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Special Issue

Compact City Strategies from the Perspective of Japan's Location Optimization Plan
: Focusing on the BUG Region*

Kamata, Yoko** · Nam, Kwang-Woo***

Abstract

Local cities in South Korea are experiencing various urban challenges due to ongoing population decline and aging. Japan's Location Optimization Plan (LOP), a compact city policy, has gained attention as a reference model. This study aimed to derive compact city strategies tailored to regional characteristics by analyzing LOP inducement measures and classifying local cities in the Busan-Ulsan-Gyeongnam (BUG) metropolitan area. A cluster analysis was conducted on 43 Si-Gun-Gu units using indicators representing population characteristics, urban compactness, and urban issues. Five regional types were identified: (1) declining inner city areas, (2) underserved small cities, (3) suburban growth areas, (4) vulnerable local cities, and (5) compact urban centers. Among these, Type 2—comprising seven municipalities in the Gyeongnam region—was found to be in a particularly critical condition. While access to social overhead capital (SOC) facilities is extremely poor, there is a surplus of public facilities and residents' health is at risk because of low levels of physical activity and limited transportation options. Therefore, urgent and proactive compact city strategies are required for this type of region. Rather than relying on land-use regulations, strategies should focus on concentrating residential and SOC facilities into accessible urban centers by providing sufficient economic incentives, reorganizing and downsizing redundant public infrastructures, and repurposing vacant land and buildings. The findings of this study offer foundational insights for developing localized and typologically informed compact city strategies in regions of South Korea facing population decline.

Keywords Compact City, Population Decline, Location Optimization Plan, Inducement Measures, Cluster Analysis

Ⅰ. Introduction

1. Background

South Korea's population peaked at 51.84 million in 2020, since when the population has declined as deaths outnumbered births. In 2023, the total fertility rate was 0.72, the lowest globally, while aging of the population progressed rapidly (Statistics Korea, 2024k). Population decline and aging are expected to accelerate, especially in regional cities, from which younger generations are migrating to the capital (Government Agencies Joint, 2023). This demographic shift in regional cities may lead to labor shortages and increased financial burdens, raising concerns about the insufficiency of essential social overhead capital (SOC) facilities, including hospitals and daycare centers. In response to

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** Research Professor, Department of Urban Planning and Engineering, Kyungsung University (First Author: okamatayoko@gmail.com)
*** Professor, Department of Urban Planning and Engineering, Kyungsung University (Corresponding Author: kwnam@ks.ac.kr)

these demographic changes, in 2023, the South Korean government introduced the First Basic Plan for Responding to Population Decline Areas (제1차 인구감소지역대응 기본계획), which explicitly mentions the compact city as an adaptive strategy, acknowledging and responding to population decline from an urban-planning perspective.

The compact city concept originally emerged as a strategy to prevent suburban sprawl in large metropolitan areas experiencing population growth, but in recent years it has also gained attention as a means to address various urban challenges in regions experiencing population decline. For example, a compact urban structure can improve residents' access to essential SOC facilities, thereby enhancing quality of life, and is also expected to reduce the fiscal burden of infrastructure maintenance and management (Kachi et al., 2006; Kutsuzawa, 2016).

While the compact city concept has been widely discussed in South Korea, an institutional framework to support its implementation has yet to be established. To realize a compact city, it is important to have a clear understanding of regional characteristics and to apply effective strategies accordingly. Although various foundational studies have been conducted to identify such characteristics in relation to compact city development (Ha and Kang, 2022; Kamata and Nam, 2024), few have directly linked them to specific strategic approaches.

2. Japan's Location Optimization Plan

A representative example of a compact city policy in the context of a population-declining society is Japan's Location Optimization Plan (立地適正化計画, LOP). In Japan, where population decline began in 2008—earlier than in South Korea—and regional cities face similar issues of decline, the government amended the "Act on Special Measures for Urban Regeneration" in 2014 and established the LOP system.

The LOP aims to create an urban structure centered around compact urban areas connected by public transportation, guided by the concept of a "compact city and network". The plan is formulated by local municipalities (市町村) with independent jurisdiction, and as of the end of March 2024, 568 out of 1,718 municipalities in Japan have developed and published their LOPs (Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT), 2024c). The plan designates urban functional zones (都市機能誘導区域) to concentrate urban functions and residential inducement zones (居住誘導区域) that are accessible by public transportation. To promote the concentration of residential settlements and urban functions within these designated areas, municipalities can apply various inducement measures (誘導施策) supported by the national government.

The most common inducement measures involve providing economic incentives for development and housing acquisition within the designated zones. In addition to these direct economic inducements, municipalities implement various compact city measures under the LOP, combining initiatives within inducement zones, such as economic revitalization through industrial promotion; environmental improvements like sidewalk development; housing supply, including municipal housing; and more efficient land use through the reorganization of public facilities, the relaxation of floor area ratios, and the effective utilization of vacant houses and land. The MLIT also encourages the suppression of development outside the inducement zones. Strengthening public transportation networks by integrating regional public transport plans is another key strategy for promoting compact city formation.

3. Objectives and Research Overview

The MLIT emphasizes that to realize a compact city a thorough understanding of regional characteristics is essential for formulating an LOP, including selection of appropriate inducement measures. Accordingly, analyzing inducement measures based on urban typology makes it possible to identify the strategies needed for different types of cities in realizing compact city formation.

