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Surviving under limitations: Street vendors' self-organized adaptation to limited infrastructure in urban public space

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Abstract

Street vendors are vital to urban economies in the Global South, supporting urban food security, employment opportunities, and affordable goods and services. Previous studies in the Global North indicate that street vending is typically supported by formal infrastructure, including permanent kiosks, electricity connections, and sanitation facilities. However, in the Global South, street vendors must operate despite limited infrastructure. This study explores how their self-organized adaptation strategies enable them to survive despite minimal infrastructure. Conducted in Kajen Town Square, Pekalongan, Indonesia, this study employs a quantitative methodology, utilizing cross-tabulation and descriptive analysis based on survey responses from 94 street vendors. The findings indicate that infrastructure availability does not significantly determine location choice; rather, foot traffic and consumer potential predominantly influence vendors' location decisions. To overcome infrastructural constraints, vendors implement various self-organized strategies, either individually or through community organizations, including shared electricity access and independent provision of clean water. This study reveals how street vendors adapt to infrastructure scarcity through self-organized strategies, a topic rarely explored in existing literature. It provides new perspectives for understanding the dynamics of the street vendor ecosystem, emphasizing the importance of inclusive urban planning that aligns with the realities of the informal economy in the Global South.

Keywords: Global South, Infrastructure, Self-organized adaptation, Street vendors.

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1. Introduction

This section comprises four subsections that provide a literature review in two parts, followed by a brief description of the case study, its objectives, and contributions. The literature discussion focuses on the context and dynamics of street vendors in urbanism to identify research gaps and the rationale for this study.

1.1. Context and Dynamics of Street Vendors in Urbanism

Street vendors play a fundamental role in urban economies, especially in the Global South, where the informal sector is integral to people's economic activities [1]. Street vendors provide significant employment opportunities and livelihoods for the community [1-3]. In many low-income countries, street vendors account for as much as 15% of the total urban workforce, confirming their significant role in cities' economic structure [4]. In addition, street vendors contribute to urban food security by providing affordable and accessible food across various social levels [5, 6]. For low-income residents, street food is often a primary source of daily nutrition and a buffer in the face of economic uncertainty [6-9]. Moreover, street vendors play a key role in the city's economic resilience; when a crisis or recession occurs, this sector absorbs workers who lose formal jobs, functioning as an economic safety net for the urban poor [10]. For example, during the COVID-19 pandemic, many laid-off workers turned to street vending as an alternative livelihood [5]. In these ways, street vendors have become an inseparable aspect of urban social and economic life in many developing countries [4].

Street vendors generally operate in public spaces with high foot traffic, such as sidewalks, parks, town squares, and markets [11-13]. These locations bring vendors closer to their consumers and hence maximize their sales potential [14]. However, selling in public spaces presents various challenges. Governments often view street vendors as "nuisances" because they use public land illegally [15]. In many cities, street vendors are stigmatized as the cause of traffic jams and sanitation problems, and as hindering the visual aesthetic of urban spaces [15]. Therefore, they face various pressures, ranging from forced displacement and confiscation of their commodities to criminalization [4, 16]. Research in Africa, Asia, and Latin America has shown that such spatial conflicts arise because street vendors often operate in a gray zone, where their existence is neither completely legal nor completely prohibited [4].

In addition, because street vendors occupy public spaces that were not originally designed for commerce, they often lack access to basic infrastructure and services. Public areas rarely provide the necessities for street vendors' activities, such as clean water, electricity, sanitation, storage, or shelter [17]. For example, the lack of public toilets and waste management facilities forces vendors to improvise, potentially leading to sanitation problems and unhealthy conditions [18-20]. Therefore, despite having a crucial economic role and contributing to the urban food system, street vendors face difficult conditions, lack formal infrastructure, and are often at risk of facing stigma or arrests.

1.2. Research Gaps and the Rationale of the Study

Studies on street vendors have been conducted in a range of contexts, differing in terms of socio-economic aspects, spatial configurations, socio-spatial conflicts, and their impact on urban spaces [17, 21, 22]. However, the role of infrastructure has received little academic attention, especially in the Global South.

In the Global North, street vendors are regulated and assigned to special zones featuring adequate infrastructure support, such as permanent kiosks, electricity connections, and government-managed sanitation systems [15, 23-25]. Lighting and electricity also play a role in attracting customers, as bright spaces are considered more desirable [26]. Other studies have found that street vendors require access to clean water, toilets, waste management, and storage space [19, 27, 28]. Having a designated vending spot supported by urban infrastructure has been highlighted as the most significant factor in street vendors' sales performance, increasing their income by approximately 27% [29]. Therefore, the literature consistently shows that good public infrastructure supports the sustainability of the informal sector by increasing vendor income, customer engagement, and long-term development.

However, conditions in the Global South are very different. Street vendors find minimal or even nonexistent infrastructure but continue to thrive. They do not always rely on formal infrastructure, indicating that infrastructure factors are not necessarily the main determinants of their practice. This mechanism, in which informal actors collectively or individually create adaptive solutions to overcome limitations, is referred to as self-organization [30-32]. This phenomenon raises two fundamental questions: if infrastructure is not the main factor in street vendors' decision-making regarding their location in the Global South, what factors are more influential? Moreover, what strategies do street vendors use to adapt to infrastructure limitations?

So far, studies on street vendors in the Global South have focused on regulatory conflicts, economic livelihoods, and the politics of urban informality. Several studies have begun to highlight infrastructure, but focus on the relationship between the lack of infrastructure and food hygiene [20, 33]. Previous studies, which have identified how street vendors overcome the limitations of infrastructure and create self-organized adaptation solutions, are scarce. This study aims to contribute to filling this gap.

