sustainability

MDPI

Article

Developing a Decision-Making Process of Location Selection for Truck Public Parking Lots in Korea

Maowei Chen [1], Tingting Zhao [2], Jungwook Lee [1] and Hyangsook Lee [1,*]

[1] Graduate School of Logistics, Incheon National University, Incheon 22012, Republic of Korea
[2] Department of Economics & Management, Hebei University of Environmental Engineering, Qinhuangdao 066102, China
* Correspondence: hslee14@inu.ac.kr

Abstract: As the number of truck registrations and the traffic volume have increased continuously in urban areas, the problem of truck illegal parking on the roadside has become more serious in Korea. Although the government presented the necessity and the construction plan of the truck public parking lots through the '4th Comprehensive Plan for Expansion of Truck Resting Facilities', there is no detailed guideline for the local government of where to construct them. The previous studies on the location selection of the parking lots have mainly focused on passenger cars and buses, but not trucks, and the process for candidate location selection was not mentioned. To fill this gap, this study presents a decision-making process for the location selection of truck public parking lots in urban areas based on mixed-integer programming; it includes a candidate location selection by spatial analysis and an optimal location determination by the application of the competitive p-median algorithm. A case study of Incheon was conducted to validate the presented decision-making process. This study introduced a systematic decision-making process that includes standards establishment, data processing, and methodology application; it is universalistic enough to be utilized as a guideline for the government to efficiently construct truck public parking lots.

Keywords: truck public parking lot; location selection; spatial analysis; competitive p-median algorithm

check for updates

Citation: Chen, M.; Zhao, T.; Lee, J.; Lee, H. Developing a Decision-Making Process of Location Selection for Truck Public Parking Lots in Korea. *Sustainability* **2023**, *15*, 1467. https://doi.org/10.3390/su15021467

Academic Editor: António Abreu

Received: 8 December 2022
Revised: 2 January 2023
Accepted: 10 January 2023
Published: 12 January 2023

1. Introduction

With economic growth, the Korean freight transportation market has developed rapidly. According to the Korea Transport Data Base (KTDB), truck registration was approximately 3.6 million in 2020. The amount of truck O/D (origin/destination) traffic was 4.45 million in 2017 and increased to 4.46 million in 2020. It is expected to exceed 5.00 million by 2030. However, truck illegal parking on the roadside is becoming more common in parallel with the number of truck registrations and the traffic volume. According to the announcement of the Ministry of Land, Infrastructure and Transport, there was a total of 205,931 illegal truck overnight parking cases from January 2016 to July 2021 in Korea [1].

In order to solve the traffic safety and parking problems and to make comfortable and safe living zones, the Ministry of Land, Infrastructure and Transport announced a plan to expand the truck public parking lots in urban areas through the '4th Comprehensive Plan for Expansion of Truck Resting Facilities (2020–2024)' [2]. This plan includes the short-term plan to expand 30 public parking lots by 2030 (Figure 1) and the long-term plan to add 32 public parking lots by 2050. Although the demand and the construction plan for the truck public parking lots in each administrative area has been identified, no comprehensive implementation plans, such as location selection, have been provided. With the growth of the e-commerce business, more parcel delivery vehicles are now traveling through urban areas. It is urgent to provide sufficient parking facilities for truck drivers and to provide citizens with a comfortable living environment.

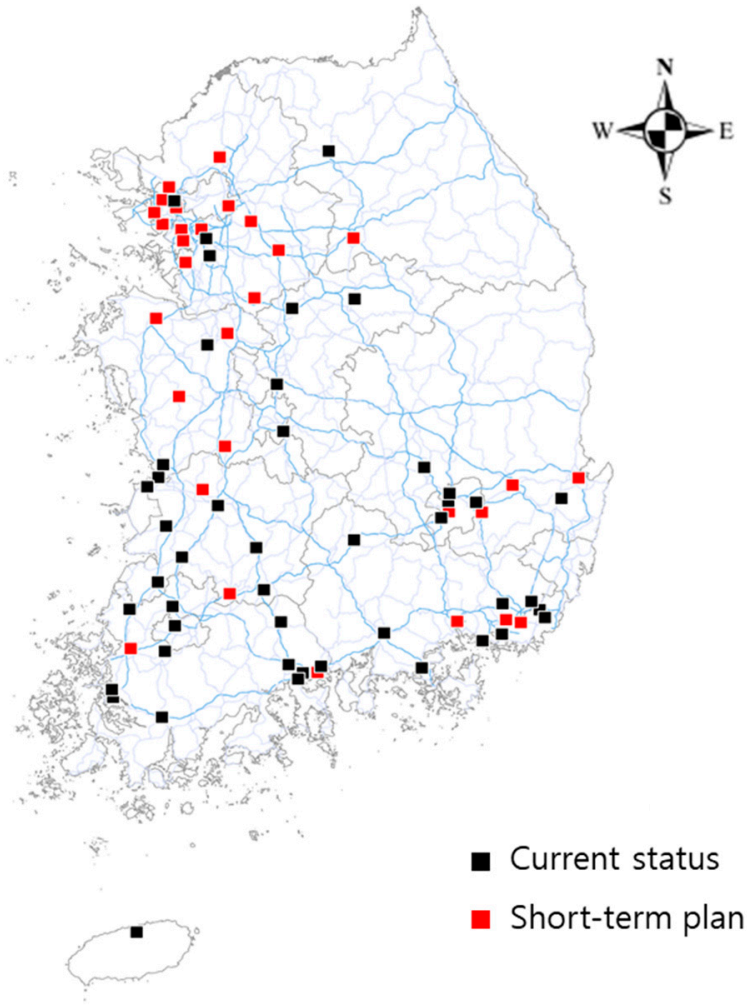


Figure 1. Location of current status of truck public parking lots and short-term plan. Source: Reprinted/adapted with permission from Ref. [2]. 2019, Ministry of Land, Infrastructure and Transport.