This study aimed to derive compact city strategies suitable for urban characteristics by classifying domestic cities based on indicators representing those characteristics and presenting directions for compact city strategies by type, drawing on cases from Japan's LOP. To this end, the study first focuses on the inducement measures of Japan's LOPs and analyzes the types of strategies adopted according to urban characteristics—both quantitatively and qualitatively through case studies (Figure 1). Next, focusing on the Busan-Ulsan-Gyeongnam (BUG) region in South Korea, where

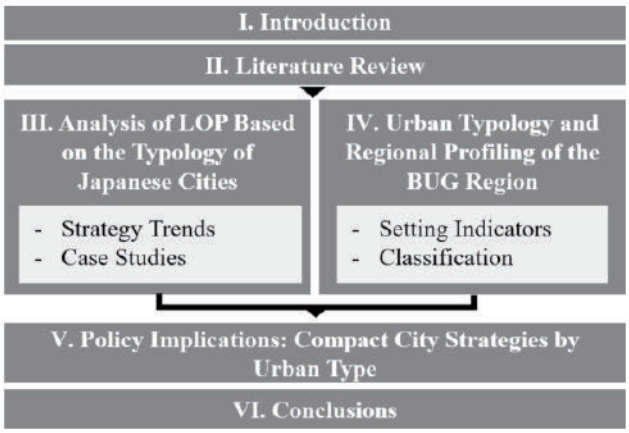

Figure 1. Study flow

population decline is progressing at a metropolitan scale, the study classifies cities based on indicators representing demographic characteristics, urban compactness, and urban issues associated with population decline. Finally, drawing on the findings from Japan's LOP analysis, the study explores compact city strategies tailored to the urban characteristics of each city type in the BUG region.

It is important to note that this study does not aim to apply the inducement measures of the LOP directly to South Korean cities. Rather, by examining LOPs, the study sought to identify trends in the types of inducement measures adopted by municipalities with different urban characteristics. The ultimate goal is to suggest possible directions for compact city strategies in South Korea, based on an understanding of what kinds of measures may be appropriate for cities with specific traits. This study contributes to the development of localized compact city strategies in response to demographic decline, offering empirical insights grounded in both Japanese and Korean contexts.

Ⅱ. Literature Review

1. Location Optimization Plan and Compact City Strategies in Korea

Numerous foundational studies have been conducted that measured urban compactness in South Korean cities (Ha and Kang, 2022; Kamata and Nam, 2024) and evaluated the effects of compact cities (Shin and Woo, 2021).

Recently, as population decline has progressed, studies have begun to explore concrete methods for realizing compact cities, with several focusing on Japan's LOP system as a benchmark for developing Korean-style strategies. Yoon and Kurose (2019) examined the LOP system and derived implications for its adoption in South Korea. Yun et al. (2023) proposed methods for designating residential inducement zones in local small and medium-sized cities. Kwon et al. (2022) reviewed methods for establishing urban hubs when applying the LOP system to rural areas in South Korea. Nam et al. (2020) classified cities in Gyeonggi Province based on indicators representing regional characteristics to promote urban compactness around station areas, with the goal of revitalizing transit-oriented development. Choi and Yoon (2025) developed indicators for understanding urban structure in regional cities in South Korea that are at risk of population decline, based on the "Handbook for the Evaluation of Urban Structure" published by Japan's MLIT. They then classified small cities with populations under 100,000 in Gyeongsangbuk-do and provided suggestions for compact city formation tailored to each city type.

Meanwhile, Tamura and Kwon (2019) offered critical insights on the LOP system and presented implications for compact city policies in South Korea. Based on case studies of compact city strategies in Toyama and Aomori, this research highlighted the need for broader regional compact city planning through cooperation with neighboring municipalities, and emphasized the importance of implementing sufficient suburban development controls alongside inducement measures under LOPs. Furthermore, noting that Japan's cities typically have structures centered around railway stations, while Korean cities tend to have more dispersed urban cores due to large-scale suburban development, the study argued that careful deliberation is required when defining urban centers if LOPs are to be introduced in Korea.

2. Discussion on the Location Optimization Plan in Japan

Since the introduction of the LOP, various studies have been conducted in Japan. These include research that identified institutional issues based on surveys of municipal officials (Asano and Ueda, 2017; Hashimoto et al., 2021), as well as studies that developed methods for designating inducement zones (Miyauchi et al., 2019; Sakurai and Ogawa, 2023). Studies have also been conducted to evaluate the effective-

ness of the LOP (Asano and Ariga, 2022).

Research on inducement measures guiding urban functions and residential areas into designated zones has been conducted by Miyazaki et al. (2019), but their study was limited to classification of such measures. Musha (2021) extracted policy guidelines related to inducement measures from the LOPs of 275 cities and classified them into 11 categories. The study also categorized the cities into four groups based on population size and their proximity to major metropolitan areas, and analyzed the inducement policies adopted by each group. The results reveal that smaller cities tended to focus more heavily on facility placement measures, leading to the conclusion that technical support for plan development is needed, particularly for small municipalities. Nozawa et al. (2019) conducted a survey of local governments regarding inducement measures and found that while many municipalities focused solely on improvements within the designated inducement zones, a small number had also attempted to revise land-use regulations in areas outside these zones.

Research on the LOP has identified numerous issues—such as opposition from residents living outside the inducement zones (Hashimoto et al., 2021) and the use of the system for development-oriented purposes within the zones (Musha, 2021). There has also been criticism regarding the effectiveness of the LOP in promoting compact city formation. Asano and Ariga (2022) concluded that the impact of the LOP has been limited to date; they also suggested improvements, such as strengthening inducement incentives and enhancing public awareness. Nevertheless, it has also been reported that, as of 2023, about two-thirds of the municipalities evaluated LOPs as effective in promoting compact city formation (MLIT, 2024a). In any case, since the national adoption of LOPs is a long-term plan with a 20-year horizon, it is still premature to assess its effectiveness at this stage. It is essential to continue efforts toward realizing compact cities that can sustain residents' quality of life—even in regions facing the risk of depopulation—while improving the identified institutional issues.

3. Research Gap

Previous studies have highlighted compact city strategies as a potential solution to urban issues arising from population decline in South Korea, with Japan's LOP often cited as a practical model. However, there is a lack of research presenting concrete methods for addressing the question of how to realize a compact city.

