is restricted to fruit and vegetables for a relevant share of consumers. (In our case, 45.5% focus only on fruit and vegetables). In general, more than half of respondents buy organic products only in the street market (53%). Alternatively, supermarkets (23%) and groceries specializing in vegetable markets (12%) were also frequented. Still, a portion of the sample group bought organics products from supermarkets (13%), and groceries specializing in vegetable markets (12%) were other usual places to buy organic products. The price of organics products was a positive point, according to the respondents' perceptions. In general, organic food prices are similar in supermarkets and street markets [26], and it is a signal of quality [34].

Table 6. Products purchased by consumers.

Type of Products	Percentage
Vegetables	41%
Fruits	15%
Bread	7%
Snacks and sweets	7%
Mushrooms	6%
Eggs	6%
Spices	3%
Cosmetics	1%
Honey	1%
Others	13%

An analysis of consumer perception was carried out using the chi-squared test (Table 7). The results indicated location and accessibility are essential and have dependence to place the organic street market. Moreover, the location and the accessibility of the organic street market were related to the quality, price, and variety of organic products, reinforcing the results of [42]. Finally, the price was dependent on the quality and variety of organic products, indicating the organic customers look for quality, variety, and price in the organic street market.

Table 7. The relation between organic street market, products, and consumer behavior.

Variables	Chi-Squared Test	df	*p*-Value
Location versus accessibility	386.99	12	<0.00
Location versus quality	166.78	12	<0.00
Location versus price	26.61	16	0.02 *
Location versus variety	110.82	16	0.00
Accessibility versus quality	170.28	9	<0.00
Accessibility versus price	41.41	12	0.00
Accessibility versus variety	71.11	12	0.00
Price versus quality	67.67	12	0.00
Quality versus variety	159.82	12	<0.00
Price versus variety	76.15	16	0.00

* Significant at 10%.

The results of the consumer geographical distribution are presented in Table 8 and Figure 6. Organic street market A has a dispersed consumer market, with an ellipse shape, similar to a circle (Figure 6A), indicating the consumers are the ones that reside close to the street market, despite some customers traveling long distances to buy at this street market. On the other hand, the organic market B has a dispersed consumer market, whose ellipses cover almost all of Belo Horizonte (Figure 6B). The organic market C has a location advantage since this market is located inside a university and has potential consumers from all over the city. Figure 6D shows that this organic market is not located close to the consumers' data set's central features, as observed in the other organic street markets.

Table 8. Consumers' geographical distribution results.

Organic Street Market	Ellipse			Standard Distance	
	Area (km^2)	Rotation	Perimeter (km)	Area (km^2)	Perimeter (km)
A	38.40	99.46	22.00	34.69	20.90
B	147.03	178.14	44.26	155.61	44.26
C	22.93	176.36	20.29	38.40	22.00
D	8.55	84.23	10.70	34.69	20.90

The organic street market C has a slim ellipse directed north–south, as its rotation is close to 180° (Figure 6C), indicating a local coverage since the consumers came from two regions. Similarly, the organic street market D has local coverage as it has the smallest ellipse area (see Figure 6D).

We did a similar analysis for the producers from organic street markets A and B (organic street markets C and D have one producer). Producers from organic street market A are closer to customers than the organic market B (Figure 7). The ellipse area for organic market B is 27 times bigger than the ellipse from organic street market A (Table 9). As a result, the mean feature from organic street market B producers is located outside Belo Horizonte.

