

OPERATIONAL AND ENVIRONMENTAL ASSESSMENT FOR NIGHT MARKETS UNDER THE INFORMAL ECONOMY IMPACTS: INSIGHTS FROM THE CASE STUDY OF SELANGOR, MALAYSIA

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ABSTRACT

As an expression of the informal economy, the night market is not only a place that could attract locals to buy goods but also a place where tourists can experience the local characteristics. While the night market brought economic vitality to the city's economy, it also brought some issues. A comprehensive literature review of night markets revealed that existing studies paid less attention to outdoor night markets' spatial operations and waste management. Grounded in the connection between sustainability and night markets, the present study reflected on existing research findings by adopting different periods of fieldwork to conduct a case study of the night market in Jalan 17/1A, Selangor, Malaysia. The study focused on three aspects of night markets: spatial operations, waste, and waste recycling. It found that night market operations brought localized regional economic benefits while causing more severe pollution issues, significantly affecting the region's environmental health and sustainable development. The findings revealed that local government regulation of night market businesses in Malaysia is weak (the issuance of business licenses is informed of the operational guidelines), and there is also no relevant monitoring and penalties by the local government to intervene in the misbehavior of night market consumers. Based on the results of the field survey and combined with the concept of sustainable development, the present study recommended suggestions for the future spatial operation and waste management of night markets. Innovative and novel perspectives of the study combined qualitative observations and data analysis to comprehensively examine how spatial considerations and waste management strategies intersect in the unique context of night markets—aiming to fill the gaps in the sustainability of night market operations and to protect the ecology of the surrounding territorial environment, contributing to the discourse on sustainable development.

KEYWORDS

Night Markets; Informal Economy; Case Assessment; Field Survey; Spatial Operation; Environmental Impact; Sustainability

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1. INTRODUCTION

The world was in an essential period of development and revolution, with development as a critical theme. How to drive economic, scientific, technological, social, and industrial innovation was a vital issue for the progress and development of human society. The United Nations proposed seventeen Sustainable Development Goals (SDGs) to promote the realization of socially, economically, and environmentally sustainable and inclusive development. Sustainable development integrates the organic unity of national and regional, overall and local, economic and social aspects, intending to ultimately realize win-win coordination, fairness and justice, efficient cooperation, and multidimensional development [1]. Among the three main elements of sustainable development, environmental sustainability was often tricky to intertwine harmoniously with economic and social sustainability [2]. Protecting environmental ecosystems while enhancing and improving the quality and standard of human life was one of the critical issues on which academics focused their discussions. As one of the essential components of the regional economy, the informal economy plays a crucial role in encouraging consumption, alleviating the pressure of unemployment, safeguarding people's livelihoods, and maintaining social stability [1]. While the informal economy permitted by the government gives some people employment opportunities in the towns and eases the employment of the unemployed, jobless, or poor, most people employed in the informal economy have fewer educational opportunities to learn about ecosystems and have a poor understanding of sustainable development management and waste recycling. Furthermore, the stereotype that night markets were run by the unemployed, the jobless, or the poor in China was gradually broken, and students and young people (many of them undergraduates or postgraduates) were actively joining the night markets because the night market which as a low-cost entrepreneurial way of starting up a business, greatly lays the practical groundwork for surviving periods of unemployment and disorientation, or for later entering the formal market [3]. Studies revealed that informal policies developed in modern urban development as a flexible strategy favored and benefited urban development [4]. As a manifestation of the informal economy, night markets were not only convenient places to attract locals to buy goods but were also places where tourists traveled to experience local characteristics, especially in Asian cities [5]. Traditional night markets were outdoor street markets that generally operated from evening to midnight, and their informal manifestation led to their operation usually being neglected by stakeholder management [5, 6, 7]. In addition, solid waste management is a serious issue not only for developed countries but also for developing countries due to the increasing population [8]. Night markets, as one of the dynamic economic expressions, were scattered like fireworks worldwide [9]. However, night markets operating outdoors were characterized by severe environmental impacts due to their direct contact with the environment [5], such as plastic packaging hazards [10], vendors' and visitors' views and behavior [11, 12], garbage pollution and hygiene problems [13], and environmental degradation [14].

According to news reports, Malaysia disposed of about 3,000 tons of preventable food waste daily [15]. As the largest contributor to solid waste and the largest source

of hazardous greenhouse gases in Malaysia, households produce enormous amounts of food waste, followed by other sources such as night markets and wet markets [15]. Evidence revealed that an average of about 38,000 tons of solid waste was sent to more than 100 landfills per day in Malaysia, with approximately 2,500 tons of solid waste collected daily from the capital city of Kuala Lumpur alone [16]. In particular, the widespread use of plastics in solid waste poses a huge disposal and environmental challenge [17]. The informality of night markets led to some neglect by stakeholders, which in turn led to issues of ecological pollution. Studies have found that concentrations of air pollutants such as carbon monoxide (CO), carbon dioxide (CO₂), particulate matter 10 (PM10), particulate matter 2.5 (PM2.5), formaldehyde (HCHO), and polycyclic aromatic hydrocarbons (PAHs) during the operating period of the night market were higher than during the non-operating period due to cooking activities, with barbecue activities cause the most severe air pollution [18]. In addition, the dumping of organic wastes into the environment might contribute to global warming, and policy actions were needed to target air pollution problems at different levels of management to create synergistic effects and reduce the impact of climate change [19, 20]. Existing studies involving the night market area included solid waste recycling from garbage bins [21], wastewater pollution generated [5], hazards of exhaust gases generated [18, 22, 23], sources of electricity for operations [6], tableware materials [24], dangers of plastic packaging for hot food [25], perceptions of using plastic packaging [26], willingness of merchants to have environmentally friendly packaging [10], and biodegradation potential of recycled wastes [27]. Sustainable development is one of the critical environmental challenges to be addressed by all parties, including governments, consumers, and producers, who need to take responsibility for the environment [28]. Establishing a sustainable pattern facilitated changes in consumer behavior, government policies, and business practices [29].