Unlike prior studies, which have focused more on the role of infrastructure in supporting hygiene or health [20, 33], this study explores infrastructural adaptation systems using a holistic, multi-dimensional lens. understanding self-organized street vendor ecosystems is important because it provides a realistic understanding of informal economic adaptation to the challenges of limited resources in the global south; unfortunately, this aspect has rarely been studied, especially concerning street vendors' need for infrastructure. however, lessons learned from previous studies are accommodated in this study, especially with regard to the infrastructural variables being assessed, i.e., electricity, sanitation, storage, water, and waste.

1.3. Case Study: Pekalongan as a Representation of a Medium-Sized City in the Global South

In the Association of Southeast Asian Nations (ASEAN), the informal sector, including street vendors, plays a significant role in the urban economy [34]. As part of ASEAN, Indonesia's informal sector is growing rapidly and becoming an integral aspect of urban economic activities, with street vendors spread widely across various public spaces. For example, Kajen Town Square in Pekalongan Regency reflects how the informal sector continues to grow in a medium-sized city in Indonesia. Pekalongan is experiencing rapid growth in the informal sector, especially in the Kajen Urban Area, which is developing due to regional expansion. This growth is in line with the findings of Suryanto et al. [35], who indicate that the informal sector, including street vendors, is growing rapidly, along with increasing urbanization.

While the informal sector is growing rapidly in Pekalongan, research on the relationship between infrastructure availability and the existence of street vendors in this area remains limited. Kajen Town Square, a public space at the center of informal economic activities, offers a relevant case study for understanding the role of infrastructure factors in the sustainability of the street vendor sector in a city in the Global South.

1.4. Research Objectives and Contributions

This study aims to explore the dynamics of street vendor location selection in Kajen Town Square and examine the public infrastructure limitations that have influenced street vendors' adaptation strategies and approaches to survival in informal urban environments. The main focus is to highlight the creative strategies developed by self-organized traders in dealing with infrastructure gaps. Therefore, this study provides a new perspective on the urban informal economy, emphasizing the often-ignored adaptability of street vendors in shaping their work environment. By understanding the mechanisms that street vendors use to replace the functions of formal infrastructure, this study offers new academic insights that serve as a reference for urban planners and governmental bodies in developing inclusive urban policies.

2. Methodology

2.1. Research Location: Kajen Square, Pekalongan, Indonesia

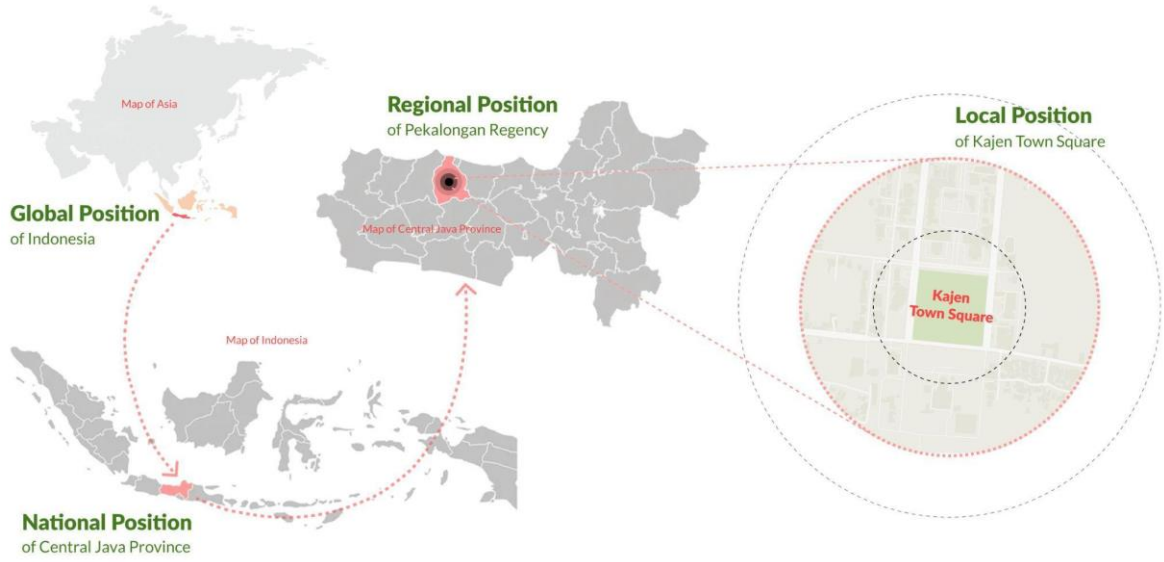

Figure 1.
Kajen Town Square Area as a Research Location.

The area of Kajen Town Square, located in the city of Pekalongan in the center of Pekalongan Regency **(**Figure 1**)**, is an open public space that serves various functions, including recreation, hosting public activities, and proximity to governmental and worship centers. As a primary public space in Pekalongan, this area functions as a hub of social and economic interactions within the local community. The diversity of community functions and high mobility contribute to its role as a magnet for street vendors operating along Mandurorejo Street, Krakatau Street, Alun-alun Utara Street, Rinjani Street, and Sindoro Street. Currently, approximately 162 street vendors sell their wares in the area, predominantly offering food and beverage products.

Despite the strategic importance of the area as a center of community activity, the limitations of the public infrastructure here, such as minimal access to electricity, sanitation, and storage facilities for street vendors, constitute a major challenge. The Kajen Town Square area developed organically, without specific planning to support the informal economy. This makes it an ideal location for exploring how street vendors cope with the limitations of the infrastructure they need through self-organized adaptation strategies. As an investigation of the adaptation patterns of street vendors in conditions of limited infrastructure, this study contributes to a broader discussion on the sustainability of the informal economy in the public spaces of cities of the Global South.

