

Distributional Characteristics of Independently-Located Factories in Non-Urbanized Area of Gimpo City, Korea

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Abstract

It has been recognized that, independently-located factories (ILF) have been recognized as serious problem from the urban planning point of view in non-urbanized area. The problem has been rooted from the fact that the factories have caused environmental pollution, destroyed landscape, and affected human health. To solve these problems, it is necessary to find the distributional characteristics of ILFs.

This study has intended to analyze the characteristics of ILFs in non-urbanized area in Gimpo city, where ILFs have been heavily agglomerated and serious environmental and human health-related problems have been shown. To reach this goal, we collected data related to ILFs located in Gimpo city from the 'Factory on system' (www.femis.go.kr). The collected data were displayed on a map. Finally, this study has tried to find the distribution patterns of ILFs from 2000 to 2013 using quadrat analysis. As a result, this study has found the following results: 1) concentric distributions appeared at the center and north-east of Daegot-myeon, south-west of Haseong-myeon and east and south of Yangchon-eup; 2) wide distributions appeared in Tongjin-eup.

Keywords: Independently-Located Factory (ILF), Urban Sprawl, Non-urbanized Area, Gimpo City, Quadrat Analysis

1. Introduction

In city planning today, industrial and urban sprawl have become huge problems. To solve these problems, the South Korean government reformed the National Land Use Plan system by integrating a number of laws into just one law, the National Land Planning and Utilization Act (NLPU). Through integrating a semi-urban area with a semi-agricultural one, which had mainly led to industrial sprawl, to create a management area based on the NLPU, the government wanted to eradicate an indiscreet development act in a non-urban area, but small developments revealed in agricultural areas and non-urban forest areas at the discretionary authority of local governments¹².

¹ This situation occurred because of a loophole in a related law and because local governments overlooked unplanned developments until administrative litigation and civil complaints (Soon Tak Suh, 2008).

Because independently located factories (ILF) are small and difficult to equip with environmental pollutant disposal facilities, the environments around factories suffer negative influences from those factories (Gyoung Ju Lee · Ihl Kweon, 2008). Additionally, the residents of these regions are small farmers who also suffer negative impacts from the environmental damage around factories. These conditions lead to deep conflicts between residents and companies, high costs for local budgets and heavy damage to ecological space and farmland. To solve this problem, ILFs in non-urban areas have been studied by a number of researchers (Rho·Ko, 1998; Lee·Jeong, 2002; Moon, 2002; Jang·Lee, 2002; Choi·Lee, 2008; Kim et al, 2010; Ban·Beak, 2010; Kim et al, 2012; An, 2012; Jeong, 2012; Lee et al, 2012; Lee·Kweon, 2013). However, these studies have nearly always analyzed present conditions or suggested ways to improve ILFs. Thus, practical research that analyzes the distributional characteristics of ILF is needed.

This study intended to analyze the distributional characteristics of ILF in Gimpo, South Korea.

2. Literature Review

In South Korea, there are two types of factories, ILFs and planned factories. Whereas planned factories are established strategically for national economic development and balanced regional development, the construction consent and land purchases for ILFs are funded by private enterprise. Therefore, these are also called freely located factories (An, 2012). ILFs have advantages such as cheap costs and good locations, but they also have problems such as contributing to environmental pollution and industrial sprawl.

Table 1. A planned locatio and an individual location

Div	Planned Location	Individual Location
Purposes	Growth of national economy and balanced development of regions through a vitalization of local economy	Effective land using through flexible respond of demand for factories location and right time to development of idle land
Process	<ul style="list-style-type: none"> •Complicated construction consent process and complicated and long influence valuation process •Local industrial park : Diversification of approval authority, overlapping discussion organization 	<ul style="list-style-type: none"> •process of establishing factory : Complication and high cost •Policy of related task : Diversified
Stage of development	<ul style="list-style-type: none"> •Public-driven development •Uniform classification and large scaled site division 	<ul style="list-style-type: none"> •Incomplete environmental prevention standard •Small effectiveness of guideline of industrial development

² In the 1990s, 51.4% of factory sites were planned and 48.6% were in unplanned locations between 1991 and 1994. From 1994 to 1998, 34.8% of sites were planned and 65.2% were unplanned. After the enforcement of the NLP, it was expected that unplanned factory locations would decrease, but the reverse happened: unplanned sites increased to 65.9% from 2003 to 2004 and to 66.2% from 2004 to 2005.