A comprehensive literature review of night markets found that there was less academic research on night markets in general, and the existing research was skewed in the direction of environmental science and monitoring, which focuses on monitoring certain types of substances involved in night markets. The results indicated that fewer existing studies consider the direction of town planning and night market governance. Some scholars' research perspectives focused on solid waste and garbage bins in night markets and lacked considerations incorporating spatial operations. Sustainable management of night markets was beneficial in helping to address several waste challenges and develop targeted and innovative solutions for organizations and society [30]. In addition, proactive management facilitated cost reductions, provided long-term value, and played a role in reducing environmental waste and improving social outcomes [31, 32]. The concept of night market operations had gained social acceptance and had been recognized by local governments as an informal form of economy, as a temporary open market operating in a public space with physical characteristics similar to those of other markets, such as issues of accessibility, transportation, infrastructure, parking, safety and security, hygiene, and cleanliness [33, 34]. Traditional tolerance of the informal economy in some Asian countries has its purpose, partly due to the local authorities' desire to gain political

support from more street vendors through a more relaxed political administration [4]. However, there were fewer academic concerns in the direction of spatial operations and waste management in outdoor night markets, probably because the operating attributes of the informal economy have led some scholars to ignore the marginal economy. Some scholars observed that night market facilities have improved significantly due to the proactive approach of the local authorities in dealing with traffic flow and parking issues, the implementation of regulations against bad behavior and excessive noise, and the rigorous cleaning of the night market premises [33, 34]. Therefore, this paper initiated an empirical study on the spatial operation and waste management of night markets in Malaysia by conducting a field survey and obtaining primary data on the actual situation of night markets at different operation times in 2023. The study focused on night markets' spatial operation and waste management aspects and recommended sustainable optimization of future night market development. The study results had research value in grasping the operational logic and mechanism of specific night market spaces in Malaysia, and the proposed optimized management measures were essential for the future sustainable development of the city and society.

2. METHODOLOGY

2.1. DESCRIPTION OF THE STUDY AREA

Malaysia is located in Southeast Asia, and its capital is Wilayah Persekutuan Kuala Lumpur (W.P. Kuala Lumpur). The country is composed of thirteen states and three federal territories. The national territory consists of the southern part of the Malay Peninsula (West Malaysia) and the northern part of the island of Kalimantan (East Malaysia) (Figure 1). As a developing country, Malaysia has achieved extensive economic progress. The resulting economic development influenced the rapid growth of population, industry, and towns. The increase in population was accompanied by an increase in the amount of merchandise consumed and waste disposed of in each region.

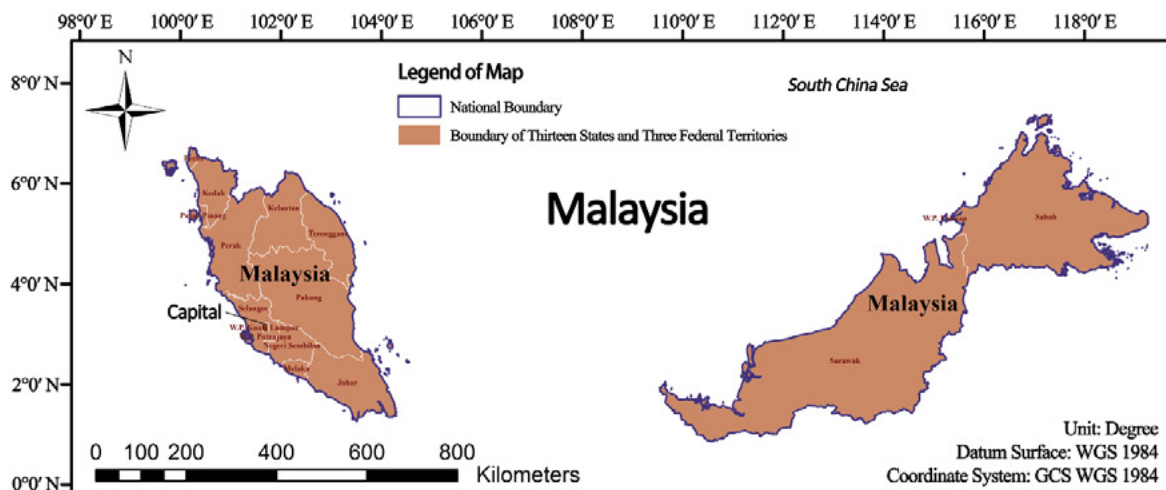


Figure 1. Geo-location and scope of Malaysia

Note: National geographical administrative data for Malaysia were obtained from publicly available data in the Humanitarian Data Exchange (HDE) (<https://data.humdata.org/>).

Night markets in Malaysia are defined as temporary weekly events that usually take place in available open spaces, temporarily closed roads or parking lots, the use of which had significant implications for the local authorities since it had to plan and control the area, especially the timing and movement of traders in and out of the area [33, 34]. There are many famous night markets in Selangor and W.P. Kuala Lumpur of Malaysia, such as Pasar Malam SS2, Pasar Malam Sri Petaling, Pasar Malam Taman Connaught, Plaza Mont Kiara Fiesta Nite Market, Pasar Malam Seksyen 3 Kota Damansara, Pasar Malam Setia Alam, Pasar Malam Taman Megah, etc [35]. These night markets were usually located in the capital city of Malaysia and other core areas, famous tourist attractions, and tourist check-in spots. As Malaysia's more famous night markets, these night markets were usually reported by the news media and recommended by mainstream travel apps. Some of them have gradually matured and improved access control, operational measures, and management systems in the feedback and evaluation of many consumers. Therefore, to maximize the generality of the study and the typicality of the results, a less well-known night market area, one located in Jalan 17/1A, was chosen to reflect the general situation of the night market in Malaysia (Figure 2). It was located in the eastern part of Petaling County within Selangor State, near the southwestern part of W.P. Kuala Lumpur (Figure 3).



Figure 2. Actual view of the night market in Jalan 17/1A (Photographed on December 5, 2023, at 5:30 and 8:30 pm)



Figure 3. Location of the night market in the study area (Coordinate of Google Maps: 3.11915N, 101.63700E)

Note: Study area surroundings information from Open Street Map (OSM) (<https://www.openstreetmap.org/>).