2.2. Analysis Methods and Data Collection

This study employs a quantitative approach, utilizing data processing methods such as cross-tabulation and descriptive analysis based on the frequency distribution of the results. This approach aims to identify how infrastructure availability influences street vendors' activities and how their adaptation strategies address limited infrastructure.

The main variables used in this study include (1) the location of street vendors, (2) the characteristics of their activities, and (3) the infrastructure supporting their activities. The variables for locations include the type of space used (roadside, park/town square, and sidewalk). The variables for the characteristics of street vendors' activities include the type of commodities, type of trading facilities, time of activity, distribution patterns, and nature of services [36]. The supporting infrastructure variables include electricity, availability of clean water, waste management, toilets, and storage space, following Wu et al. [20], Ojeda and Pino [17] and Rosales et al. [19]. These variables were chosen because of their roles in supporting street vendor operations, especially in the context of sanitation, cleanliness, and storage.

Research data were collected through field observations, semi-structured interviews, and questionnaires. The observations were used to obtain an accurate picture of the context in the field [37], registering how street vendors adapt to the lack of infrastructure at the study location. Interviews were conducted to explore the motivation and adaptation strategies of street vendors as they dealt with limited infrastructure. The questionnaire, which included closed- and open-ended questions, was distributed to street vendors.

The sample size was calculated using Krejcie and Morgan [38]. To produce a 90% confidence level and a 5% margin of error, a sample size of 94 was required. A disproportionate stratified random sampling technique was employed [39] where street vendors were grouped based on the category of trading location on the road corridor and their type of business. Samples were then randomly selected from each category to ensure that the data were representative. The distribution of the sample by category can be seen in Table 1.

Table 1.
Sample Distribution.

Type of commodity	Type of commodity (A)	Population per type (B)	Sample per type (C)	Sample (D = A/B × C)	Number of Samples
Mandurorejo Street					
Food and Beverages	31	162	65	12.44	16
Packaged Food and Beverages	3	162	8	0.15	3
Toy Rental	22	162	21	2.85	11
Krakatau Street					
Food and Beverages	66	162	65	26.48	37
Packaged Food and Beverages	2	162	8	0.10	2
Toy Rental	15	162	21	1.94	10
Alun-Alun Utara Street					
Food and Beverages	10	162	65	4.01	5
Packaged Food and Beverages	3	162	8	0.15	3
Rinjani Street					
Food and Beverages	5	162	65	2.01	4
Sindoro Street					
Food and Beverages	5	162	65	2.01	3
Total Research Samples					94

3. Result and Discussion

3.1. Characteristics of Street Vendor Activities in the Kajen Town Square Area

3.1.1. Types of Commodities

The questionnaire results indicated that the types of street vendors' merchandise in the Kajen Town Square area are dominated by the food and beverage sector processed onsite, comprising 69.2% of the total traders. This type of merchandise includes typical dishes, such as meatballs, megono rice, and orange juice. The second-most frequent category is toy rentals (22.3%), including rental services for cars, horse carts, painting equipment, and trampolines. Packaged food and beverages, such as bottled drinks and ready-to-eat snacks, have the lowest rate of appearance (8.5%).

3.1.2. Types of Trading Facilities

The range of commodity types has implications for the variety of trading facilities used by street vendors. The results indicate that carts are the most dominant trading facilities used by street vendors, especially for food and beverage traders providing their wares onsite. Some vendors also rely on motorbikes or cars as mobile stalls, especially for selling pre-packed items. In contrast, the types of trading facilities are more diverse in the toy rental category, including toy vehicles, painting booths, inflatable playgrounds, trampolines, wooden boxes, and chairs. The floor tent type of trading facility is less frequently used, being only found on Sindoro Street. Figure 2 presents visual examples of the different types of trading facilities observed in the field.

Figure 2.
Common Types of Trading Facilities Used by Street Vendors in Kajen Town Square.

3.1.3. Activity Time

Most street vendors (86.2%) in the Kajen Town Square area operate from the afternoon to the evening, between 15:00 and 24:00. This is due to the high number of visitors who visit the square for recreational activities during this time. However, some street vendors operate from noon, such as from 13:00 to 22:00 (8.5%) or from 09:00 to 22:00 (5.3%), serving visitors who arrive outside of recreational hours, including office workers and individuals active in government and worship areas. Figure 3 presents examples of street vendor activity time operations in Kajen Town Square, illustrating typical afternoon vending (left) and evening vending (right). These variations in operating times reflect the vendors' flexibility in adapting to diverse consumer flows throughout the day, with evening vendors relying on self-organized electricity sources for lighting.

Afternoon Evening

Figure 3.
Street Vendors' Operating Hours: Afternoon (left) and Evening (right) Activities at Kajen Town Square.

3.1.4. Distribution Pattern and the Nature of Street Vendor Services

Food and beverage vendors in the Kajen Town Square area largely occupy spaces on the roadside and sidewalks, following a linear distribution pattern. Street vendors engaged in the toy rental sector tend to cluster at strategic points, such as Pendopo Kajen Park and on the west of Kajen Town Square. This distribution pattern is in line with the findings of Liu and Liu [40], who note that in the residential area of Shenzhen, China, street vendors tend to spread out linearly along the main routes of movement.

The street vendors in Kajen Square are generally permanent, occupying the same location daily during operating hours. This contrasts with a more mobile pattern, where street vendors tend to follow consumer movements. Further mapping of the characteristics of street vendor activities in Kajen Town Square is provided in Figure 4.