While this study shares similarities with the work of Choi and Yoon (2025) and Nam et al. (2020), who classified regional cities using indicator-based typologies, its originality lies in linking this classification with an analysis of Japan's LOP experience. By doing so, it presents more concrete strategies for compact city formation.

Ⅲ. Analysis of Location Optimization Plans Based on the Typology of Japanese Cities

1. Policy Trends by City Type

1) Typology and Framework

The descriptions of inducement measures in LOPs vary widely across municipalities, making quantitative evaluation challenging. To clarify how Japanese local municipalities adopt compact city strategies based on urban typology, this study focuses on a list of "independent inducement measures" provided by Japan's MLIT (MLIT, 2024b). In some municipalities, in addition to the government-supported guiding policies, unique inducement measures have been established independently to suit their specific circumstances. These independent measures provide valuable insights into the strategies that municipalities facing different situations consider effective for promoting compact city formation. The independent inducement measures are cross-tabulated based on municipal population size and growth, and the relationships between these compact city measures and regional situations are analyzed.

When discussing compact city strategies, it is essential to understand whether a city is large or small, and whether its population is growing or declining (OECD, 2013). Accordingly, cities are classified into four types based on population size and growth characteristics: small-scale declining (SD), small-scale growing (SG), large-scale declining (LD), and large-scale growing (LG). Following Musha (2021), city size is categorized as large for municipalities with a population of over 100,000 and small for those with less than 100,000. The population data used as the basis for this analysis are from

2015 (Statistics Bureau of Japan, 2024), as many municipalities formulated their LOPs after 2015.

The independent inducement measures can be broadly classified into six major categories—economic incentives, environmental improvements, economic revitalization, public-transportation enhancements, housing supply, and land-use efficiency—based on previous studies (Miyazaki et al., 2019; Musha, 2021).

The economic incentives are intended to promote the concentration of SOC facilities and housing within inducement zones. Incentives include subsidies for businesses developing or relocating SOC facilities within the zones, as well as financial support for individuals purchasing housing or relocating to the zones. Environmental improvements are divided into categories such as green-space development, landscape enhancement, safety improvements to defend against natural disasters, and the management of abandoned spaces, such as vacant houses and lots, to improve the urban environment through appropriate maintenance. Some policies have focused on childcare and welfare facilities, station-area improvements, and pedestrian-environment enhancements, but these measures were adopted only by LG cities and were therefore classified as "Other." The measures aim to concentrate SOC facilities and housing by improving the environment within the zones. Policies to improve land-use efficiency include utilizing vacant houses and idle land within the inducement zones, intensifying land use through mixed land use and relaxation of floor-area ratios, and optimizing land use through the reorganization of public facilities.

For each city type, the number of policies and their proportion relative to the total number of policies were calculated.

2) Inducement Measures by City Type

〈Table 1〉 summarizes the status of the local governments in Japan that have adopted independent LOP inducement measures. For each type, the proportion of cities that have formulated an LOP (as of the end of March 2024) in relation to the total number of cities is calculated, as well as the proportion of cities that have adopted independent measures out of those that have formulated an LOP. As of the end of July 2023, a total of 148 cities had adopted independent inducement measures, with 323 such measures in place. Some cities have implemented multiple independent measures.

Table 1. Status of municipal independent initiatives

Type	Total number of cities	Number of cities with plans (Percentage of all cities)	Number of cities with independent initiatives (Percentage of cities with plans)	Number of independent initiatives
SD	1,266	332 (26.2)	78 (23.5)	144
SG	191	52 (27.2)	7 (13.5)	12
LD	152	112 (73.7)	48 (42.9)	105
LG	109	72 (66.1)	15 (20.8)	62
Total	1,718	568 (33.0)	148 (26.1)	323

Assuming that cities adopting independent measures are more proactive in formulating plans due to the greater need for compact city development, LD cities are the most active, with 73.7% of all LD cities formulating an LOP, and 42.9% of those also adopting independent measures. In contrast, SG cities are the least proactive, with 27.2% of total SG cities formulating an LOP, and only 13.5% of those adopting independent measures. Although SD cities have the lowest proportion of LOP adoption among all types at 26.2%, 23.5% of those that adopted an LOP have implemented independent measures, the second highest following LD cities. This implies that SD cities may require inducement strategies with greater flexibility than those defined by the nationally established framework.

To analyze the effectiveness of different strategies by city type, 〈Table 2〉 categorizes and summarizes the independent inducement measures according to city type. The results show that, except for LG cities, all city types commonly adopted policies that provided financial incentives for relocation and settlement as the most frequent strategy, followed by policies aimed at utilizing vacant spaces to improve land-use efficiency.

SG cities, in particular, had the highest proportion of policies related to migration and settlement under economic incentives, as well as measures aimed at housing supply and the utilization of vacant land to improve land-use efficiency. Unlike other city types, SG cities did not adopt policies focused on environmental improvements or economic revitalization. This indicates a trend in SG cities to prioritize housing supply and effective use of vacant land to accommodate the growing population within the inducement zones.

Table 2. Compact city measures by city type

Type	Economic incentives		Environmental improvement					Economic revitalization	Public transportation enhancements	Housing supply	Land-use efficiency			
	Facility relocation	Residential relocation	Green spaces	Landscape	Safety	Management of abandoned spaces	Others				Land-use intensification	Reorganization of public facilities	Utilization of vacant land	
SD	1 (0.7)	66 (45.8)	1 (0.7)	2 (1.4)	0 (0.0)	9 (6.3)	1 (0.7)	10 (6.9)	0 (0.0)	13 (9.0)	0 (0.0)	0 (0.0)	41 (28.5)	
SG	1 (8.3)	7 (58.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	3 (25.0)	
LD	5 (4.8)	42 (40.0)	0 (0.0)	1 (1.0)	1 (1.0)	9 (8.6)	0 (0.0)	8 (7.6)	2 (1.9)	7 (6.7)	2 (1.9)	0 (0.0)	28 (26.7)	
LG	5 (8.1)	9 (14.5)	5 (8.1)	0 (0.0)	2 (3.2)	1 (1.6)	17 (27.4)	5 (8.1)	4 (6.5)	2 (3.2)	4 (6.5)	2 (3.2)	6 (9.7)	

Note: Unit—Number of measures, (Percentage of total measures)

LG cities adopted a more diverse range of measures, with a strong focus on environmental improvements. They also had more measures related to economic revitalization, public transportation enhancement, land-use intensification, and the reorganization of public facilities. In these densely populated and growing cities, the LOP system is used more for environmental improvements and efficiency than to induce residential or urban functions.