2.2. DATA COLLECTION

The night market's surroundings were informed by the Open Street Map (OSM) and the functional attributes of its neighboring buildings through Google Maps. The geological information provided data about roads, buildings, and other characteristics. The authenticity of its data sources could be verified, and its accuracy updated by other users and contributors through remotely sensed imagery, GPS devices, and field measurements. The night market's basic information and operational data were derived from precise on-site field exploration and measurement, and the actual data was recorded, counted, and analyzed in depth through modern electronic equipment (cell phones, cameras, and tablets). These technical tools ensured access to trustworthy, accurate, and comprehensive primary data, providing a reliable basis for the in-depth understanding of the night market's basic information and operational mechanisms. The methodology based on integrating technologies and the field

provided more depth and reasonableness to the study and gave strong data support for the night market research.

2.3. DESIGN OF THE STUDY

After selecting the night market in Jalan 17/1A of Petaling, Selangor, Malaysia, the present study investigated the background situation related to the night market by exploring the scope information, location information, and the surrounding environment and collected the background information through the secondary open data platforms, such as Open Street Maps (OSM) and Google Maps. To further understand the night market's spatial operation and waste management, the present study used fieldwork to collect primary data on the spatial operation, waste issues, and waste recycling aspects. Specifically, knowing that the night market operated from Tuesday afternoon to midnight, the present study adopted a time-phased fieldwork method to analyze the environment of the night market and its surrounding area, which mainly included three time periods during the operation of the night market (5:30-8:30 pm on December 5, 2023), after the night market (9:30-11:30 pm on December 5, 2023) and the next day after the night market (1:30-3:30 pm and 9:30-11:30 pm on December 6, 2023).

The field survey was conducted using a four-step process: visual recording, photographic recording, statistical surveys, and inductive analysis. The specific design of the research process was implemented in three steps. The first step of the fieldwork was conducted through visual records and filming records to collect basic information about the night market and the spatial management, waste information, and waste recycling under consideration. The second step was to analyze and summarize the issues and impacts of the night market in three periods through survey statistics: during the night market operation, after the night market operation, and the next day after the night market operation. The third step aimed to investigate the night market operation issues and propose sustainable optimization strategies for future night market operations.

3. RESULTS AND FINDINGS

3.1. BACKGROUND OF THE NIGHT MARKET IN JALAN 17/1A

3.1.1. SURROUNDINGS OF THE NIGHT MARKET IN JALAN 17/1A

Selangor is one of the thirteen states under Malaysia, located in the central west coast region of West Malaysia. The night market was on Jalan 17/1A, Petaling Jaya, Petaling County, Selangor. The surrounding environment included residential areas, shopping malls, universities, hospitals, and other building infrastructure (Figure 4). The night market in Jalan 17/1A was located in the northern part of Jaya One, and the

night market in the area was open every Tuesday afternoon until midnight. The south region of the night market was a park (Section 17 Flats Park) for people to relax and enjoy. For residents in the neighborhood, the temporary night market greatly facilitated their daily needs, with some of the night market's items offering very cost-effective prices.

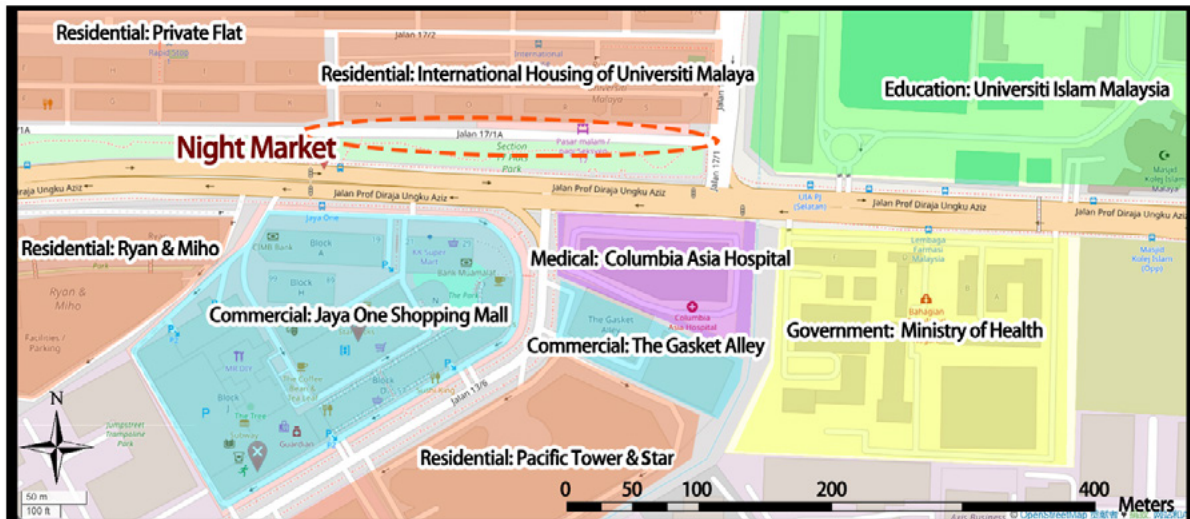


Figure 4. Information on the surroundings of the night markets

Note: Surroundings information from Open Street Map (OSM) (<https://www.openstreetmap.org/>).

3.1.2. COMPOSITION OF BUSINESSES AT NIGHT MARKETS IN JALAN 17/1A

Malaysia's night markets were based on the concept of open-air shopping, with street vendors or small traders occupying designated areas of the street to set up stalls, and could be seen as small incubators for aspiring entrepreneurs, as they required very little investment to set up a business and had little risk of failure while having the opportunity to earn a good income [33, 34]. All of the businesses at the night market site were mobile and temporary, with operations primarily relying on minor traffic space normally used for vehicle traffic, which would leave and vacate the traffic space at the end of the night market. The visual analysis of fieldwork was used to analyze the composition of the night market businesses, and it was found that the businesses were mainly Malays and included a few Chinese. Regarding scholars' various categorization standards for outdoor goods, this study combined the observations from the field survey to re-divide the varieties of goods operated by multiple types of businesses in the night market and the categories of goods operated by businesses in the night market involved such as fast food, apparel, fruit, vegetable, fresh meat, beverage, and other daily items, totaling seven types [36, 37]. Based on the survey statistics and analysis of night market businesses on Tuesday, December 5, 2023, it was found that the number of night market businesses totaled 129, where the dominant categories of the night market were fast food and apparel (Table 1).