Public parking lots for trucks have a different function than the normal parking lots in Korea. Unlike the normal parking lots, which are usually located near the commercial centers to serve all drivers who park their cars for several hours, the truck public parking lots only provide parking service for commercial trucks. Truck drivers can also maintain the trucks at the truck public parking lots. Therefore, the area of a truck public parking lot is wider than the normal parking lots. Due to the limited land usage, finding an optimal location for a public parking lot is difficult [3]. To construct truck public parking lots in urban areas efficiently, this study aims to develop a decision-making process for the location selection of truck public parking lots. Compared with most location problem studies of parking facilities, which exclude the phase of candidate location selection, this paper presents a decision-making process that includes candidate location selection based on geographic information system (GIS) spatial analysis and optimal location determination by applying a competitive p-median algorithm. Furthermore, Michuhol-gu in Incheon, where it is urgent to expand the parking space for trucks, will be analyzed as a case study to validate the presented decision-making process. In order to enable local governments to effectively apply the decision-making process to the construction of truck public parking lots, this study proposes a more systematic and universal location selection process, including the standard establishment, data collection and processing, and methodology application. This study can be widely utilized as a guideline for the government to construct truck public parking lots in urban areas. The flow of this study is as below (Figure 2).

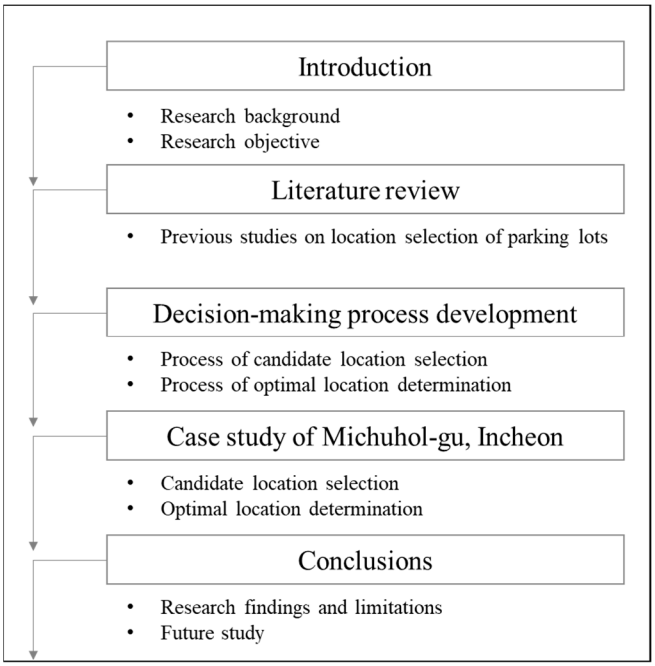


Figure 2. Research flow.

2. Literature Review

Parking space allocation and location selection are two typical topics in the previous studies related to parking lots. In the parking space allocation problem, most studies [4–7] presented mathematical models with time-window constraints that considered the characteristics of the reservation of the available parking lots. With technology development, several studies [8,9] solved parking space allocation problems with a focus on IoT-based and smart parking lots. In huge cities with large-scale applications of parking space allocation problems, the genetic algorithm and tabu search are representative methodologies for large-scale applications in huge cities [10]. For the efficient supply of parking spaces, it is important to establish strategies according to the type of users (fixed users or not, public users or private users, etc.) [5].

The main purpose of this section is to review the studies that focused on location selection problems for parking lots rather than the parking space allocation problems. Based on the literature review (Table 1), the research approaches for the location selection problems of parking lots can be classified as mixed-integer programming (MIP) and multi-criteria decision making (MCDM). The goals of the MIP model are generally cost minimization or coverage maximization [11]. As one of the typical algorithms for minimizing cost (distance or time), the p-median was mentioned repeatedly in the previous studies [3,12,13]. In addition, Kim and Ahn [14] established an MIP model to minimize the driving time when selecting a parking lot nearby a subway station. Coverage maximization was commonly employed to find the smallest number of parking lots, although it did not appear as frequently as cost minimization in the past studies. Ruan et al. [15] developed an MIP model intended to maximize coverage in order to determine the required number of parking spaces. Several studies considered the capacity of parking lots as well as the weight when applying MIP models for the location selection. Aliniai et al. [16] presented an MIP model to select the optimal locations for passenger cars by considering the area as the capacity of the parking lots. Kazemi et al. [17] considered the number of electric vehicles as the capacity when selecting the best locations for electric vehicle parking lots. The parking lot's area and the number of available parking spaces were commonly used as the capacity. Whether weight can be considered depends on the characteristics of the parking lots. In the case of the location selection of the passenger car parking lots in the city area, the weight is hard to consider due to no units being the cause of the demand (passenger cars). When

there are specific service targets for the parking lots, the weight can be considered. Kim [11] applied the number of school bus operation days as a weight when selecting the location for the school bus parking lot. Park et al. [13] considered the population as a weight for selecting the bicycle parking lot location.

Table 1. Summary of the literature review.

Model	Author	Facility	Method	Main Factors
MIP	Go et al. [3]	Bus public parking lot	Distance minimization/p-median	Parking area, Travel distance
	Kim [11]	School bus parking lot	Cost minimization	Installation and operating cost, Bus operating distance
	Wann-Ming [12]	Parking lot	Distance minimization/p-median	Travel distance
	Park et al. [13]	Bicycle parking lot	Cost minimization/p-median	Installation cost, Walking time
	Kim and Ahn [14]	Subway station parking lot	Time minimization	Travel time by car, Walking time, Subway travel time
	Ruan et al. [15]	Parking lot	Space–time accessibility maximization	Travel time, Spatial network
	Aliniai et al. [16]	Parking lot	Cost minimization/Cover maximization	Travel time
	Kazemi et al. [17]	Electric vehicle parking lot	Profit maximization	Cost of installation and maintenance
MCDM	Penki et al. [18]	Parking lot	AHP and GIS	Distances from commercial centers, administrative centers, educational centers, hospitals, and cultural and recreational centers
	Baseri et al. [19]	Public parking lot	AHP–GIS	Distance from the commercial centers, Distance from the sanitary–therapeutic centers, Distance from the official governmental centers, Distance from educational recreational centers
	Kulinich and Lee [20]	Parking lot	GIS	Distance to major centers, Population, Efficient land use for parking places, Attainment of major streets, Existing parking facilities
	Kazazi Darani et al. [21]	Parking lot	AHP–TOPSIS	Population density, Traffic congestion, Air pollution, Accessible routes, Distance from public places, Value of property
	Karimi et al. [22]	Public parking lot	AHP–GIS	Distance from the trade, Service, Office, Tourist centers, Attainment, Construction quality

The MIP model has the advantage of being a way of finding a solution using a mathematical model, which ensures the objectivity of the selection outcome and has great analysis efficiency. However, the external influence elements, such as policy issues and public attitudes, cannot be considered. In the case of using MCDM, the analytic hierarchy process (AHP) is the representative method. The AHP method is used for ranking and weighing the different criteria that affect the selection of parking facilities [18]. The distances from commercial centers [19,20], administrative centers, educational centers [19,21], tourist centers [22], and other places were commonly considered. The selected factors are ranked and weighed using AHP. The GIS can always be applied to obtain information about land usage. As the MCDM model mainly conducts surveys, the external influence factors (policy issues, opposition from residents, etc.) can be reflected through qualitative evaluation. However, it lacks impartiality when compared to the MIP model and has the drawback of results that vary significantly depending on the survey participants.