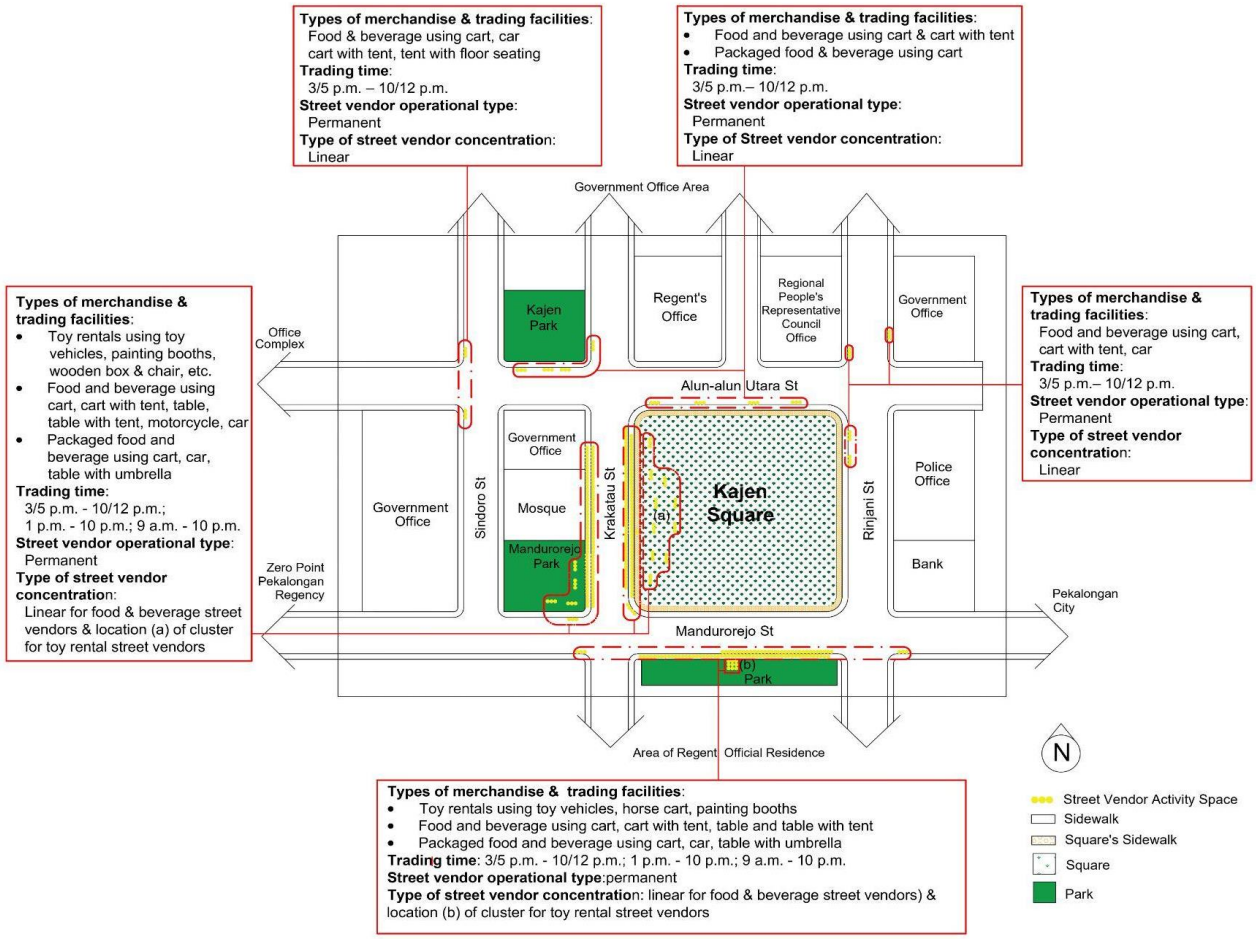

Figure 4.
Characteristics of Street Vendors in the Kajen Town Square Area.

3.2. Is Infrastructure a Factor for Street Vendors in Choosing Their Location in the Area of Kajen Town Square?

The results indicate that the choice of trading location by street vendors in the Kajen Town Square area is not based on the availability of infrastructure but on the number of visitors and community activities: 77.66% of street vendors chose

their location due to the high activity of people walking, exercising, and cooking there. Meanwhile, 13.83% of the respondents stated that they chose their location because many people were engaged in recreational activities, and 8.51% considered the location based on the rate of pedestrian traffic.

These findings are in line with Ma et al. [41], who showed that street vendors tend to be located in spaces with high foot traffic. They are also in line with the results of Anaafo et al. [42], who found that the main factor in street vendors' location choices was proximity to consumers.

No street vendors in the Kajen Town Square area indicated that they chose their location based on the availability of infrastructure. This contrasts with the results of several studies conducted in the Global North, where street vendors generally operate in zones that have been designed with the support of formal infrastructure, including permanent kiosks, electricity access, and government-managed sanitation systems [15, 23-25]. However, in the Global South, public spaces often do not consider the infrastructure needs of the informal sector, including street vendors; therefore, basic infrastructure is not a major factor in street vendors' spatial decisions.

These findings indicate that the lack of infrastructure is not a major obstacle for street vendors because they can develop adaptation strategies independently. In other words, for street vendors, the main factor in location choice is the presence of consumers who guarantee continued business. This finding aligns with those of Ma et al. [41] and Anaafo et al. [42], who found, respectively, that traffic flow and proximity to consumers are more dominant factors in location choice. These findings imply that the informal economy sector in the Global South tends to be flexible and adaptive, allowing vendors to survive even in environments featuring limited infrastructure.

However, with limited infrastructure available, what adaptation strategies should street vendors implement to continue operating? This question guides further exploration of the self-organized adaptation mechanisms vendors use.

3.3. Self-Organized Adaptation of Street Vendors to Infrastructure Limitations in Kajen Town Square Area

Several studies have highlighted that street vendors require supporting infrastructure, including electricity, clean water, sanitation, and storage space, to carry out their activities [19, 27, 28]. However, the street vendors in Kajen Town Square operate under conditions of minimal infrastructure. These limitations do not prevent them from continuing to engage in their trade. These street vendors have independently organized various adaptation strategies to meet their basic needs without relying on formal infrastructure.