Table 1. Composition information of the night market businesses in Jalan 17/1A

Note: Night Market business information was based on fieldwork conducted on Tuesday, December 5, 2023, from 6-8 pm under sunny weather.

Type of Businesses	Items	Number of Businesses (n)
Fast food	Pancakes, economy rice, hot dogs, fried chicken, burgers, skewers, grilled lamb, purple rice pancakes, spicy hot pot, grilled chicken thighs, grilled corn, etc.	36
Apparel	Dresses, short sleeves, pants, socks, shoes, underwear, bags, earrings, etc.	29
Fruit	Strawberry, mangosteen, rambutan, orange, longan, watermelon, banana, tangerine, grape, papaya, longan, coconut, mango, pineapple, durian, etc.	17
Vegetable	Peppers, bitter melon, tomatoes, potatoes, cucumbers, cauliflower, carrots, okra, loofah, ginger, cabbage, broccoli, etc.	15
Other Daily Items	Cell phone film, headphones, cell phone cases, combs, perfume, locks, key copies, bed sheets, toys, etc.	13
Fresh Meat	Chicken, lamb, eggs, shrimp, fish, beef, etc.	10
Beverage	Pressed coconut juice, pomegranate juice, coconut smoothies, sugar cane juice, blended juices, canned beverages, 100Plus beverages, etc.	9
Total	/	129

Further analysis of night market businesses revealed that the type of fast food had the highest number, with 36 of the night market businesses accounting for 28% of the total. The type of apparel had the second highest number of businesses, with 29 of the night market businesses accounting for 22% of the total, and these two items accounted for nearly half of all businesses in the night market (Figure 5). Fresh meat and beverages were less numerous, with 10 and 9 businesses representing 8% and 7% of the total night market businesses, respectively.

■ Fast Food ■ Apparel ■ Fruit ■ Vegetable ■ Other Daily Items ■ Fresh Meat ■ Beverage

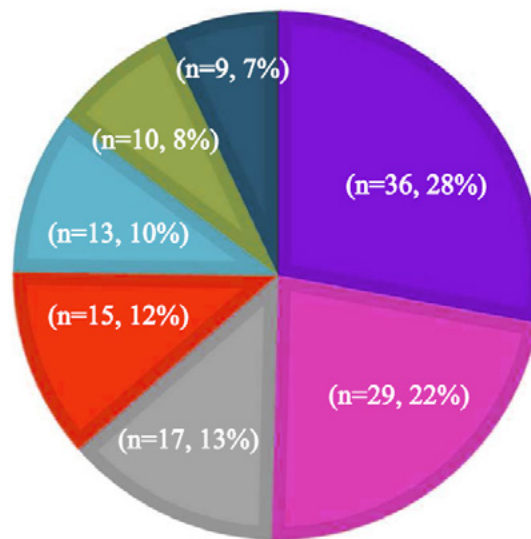


Figure 5. Percentage of each business type for the night market in Jalan 17/1A

3.1.3. COMPOSITION OF CONSUMERS AT NIGHT MARKETS IN JALAN 17/1A

Malaysia is a multi-ethnic country with three major ethnic groups: Malays, Chinese, and Indians. Visual, listening, and communicative observations of the demographic information of the night market consumers were conducted through fieldwork in the night market to infer their ethnicity through their looks, skin color, demeanor, mannerisms, and the way of speaking and the language of conversation when buying. The night market consumers were Malays, Chinese, Indians, and foreigners (mainly international students from China). Visual and listening observations through multiple trips to and from the entrance on one side of the night market and the exit on the other revealed that the night market's main consumers were Malays. By analyzing the environment around the night market, it was revealed that there were Malaysian universities and international student housing (including Universiti Islam Malaysia and Universiti Malaya) in the vicinity. Therefore, the night market was patronized by Malaysian locals and international students from various countries (mainly from China).

3.2. OPERATION ISSUES AND IMPACTS OF THE NIGHT MARKET IN JALAN 17/1A

3.2.1. DURING THE OPERATION OF THE NIGHT MARKET IN JALAN 17/1A (FROM 5:30-8:30 PM)

During the night market operation, the present study organized the actual situation through visual recording, photographic recording, statistical surveys, and inductive

analysis, focusing on three aspects of the night market operation: spatial, waste, and waste recycling. The specific conditions were summarized as follows (Table 2).

Table 2. Issues and impacts during the operation of night markets in Jalan 17/1A

Analytical perspectives	Classification in different dimensions		Issues and impacts
Spatial aspects	Businesses Consumers Surroundings	/	<ol style="list-style-type: none"> 1. Night markets were less flexible due to their cramped and crowded nature, where businesses had to enter early, and were too dense in some areas and too sparse in others. 2. Narrow routes for people to move around and the high volume of consumers at the night market's peak triggered congestion and overcrowding problems. 3. The lack of warning signs on the closed sections of the night market led to traffic congestion caused by some vehicles driving to the vicinity of the night market and finding that the intersection was closed.

Waste aspects	Solid waste	<ol style="list-style-type: none"> 1. Fast Food: packaging bags, lunch boxes, bamboo sticks, chicken bones, paper bags, sheep bones, plastic bags, corn picks, eating corn on the cob, packing box straps, beef bones, plastic spoons, chopsticks, etc. 2. Apparel: plastic bags, packaging bags, packaging boxes, cartons, wrapping paper, waste newspapers, etc. 3. Fruit: durian peel, rotten mangosteen, rotten orange, pomegranate peel, orange peel, coconut shell, longan core, longan peel, grape peel, rambutan peel, watermelon peel, fruit packaging, etc. 4. Vegetables: rotten vegetable leaves, fallen leaves, vegetable peels, packaging, etc. 5. Other daily items: masks, cigarette butts, cigarette boxes, mobile phone cases, packaging boxes, napkins, packaging bags, packaging boxes, paper labels, invoices, labels, tags, etc. 6. Fresh meat: shrimp shells, fish scales, fish bones, beef bones, chicken bones, egg shells, etc. 7. Beverage: plastic cups, bags, straws, coconut shells, unfinished drinks, cans, etc. 	<ol style="list-style-type: none"> 1. Solid waste mainly came from the two processes of selling products by businesses and using products by consumers. The solid waste during the night market operation mainly came from fast food, beverages, and other daily items. Food waste is one of the more serious ones. 2. Due to the difficulty in collecting waste liquid and the mobility of waste liquid, some businesses dumped a large amount of waste liquid into the nearest gutter. In contrast, a small amount of waste liquid was spilled on the ground. In addition, some consumers threw away unfinished drinks. 3. Many businesses used high-powered gasoline generators and gas canisters, and fewer used environmentally friendly machines. In addition, the barbecue and frying operated by some businesses resulted in a large amount of smoke and pungent odors in the air.
	Waste liquid	<ol style="list-style-type: none"> 1. Water after cleaning pots, water for cleaning aquatic products, blood water from fresh meat, oil for frying, poured juice, scattered sauces, spilled drinks, egg liquid, 	