Overall, the implications of the literature review on location selection for parking lots can be summarized in two parts. (1) Inadequate research has been conducted on truck parking facility location selection. Most papers have focused on the location selection for general parking lots, which mostly provide space for passenger cars and buses in urban areas. Unlike the general parking lots, and considering the accessibility to the commercial and administrative centers, the location of the truck public parking lot should have good accessibility to the logistics facilities and highways. However, no studies focused on it. (2) Before determining the optimal locations for the parking facilities, the method for

selecting the candidate locations was not introduced. The previous papers that apply the MIP model usually use the existing locations or select the candidate locations arbitrarily. However, from the perspective of local government (the responsible party for truck public parking lot construction), a systematic and universal decision-making process that includes candidate location and final location selection is required.

3. Decision-Making Process Development

From the perspective of public institutions, the location selection for public facilities has the primary goal of social minimization, access, deficiency, and equity [23]. Given that the MIP model has high objectivity and efficiency, this study presented a two-phase decision-making process based on the MIP model.

3.1. Process of Candidate Location Selection

The factors to be considered in selecting candidate locations for truck public parking lots include the following items: exclusion zones, the shortest distance to living facilities, land area, average slope, and accessibility.

The exclusion zones mean the lands that already have existing facilities or are restricted from being developed (including the urban planning ordinance). Based on the 'Enforcement Rules of the Parking Lot Act' and Go et al. [3], the shortest distance to living facilities can be arranged as in Table 2. In this study, the shortest distance to living facilities was set by the strictest standard of 100 m (based on the boundaries).

Table 2. Summary of the shortest distance to living facilities.

Type of the Facility	Shortest Distance
Residence	100 m
Educational facilities	50 m
Medical facilities	25 m
Type 1 * protection facilities excluding medical and educational facilities	17 m
Type 2 ** protection facilities excluding apartment houses	12 m

* Type 1 protection facilities: schools, kindergartens, daycare centers, children's playgrounds, private educational institutes, hospitals (including clinics), libraries, youth training facilities, senior citizens' halls, markets, public baths, hotels, theaters, churches; buildings accommodating people (excluding temporary buildings) with a total floor area of at least 1000 m^2 of virtually independent parts; wedding halls, funeral halls, exhibition halls, and other similar facilities which can accommodate more than 300 people; buildings that can accommodate more than 20 people as a child welfare facility or a welfare facility for the disabled; buildings designated as cultural properties. ** Type 2 protection facilities: apartment houses; buildings accommodating people (excluding temporary buildings) with a total floor area between 100 m^2 and 1000 m^2.

The minimum land area was presented based on the average area (35,754 m^2) of the public lots for trucks in operation and under construction (Table 3).

Table 3. The average area of truck public parking lots.

Section	Number	Average Area	Average Capacity
In operation	30	34,996 m^2	237 trucks
Under construction	22	36,545 m^2	291 trucks
Total (Average)	52	35,754 m^2	263 trucks

Source: National Logistics Information Center [24].

According to the 'Enforcement Rules of the Parking Lot Act', the slope of the parking ramp should not exceed 17° in the straight part and 14° in the curved part. As the existing 32 truck public lots are located nearby the highway IC, within 5 km, and considering the truck transport pattern, in which trucks enter the highway with cargo loaded, the distance from the highway IC was set to 5 km for the traffic accessibility of truck public lots in this study.

Synthesizing the standards above, a process of selecting candidate locations for truck public parking lots is presented in Figure 3.

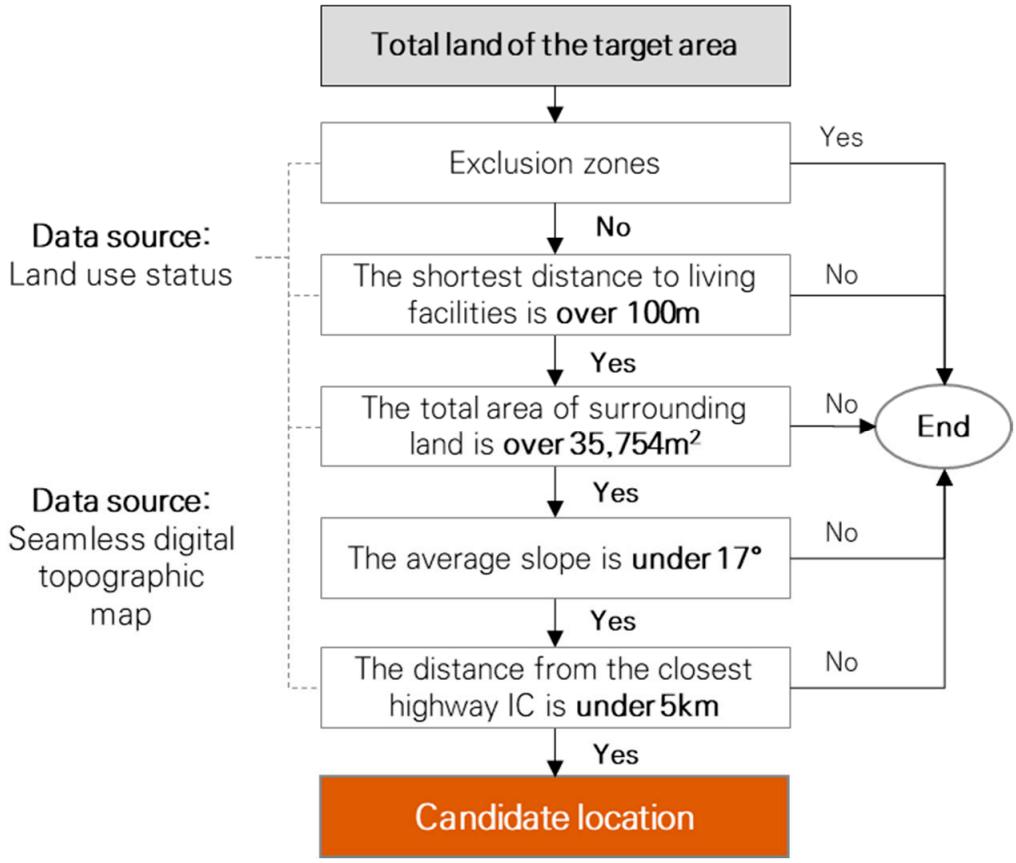


Figure 3. Process of selecting candidate locations.