3.1.1. Electrical and Lighting Infrastructure

Street vendors in the study area are mostly active at night. Ideally, according to Szakonyi and Urpelainen [26] Street vendors who are active at night need bright lighting because it plays an important role in attracting customers and creating a safe trading environment. However, the limitations of the electricity infrastructure in the study area require street vendors to develop mechanisms to meet their electricity needs.

The survey results indicate that street vendors tend to use electricity sources managed by an association of vendors. This association collectively subscribes to electricity from the State Electricity Company, and the battery recharges are managed independently by members of the association through a self-help system. Each vendor who uses electricity from the association is charged a rate of IDR 3000 (USD 0.17) per street vendor per night. Some street vendors also use personal electricity sources, such as power banks, motorcycle batteries, or connections from public facilities, such as a nearby mosque.

From the State Electricity Company connection (managed by the vendor association)

Motorcycle Batteries as a portable electricity source for lighting

Power Bank used by street vendors to power small lights or devices

Figure 5.
Self-Organized Mechanism of Electricity Infrastructure by Street Vendors in the Kajen Town Square Area.

Street vendors in different areas fall into different patterns in terms of electricity use:

- Street vendors on Mandurorejo Street: The overwhelming majority (81.8%) use electricity supplied by the association, and a small group (9.1%) either bring their own electricity source or do not use electricity at all.

- Street vendors on Krakatau Street: Almost half (47.2%) use electricity from the association, but, notably, 44.4% bring their own electricity source, indicating higher independence compared to other street sections.
- Street vendors on Alun-Alun Utara Street: The majority (62.5%) rely on electricity from the association, whereas the remainder use private sources or do not need electricity.
- Street vendors on Rinjani Street and Sindoro Street: Unlike those on other streets, these vendors mostly bring their own sources of electricity (75%–100%), indicating a low level of dependency on the association.

This pattern indicates that although street vendors have limited access to formal electricity infrastructure, they can still carry out their activities by adapting to their location. Association-based electricity management is a common collective strategy, and independent street vendors can bring their own electricity to preserve operational flexibility.

The adaptation ecosystem observed among street vendors in the study area reflects the dynamics of self-organized adaptation, as discussed by Chiu [30], Dovey [31] and Malefakis [32]. These scholars describe how informal sector communities develop collective strategies to address infrastructural deficits in the absence of state provisions. In the case of street vending, this study shows that vendors adapt to infrastructural limitations and construct association-based systems to sustain their activities and enhance operational resilience.

Thus, the street vendors' electricity adaptation in the Kajen Town Square area is not only a survival strategy but also an example of how infrastructural limitations can foster the development of flexible and resilient community-based systems in the informal economy.

3.1.2. Clean Water Infrastructure

Clean water is an important infrastructural aspect required by street vendors, especially those selling food and beverages. For example, Kariuki et al. [33] found that a lack of access to clean water can increase the risk of food contamination and reduce hygiene standards. Street vendors in the study area face limited access to clean water, requiring them to develop adaptation mechanisms to meet their clean water needs.

Most vendors bring water from home as the primary strategy to overcome the limitations of clean water infrastructure in public spaces. In addition, a small number take water from the nearest mosque, indicating that religious facilities are often an alternative source of water. Finally, vendors who sell dry commodities, such as packaged food and beverages or toy rentals, generally do not require water in their activities; hence, they do not face the same obstacles.

Vendors bring clean water from home using water gallons while operating in public spaces

Figure 6.
Self-Organized Mechanism of Clean Water Infrastructure by Street Vendors in the Kajen Town Square Area.

By location, the self-organized adaptation mechanism for fulfilling the clean water needs of street vendors is as follows:

- Street vendors on Mandurorejo Street: The majority (81.7%) bring their own water, while 18.3% do not require water for trading.
- Street vendors on Alun-Alun Utara Street: 100% of street vendors bring their water, indicating that there are no alternative sources of clean water in this location.
- Street vendors on Rinjani Street: No street vendor on this street requires water in their activities.
- Street vendors on Krakatau Street: The majority (80.6%) bring their water, whereas others (13.9%) take water from a mosque.
- Street vendors on Sindoro Street: Here, an interesting pattern emerges where 50% bring their own water, whereas the other 50% take water from a mosque, reflecting the highest level of dependence on public facilities in the survey.

These findings indicate that, due to the unavailability of clean water infrastructure for street vendors, they must develop adaptation strategies. While some street vendors choose to bring water from home, others rely on public facilities that are not formally intended for them, such as mosques.

The adaptation mechanisms adopted by street vendors in Kajen Town Square align with the broader conceptualization of self-organized adaptation articulated by Chiu [30], Dovey [31] and Malefakis [32]. These scholars describe how informal urban actors often function through community-based strategies by mobilizing locally available resources. Their studies were conducted in different socio-spatial contexts, but the case of street vendors in Kajen Town Square extends the

empirical resonance of their framework, illustrating how street vendors respond to infrastructural deficiencies while proactively establishing collective systems for infrastructure management.

It should be noted that dependence on public facilities such as mosques poses long-term challenges related to the sustainability of infrastructure access for street vendors, as these facilities are not designed to support informal economic activities. Therefore, a more inclusive approach is required, where the government can accommodate the needs of street vendors without compromising the flexibility of the informal sector. The pattern of clean water adaptation conducted by street vendors in the Kajen Town Square area reflects how limited infrastructure encourages the formation of a flexible and resilient community-based system in the context of the informal economy.

3.1.3. Waste Management Infrastructure

Waste is among the main challenges in street vendor activities, especially in public spaces that are not specifically designed for informal trade. Wu et al. [20] found that poor waste management can give the impression of a slum, create a negative stigma against the informal sector, and contribute to environmental and hygiene problems in urban public spaces. Thus, the availability of a functional waste management system is crucial for supporting the sustainability of street vendors and maintaining a balance between the interests of the informal economy and the maintenance of cleanliness in urban spaces.