	Harmful gas	1. Pollutant gases produced by barbecues, polluted gases produced by generators burning gasoline, polluted gases produced by frying in iron pots, etc.	
Waste recovery aspects	Businesses Consumers	<ol style="list-style-type: none"> 1. Not cleaned up and sprayed on the side of the road. 2. Cleared and left on the side of the road. 3. Cleaned up and taken away/put in trash. 	<ol style="list-style-type: none"> 1. There were no dedicated garbage bins for the night market, and the number of garbage bins in the surrounding area was grossly insufficient (one red and eight blue garbage bins exist) to recycle the large amount of waste generated during the night market operation. 2. Existing garbage bins were too small, poorly categorized, and poorly located, making it inconvenient for businesses and consumers to recycle their waste. 3. Differences in the quality of people's behavior during the night market operation, both among businesses and consumers, led to positive or negative actions towards waste recycling.

To explore the issues of spatial operation in the night market, the present study was based on three perspectives: businesses in the space, consumers in the space, and people surrounding the space. It was found that in terms of the businesses in the space, the businesses were less flexible due to the narrow and crowded nature of the night market after they had entered the night market early, resulting in the emergence of high and low-crowd-density zones in the night market space (Figure 6a). In terms of consumers in the space, the high number of consumers in the area during the peak period of the night market led to the problems of congestion and narrow congestion (Figure 6b). Regarding the surrounding crowds in the space, the lack of warning signs for the closed sections of the night market caused some vehicles to drive to the entrance to find that they could not enter, which caused traffic jams (Figure 6c).



Figure 6. People flow and traffic during the operation of the night markets

To explore the waste management issues in the night market operation, the present study divided the waste for the night market into three main categories: solid waste, waste liquid, and harmful gas. Solid waste was mainly generated from businesses' two processes of selling items in the night market and using the items by consumers. Based on the seven categories of products in the night market, it was found that solid waste was mainly generated from fast food, beverages, and other daily items (Figure 7a). Due to the difficulty of collecting the waste liquid and its mobility, some businesses directly discharged a large amount of waste liquid into the nearest gutter. In contrast, a small amount of wastewater was directly spilled on the ground (Figure 7b). Some consumers threw away unfinished drinks (Figure 7b). In addition, high-powered gasoline generators and gas canisters were everywhere in the night market, and barbecue and frying operated by some businesses resulted in pungent odors and lots of smoke in the air (Figure 7c).



Figure 7. Potential environmental hazards during the operation of night markets

The study investigated and analyzed the recycling of waste from the night market and found that there were no particular garbage bins for the night market in the area and that there were one red and eight blue garbage bins (located in the park to the south of the night market) within a 20 meter of the night market. The number of garbage bins in the immediate area was grossly insufficient to recycle the large amount of waste generated during the operation of the night market (Figure 8a). Existing garbage bins lacked waste segregation, were too small, and positioned too far away from people, making it inconvenient for businesses and consumers to recycle waste (Figure 8b). In addition, there was a big difference in the behavioral qualities of different people among consumers and businesses, leading to positive and negative practices towards waste recycling (Figure 8c).



Figure 8. Waste recycling during the operation of night markets

3.2.2. AFTER THE OPERATION OF THE NIGHT MARKET IN JALAN 17/1A (FROM 9:30-11:30 PM)

At the end of the night market operation, the spatial environmental conditions after the area was used that night were investigated and analyzed from two perspectives: the site where the night market operated and the surrounding area where the night market operated. Different businesses were found to have different behaviors towards the waste in the night market area where they were operating, with some businesses scattering the waste directly on the roadside without cleaning it up after the night market (Figure 9a); some businesses bagging the waste and then setting it aside on the roadside (Figure 9b); as well as some businesses bagging the waste and taking it away. In addition, the waste surrounding the area where the night market operates

was not attended to, and garbage was still everywhere compared to when the night market was in operation (Figure 9c).



Figure 9. Spatial environment after the operation of night markets

Following the end of the night market operation at approximately 11 pm, the area of the night market operation was cleaned up by the solid waste removal department's garbage trucks (truck information: KDEB WASTE, #Smart Selangor), with the project involving solid waste on the roadway surface (Figure 10a). However, a small amount of solid waste that was small and difficult to clean remained after the cleanup (Figure 10b). In addition, the waste removal trucks only targeted solid waste on the roadway surface of the night market. The solid waste in the surrounding areas of the night market was a priority area that they neglected, including the park lawn south of the night market, the drainage ditch near the night market, the flower basins near the night market, the pavilions near the night market; and outdoor fitness equipment near

the night market (Figure 10c). The field survey revealed that a large amount of solid waste around the night market was generated by people using the waste after purchasing at the night market, including various categories of solid and liquid waste.