3.2. Process of Optimal Location Determination

This study presents the p-median algorithm to determine the optimal location among the candidates. The p-median algorithm was first introduced by Hakimi [25] to select the optimal switching center in a communication network and the best place to build a 'police station' in a highway system; the objective is to minimize the total weighted travel distance associated with a network of demand nodes by locating p-facilities on the network, where each demand node is served by its closest facility [26]. To provide a more realistic solution for the optimal location, the p-median algorithm was applied to minimize the total weighted driving time between the truck public parking lots and the logistics facilities in this paper, and can be described by the equations given below:

$$\text{Minimize} \quad \sum_{i \in I} \sum_{j \in J} h_i t_{ij} Y_{ij} \tag{1}$$

$$\text{Subject to} \quad \sum_{j \in J} Y_{ij} = 1 \; \forall i \in I \tag{2}$$

$$\sum_{j \in J} X_j = P \tag{3}$$

$$Y_{ij} \leq X_j \; \forall i \in I, \; \forall j \in J \tag{4}$$

$$X_j \in \{0, 1\} \; \forall j \in J \tag{5}$$

$$Y_{ij} \in \{0, 1\} \; \forall i \in I, \; \forall j \in J \tag{6}$$

Input parameters:
Set J is the candidate truck public parking lot;
Set K is the existing truck public parking lot;
Set I is the logistics facility;

h_i is the weight of the logistics facility i;

t_{ij} is the driving time between the candidate truck public parking lot $j \in J$ and the logistics facility $i \in I$;

P is the number of truck public parking lots.

Decision variables:

If a candidate truck public parking lot j is installed, $X_j = 1$; otherwise, $X_j = 0$;

If logistics facility i uses candidate truck public parking lot j, $Y_{ij} = 1$; otherwise, $Y_{ij} = 0$.

However, the basic p-median algorithm could not reflect the fact that some of the drivers will choose the closest existing truck public parking lot. To reflect the sharing of the existing lots, this study introduces a competitive p-median algorithm to solve the problem.

$$\text{Minimize} \quad \sum_{i \in I} \sum_{j \in J} \sum_{k \in K} (h_i t_{ij} Y_{ij} + h_i t_{ik} Y_{ik}) \tag{7}$$

$$h_i = 8.96 + 0.0008 \times Area_i \left(\text{unit}: \ \text{m}^2\right) \tag{8}$$

$$\text{Subject to} \quad \sum_{j \in J} Y_{ij} = 1 \ \forall i \in I \tag{9}$$

$$\sum_{j \in J} X_j = P \tag{10}$$

$$Y_{ij} \leq X_j \ \forall i \in I, \ \forall j \in J \tag{11}$$

$$X_j \in \{0, 1\} \ \forall j \in J \tag{12}$$

$$Y_{ij} \in \{0, 1\} \ \forall i \in I, \ \forall j \in J \tag{13}$$

$$Y_{ik} \in \{0, 1\} \ \forall i \in I, \ \forall k \in K \tag{14}$$

Input parameters:

J is the candidate truck public parking lot;

K is the existing truck public parking lot;

I is the logistics facility;

h_i is the weight of the logistics facility i;

$Area_i$ is the area of the logistics facility i;

t_{ij} is the driving time between the candidate truck public parking lot $j \in J$ and the logistics facility $i \in I$;

t_{ik} is the driving time between the existing truck public parking lot $k \in K$ and the logistics facility $i \in I$;

P is the number of truck public parking lots.

Decision variables:

If t_{ij} is greater than t_{ik}, the logistics facility i will use the existing truck public parking lot k; $Y_{ij} = 0$. In this case, a logistics facility i uses the existing truck public parking lot k; $Y_{ik} = 1$.

If t_{ik} is greater than t_{ij}, the logistics facility i will use the candidate truck public parking lot j; $Y_{ik} = 0$. In this case, if a candidate truck public parking lot j is installed, $X_j = 1$; otherwise, $X_j = 0$. If logistics facility i uses candidate truck public parking lot j, $Y_{ij} = 1$; otherwise, $Y_{ij} = 0$.

Using the volume of the truck trip generation as the weight of each logistics facility is the best option; however, it is hard to obtain the exact data. In the previous studies on truck trip generation estimation, multiple-regression analysis, cross-classification, and land area and trip rate analysis were the typical techniques [27]. The land area and the number of employees were presented as the most common factors. de Oliveira et al. [28] developed a model (Table 4) for estimating the warehouse truck trip generation, which is applied in this study as Equation (8).

Table 4. Warehouse freight trip generation model, developed by de Oliveira et al. [28].

Variable	Coefficient	R^2	*t*-Test *	*p*-Value
Intercept	8.96	0.83	7.378	0.00 *
Total area	0.0008		9.913	

* 99% confidence level.

4. Case Study

To validate the presented decision-making process, Michuhol-gu of Incheon was analyzed as a case study. According to the '4th Comprehensive Plan for Expansion of Truck Resting Facilities (2020–2024)', Michuhol-gu of Incheon has no public parking lots for trucks and needs to construct one in the short term. The number of registered trucks in Michuhol-gu was 22,492, and the number of registered special vehicles was 1277 [29]. In 2020, the number of illegal overnight parking trucks in Michuhol-gu was 899 [30].

4.1. Candidate Location Selection

The candidate locations for the truck public parking lots in Michuhol-gu were selected by the process presented in Section 3.1. The overall land use status of Michuhol-gu was selected in the National Geospatial Information Portal and analyzed by ArcGIS Pro (Figure 4). Until July 2021, the total land area of Michuhol-gu was about 24,867,000 m^2, and the residential and commercial areas were 21,834,000 m^2, accounting for 88%.