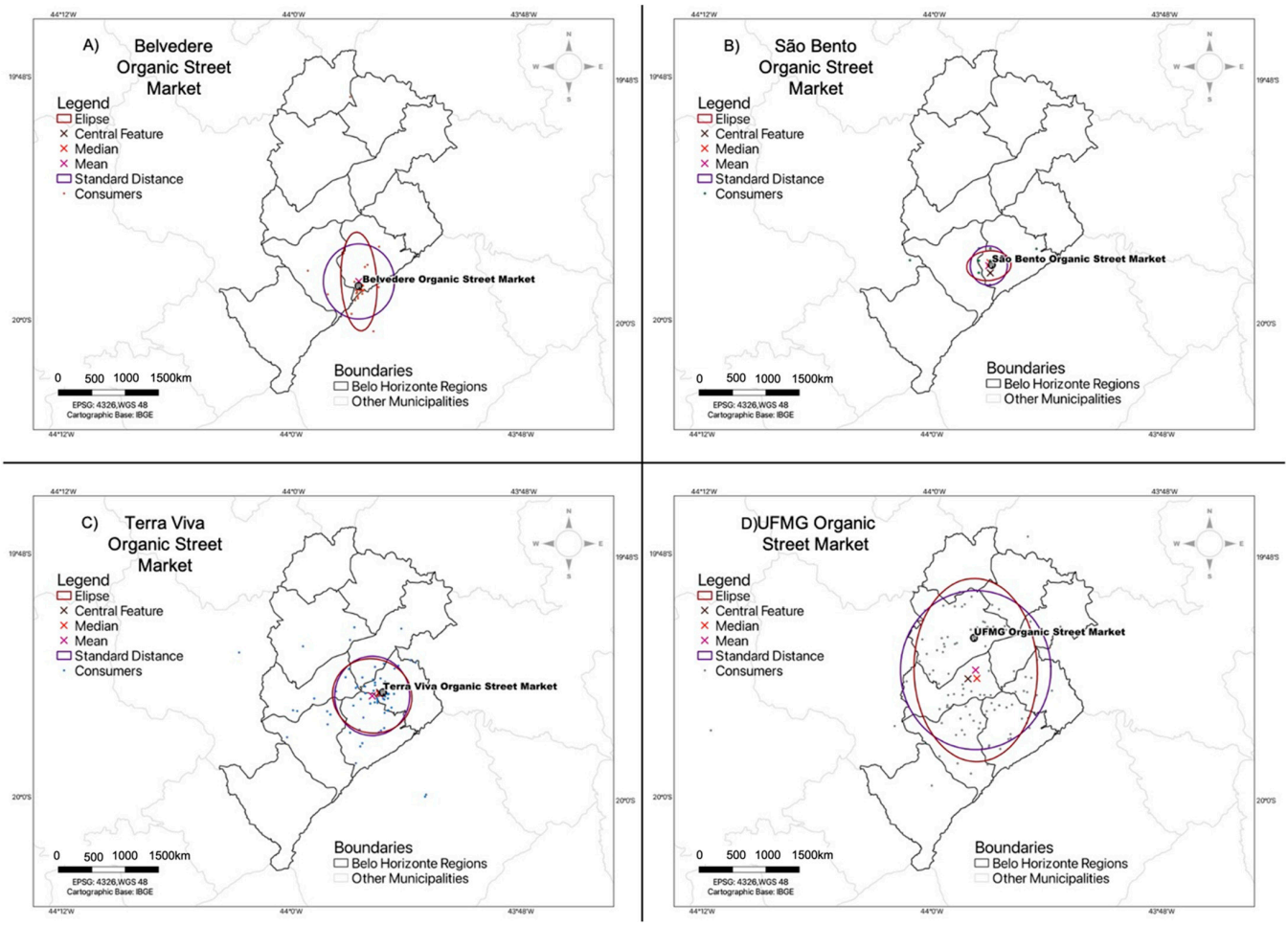

Figure 6. Consumers' geographical distribution.

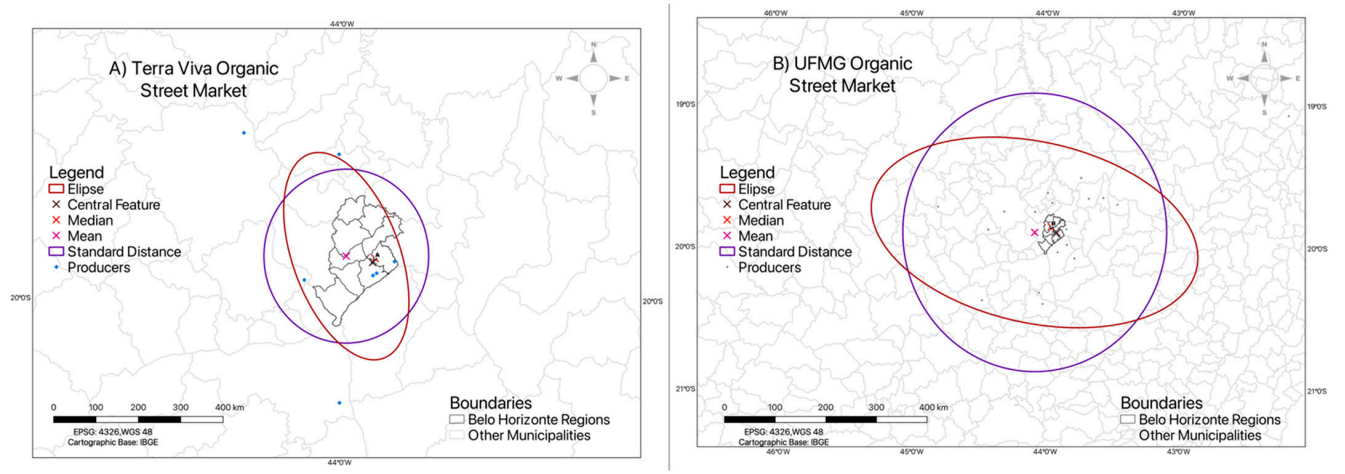

Figure 7. Producers' geographical distribution.