In LD cities, which face the most pressing need for compact city formation, the proportion of measures related to the management of vacant spaces within the inducement zones was higher than in other types. This implies that suburban expansion during the population growth period led to hollowing out of central urban areas, a problem exacerbated by population decline, with abandoned homes negatively affecting the living environment.

Finally, SD cities, which make up more than half of all cities, adopted a wide range of measures, including financial incentives for relocation and settlement, and vacant space utilization. In addition, they adopted a balanced range of measures on environmental improvements, economic revitalization, and housing supply and maintenance. The low proportion of financial incentives for facility relocation and attraction implies that, as in South Korea, these cities may be experiencing an excess of urban facilities.

2. Case Studies by City Type

Furthermore, this study investigates representative LOP cases based on population size and growth characteristics, organizing the urban challenges and specific compact city strategies. LOP structures vary by municipality, but this study examines the sections in which specific measures for guiding development into inducement zones are outlined. Urban challenges are extracted from the LOP summaries. At this stage, the compact city strategies include not only the independent inducement measures but also other common strategies. The compact city strategies of each municipality are considered identifiable through the policies adopted by each municipality.

Mihara City (Hiroshima Prefecture), Oji Town (Nara Prefecture), Kitakyushu City (Fukuoka Prefecture), and Kumamoto City (Kumamoto Prefecture) were selected as case studies representing the SD, SG, LD, and LG types,

respectively. As shown in 〈Table 3〉, the urban challenges and compact city measures described in each city's LOP are summarized.

As confirmed in the previous section, Kitakyushu City, which falls under the LD category and has been the most proactive in formulating an LOP, faces challenges in providing public transportation and maintaining urban infrastructure due to rapid population decline and the geographical features of the urban areas in recent years. The city has comprehensively implemented compact city measures

Table 3. Previous inducement measures

Type	City	Urban issues	Compact city strategies
SD	Mihara	Decline in the central urban area due to changes in industrial structure, the aging of public facilities, and their oversupply.	**Economic Incentives:** Support for the relocation of urban function facilities to designated zones, as well as subsidies for the relocation of young and child-rearing households. **Environmental Improvement:** Improvements in pedestrian spaces at railway stations and bus stops, focused development of parks and green spaces, creation of a comfortable living environment through landscape planning, installation of streetlights, promotion of seismic retrofitting and fireproofing of buildings in densely populated urban areas, and removal of dangerous vacant houses. **Public Transportation Enhancements:** Promotion of barrier-free initiatives. **Housing Supply:** Concentration of housing supply in designated zones through reorganization of public housing, with an emphasis on improving housing options within inducement areas. **Land-Use Efficiency:** Effective use of unused public real estate resulting from the consolidation and closure of public facilities, expansion of vacant house banks, and support for community activity centers utilizing historic buildings. Review of land use and relaxation of floor area ratio and zoning restrictions in designated areas. **Others:** Restriction of residential development outside designated areas and strengthening of land-use regulations.
SG	Oji	Increase in vacant houses, decline in land prices in commercial areas, insufficient public transportation, and reduced tax revenue due to decreasing working-age population.	**Economic Incentives:** Expanded housing acquisition support for multi-generational families within residential inducement areas. **Public Transportation Enhancements:** Reorganization of bus routes, subsidies for bus use by elderly residents, and attraction of medical facilities to transportation hubs. **Land-Use Efficiency:** Effective use of vacant land, effective use of public land, and review of height restrictions.
LD	Kitakyushu	Increase in vacant houses, decline in land prices in commercial areas, insufficient public transportation, and reduced tax revenue due to decreasing working-age population.	**Economic Incentives:** Expansion of economic incentives for housing acquisition within residential inducement zones (such as housing support for local employment of new graduates, support for migration from the metropolitan area, etc.). **Environmental Improvement:** Station-front redevelopment, hospital relocation, library development, removal of deteriorated vacant houses, river improvements for flood disaster prevention, and park development. Operation of childcare facilities, renovation of shopping streets. Economic Revitalization: Relaxation of regulations to attract businesses (floor area ratio, parking), development of office buildings, and tourism revitalization (manga museum). **Public Transportation Enhancements:** Subsidies for public transportation for outings, maintenance of routes through operation of small buses, and enhancement of feeder routes connecting to main lines. **Housing Supply:** Development of public housing and renovation of public corporation rental housing. **Land-Use Efficiency:** Vacant house bank, relaxation of floor area ratio regulations, consolidation of subdivided land, and reorganization through the integration and multiplexing of public facilities. **Others:** Establishment of a migration consultation office.
LG	Kumamoto	Management crisis of private bus companies due to decreased number of passengers.	**Economic Incentives:** Increase in floor area ratio and financial support based on public contributions, such as strengthening the disaster prevention functions of buildings and subsidies for purchasing resale homes for migrants. **Environmental Improvement:** Development of bicycle lanes, improvements in pedestrian spaces through greening, support for enhancing disaster resistance in residential areas within inducement zones, development of vacant houses and land, and improvement of narrow roads. **Public Transportation Enhancements:** Regeneration of bus terminals in the city center, and development and restructuring of bus routes. **Land-Use Efficiency:** Vacant house bank, relaxation of floor area ratio for disaster-resistant buildings, preferential location of social welfare facilities within urban functional zones, effective land use through land-use review, development of mixed-use facilities including commercial spaces, housing, and multi-purpose halls (city-owned) integrated with bus terminals. **Others:** Support for community activities, stricter land-use regulations.

across all categories. Notably, initiatives such as rent subsidies for municipal rental housing targeting young people employed locally and financial support and consultation offices to promote migration from the Tokyo metropolitan area stand out as measures aimed at encouraging inflow of residents into the inducement zones from external regions.