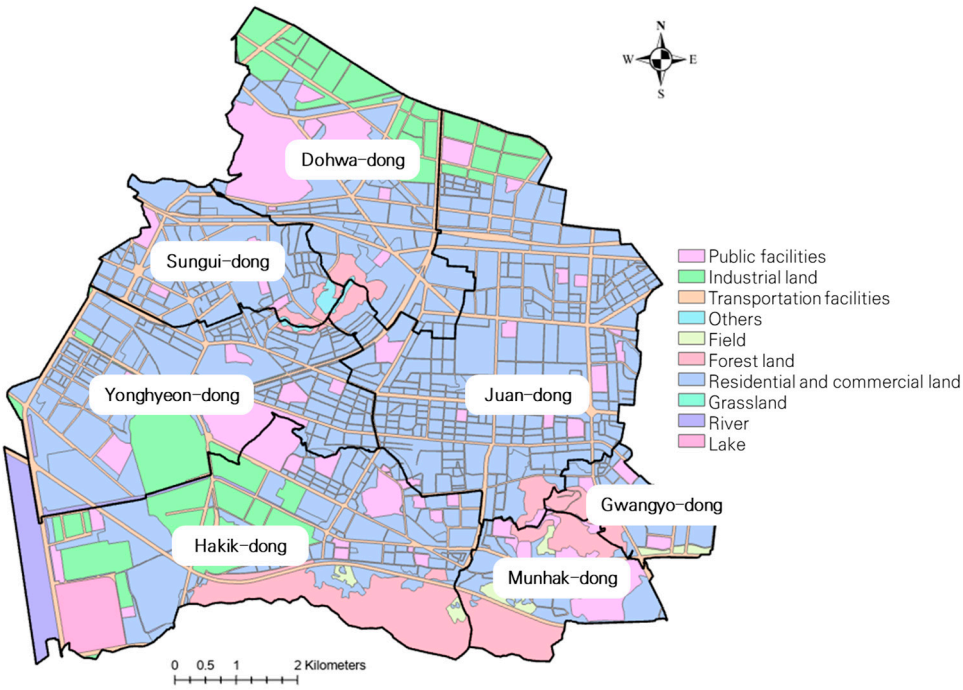


Figure 4. Overall land use status of Michuhol-gu.

The candidate locations were selected by following steps:

1. Deleting the exclusion zones and the lands with the shortest distance to living facilities under 100 m (Figure 5a).
2. Deleting the lands which have an area under 35,754 m^2 (Figure 5b).
3. Using the 3D function of ArcGIS Pro to analyze the seamless digital topographic map and exclude the lands with an average slope higher than 17° (Figure 5c).
4. Excluding the lands with a driving distance of more than 5 km to the highway IC (Figure 5d).

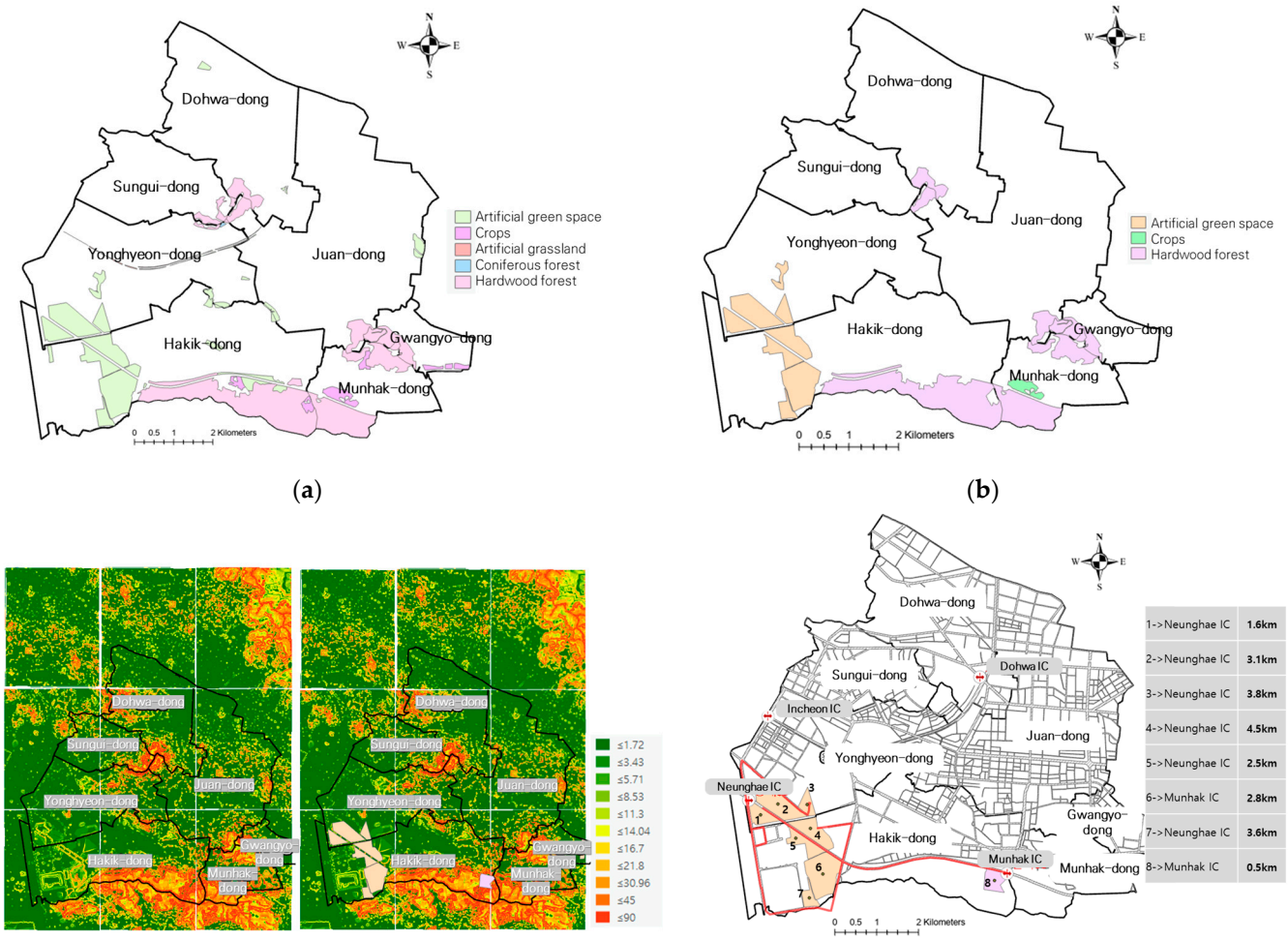


Figure 5. Results of candidate location selection by steps. (**a**) Available location after step 1. (**b**) Available location after step 2. (**c**) Available location after step 3. (**d**) Available location after step 4.

In the final stage of the candidate location selection, this paper accurately identified the actual land condition and presents three candidate locations for the truck public parking lots in Michuhol-gu, as shown in Figure 6.