Table 9. Producers' geographical distribution results.

Organic Street Market	Ellipse			Standard Distance	
	Area (km^2)	Rotation	Perimeter (km)	Area (km^2)	Perimeter (km)
A	1046.98	157.87	125.52	1288.42	127.33
B	28,516.45	101.12	639.97	34,905.49	662.67

The last analysis concerned the influence area of each organic street market. We made five buffers with 500 m each (Figure 8). The organic street market A has a dispersed consumer market, concentrated inside the 2500-m buffer. Organic street markets C and D have overlapping areas, and most of their consumers are inside the 2500-m buffer. On the other hand, the organic street market B has a small fraction of its consumers inside the 2500-m buffer. The university campus has 8.77 km^2, which represents more than 40% of the organic street market's buffer area.

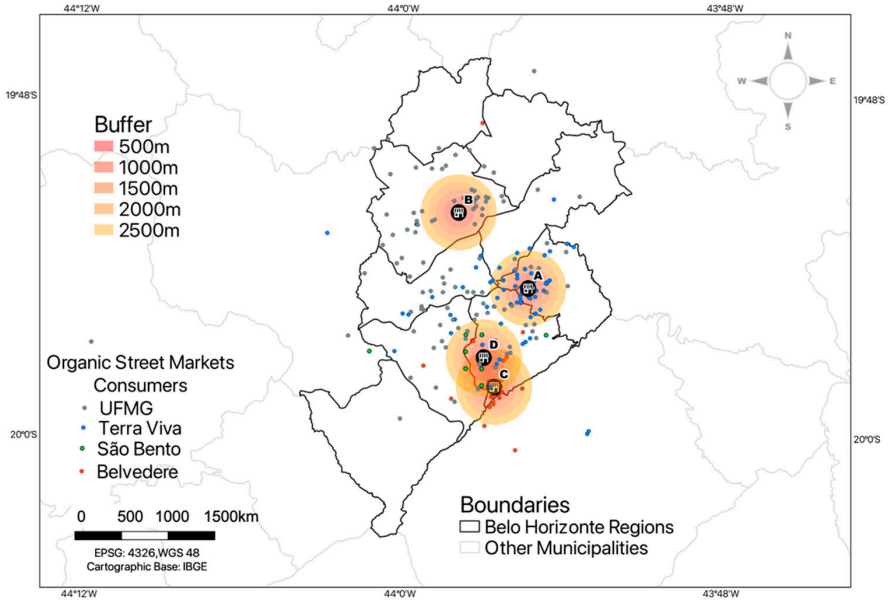

Figure 8. Organic street markets' buffers.

Figure 9 displays the attending neighborhoods by each organic street market buffer. Table 10 details the potential population attending. The organic street market A covers a highly populated area and can attract more consumers in a smaller area. On the other hand, organic market B has a smaller potential consumer attendance, due to its usual customers living far from where the fair occurs. Organic street markets C and D can attract local customers and are located in a high-population-density area.

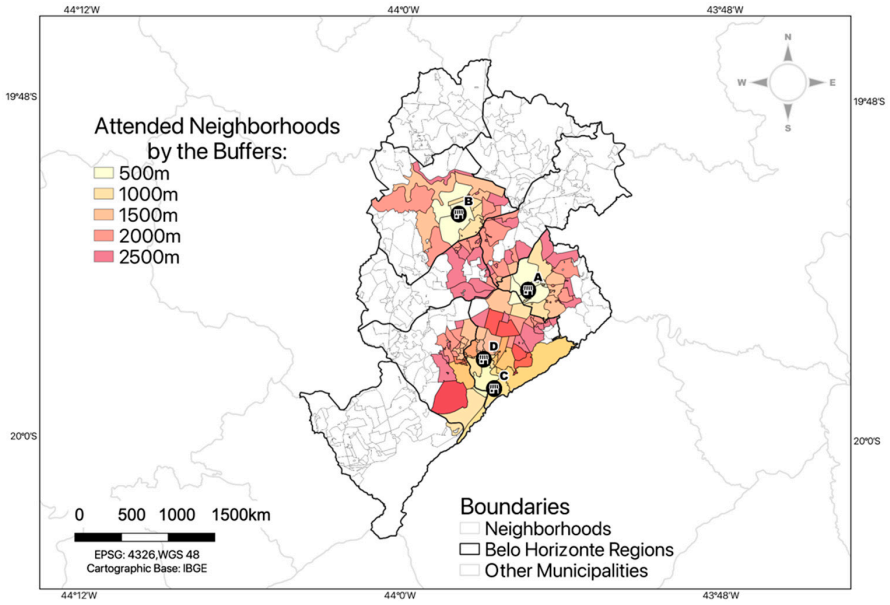

Figure 9. Organic street markets' neighborhoods attracted within the buffers.