In contrast, although Kumamoto City, a government-designated city (政令指定都市) located in Kyushu, was experiencing population growth as of 2015, maintenance of bus routes remained a significant challenge. As part of its compact city strategies, the city is implementing measures such as bus route reorganization to improve efficiency, promoting barrier-free environments, and raising awareness to encourage public transportation use. Additionally, stricter development regulations in urbanization control areas have been enforced, indicating concerns about increasing development pressure in suburban areas.

Mihara City in Hiroshima Prefecture has experienced population decline since 1985, and an excessive supply and aging of public facilities have become challenges due to the burden of maintenance and management. It is evident that the city is combining various measures, such as reorganization through consolidation and integration of public facilities and effective use of sites resulting from this reorganization. Additionally, the city is actively promoting compact city formation by designating "Residential Adjustment Areas" and restricting development outside these designated zones.

Ōji Town, classified as SG—the least proactive category in formulating LOPs—was experiencing population growth as of 2015. However, typical social issues associated with population-declining regions, such as reduced tax revenue due to aging and insufficient public transportation, have emerged. The compact city strategies outlined in its LOP are limited, focused on subsidies for housing acquisition within inducement zones for multi-generational households and ¥100 bus tickets for the elderly.

3. Summary

Through organization of the unique municipal initiatives under the LOP system and the relevant case studies, the following points became evident.

First, regardless of the population situations of municipalities, insufficient public transportation emerged as a common regional issue. Strengthening public transportation networks was identified as a shared strategy for compact city formation. Meanwhile, in municipalities experiencing population decline, an oversupply of public facilities and the burden of their maintenance and management posed significant challenges. As a result, the reorganization and consolidation of public facilities were highlighted as a key compact city strategy.

Next, the tendencies of strategies adopted by municipalities were found to differ depending on their demographic characteristics. Notably, municipalities with large populations experiencing population decline were the most proactive in pursuing compact city formation. These municipalities adopted a wide range of initiatives centered on environmental improvements, such as the removal of vacant houses, in addition to providing economic incentives to promote population concentration.

In contrast, municipalities with smaller populations appeared to be somewhat less proactive in compact city formation. Among them, municipalities experiencing population growth primarily adopted limited measures focused on economic incentives to promote migration and the supply of housing. Compared to this, larger municipalities experiencing population growth, such as Kumamoto City, implemented stricter land-use regulations to curb urban sprawl and pursued a more diverse range of initiatives for compact city formation. As pointed out by Musha (2021), smaller municipalities tend to adopt unbalanced measures. This is attributed to a lack of technical capacity and human resources for LOP formulation.

Ⅳ. Urban Typology and Regional Profiling of the BUG Region

1. Study Area

The case study region was set in the BUG metropolitan area (Figure 2), where population decline is progressing at a regional level. The rates of population change from the previous year (2020) show a decline in all areas: Busan −0.7%, Ulsan −0.7%, and Gyeongnam (GN) −0.4% (Statistics Korea, 2024j). The study's temporal scope was the year 2020.

Busan Metropolitan City covers an area of 770 km² with a population of 3.35 million, consisting of 15 districts (*gu*) and

Figure 2. Study area

1 county (*gun*) (Statistics Korea, 2024b). Ulsan Metropolitan City has an area of 1,062 km^2 and a population of 1.14 million, divided into 4 districts and 1 county (Statistics Korea, 2024l). Gyeongsangnam-do (GN) is the largest in area, spanning 10,540 km^2 with a population of 3.33 million. It comprises 8 cities (*si*) and 10 counties, including 5 districts within Changwon City (Statistics Korea, 2024e).

2. Methods

1) Indicators for Urban Typology

Even in regions experiencing overall population decline in South Korea, certain areas exhibit localized population inflow and growth, while others face outflow and the risk of disappearance (Kamata and Nam, 2024). The strategies required to promote compact city formation should differ between areas experiencing population growth and those facing population decline. Furthermore, even in regions with similar demographic profiles, effective compact city strategies must take into account the specific urban structure and challenges unique to each locality.

To develop compact city strategies tailored to domestic cities, this study aimed to classify cities based on key indicators representing urban typology. These indicators, identified through a literature review and shown in 〈Table 4〉, include population traits, urban compactness, and factors related to urban issues of concern in an era of population decline and aging. In total, 12 indicators were selected for analysis.

(1) Demographic Characteristics

As previously noted, understanding demographic characteristics—such as whether a city is large or small, and whether its population is growing or declining—is essential when discussing compact city strategies (OECD, 2013). Therefore, population size and population growth were selected as indicators of demographic characteristics. In case of the population growth rate compared to a reference year, which is commonly used to assess population trends, changes in areas with small populations tend to be overestimated (Nam et al., 2001). Therefore, this study used population density increase (Nam et al., 2001) as an indicator of population growth.

(2) Urban Compactness

Various studies (Ha and Kang, 2022; Shin and Woo, 2021) have proposed indicators to evaluate urban structure from the perspective of compactness. In this study, the Comprehensive Compactness Index proposed by Kamata and Nam (2024) was adopted. This index allows detailed assessment of urban compactness at the *Si-Gun-Gu* level and is calculated by summing the standardized values of four components—density, degree of clustering, degree of equal distribution, and dispersiveness—all derived from 100-meter grid population data.