4.2. Optimal Location Determination

4.2.1. Truck Trip Generation and Driving Time Calculation

The location information of the logistics facilities located in Incheon was collected from the National Logistics Information Center. There are about 337 logistics facilities registered as warehouse businesses in Incheon and 3 of them are located in Michuhol-gu. Jung-gu is adjacent to Michuhol-gu and has the largest number (207). The truck trip generation from each logistics facility was calculated based on Equation (8), as presented previously (Table 5).

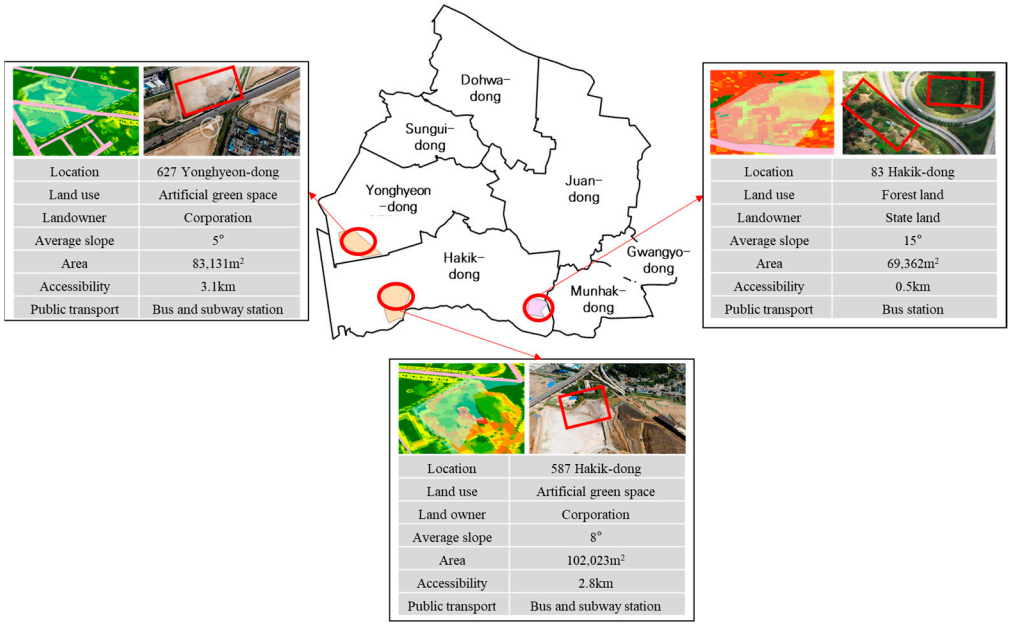


Figure 6. Results of candidate location selection.

Table 5. Basic statistics results of logistics facility area and truck trip generation.

Section	Area (m^2)	Truck Trip Generation
Total	5,669,125	4544
Min	1	9
Max	747,590	607
Average	16,822	22

Source: National Logistics Information Center [24].

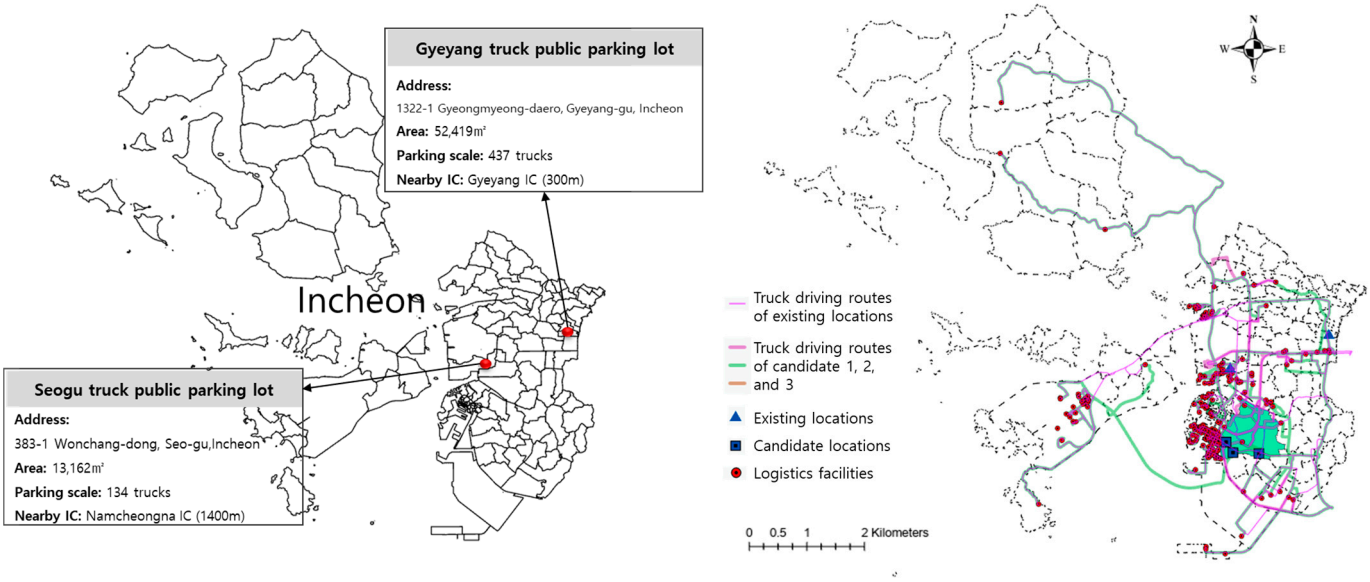
The existing truck public parking lots in Incheon were confirmed by the Taxi and Logistics Division of Incheon City (April 2022). There are two existing truck public parking lots; one is located in Seogu, and the other is located in Gyeyang (Figure 7a). By using the truck vehicle travel time analysis function provided by ArcGIS Pro, the driving time from the candidate locations to the logistics facilities was derived (Figure 7b).

The total and average truck driving time in 627 Yonghyeon-dong was the shortest. On the other hand, in 587 Hakik-dong it was the longest (Table 6).

Table 6. Truck driving time from candidate locations to logistics facilities.

Parking Lot Location		Total	Min	Max	Average
Existing parking lots	Seogu	6097	1	60	18
	Gyeyang	8166	6	67	24
Candidate parking lots	627 Yonghyeon-dong	4710	2	83	14
	587 Hakik-dong	8590	13	82	26
	83 Hakik-dong	8204	12	80	24

Unit: min.