In the Kajen Town Square area, street vendors do not primarily rely on the government's formal waste system. Some have self-organized adaptation mechanisms as an independent strategy for managing their waste, such as collecting it in personal bins to take their waste home or disposing of it independently at a temporary disposal site. Some street vendors use the trash bins available in public spaces and rely on government sanitation workers to collect their waste, with the service fee managed collectively through a vendor association.

Use public trash bins provided in the square

Use personal bins

Figure 7.
Self-Organized Mechanism of Waste Infrastructure by Street Vendors in the Kajen Town Square Area.

Street vendors use the following adaptations to address their waste management needs in different areas:

- Street vendors on Mandurorejo Street and Krakatau Street: Almost all vendors (90.9% on Mandurorejo Street and 97.2% on Krakatau Street) use the waste collection system implemented by sanitation workers, and a small number of them dispose of their waste independently at a waste transfer station.
- Street vendors on Alun-Alun Utara Street: This area demonstrated a higher level of self-organization, with 25% of street vendors independently disposing of their waste at a temporary disposal site, while the remaining 75% relied on sanitation staff.
- Street vendors on Rinjani Street: Interestingly, 66.7% of street vendors in this area did not produce waste; the trading activity taking place in this location is likely related to non-consumer goods.
- Street vendors on Sindoro Street**:** All the street vendors on this route rely on the government's waste collection system, indicating a higher dependence on public facilities.

These results indicate that there is adequate provision of garbage bins in this area, but the role of the community in waste management remains important. The existence of the street vendor association as an informal organization allows for better coordination in disposing of waste at the collection points that have been provided.

These findings show a difference with the study by Wu et al. [20], who found that in many Global South cities, street vendors have limited waste facilities available to them and are not equipped with covered bins. By contrast, in the Kajen Town Square area, the provision of waste infrastructure is relatively good, with bins having lids and an organized waste collection system.

However, the existence of street vendors who dispose of their waste independently demonstrates that individuals' self-organized adaptation mechanisms remain part of the survival strategies of the informal sector. This highlights how street vendors are not only passive users of public space but also contribute to collective cleanliness management, both through associations and individual initiatives.

The adaptation mechanism observed among street vendors in Kajen Town Square reflects the concept of self-organized adaptation, as proposed by Chiu [30], Dovey [31] and Malefakis [32], where informal urban actors collectively develop context-based solutions through accessing available local resources. Although their studies were conducted in

different urban contexts, the findings in Kajen Town Square are relevant and provide expansion and support for the empirical relevance of this concept, which suggests that limited infrastructure may not act as a barrier but as a catalyst for community-driven, adaptive responses in the informal sector.

3.1.4. Storage Infrastructure

Storing strategies are an important aspect of street vendors' operations. In many cities in the Global South, it is challenging to utilize the limited storage space available at trading locations [28], in particular, due to government policies that prohibit the use of public spaces for storage after operating hours, which encourages street vendors to develop adaptation mechanisms to continue operating without violating regulations.

It was found that the main adaptation performed by street vendors in the study area is to take home all their trading facilities after finishing selling in the public space. This is done to maintain the order of public space and prevent the permanent use of the trading area by street vendors. With no storage facilities provided by the government or association, street vendors must find independent solutions, such as taking home all of their merchandise every day.

One adaptation strategy employed by street vendors is to use a cart with wheels that can be attached to a motorbike, enabling them to easily transport their trading facilities home. Consequently, street vendors in the Kajen Town Square area have developed a mobility-based storage system, adapting to existing policies and demonstrating a higher level of independence in their adaptation efforts. They do not depend on external storage facilities but instead make their homes the primary logistics centers for storing their equipment.

Cart using wheels for easy moving

Vendors using vehicles (e.g., motorbikes, bicycles)

Figure 8.
Self-Organized Mechanisms for Storage Solutions by Street Vendors in the Kajen Town Square Area.

This aligns with the concept of self-organized adaptation, Chiu [30], Dovey [31] and Malefakis [32], where informal sector communities (collectively and individually) develop organic solutions to overcome infrastructural limitations without relying on formal government intervention. For street vending, such adaptation mechanisms illustrate how the informal sector develops a flexible, mobility-based operational ecosystem supporting the continuity of its economic activities.

Therefore, the storage strategy of street vendors in Kajen Town Square demonstrates how infrastructural limitations can foster innovation in vendors' operational practices. The use of mobility-based trading facilities as a storage strategy provides flexibility in choosing trading locations, thereby reducing the risks of conflicts with authorities resulting from violations of public space regulations. This adaptation pattern confirms that the informal sector functions as a resilience mechanism, enabling vendors to survive and thrive despite strict regulations and significant infrastructural limitations.

3.1.5. Toilet and Sanitation Infrastructure

Toilets form an important aspect of sanitation infrastructure for users of public spaces, including street vendors. Mahadevia et al. [27] considered toilets to be a basic human need and part of the essential infrastructure of public spaces. However, in many studies, street vendors have been identified as having limited access to sanitation facilities, particularly in public spaces that are not designed to support their activities [43, 44].

In Alun-Alun Kajen, this study found that toilet infrastructure is available but in limited quantities. There is only one public toilet accessible to street vendors, located in Mandurorejo Park, Krakatau Street. Additionally, many street vendors use toilets within the Al-Muhtaram mosque complex, which serves as their primary sanitation facility. Therefore, although there are no sanitation facilities specifically designated for street vendors, they can still meet their needs by utilizing existing facilities in the surrounding public space. These results are unlike those of Baluka et al. [43] and Soon [44], who found that street vendors often did not have access to toilets. This difference is likely due to the existence of public facilities that can be accessed by street vendors without significant restrictions. In this context, street vendors are not completely marginalized from the sanitation infrastructure but also do not have facilities that are intended specifically for them.