Table 10. Population attracted within the buffers in organic street markets.

Distance Buffer	A	B	C	D	Total
500 m	65,777	4762	16,053	49,926	136,518
1000 m	91,555	18,802	19,566	56,959	186,882
1500 m	151,714	43,519	61,574	142,034	398,841
2000 m	212,405	35,681	100,187	218,945	567,218
2500 m	359,272	155,652	157,086	295,389	967,399

4. Discussion

The results found out in this article concerning the consumers' profile corroborated the literature review, as 60% were between 21 and 50 years old, and 45% went to the organic street market by car [3]. Additionally, 56% of our sample bought fruits and vegetables, converging to the literature [3,31]. The producers' farms came from outside Belo Horizonte, the city where the street markets occur, and used private cars (60%) as a transportation mode.

The measure of the geographical distribution of producers and customers is a way to analyze the SFSC. In our case, the organic street markets have a local influence area, except the organic street market B. The average distance between producers and consumers varied, with 395 km for producers and 27.02 km for consumers. Thus, the organic street market in Belo Horizonte is a short organic food supply chain and a local food system.

The buffer analysis results indicated the organic street markets are a local organic market, except for organic street market B. The majority of customers are located inside the 2500-m buffer, indicating around a 30-min walk to reach it. So, this result shows the potential use of non-motorised transportation modes. Pretty et al. [38] pointed out the economic benefits of using sustainable transportation modes in the UK.

The chi-squared test results showed the relation between quality, price, and variety of organic products, indicating the importance of these factors for organic consumers. They do not look only for quality, price, or variety. The organic consumer looks for quality, price, and variety of organic products. These results also present convergence to the literature [24], showing the importance of product-related factors to improve the customer experience.

The chi-squared test results also showed the relationship between location and accessibility of organic street market, indicating a potential to reach non-motorised customers concerned with environmental issues. This result reinforces the importance of promoting sustainable strategies to divulge the organic street market location and the customer displacements by non-motorised transportation modes. Denver et al. [25] showed the importance of geographical proximity as a strategy to increase the added value of products. Still, local markets' development is linked to organic farming [37]. Thus, a viable and sustainable economic circle is stimulated with the local organic market's development, contributing to a sustainable short organic food supply chain.

5. Conclusions

Organic products can enrich people's health by the quality of the food and improve small economies by developing small supply chains. This paper focused on analyzing the short organic supply chains in their geographical distributions. It is essential to highlight that the authors did not find any studies that analyze the geographical distance between producers and consumers of the organic street markets: This is the research gap this article sought to fill. The customers looked for fruits and vegetables and bought most of their organic products at organic fairs. Their ages were between 21 and 50 years old and they went to the markets each time they happened, usually by car. The chi-squared test showed that customers look for quality and variety when shopping at organic fairs.

The geographical distance analysis showed that street markets could reach customers of all parts of the city, if they are well located and have a good product set. Organic

street markets that offer more products have customers willing to travel long distances to buy them. Even though most of the consumers used their private cars to reach the street markets, it was possible to observe that most of the consumers were located inside a distance where active modes of transportation are possible. These transportation modes are not highly used in Belo Horizonte because of sidewalks' precarious conditions and the lack of bike lanes.

This study revealed the importance of local characteristics of the organic street markets. To achieve more customers and promote a healthy alimentation, public administrations could stimulate more organic street markets distributed over the city, achieved mainly by non-motorised transportation modes. Additionally, the strategic location in places that naturally attract is one opportunity to consider for the organic street market. For this reason, when fomenting the geographical dispersion of the organic street markets, the public administration should indicate its location near schools and universities.

However, the increase of organic street markets' supply will only be possible with the increase of organic production. Strategies, such as tax breaks, funding facilities, and fomenting programs, are desirable and should be promoted. Moreover, initiatives, such as urban farms, reported by Oliveira et al. [43], should be stimulated by the municipality to increase organic production.

This research revealed there is a latent demand for organic products if they are available. To increase their reach and to increase the number of customers, it is necessary to improve the accessibility to producers and to study the organic fair location and day it is realised. Therefore, further studies may analyze the accessibility conditions to producers and customers.

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