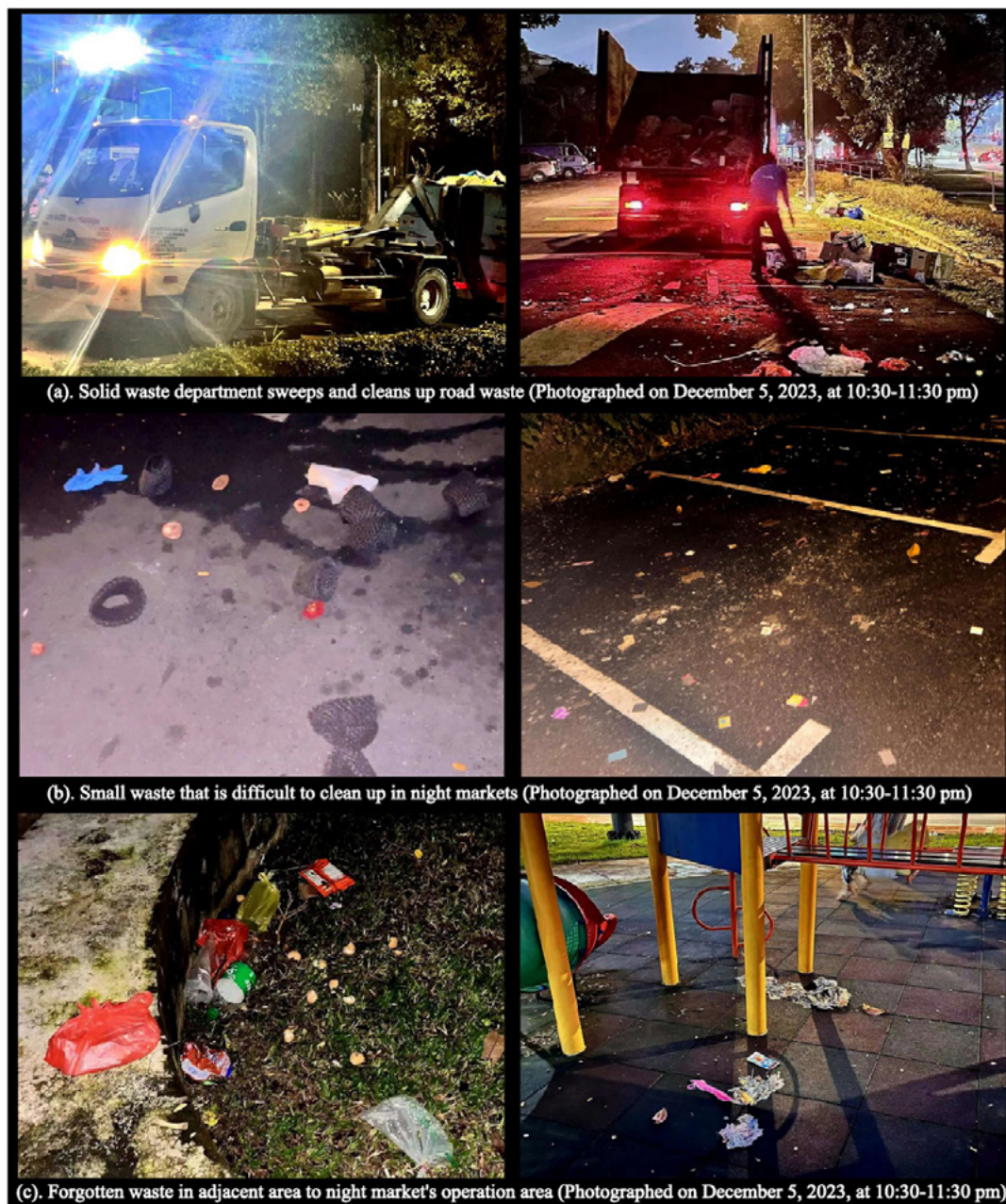


Figure 10. Night markets and surroundings after being cleaned up by the solid waste department

3.2.3. AFTER THE OPERATION OF THE NIGHT MARKET IN JALAN 17/1A (THE NEXT DAY FROM 1:30-3:30 PM & 9:30-11:30 PM)

Malaysia is near the equator and has a tropical rainforest climate with high temperatures and yearly rainfall. In the early morning of December 6, 2023, the liquid and solid waste in the night market operation area was affected by gravity due to the

heavy rainfall weather. The rainwater washed them away to the low-lying areas in the pavement area of the night market, such as the drainage ditch near the night market (Figure 11a). A field investigation on December 6, 2023, at 1:30 pm found that the drainage ditch became a solid and liquid waste-infested area after the night market operation (Figure 11b), with a pungent odor of rotting garbage and infested with flying insects in the air (Figure 11c), and the area was in terrible environmental condition. Additionally, as of 11:30 pm on December 6, 2023, garbage bins surrounding the night market had not been professionally picked up (Figure 11d), and solid waste was still everywhere (Figure 11d). Therefore, the surrounding environmental conditions resulting from the night market operation were terrible, and sustainable management measures needed to be devised to guarantee the night market operation and promote the surrounding area's positive development.



Figure 11. Environmental conditions on the day after the night market operation

4. DISCUSSIONS

4.1. OPTIMIZATION STRATEGIES OF THE NIGHT MARKET IN JALAN 17/1A

4.1.1. EFFECTIVE WASTE MANAGEMENT, SEGREGATION, AND RECYCLING

In response to the issues of waste management and recycling in night markets, it is recommended that the relevant departments and organizations (such as the National Solid Waste Management Department, Solid Waste and Public Cleansing Management Corporation, and Non-governmental Organizations for Waste Environment Protection) take proactive measures to protect the environment. The provision of specialized garbage bins can be increased for informal night markets or prepared by the business owners themselves, and more garbage bins need to be planned for the surrounding areas of the night markets to increase the overall waste holding capacity. In particular, large-sized garbage bins should be provided to meet the demand for bulky waste capacity. The newly deployed garbage bins are equipped with clear segregation signs to encourage night market participants to put out their waste in an orderly manner, facilitating effective waste segregation and recycling. Optimizing the spatial location of garbage bins to match the behavior of participants and adjusting the layout of garbage bins according to people's usage behavior could help improve the effectiveness of drop-offs and increase recycling efficiency. In addition, garbage bins in the surrounding area of the night market should be recycled more frequently, especially after the night market, and the garbage bins should be cleaned out promptly to ensure that the waste management system can be operated efficiently and realize sustainable development.