Public toilet in Mandurorejo Park Toilet in Al-Muhtaram mosque

Figure 9.
Self-organized Mechanism of Toilet Infrastructure by Street Vendors in the Kajen Town Square Area.

3.1.6. Mapping the Self-Organized Infrastructure Ecosystem

This reflects the flexibility and resilience of the informal economy sector in navigating urban challenges in the Global South. The various strategies that have been implemented by street vendors in accessing electricity, water, sanitation, and waste management are presented in Figure 10, which emphasizes how street vendors use the resources available in public spaces to support their selling activities.

This spatial mapping serves as a synthesis of the field findings, showcasing how informal actors mobilize localized, context-sensitive adaptations across the town square. By visualizing these self-organized mechanisms geographically, the map not only highlights the diversity of practices across different street corridors but also reveals the micro-level governance emerging from vendor collectives. Such representation is particularly useful for planners and policymakers to understand how urban space is used, negotiated, and adapted outside formal infrastructure provision.

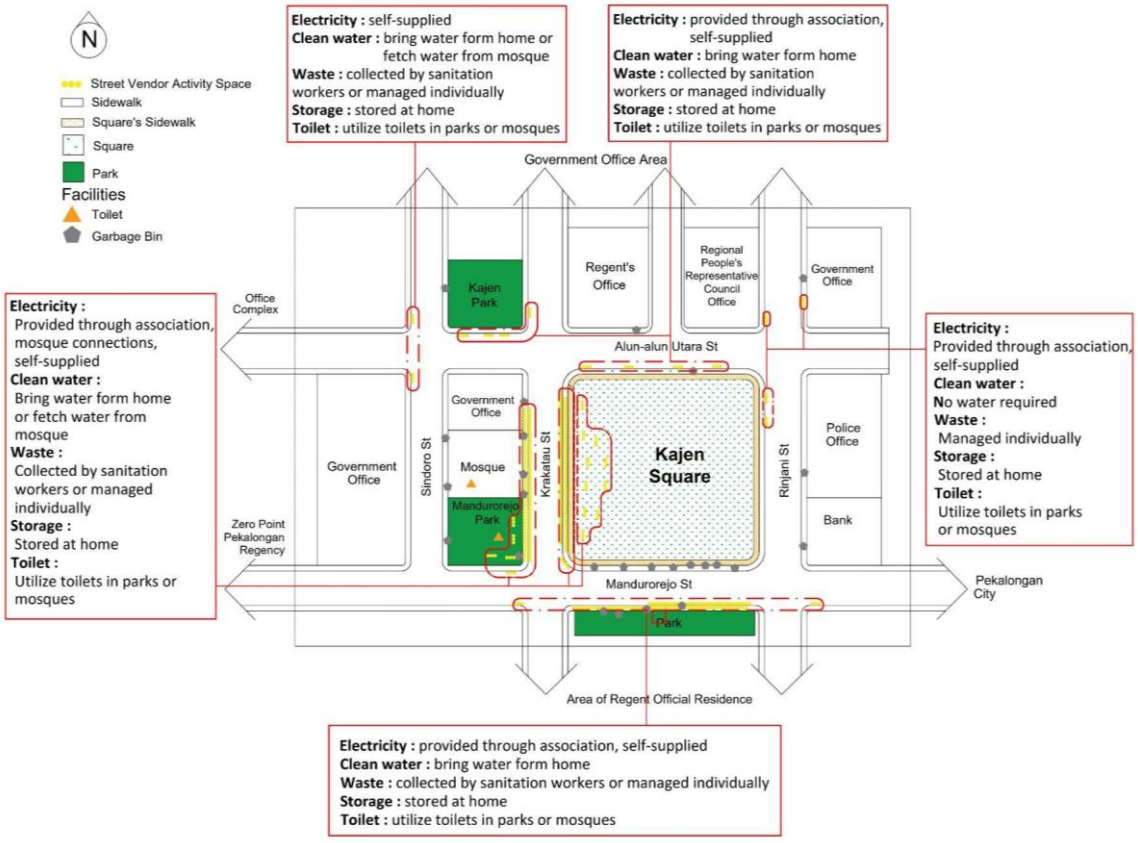

Figure 10.
Spatial Mapping of Self-Organized Adaptation Mechanisms by Street Vendors to Infrastructure Limitations in the Kajen Town Square Area, Based on Road Corridors.

A summary table (Table 2) is provided to outline the key self-organized adaptation strategies employed by street vendors in accessing basic infrastructure. This table synthesizes the variations observed across different street corridors and highlights how vendors, both individually and collectively, creatively overcome infrastructural limitations through community-based and mobile solutions.

Table 2.
Summary of Self-Organized Adaptation Mechanisms by Street Vendors in Kajen Town Square.

Infrastructure Type	Self-Organized Adaptation Mechanism
Electricity & Lighting	Electricity is shared collectively through vendor associations (paid daily) or self-supplied via power banks, motorcycle/car batteries, or mosque connections.
Clean Water	Vendors bring water from home using reused gallons or fetch water from mosque facilities.
Waste Management	Trash is disposed of in public bins (collected by sanitation workers through vendor-paid services) or managed individually using personal bins and taken to transfer stations.
Storage	Vendors store goods at home and transport them daily using mobile carts or modified vehicles (motorbikes, bicycles, or cars).
Toilet & Sanitation	Vendors utilize public restrooms available in mosques or nearby public parks.
General Pattern	Street vendors rely on a flexible, community-driven ecosystem to meet infrastructure needs without formal government support, demonstrating resilience and autonomy.