Density is one of the most representative indicators for evaluating urban compactness, and this study uses population density within urbanized areas. Population clustering is measured using Moran's Index, which ranges from –1 to 1, with higher values indicating stronger spatial autocorrelation. A higher Moran's Index for population distribution implies a more monocentric urban structure (Tsai, 2005). Degree of equal distribution is measured using the Gini coefficient, which ranges from 0 to 1; higher values indicate greater disparity between densely and sparsely populated areas and may reflect the presence of undeveloped land (Tsai, 2005). Dispersiveness is assessed using the standard distance of population distribution, calculated by weighting each location by its population (Kutsuzawa, 2016). Higher compactness is defined as higher population density, higher Moran's Index, higher Gini coefficient, and lower dispersiveness.

(3) Urban Issues

For urban issues, this study referred to the Handbook for

Table 4. Indicators for urban typology

Indicator			Description	Source of data
Demographic characteristics	Population		Total population of administrative regions (10,000 people).	Grid Statistics, Population (Statistics Geographic Information Service, 2024)
	Growth		Population increase density (2015–2020) (persons/km²).	
Compactness	Compactness index		Sum of the standardized values of net population density, Moran's Index, Gini coefficient, and standard distance of population distribution.	Grid Statistics, Population (Statistics Geographic Information Service, 2024) Kamata and Nam (2024)
Urban issues	Environment	Air pollution*	Annual average concentration of PM2.5 (μg/m³).	Air Pollution Status (Statistics Korea, 2024a)
	Convenience, safety & health	Access to living soc facilities*	Access time to hospitals and clinics via walking and public transportation (min).	Traffic Accessibility Indicators (Korea Transport Institute, 2024)
		Public transportation supply	Ratio of bus and subway stops to urbanized area (stops/km²)	Public Transportation Usage Analysis Indicators (Korea Transportation Safety Authority, 2024)
		Elderly facilities supply*	Number of elderly persons per elderly facility	Korea Urban Statistics (Statistics Korea, 2024i)
		Vacancy rate*	Ratio of vacant houses (%)	Housing Census (Statistics Korea, 2024j)
		Walking activity	Percentage of people who walked for at least 30 minutes a day (%)	Community Health Survey (Statistics Korea, 2024c)
	Economy & finance	GRDP	Gross regional domestic product (billion KRW)	Gross Regional Domestic Product (Statistics Korea 2024f, 2024g, 2024h)
		Fiscal burden*	Local tax burden per person (thousand KRW)	Korea Urban Statistics (Statistics Korea, 2024i)
		Oversupply of educational facilities	Number of students per elementary school facility (students)	Current Status of Urban Planning (Statistics Korea, 2024d)

Note: * Inverse indicators were used; therefore higher indicator values indicate better urban conditions.

the Evaluation of Urban Structure (都市構造の評価に関するハンドブック) (MLIT, 2014), which highlights key urban problems caused by population decline and aging. Based on six elements—environment, living convenience, safety, health, economy, and administrative operations—indicators were established to reflect the domestic context.

According to the handbook, as population decline progresses in cities, the population density within urban areas decreases, making it difficult to sustain facilities such as shops and essential life-related SOC services like medical and welfare facilities, thereby reducing living convenience (Kim et al., 2024; Choi and Yoon, 2025). Population decline also leads to disruptions in public transportation, such as the cancellation of bus routes (Matsubara and Tayanagi, 2015). A lack of access to public transportation reduces opportunities for going out, which can negatively affect residents' health (Saelens et al., 2014). It further contributes to increased automobile dependency and environmental deterioration due to rising vehicle emissions (Bi et al., 2024). The increase in vacant houses raises safety concerns by elevating the risk of crime (Branas et al., 2013). In addition, regional economic decline may result from a shrinking workforce and the deterioration of administrative operations due to reduced tax revenues (Nakajima, 2022). Meanwhile, the Korean government, in its Population Structure Change and Response Measures (Presidential Committee on Ageing Society and Population Policy and Relevant Ministries, 2022), identified urban problems caused by population decline, such as worsening residential environments due to an increase in vacant and underutilized spaces, inefficient land use, and reduced accessibility to essential SOC facilities. It also pointed out the oversupply of educational facilities due to a decline in the youth population, while raising concerns about the lack of welfare service facilities for the increasing elderly popula-

tion. An oversupply of public facilities places a financial burden on local governments.

In consideration of the above-mentioned urban issues associated with a population-declining society and the availability of relevant data, this study established specific indicators for each element: air pollution concentration (environment); accessibility to hospitals and clinics, public transportation supply, availability of elderly care facilities, vacant house ratio, and walking activity status (convenience, safety, and health); gross regional domestic product, local tax burden per resident, and the number of students per elementary school (economy and finance).

2) Cluster Analysis

The basic units of analysis were the 43 municipalities (Si-Gun-Gu) in the BUG metropolitan area. The timeframe were primarily set to 2020, but data from years close to 2020 were used when more recent data was unavailable. Classification was performed using cluster analysis based on z-scores for the selected indicators. A non-hierarchical k-means method was applied, and the number of clusters was set to five based on exploratory hierarchical clustering results (squared Euclidean distance, Ward's method). The descriptive statistics of the indicators are shown in 〈Table 5〉.

Table 5. Descriptive statistics (n=43)

Indicator	Min.	Max.	Mean	Std.
Population	2.87	52.80	17.87	11.39
Population growth	-1272	239	-174	332
Compactness index	-4.23	4.55	0.00	2.03
Air pollution	12.67	20.21	16.40	1.71
Access to living SOC facilities	3.42	59.72	13.76	14.63
Public transportation supply	0.10	52.20	22.46	16.55
Elderly facilities supply	15	330	135	105
Vacancy rate	5.39	21.48	11.39	4.30
Walking activity	16.50	82.00	39.20	11.80
GRDP	976	26,062	6,314	5,062
Fiscal burden	516	3056	1292	479
Oversupply of educational facilities	53	811	432	204

3. Results of Cluster Analysis

The features of each cluster obtained from the cluster analysis of the BUG metropolitan area are shown in 〈Table 6〉 and visually depicted in 〈Figure 3〉 . The distribution of the types is shown in 〈Figure 4〉 .