4.1.2. PROMOTION OF ENVIRONMENTAL AWARENESS AND USE OF SUSTAINABLE RESOURCES

In response to the issues of weak environmental awareness and the use of high-powered polluting machines in night markets, it is suggested that the relevant departments and organizations (such as Solid Waste and Public Cleansing Management Corporation and Non-governmental Organizations for Waste Environment Protection) should take proactive measures to protect the environment. Businesses could be encouraged to be more environmentally conscious and to pack the waste generated in their area after the night market. It is recommended that businesses that generate a lot of waste, such as fast food, beverage, and fruit, have garbage bins and provide consumers with adequate and convenient disposal services. The use of biodegradable plastics, eco-friendly cartons, and other materials in the packaging of items offered by businesses is strongly advocated to minimize the adverse impact on the surrounding environment. Regarding the source of electricity

required for operations, businesses are encouraged to use environmentally friendly practices, such as LED or green batteries, to replace traditional generator lighting, with the aim of meeting lighting needs while reducing the burden on the environment. In addition, it could promote green, environmentally friendly, and sustainable concepts to businesses and encourage the adoption of low-energy consumption and environmentally friendly machines, avoiding the use of high-power and highly polluting equipment. In addition, if technological conditions permit, renewable energy, such as solar energy, could be advocated for a more environmentally friendly night market operation. Through environmental awareness campaigns on the hazards of pollution, businesses and consumers could be sensitized to the sustainable use of energy, which would further lead to a wider consensus on environmental protection and promote substantial progress in sustainability.

4.1.3. RATIONAL SPATIAL PLANNING AND SECURITY MANAGEMENT

In response to the spatial planning and safety management issues arising from the operation of night markets, it is recommended that the relevant departments and organizations (such as the Ministry of Housing and local authorities) take proactive measures to protect the environment. Security or safety guards could be assigned to the night market during operation to ensure safety and reasonable crowd control. It is suggested that the main vehicle entrances and exits within 30 meters of the closed sections for the night market should be marked with eye-catching signs, vehicles be encouraged to choose other roads to pass, and pedestrian-vehicle segregation be implemented to improve the safety of the night market. Where technological and economic conditions permit, intelligent monitoring systems could be introduced to monitor the operation of night markets in real-time to ensure the effective implementation of spatial planning measures and further enhance the safety and regulatory level. On the other hand, the night market planning and evacuation proposal emphasizes planning interventions, rational planning, and evacuation design for dense areas to ensure effective use of night market and space safety. Consideration of adjustments to the layout of business stalls and evacuation adjustments could reduce overcrowding and improve the flow of people in night market operations, which would help minimize potential hazards. Providing holistic spatial planning and safety management aims to create a more pleasant environment for the night market and a new vitality for sustainable development.

4.1.4. MONITORING OF WASTE MANAGEMENT EFFICACY

In optimizing night markets' sustainability and waste management, monitoring waste management efficacy is a critical part of the process. Waste management efficiency is an issue that needs to be focused on, which is an essential factor contributing to the environmental problems observed in this study in night markets. Businesses in Malaysian night markets have operational guidelines from the local

government at the time of their business license issuance. However, the observations suggest that the macro rules guidance is ineffective. The local authority approving business licenses and collecting part of the taxpayers' fees also requires the local authority to contribute more effort to the night market control and governance. Although the macro-operational guidance for night markets exists, weak regulation and lack of detail in some sub-programs lead to almost ineffective governance implementation. In addition, it is not desirable to increase the governance pressure on businesses alone, and more importantly, the misbehavior of night market consumers is nearly not intervened by the local authorities. Therefore, when it comes to the efficiency of waste governance, government regulators need to take responsibility for improving the efficiency of personnel governance for various stakeholders (including government personnel, contractors (who exist in some night markets), merchants, consumers, etc.), and to strengthen the monitoring mechanism among various stakeholders. Encourage the government or local authorities to provide incentives and subsidies for good environmental practices rather than just asking people to initiate change, as most people, including businesses or consumers operating in night markets, might be less understanding of sustainable ecology and less awareness of the need to protect the environment on one's own.

4.1.5. DEVELOPING REGULATIONS AND STRENGTHENING SUPERVISION

In optimizing night markets' sustainability and waste management, formulating regulations and strong supervision is a critical part of the process. It is recommended that the local authorities of Solid Waste Management and Public Cleansing Management set out more detailed regulations and standards for informal and temporary night markets and clarify who is responsible for the waste disposal. Night market traders could be encouraged to set up night market management committees, with the business owners taking turns acting as regulators. Conduct feasibility analysis and implement specific policies to meet the waste disposal needs of night markets, both in terms of allocating particular garbage bins for night markets and increasing the number of garbage bins in the surrounding area. Strengthen law enforcement to monitor waste around the night market, with special attention to critical regions of waste concentration, and regularly clean solid waste from the drains to ensure proper functioning of the drainage system. Poor solid waste management might lead to inefficiency or malfunctioning of the drainage system, which could lead to problems such as flash flooding, while uncleared solid waste covering greenery might also affect the efficiency of rainwater infiltration during heavy rainstorms and regional waterlogging. Modifying and adjusting the existing recycling frequency and encouraging the increase of recycling frequency of garbage bins in the area around the night market could help to reduce the accumulation of waste and pollution issues effectively. On the other hand, scientific assessment could lead to the development of feasible mechanisms for waste management to effectively promote better environmental responsibility among night market participants by rewarding businesses that clean up their waste in an orderly manner and penalizing those that fail to dispose

of their waste. In addition, businesses that emit large amounts of pollutant gases could be restricted and encouraged to replace their equipment with environmentally friendly ones to safeguard the environmental quality and operation towards the sustainable development of the night market.