The Concept of and Problems with Nonurban Areas

According to the National Land Use Classification of Article 1 of Chapter 1 of the National Land Planning and Utilization Act, national land can be classified into four types—urban, management, rural, and natural conservation—based on the land’s utilization state and characteristics, future utilization, and mutual development between regions. Particularly, “non-urban area” is an all-encompassing term that refers to a management, rural or natural conservation area—that is, excluding any urban areas—and its definition can be extended to “non-urbanized use” to include rural areas within an urban area (refer to Figure 1).

Management areas can be designated as conservation management, production management, or plan management

areas depending on whether they are systematically managed as urban areas to support urban populations and industries; as rural areas to support the agriculture and forestry industries; or as natural conservation areas to conserve the environment and forestry. Rural areas are

either agriculture promotion areas controlled under the Agricultural Land Law or conserved mountainous lands controlled under the Mountain Land Management Law, both of which aim to promote agriculture and forestry.

Natural conservation areas are needed to protect and promote fishery resources and to preserve the natural environment, water resources, the seashores, the ecosystem, and water supply sources, as well as cultural assets. These nonurban areas have a number of problems. First, there is no comprehensive management plan for them. The national land planning law oversees both urban and nonurban areas, but only as a formality; the system is, in essence, focused on urban areas. The planning standard and content of the law’s basic urban plan, which serves primarily urban areas, do not expand upon the existing framework, resulting in inadequate planning standards and contents for nonurban areas. Although nonurban areas show different traits from urban areas, identical land-use plans are applied to both, leading to the uniform use of land. (Ministry of Land, Transport and Maritime Affairs, 2009). Second, there is increasing pressure to relax regulations for nonurban areas. Development pressure attributable to rapid urbanization has increased the demand for relaxed regulations in nonurban areas, and the limited and sporadic development of quasi-agricultural areas in 1994 has led to inadequate infrastructure, environmental damage, small individual factory lots, and quasi-urban management problems related to community district planning. Third, infrastructure is inadequate because of inappropriate development. Because they did not consider the capacity of the existing infrastructure, indiscriminate development projects and the free use of existing infrastructure have led to either inadequate or excessive infrastructure. This inadequate infrastructure leads to poor residential conditions and inefficient urban spatial structuring, all of which contribute to reduced urban competitiveness (Yong Woo Lee, 2001). Fourth, there are also the problems of natural scenery damage and environmental pollution. The simultaneous establishment of both production and living spaces in rural and mountainous regions has led to incongruous agricultural/mountainous regions and communities, and because of different types of lands used for agriculture vs. mountain preservation, indiscriminate development is more likely in the relatively less regulated reserved forest lands. These conditions result in recurring problems such as narrow roads and excessive development of sloped lands, both of which increase disaster risks, and blue and orange exteriors and irregularly shaped sites, which both result in inharmonious landscapes and scenery (Sang Jo Kim, 2013). The last and fifth problem is the conflict among stakeholders. Civil complaints can arise regarding omissions or misjudgments related to restitution for the developed properties and to conflicts about the proper standards for measuring areas to

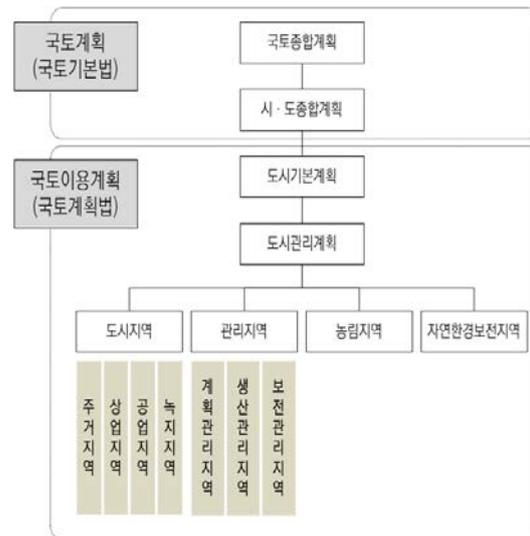


Figure 1. system of NLPU

determine how much to reimburse for the development.