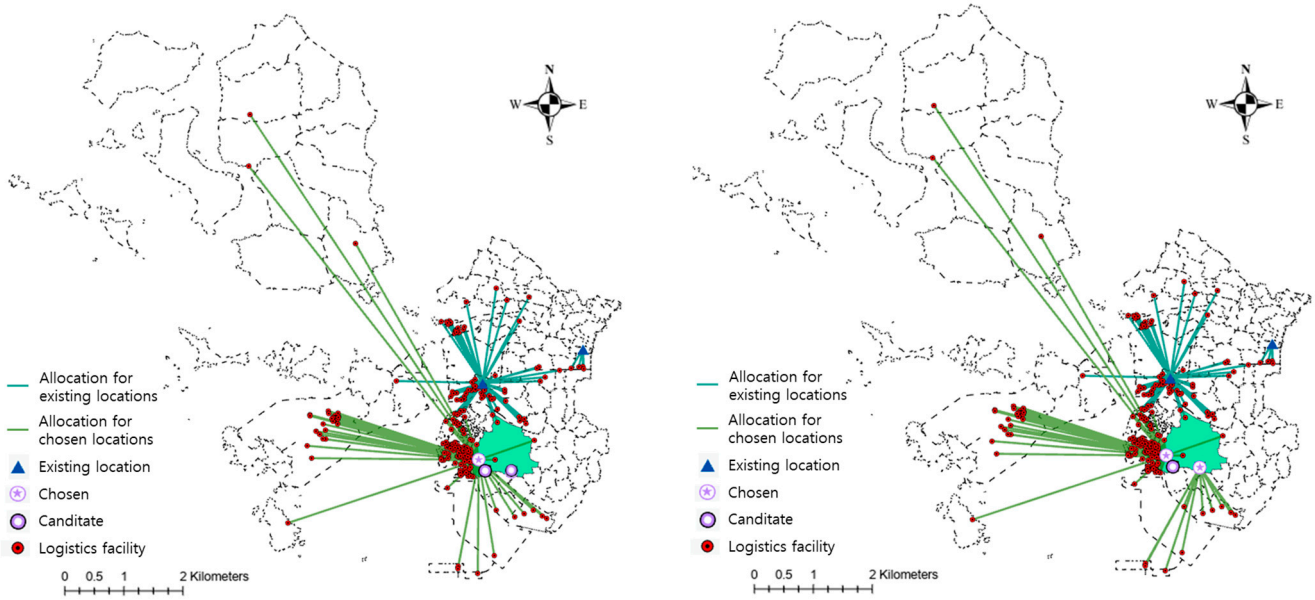
(**a**) (**b**)

Figure 7. Driving time calculation by ArcGIS. (**a**) Location of existing truck public parking lots. (**b**) Real driving time by trucks.

4.2.2. Scenario of Results

This study used the IBM ILOG CPLEX Optimization Studio program to apply the competitive p-median algorithm and showed a scenario in which the final number of public lots for trucks in Michuhol-gu is one and two. The areas of the logistics facilities were applied as the weight.

When applying the competitive p-median algorithm, which considered the existing lots' locations, 627 Yonghyeon-dong was presented as the best location in Michuhol-gu (Figure 8a). If two public parking lots for trucks were needed, 83 Hakik-dong would be the other optimal location (Figure 8b). Detailed information about each location is shown in Table 7.



(**a**) (**b**)

Figure 8. Results of optimal location selection. (**a**) $p = 1$. (**b**) $p = 2$.

Table 7. Information about optimal locations.

p Value	Location	Land Use	Landowner	Average Slope	Area	Accessibility
$p = 1$	627 Yonghyeon-dong	Artificial green space	Corporation	5°	83,131 m^2	3.1 km
$p = 2$	627 Yonghyeon-dong 83 Hakik-dong	Artificial green space Forest land	Corporation State land	5° 15°	83,131 m^2 69,362 m^2	3.1 km 0.5 km

5. Conclusions

With the number of registered trucks and the amount of traffic in Korea gradually increasing, it is urgent to ensure sufficient resting facilities for truck drivers. The Ministry of Land, Infrastructure and Transport established a plan for the construction of rest facilities to provide convenience to truck drivers through the '4th Comprehensive Plan for Expansion of Truck Resting Facilities (2020–2024)'. However, there are no detailed guidelines for the construction.

This paper presented a decision-making process for selecting the optimal locations of truck public parking lots based on the MIP model. The decision-making process includes candidate location selection and optimal location determination, which are implemented individually by spatial analysis and a competitive p-median algorithm. Exclusion zones, the shortest distance to living facilities, land area, average slope, and accessibility are considered in the phase of candidate location selection. The competitive p-median algorithm used in this study was improved by considering existing lots' influence in minimizing the driving time, rather than the distance, to reinforce the rationality. Moreover, Michuhol-gu of Incheon was implemented as a case study to validate the developed decision-making process and provide a more detailed process description.

As finding optimal locations for truck public parking lots is difficult in urban areas, the decision-making process presented in this study has the excellence of objectivity, scientificity, and rationality; moreover, it contributes academically to the more efficient construction of the truck public parking lots. However, this study still has limitations such as a lack of reflection on the social issues, such as opposition from residents. The detailed master plan of urban planning could not be considered due to the unestablished spatial data about it. Because the data such as the number and types of trucks from the logistics facilities were not provided, this study could not consider the capacity and the relationship between the trucks and the facilities. In the future, the related statistic institutes are recommended to make a system to select the detailed data of trucks, and the capacity and relationship between the trucks and the facilities can be considered based on that. Moreover, depending on the future policy changes and data quality improvement, future studies will be able to continuously improve the decision-making process of the location selection for truck public parking lots based on this study.

Author Contributions: Conceptualization, M.C. and H.L.; methodology, M.C. and H.L.; software, M.C.; resources, M.C., T.Z. and J.L.; data curation, M.C., T.Z. and J.L.; writing—original draft preparation, M.C., T.Z. and J.L.; writing—review and editing, M.C. and T.Z.; visualization, M.C.; supervision, H.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Publicly available datasets were analyzed in this study. These data can be found here: [https://www.nlic.go.kr/nlic/front.action] accessed on 1 October 2022, [https://www.ktdb.go.kr/eng/index.do] accessed on 1 October 2022, [http://www.nsdi.go.kr/lxportal/] accessed on 1 October 2022.