Type 1 consists of eight municipalities. This type is characterized by being located in the old town areas of Busan and Ulsan, regions experiencing population decline and relatively low urban compactness. Although public transportation is well-developed, there is a significant need for the provision of facilities for the elderly and economic revitalization. Given these characteristics, Type 1 was named as the "declining inner city areas."

Type 2 includes seven municipalities. This area, located on the western side of GN with a smaller population size, exhibits the lowest compactness. While it has well-developed elderly care facilities and low air pollution, most indicators show the lowest values among all five types. Access to SOC facilities is particularly poor, and public transportation options are insufficient. According to MLIT (2014), these deficiencies limit opportunities for residents to go out, contributing to deteriorating health. The fact that walking activity among residents is the lowest among all types highlights concerns that urban issues driven by population decline

Table 6. Average values of indicators by type

Indicator	Type 1	Type 2	Type 3	Type 4	Type 5
Population	14.1	4.3	19.3	11.1	31.2
Population growth	-604	-2	24	-10	-233
Compactness index	-1.2	-1.8	0.6	-0.2	1.5
Air pollution	15.9	14.6	16.8	17.1	17.1
Access to living SOC facilities	4	41	7	21	5
Public transportation supply	36.8	5.7	10	15.6	36
Elderly facilities supply	272	37	51	57	211
Vacancy rate	11	18	9	15	8
Walking activity	45	26	37	49	39
GRDP	4,368	1,410	9,956	3,913	9,141
Fiscal burden	1,187	1,198	1,683	1,286	1,126
Oversupply of educational facilities	543	193	461	293	558
N	8	7	9	7	12

(a) Type 1 (b) Type 2 (c) Type 3 (d) Type 4 (e) Type 5

Figure 3. Regional characteristics by type

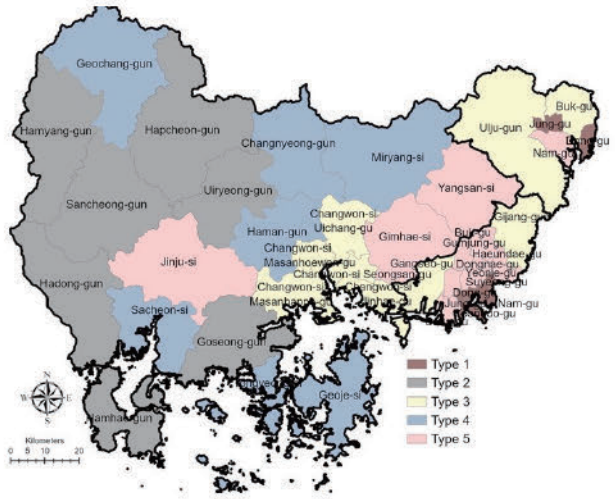

Figure 4. Urban categorization on the map

Table 7. List of cities corresponding to each cluster

Cluster	Cities
Type 1	Busan (Jung-gu, Seo-gu, Dong-gu, Yeongdo-gu, Nam-gu, Suyeong-gu), Ulsan (Jung-gu, Dong-gu)
Type 2	GN (Uiryeong-gun, Goseong-gun, Namhae-gun, Hadong-gun, Sancheong-gun, Hamyang-gun, Hapcheon-gun)
Type 3	Busan (Gangseo-gu, Gijang-gun), Ulsan (Buk-gu, Ulju-gun), GN (Changwon-si Uichang-gu, Changwon-si Seongsan-gu, Changwon-si Masanhappo-gu, Changwon-si Masanhoewon-gu, Changwon-si Jinhae-gu)
Type 4	GN (Tongyeong-si, Sacheon-si, Miryang-si, Geoje-si, Haman-gun, Changnyeong-gun, Geochang-gun)
Type 5	Busan (Busanjin-gu, Dongnae-gu, Buk-gu, Haeundae-gu, Saha-gu, Gumjung-gu, Yeonje-gu, Sasang-gu), Ulsan (Nam-gu), GN (Jinju-si, Gimhae-si, Yangsan-si)

may pose health risks to those living in Type 2 areas. Meanwhile, there is an oversupply of educational facilities. These areas are most in need of compact city formation by appropriately allocating urban infrastructure and guiding residential areas. Type 2 was named the "underserved small cities."

Type 3 comprises nine municipalities. This area includes suburban regions, such as Gijang-gun and Gangseo-gu, where new urban developments are underway, and the population is on the rise. While the gross regional domestic product is high, the financial burden is also significant, and public transportation infrastructure is lacking. Type 3 was named the "suburban growth areas."

Type 4 encompasses seven municipalities. Distributed in the GN area, this type has the second smallest population size after Type 2. While elderly care facilities are well-established, making it a region where residents walk the most and lead healthy lifestyles, most of the other indicators show relatively low values. Similar to Type 2, this region requires an appropriate allocation of urban functions and residential areas to enhance its overall compactness. Type 4 can be named the "vulnerable local cities."

Type 5 consists of twelve municipalities. This type includes the city centers of Busan and Ulsan, characterized by the largest population sizes and the highest levels of compactness, despite the ongoing population decline. Overall, the indicator values for this type are favorable, although air quality is poor and there is a shortage of elderly care facilities. Type 5 was named the "compact urban centers."

A list of municipalities of each type is provided in 〈Table 7〉 .