Individual Site Systems

The laws and systems related to individual locations include district-based planning, a development permit system, an infrastructure conjunction system, factory construction promotion areas, and regulations regarding infrastructure areas, quasi-industrial complexes, and adjacent development restrictions. Although the laws and systems have all been established to prevent indiscriminate development, their details are different. District-based planning justifies and enhances the land use of district-based planning areas, improving the scenery and beauty, securing healthy environments, and systematically and intentionally developing and managing areas of interest to allow for flexibility in building size and type or for relaxing building coverage and floor area ratios. Among these plans, district unit planning type 2 was introduced when the National Land Use Management Law and the Urban Development Law were integrated under the National Land Planning and Use Law to address indiscriminate development in nonurban areas and to intentionally and systematically manage these areas. The individual permit system prevents indiscriminate development by issuing development permits based on a plan's validity, the likelihood of securing infrastructure, and the degree of harmony between a development and its surrounding environment. By tying infrastructure capacity to the development permit, the infrastructure conjunction system permits development within the capacity range of the infrastructure. Factory location promotion areas are areas that are favorable for factory construction and that have been set aside or officially designated by the city mayor or the county head in accordance with the Industrial Site and Development Law to facilitate factory construction. Infrastructure areas are areas other than development density management areas that have been specified or officially designated in accordance with the National Land Planning and Use Law for constructing infrastructure or for securing it in areas that require it, such as roads, parks, farmland, etc., because of development. A quasi-industrial complex is a specified and officially designated single group of land facilities that is established for the intentional management of individual factories that are located in cities overcrowded with factories—and their surrounding areas—and that have higher densities than those of other areas under a comprehensive plan in accordance with the Industrial Location and Development Law. The adjacent development limit is a system that limits development such as building construction, land use changes, land divisions, rock excavation, and the sizes of the structures that are installed, that is, the total amount of the development permit areas of farmland that lack infrastructure and the adjacent nonurban areas. However, this limit was abolished because it actually promoted indiscriminate development in nonurban areas.

Discussion of Previous Research

The various studies on individual locations all aimed to investigate efficient methods of individual location management.

In previous studies on individual location management, Roh Keun Ho and Go Young Goo (1998) compared and analyzed individual locations primarily in the Chungbuk Province, including their status and efficiency, in addition to recommending the direction of Chungbuk Province's industrial site policies. Choi Chang Gyu and Lee Won Young (2008) applied weights derived from the results of analytic hierarchy process questionnaires to the results of satisfaction questionnaires to determine the factors that influenced development locations. Ban Yong Un and Baek Jong In (2010) deduced the implications of development locations and their problems to suggest a strategy for establishing quasi-industrial complexes at different locations. AhnJong Dae (2012) reviewed the state of indiscriminate development in the Kimpo area and suggested urban planning management by establishing the indicators of indiscriminate factory development, analyzing the types of indiscriminate

development, and applying the local Moran's I to actual spaces. Jung Hyo Jin (2012) suggested methods for resolving the problems of factory location regulation using real-world investigation and analysis of the state of individual locations in Korea and of individual location regulations and by analyzing and surveying Kimhae's individual development locations. Lee Kyung Joo and Kwon Il (2013) proposed a method for indiscriminate development monitoring to analyze the state of indiscriminate development in nonurban areas by applying spatial statistics and time-series statistical techniques.

Furthermore, the nonurban areas where most individual locations are being developed are being actively studied. Lee Seung Il and Jung Il Hoon (2002) identified environmental issues concerning the current national land planning system and proposed applying transit-oriented development and raster geographic information system (GIS) procedures to actual conditions to study environmentally friendly development methods for nonurban areas. Moon Chae (2002) proposed methods for improving systems related to nonurban areas by analyzing their actual conditions and reporting the implications of these conditions. Jang Hyun Woong and Lee Myung Hoon (2002) proposed directions for appropriate land use by evaluating land suitability through a sub-county principle component analysis of Hwasung City. Kim Jae Myung et al. (2010) proposed installing a GIS in addition to basic strategies and implementation plans for efficiently managing nonurban areas. Kim Kwon Wook et al. (2012) analyzed the actual establishment of nonurban industrial district-unit planning areas, reported their problems, and suggested improvement methods. Lee Wae Hee et al. (2012) analyzed the current state and related systems of nonurban areas in Gyeonggi Province to assess the nonurban area development trends, and they proposed methods for maintaining and managing nonurban areas in Gyeonggi Province.