4.2. NIGHT MARKETS AND WASTE MANAGEMENT PRACTICES AND EXPERIENCE FROM MALAYSIA

The study of spatial operations and waste management generated in the Jalan 17/1A night market in Selangor, Malaysia, reflected the negligence of the Malaysian government towards spontaneous night market spaces formed in the context of the informal economy within a specific region and the challenges of waste management practices in Malaysian night markets. Since 2005, Malaysia's National Strategic Plan (NSP) had a vision for Malaysia to achieve the waste management target of recycling 22% of waste by 2020; however, it was reported that nearly 90% of waste is disposed of in landfills and only 10.5% is recycled [38]. In terms of regulation and enforcement, the two main agencies in Malaysia responsible for the implementation of solid waste management policies and enforcement of regulations are the National Solid Waste Management Department (abbreviated as JPSPN in Malay) and Solid Waste and Public Cleansing Management Corporation (SWCorp), which are under Ministry of Housing and local authorities (abbreviated as KPKT in Malay), and operates and implemented following the Solid Waste and Public Cleansing Management Act 2007 (Act 672) [39]. Evidence revealed that an average of about 38,000 tons of solid waste was sent to more than 100 landfills per day in Malaysia, with approximately 2,500 tons of solid waste collected daily from the capital city of Kuala Lumpur alone, which could be piled up to the height of the Twin Towers in just one week [16]. Therefore, the huge amount of solid waste disposal overloaded the traditional landfill way of disposal in Malaysia (it takes about 20 years to rehabilitate a landfill after it is filled and closed), and the government was trying to build waste-to-energy (WTE) plants and Integrated Recycling Facility (which had an anaerobic digester facility to produce biogas, electricity, and bio-fertilizer) to cope with the shortage of landfills [16].

The night market is indeed a popular activity place for locals in Malaysia; however, night market usually generates a large amount of waste, especially the use of single-use plastics, and some of the zero-waste promoters respond to environmental protection by bringing their utensils and containers to consume at SS2 night market, a behavior that might be rewarded with a certain amount of discounts [40]. The government authorities and waste operations departments have been actively pursuing options for sustainable waste treatment and management by attempting to introduce circular economy and waste recycling practices from developed countries into Malaysia's waste management, but the results have been ineffective in terms of public initiative in sorting, difficulty in sorting wastes, public awareness in recycling, difficulty in recycling, reuse of wastes and energy conversion [16, 39]. Relevant waste management had been actively collaborating with stakeholders, including the community, business sector, and government agencies, to publicize the huge potential

of waste management; nevertheless, after many recycling campaigns conducted by the government over the past decades, most Malaysians still failed to realize the high commodity value of the garbage generated by them, such as causing Malaysia to lose RM476 million worth of recyclable resources annually simply because recycling practices have yet to become the norm in the country [16].

Regulatory controls on waste segregation in Malaysia included fines for people, but people could take advantage of the lack of regulation to avoid the fines, which proved inefficient and even ineffective due to the regulation because there were not enough supervisors [41]. In addition, illegal corruption, management corruption, and insufficient funds were the major reasons that affected the speed of the sustainable waste management process in Malaysia; the local authorities in charge of solid waste management usually outsourced the collection and disposal of solid waste to private companies for operation due to the limited capacity of the governmental personnel in the department, but the municipal solid waste companies that contracted with the local authorities often illegally collected commercial and industrial wastes and other solid wastes to increase the load and difficulty of their operation to obtain more financial expenses, and even imported illegal plastics from other countries overseas for recycling [39]. Therefore, there are several challenges in the exposure of waste management in Malaysia, including the lack of system development for sustainable waste and circular economy, the challenges of waste collection strategy, waste recycling strategy, and waste disposal strategy, and also the lack of people's awareness of waste recycling and environmental protection, which contributed significantly to the problems with the operation and waste management of the night market space in this study.

5. CONCLUSIONS

As one of the dynamic economic manifestations, night markets opened like fireworks in all corners of the world. However, the informality of night markets led to some neglect by stakeholders, which further led to the issues of ecological and environmental pollution. The spatial operation and waste management direction of outdoor night markets had received less attention from academics. In this paper, a field survey on the spatial operation and waste management of night markets in Malaysia was conducted, and the night market in Jalan 17/1A was selected as the case study area to conduct the study at different periods. The result of analyzing the basic information of the night market in Jalan 17/1A showed that many residential areas around the night market brought many consumers, and Malays mainly dominated the businesses. The businesses at the night market specialized in seven types of items: fast food, apparel, fruits, vegetables, fresh meat, beverages, and other daily items. The most numerous of these merchant-operated programs were mostly fast food and apparel. A field study was conducted on the operation of the night market during three critical periods: during the night market operation (5:30-8:30 pm), after the night market operation (9:30-11:30 pm), and the next day after the night market operation (1:30-3:30 pm and 9:30-11:30 pm). The study results found that

night market operations, as a type of urban informal economy, brought economic vitality and economic benefits to the region while simultaneously creating some social and environmental issues. Social issues included overcrowding, traffic congestion, behavioral quality differences, safety hazards, noise from high-power equipment, clogged drains, lack of garbage bins, ill-designed garbage bins, and low frequency of recycling in the waste system. Environmental issues included the three main types of solid waste: fast food, beverages, and other daily items; liquid waste from indiscriminate disposal; high-powered equipment; and smoke gas pollution from cooking.

Based on the night market information analysis results and the time-phased field survey, it is recommended that the relevant departments and organizations take active measures to protect the environment by focusing on the issues arising from spatial operation and waste management. Concentrate on the problems and challenges exposed by night markets, the future sustainable optimization of night markets could emphasize five aspects: effective waste management, segregation, and recycling; promotion of environmental awareness and use of sustainable resources; rational spatial planning and security management; monitoring of waste management efficacy; and developing regulations and strengthening supervision. Recommend targeted and sustainable strategies for the spatial operation and waste management of the night market, aiming to promote the positive development of the surrounding area, creating a more pleasant environment and a newly energized night market. In addition, some policies, practices, and challenges in night markets and waste management in Malaysia were discussed. The study contributed to the broader understanding of sustainable urban practices, with potential implications for urban planning and waste management policies.

This paper conducted a case study on the night market in Selangor, Malaysia, which could focus on the actual situation of the Malaysian night market to a certain extent. However, the results of the fieldwork were only focused on a specific period. Therefore, the present study's findings reflected some of the characteristics and problems of the Malaysian night market but with some limitations. The present study hoped that spatial operation and waste management of night markets would receive more attention from government departments, environmental organizations, and other stakeholders. Hope other researchers explore the sustainable development of night markets in more different regions or by using a more extended period of fieldwork in the future.

6. DATA AVAILABILITY

All the data for this study is available upon request to the author.

7. CONFLICT OF INTEREST

The authors declare that the research has no financial or personal relationships with other people or organizations that can interfere with it.

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