Acknowledgments: This research was presented at the 9th International Conference on Transportation & Logistics (T-LOG 2022).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Daily Consumer News. Available online: https://www.dailycnc.com/news/articleView.html?idxno=208249 (accessed on 1 October 2022).
2. Ministry of Land, Infrastructure and Transport. *4th Comprehensive Plan for Expansion of Truck Resting Facilities (2020–2024)*; Ministry of Land, Infrastructure and Transport in South Korea: Seoul, Republic of Korea, 2019.
3. Go, S.R.; Park, J.S.; Kim, G.J.; Choi, Y.S. Methodology for Location Problem of Public Bus Depot: Focusing on Incheon City. *J. Transp. Res.* **2019**, *26*, 101–113.
4. Shao, C.; Yang, H.; Zhang, Y.; Ke, J. A simple reservation and allocation model of shared parking lots. *Transp. Res. Part C Emerg. Technol.* **2016**, *71*, 303–312. [CrossRef]
5. Cai, Y.; Chen, J.; Zhang, C.; Wang, B. A parking space allocation method to make a shared parking strategy for appertaining parking lots of public buildings. *Sustainability* **2018**, *11*, 120. [CrossRef]
6. Xue, Z.; Cheng, J.; Ji, K. An Allocation Model of Shared Parking with Continuous Time Windows. In Proceedings of the 2021 IEEE 8th International Conference on Industrial Engineering and Applications (ICIEA), Chengdu, China, 23–26 April 2021.
7. Zhao, P.; Guan, H.; Wei, H.; Liu, S. Mathematical modeling and heuristic approaches to optimize shared parking resources: A case study of Beijing, China. *Transp. Res. Interdiscip. Perspect.* **2021**, *9*, 100317. [CrossRef]
8. Kotb, A.O.; Shen, Y.C.; Zhu, X.; Huang, Y. iParker—A new smart car-parking system based on dynamic resource allocation and pricing. *IEEE Trans. Intell. Transp. Syst.* **2016**, *17*, 2637–2647. [CrossRef]
9. Kong, X.T.; Xu, S.X.; Cheng, M.; Huang, G.Q. IoT-enabled parking space sharing and allocation mechanisms. *IEEE Trans. Autom. Sci. Eng.* **2018**, *15*, 1654–1664. [CrossRef]
10. Errousso, H.; El Ouadi, J.; Alaoui, E.A.A.; Benhadou, S. Dynamic parking space allocation at urban scale: Problem formulation and resolution. *J. King Saud Univ. Comput. Inf. Sci.* **2022**, *34*, 9576–9590. [CrossRef]
11. Kim, K.H. The Optimal Location of School Bus Depot System. *KSCE J. Civ. Environ. Eng. Res.* **2000**, *20*, 647–656.
12. Wann-Ming, W. Dynamic parking facility location with time-dependent demands: The progressive p-median problem. *Proc. East. Asia Soc. Transp. Stud.* **2003**, *4*, 462–469.
13. Park, B.R.; Lee, K.J.; Choi, K.J. Optimum Location Choice for Bike Parking Lots Using Heuristic P-Median Algorithm. *J. Korean Soc. Civ. Eng.* **2013**, *33*, 1989–1998. [CrossRef]
14. Kim, Y.T.; Ahn, B.T. Model establishment and case analysis for optimal location selection of parking lot near station area. *Stat. Consult.* **1990**, *5*, 29–39.
15. Ruan, J.M.; Liu, B.; Wei, H.; Qu, Y.; Zhu, N.; Zhou, X. How many and where to locate parking lots? A space–time accessibility-maximization modeling framework for special event traffic management. *Urban Rail Transit* **2016**, *2*, 59–70. [CrossRef]
16. Aliniai, K.; Yarahmadi, A.; Zarin, J.Z.; Yarahmadi, H.; Lak, S.B. Parking lot site selection: An opening gate towards sustainable GIS-based urban traffic management. *J. Indian Soc. Remote Sens.* **2015**, *43*, 801–813. [CrossRef]
17. Kazemi, M.A.; Sedighizadeh, M.; Mirzaei, M.J.; Homaee, O. Optimal siting and sizing of distribution system operator owned EV parking lots. *Appl. Energy* **2016**, *179*, 1176–1184. [CrossRef]
18. Penki, R.; Srinivasa Rao, T.; Vinod Naik, G.; Aparna, R. Identification of Parking Sites in the Kukatpally Region Using GIS and AHP. *Adv. Constr. Mater. Sustain. Environ.* **2022**, *196*, 447–456.
19. Baseri, M.A.; Malekabadi, R.M.; Gandomkar, A. Site selection of public parking in Isfahan City, using AHP Model. *Int. J. Humanit. Soc. Sci.* **2012**, *6*, 547–550.
20. Kulinich, I.; Lee, H. Parking Site Selection in Downtown of Khabarovsk City Using GIS. *Int. J. Smart Home* **2016**, *10*, 15–24. [CrossRef]
21. Darani, S.K.; Eslami, A.A.; Jabbari, M.; Asefi, H. Parking lot site selection using a fuzzy AHP-Topsis framework in Tuyserkan, Iran. *J. Urban Plan. Dev.* **2018**, *144*, 04018022. [CrossRef]
22. Karimi, W.; Ebadi, H.; Ahmadi, S. Public Parking Site Selection using GIS. *Map World Forum* **2016**, *112*, 1–9.
23. Haase, K.; Knörr, L.; Krohn, R.; Müller, S.; Wagner, M. Facility location in the public sector. In *Location Science*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 745–764.
24. National Logistics Information Center. Available online: https://www.nlic.go.kr/nlic/front.action (accessed on 1 October 2022).
25. Hakimi, S.L. Optimum locations of switching centers and the absolute centers and medians of a graph. *Oper. Res.* **1964**, *12*, 450–459. [CrossRef]
26. Church, R.L.; ReVelle, C.S. Theoretical and computational links between the p-median, location set-covering, and the maximal covering location problem. *Geogr. Anal.* **1976**, *8*, 406–415. [CrossRef]
27. Brogan, J.D. Development of truck trip-generation rates by generalized-land use categories. *Transp. Res. Rec.* **1979**, *716*, 38–43.
28. de Oliveira, L.K.; Lopes, G.P.; de Oliveira, R.L.M.; Bracarense, L.D.S.F.P.; Pitombo, C.S. An investigation of contributing factors for warehouse location and the relationship between local attributes and explanatory variables of Warehouse Freight Trip Generation Model. *Transp. Res. Part A Policy Pract.* **2022**, *162*, 206–219. [CrossRef]
29. Korean Statistical Information Service. Available online: https://kosis.kr/index/index.do (accessed on 1 October 2022).
30. Incheonilbo. Available online: http://www.incheonilbo.com/news/articleView.html?idxno=1083981 (accessed on 1 October 2022).