Although various studies such as those mentioned above regarding individual locations and nonurban areas have been conducted, they have been generally limited to state analysis and improvements. Thus, there has been a lack of studies on the actual collective conditions of individual locations in specific cities. Some studies have attempted to realize the accumulated form of individual locations, although some may have found it difficult to show detailed collective forms because the locations were classified as administrative units.

III. Method of Analyzing the Characteristics of Individual Industrial Locations in Non-urban Regions

1. Obtaining data on individual industrial locations in non-urban regions

To identify the status of individual factory locations in Gyeonggi-do and Gimpo-si, development status, percentage of non-urban regions, percentage of management regions, types of management regions, and development permit status were examined by analyzing statistical yearbooks on urban planning status for three years, 2010–2012, published by the Ministry of Land, Infrastructure and Transport.

Furthermore, to obtain data regarding individual factories in Gimpo-si, addresses, included districts and registration dates³ of individual factories located in Gimpo-si were obtained by using Factory-On (www.femis.go.kr), which is an online support system for establishing factories. As part of the process of obtaining the data for individual factories, data for currently included districts that were insufficient or lacked address information were excluded.

³ Factory registration date was considered a reference instead of establishment year, because a considerable number of factories lacked registered establishment year dates.

2. Analysis of distributional characteristics of IFLs in non-urban regions

To analyze the distributional characteristics of IFLs in Gimpo city, a quadrat analysis and a geographic information system (GIS) were used. The quadrat analysis is the simplest method available for analyzing every point of a distribution pattern; by using this method, the number of points in each square can be counted by dividing the subject study area into a grid of equal intervals (Choi, 2007). Specifically, a 500 m × 500 m grid is drawn on the map of Gimpo-si, and the address and registration date of each individual factory are obtained from Factory-On and plotted. Subsequently, the number of factories included in each square is counted to identify the square containing the most individual factories.

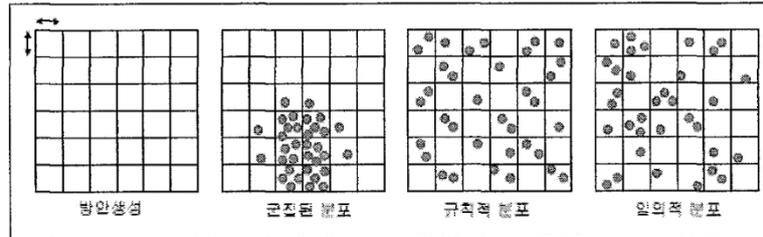


Figure 2. Example of quadrat analysis

IV. Analysis of the Distributional Characteristics of IFLs in Non-urban Regions

1. Status of non-urban regions in Gimpo city

The area of non-urban regions by land use in Gimpo-si decreased from 190km² in 2010 to approximately 175 km² (276km² in total) in 2012, whereas the area of its managed regions increased from 85km² to 90km². Specifically, the area of conservation management regions showed the greatest increase, 4.92%, due to the increase in the number of individual factories in non-urban regions in Gimpo-si.

Examining factory registration status for each eup (town), myeon (township), and dong (neighborhood) of Gimpo-si indicates that, of 4366 individual factories, Daegot-myeon had the highest number of factories, 1519, followed in order by Tongjin-eup, Yangchon-eup, Haseong-myeon and Wolgot-myeon. If unregistered factories and factories and manufacturing plants too small to be registered were in fact registered, it is estimated that the number of factories would be greater than 10,000. Accordingly, investigating the status of discharge facility installation permits (registrations) for each eup (town), myeon (township) and dong (neighborhood) confirms that among 6208 facilities, Daegot-myeon had the highest number of registered discharge facilities, 2348, followed in order by Tongjin-eup, Yangchon-eup, Haseong-myeon and Wolgot-myeon.

Table 2. The status of discharge facilities in Gimpo-si

Div	Total	Tongjin	Gochon	Yangchon	Deagot	Wolgot	Haseong	neighborhoods
Total	6,208	1,163	88	891	2,348	517	703	498
Atmosphere	2,156	408	22	321	844	179	234	148
Water quality	848	163	26	80	283	83	88	125
Noisy and quake	3,204	592	40	490	1,221	255	381	225

The number of development activities performed in non-urban regions of Gimpo-si was 3732 in 2010–2012; 42.18%, 30.63% and 27.20% of these activities were conducted in the management region, agriculture and forestry region, and urban region, respectively. Accordingly, among the total development activity permit area of $8391 \times 103 \text{ m}^2$, the management region, agriculture and forestry region, and urban region accounted for 28.57%, 49.10%, and 17.97%, respectively. Considering the number and area, it is confirmed that development activities are mainly performed in non-urban regions rather than in urban regions in Gimpo-si. Furthermore, from 2010–2012, the second district unit plan zone of Gimpo-si constantly maintained five regions, which accounted for only 0.6% of the total area of the non-urban regions of Gimpo-si.