3.2. Implications of Findings: Self-Organized Street Vendor Ecosystem and Urban Governance Challenges

From the above discussion, it can be concluded that the sustainability of street vendors' activities in the study area does not depend on the government's provision of formal infrastructure but on street vendors' and their associations' self-organized adaptation mechanisms. The vendors' needs for electricity, clean water, storage, and waste infrastructure are fulfilled independently, either through collective initiatives of an association or by vendors finding individual solutions. In addition, for sanitation infrastructure, such as toilets, the vendors rely on public facilities, such as parks and mosques.

This mechanism indicates that the lack of infrastructure is not a barrier for the informal sector but a challenge they can overcome through community-based adaptation. This finding aligns with the concept of self-organized adaptation in the informal economy by Chiu [30], Dovey [31] and Malefakis [32], in which informal sector communities must survive in limited conditions and create management systems that are responsive to their needs. This study's findings confirm the existence of this mechanism in the study area, showing that self-organization can work in various aspects of infrastructure at once, proving that the informal sector can create a resilient alternative system. This supports the findings of Mahadevia et al. [27], Roever [45], and Gehlot et al. [46], who show that limited infrastructure often forms an obstacle for street vendors, which can encourage creative innovation in taking advantage of existing resources. This study thus broadens the understanding of street vendor adaptation from the aspect of spatial configuration [11] as well as in terms of realizing street vendor infrastructure independently and collectively.

However, while the self-organized adaptation mechanism allows street vendors to survive, the question is to what extent such strategies can be sustained in the long term. While reliance on informal initiatives could be effective over the short term, without inclusive policy interventions, the economic sustainability of the street vendors remains vulnerable to regulatory changes and other external pressures. This is in line with Chiu [30], who reported that informal systems can develop adaptation mechanisms in the absence of formal institutional and regulatory support, but in the long term, they will risk spatial exclusion, such as eviction and unfair allocation of space within their informal networks.

The absence of formal regulations in self-organized practices can lead to challenges in urban governance, including spatial irregularities, environmental degradation, and conflicts over the use of public space. Risks such as problems in waste management, sanitation, and hygiene, as well as potential safety hazards, become major challenges when the informal sector develops its own solutions without a clear structure [18-20]. In other words, self-organization mechanisms can create short-term solutions; however, without adequate governance, such solutions can exacerbate long-term urban fragmentation.

The governance approaches applied in the Global North, where street vendors are often regulated in special zones with strict regulations, are subject to ongoing analysis and debate [15, 23-25] cannot be directly applied in the Global South, where urban structures are more dynamic and fluid and the informal sector develops organically and adaptively, making it an integral part of the urban ecosystem. As argued by Dovey and Recio [47], regulatory models that are too rigid can hinder the flexibility that remains the primary advantage of the informal sector. Therefore, a more flexible governance approach is needed to balance the needs of the informal sector with more structured urban planning.

How can cities balance the flexibility of the informal sector with more structured urban governance? The implications of this study's findings entail the need for policies with a hybrid urban governance approach that accommodates self-organization mechanisms developed in the field. This supports the opinion of Dovey et al. [48] concerning the "cat and mouse game" between the government and street vendors in most cities of the Global South, which often only rely on "street cleansing" policies that focus on relocation without developing alternative solutions that consider street vendors' self-organized adaptation mechanisms. Therefore, instead of considering street vendors as a problem, governments can facilitate the systems that are already working in the field, for example, by providing basic infrastructure (water, sanitation, electricity, etc.) at street vendor locations that are already organized by the community or involving street vendor representatives in formulating fair zoning regulations.

Participatory, contextual approaches that show sensitivity to local adaptation mechanisms are more effective in organizing street vendors without compromising their economic sustainability. This echoes Suhartini and Jones [49], who emphasized that understanding the city using a self-organization perspective can create an urban planning system that provides regulatory certainty while continuing to open up space for innovation, dynamics, and flexibility. Therefore, inclusive urban governance should not aim to eliminate the informal sector but integrate it into the urban system in a

sustainable manner. Over the long term, this would improve the welfare of street vendors and help create more organized, clean, functional, and inclusive public spaces for the urban community.

4. Conclusion

This study found that the sustainability of street vendors' activities in the Kajen Town Square area does not depend on the provision of formal infrastructure but on the self-organized adaptation mechanisms that they carry out independently or collectively. While the vendors meet their infrastructure needs for electricity, clean water, and waste independently, they rely on existing facilities for public toilets. The main factor in their location choices is not the availability of infrastructure but the flow of visitors and proximity to consumers. However, while these strategies are effective over the short term, the self-organization model faces challenges over the long term, such as the potential for disorder, environmental pollution, and conflicts over the use of public space. Therefore, a more adaptive and inclusive urban governance approach is needed to ensure that the sustainability of street vendors' activities is balanced with the quality of the urban environment.

In particular, the findings of this study provide a better understanding of how the informal sector, especially street vendors, survives through self-organized adaptation mechanisms despite minimal formal infrastructure support. Policymakers and government officials can use the findings as a basis for formulating flexible urban governance policies, such as providing basic infrastructure that does not limit the flexibility of street vendors, zoning based on actual needs, and a collaborative management model between the government and street vendor associations for the management of public spaces. By adopting an inclusive approach, the government can ensure harmony between the community's economic needs and improved urban planning.

From an academic point of view, this study enriches the scientific knowledge related to the informal economy sector in the Global South and provides opportunities for further research exploring self-organized adaptation across various contexts of urban public spaces. Wider exploration in various cities in the Global South could deepen the understanding of the pattern of self-organized street vendor ecosystems in responding to infrastructure limitations to help develop a contextual and applicable framework according to the specific characteristics of cities. This will help develop a stronger conceptual foundation to design policies that are based on formal regulations while considering the flexibility and adaptive capacity of the informal sector.

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