Table 1 The status of the second district unit plan in the non-urban region of Gimpo-si

Div	District unit plan of residents		District unit plan of industry and distribution		District unit plan of tourism		District unit plan of specific purpose		District unit plan of complex	
	location	Area	Location	Area	Location	Area	Location	Area	Location	Area
2010	4	984,000	0	0	1	87,366	0	0	0	0
2011	4	984,000	0	0	1	87,366	0	0	0	0
2012	4	984,000	0	0	1	87,366	0	0	0	0

2. Analysis of the distributional characteristics of IFLs in non-urban regions of Gimpo city

Examining the status of the individual factory location in Gimpo city using data obtained from the present study indicates that a very small number of factories were established before 1995, whereas the number of established factories has rapidly increased since 2010. Figs. 5 and 6 show data from 2000 and 2013, which show rapid changes, represented by points in space, among the data obtained from Factory-On.

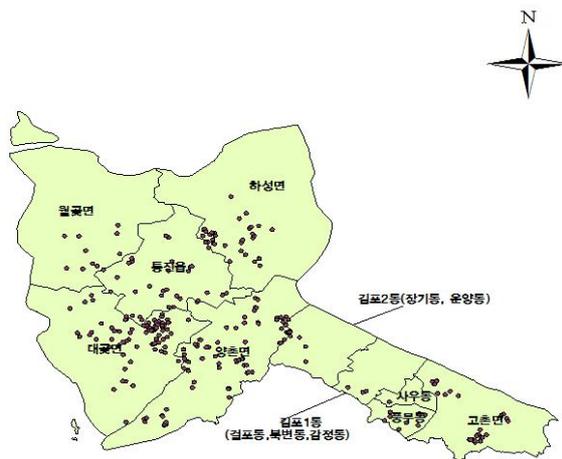


Figure 3. Distribution of IFLs(2000)

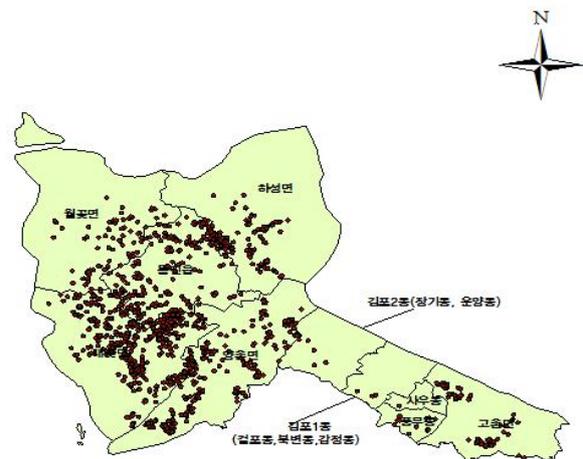


Figure 4. Distribution of IFLs(2013)

Although rapid industrial growth was observed in 2000 as compared to previous years; except for the northeast of Daegot-myeon, individual factory locations were sporadically scattered. Currently, individual factories are located mainly in eup and myeons; it is predicted that some areas will show sporadic characteristics, while others areas will show strong clustering characteristics. The results of analyzing individual industrial location forms of Gimpo-si through the quadrat analysis are illustrated in Figs. 7 and 8.

Spatial clustering of individual factories in Gimpo-si in 2000 was mainly found in the northeastern areas of Daegot-myeon, whereas in other areas, the clustering occurred sporadically. As of 2013, high clustering was observed in the central and northeastern parts of Daegot-myeon, the southwestern part of Haseong-myeon, and the near eastern and southern parts of Yangchon-eup. In particular, clustering of many factories similar to an industrial park can be observed in Daegot-myeon. It is thought that if such areas of concentrated factories are systematically managed by formulating laws and systematic management techniques to encourage future semi-industrial complexes, the problems of sprawling development and environmental problems in non-urban regions can be resolved. On the other hand, because individual factories were sporadically scattered throughout Tongjin-eup, this eup requires more systematic management planning than do the areas with concentrated numbers of individual factories. Wolgot-myeon and Haseong-myeon do not have isolated factory locations except in the area near central Gimpo. It is thought that in such areas, there is a need for precautionary policies before individual factories are actively located. Comparing the data of 2000 and 2013 confirms that there was almost no change in the degree of spatial distribution of factories in Gimpo 1-dong and 2-dong. On the other hand, the individual factories were located mainly in eup and myeon areas. From this pattern, it can be inferred that the residents of eup and myeon areas or non-urban regions are more vulnerable to environmental damage than are those of urban regions; the case of damages resulting from foundries in Gimpo-si, which recently has come into the limelight, is also due to negative environmental effects.

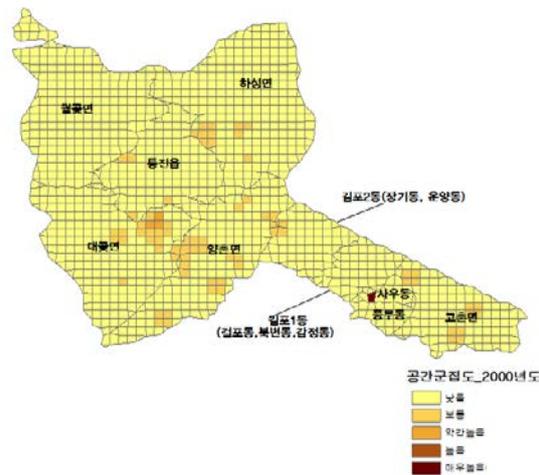


Figure 5. The status of crowding of IFLs(2000)

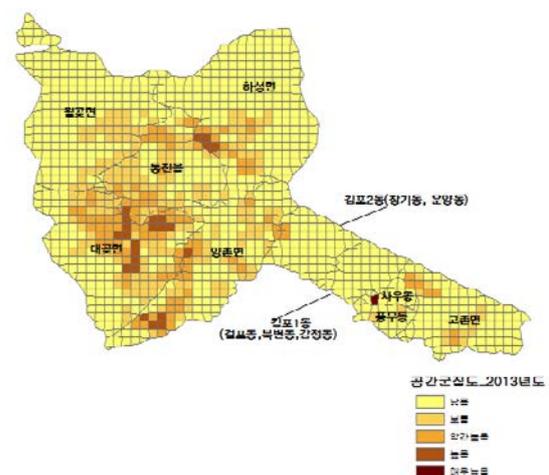


Figure 6. The status of crowding of IFLs(2013)

V. Conclusions

As the development of urban areas is reaching saturation, regulations with regard to non-urban regions become relaxed, thus leading to unplanned sprawling development exemplified by individual industrial locations. To solve these problems, solutions and alternatives are being steadily proposed; however, sprawling development has been accelerated by interest groups that seek developmental profits by manipulating legal and systematic loopholes. In developed countries such as the United Kingdom, Germany, the United States, and Japan, problems from sprawling development were identified at an early stage, and efforts have been made in these

countries to permit limited development, formulate management plans at national and local levels, and construct a flexible system that can easily reflect regional characteristics.

For effective maintenance and management of non-urban regions, it is necessary to develop plans to organize supporting governance that can promote self-sufficient village maintenance projects and provide guidelines on where to locate factories to facilitate their harmonizing with their surroundings. Furthermore, environmental management plans should be formulated in regions with densely located factory clusters to prevent increase in environmental pollution. In addition, small-scale development must be regulated by strengthening the content and qualification conditions of a development activity permit, and development must be achieved evenly in areas by establishing planned urbanized areas. Moreover, to improve the viability of semi-industrial complexes, a plan to bring existing factories under collective control must be formulated; In addition, before implementation, it must be exhaustively verified through planning and consultation with experts, citizens, and non-governmental organizations.

In the present study, with Gimpo-si as the subject, the status of individual industrial locations and spatial characteristics of non-urban regions were examined. However, this study has a limitation in that not all the data from Factory-On were used, and weighted spatial distribution values were not considered. In future research, all of the data will be obtained, and the methods of Getis-Ord General G, Ripleys K Function, Moran I for spatial weighting values will be applied. In addition, if possible, problems in terms of environmental effects of urban and non-urban regions will be analyzed by constructing environmental effect index for each area.

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