Ⅴ. Policy Implications: Compact City Strategies by Urban Type

1. Type 1: Declining Inner City Areas

Based on the results described in Sections Ⅲ and Ⅳ, this section examines compact city strategies for each cluster in the BUG area.

According to Kamata and Nam (2023), Type 1 regions are experiencing urban hollowing due to the aging of infra-

structure and new suburban developments, leading to population decline. At the same time, the presence of commercial districts offering high-quality jobs results in an increase in the daytime commuting population. Furthermore, Kamata and Nam (2024) noted that although the overall compactness of regions falling under this type is relatively low, population density is relatively high, and population concentration is occurring locally through the redevelopment of low-rise residential areas.

Based on these characteristics and the findings in previous chapters, compact city strategies for Type 1 regions include economic revitalization targeting the abundant number of visitors, improvement of living conditions through renovation of aging urban infrastructure, and the development of efficient elderly care facilities, taking into account the distribution of elderly populations. Regarding the development of elderly care facilities, as seen in the inducement measures of Japan's LD-type cities, effective utilization of vacant houses and land is considered desirable.

2. Type 2: Underserved Small Cities

Type 2 represents the area where compact city formation is most urgently needed, and considering its characteristics, priority should be given to the consolidation of urban functions and residential settlements in well-connected central urban areas rather than expanding SOC infrastructure. This point was also emphasized in the study by Choi and Yoon (2025), which highlighted the necessity of establishing regional hubs and promoting urban consolidation in small- and medium-sized cities where living convenience has significantly deteriorated. As Asano and Ueda (2017) argued, in cities with small and declining populations, where development pressure on suburban areas is relatively low, compact city formation can be more effectively achieved through strategies that induce concentration into urban centers rather than by imposing strict land-use regulations.

In light of similar demographic characteristics and challenges, such as the oversupply of public facilities, the strategies observed in Japan's SD-type cities may provide useful reference points. Accordingly, efficient land use should be promoted by repurposing vacant spaces in urban centers and reorganizing public facilities, including educational ones, to optimize existing resources.

Moreover, since our study observed low health-related indicator values among residents in Type 2 areas, it is necessary to expand public transportation options and support residents leading their daily lives through the use of walking and public transit. However, as Kwon et al. (2022) pointed out, in population-declining areas of South Korea that correspond to Type 2, especially in *eup or myeon* regions that are not yet urbanized[1], the reality is that public transportation is extremely limited—not only lacking rail-based systems like those in Japan but also having insufficient bus services. As Kwon et al. (2022) suggested, in such areas, guiding residential settlement around community facilities such as gyeongnodang (senior community centers) or *maeul hoegwan* (village halls) may be a more realistic approach to ensuring that residents have opportunities to go out and participate in daily life.

3. Type 3: Suburban Growth Areas

The compact city strategy for Type 3 should emphasize strengthening the transportation network through the expansion of public transport and promoting urban concentration around these transport hubs, as these measures are essential to achieving compact urban form in newly developing areas. For instance, the planned development of the BuTX hydrogen rail line and the Busan-Yangsan-Ulsan metropolitan railway aims to enhance the regional public transportation network. Since major stations along these lines are expected to serve as regional hubs, applying a transit-oriented development (TOD) approach—concentrating residential, commercial, and public functions around transit nodes—can effectively support compact city formation. Specifically, Nam et al. (2020) highlighted TOD strategies for newly developed areas in Korea, such as the integration of residential, commercial, and business functions through public–private partnerships, and the creation of pedestrian-oriented living zones by introducing multi-layered urban planning. However, as Tamura and Kwon (2019) pointed out, Korean cities have a different urban structure compared to Japan, where development is typically centered around railway stations. Therefore, the development of urban hubs in Korea should be carefully planned, taking into full consideration the existing distribution of urban functions.

Drawing on examples from Japan's LG-type cities, which face similar challenges, it is important to improve residential environments in urban centers by enhancing green spaces and parks, and to promote fiscal efficiency through the restructuring and maintenance of public facilities. Furthermore, Type 3 should take into account future demographic changes. Therefore, controlling suburban development through land-use regulations is necessary to prevent urban sprawl and maintain urban compactness.

4. Type 4: Vulnerable Local Cities

Type 4 municipalities face urban challenges due to population decline, second only to Type 2. Given the urban challenges of population characteristics, oversupply of public facilities, and insufficient public transportation, the compact city strategy for Type 4 can draw insights from Japan's SD- or LD-type city strategies. The proposed compact city strategy for this type includes guiding policies to allocate SOC living facilities appropriately in concentrated residential areas, alongside expanding public transportation to improve access to these facilities. Additionally, the strategy should focus on promoting mixed-use development in these areas to ensure a balanced urban structure, while also addressing the need for more efficient land-use and infrastructure management.

These areas are also adjacent to Type 3 municipalities, which are experiencing population growth, and Type 5 areas, which have larger populations and more vibrant economies. Given this spatial relationship, strengthening inter-municipal collaboration may offer opportunities for regional economic revitalization (Yang and Nam, 2022).

As with Type 2 municipalities, Musha (2021) pointed out that municipalities with small populations and limited human resources tend to adopt compact city strategies that rely heavily on economic incentives, such as attracting commercial facilities. Therefore, by providing adequate technical and human resource support for urban planning, it becomes possible to develop more balanced and effective compact city strategies.

5. Type 5: Compact Urban Centers

Finally, while Type 5 corresponds to Japan's LD type in terms of population factors, it exhibits a relatively well-balanced supply of public transportation and public facilities. According to Kamata and Nam (2024), some areas are experiencing localized population concentration through redevelopment, such as the construction of high-rise buildings in place of low-rise residential areas.

The compact city strategy for Type 5 includes appropriate placement of elderly care facilities and improvements in air quality through the development of parks and green spaces. Given the ongoing population decline, the focus should be on ensuring the proper distribution of SOC facilities rather than expanding their supply. Additionally, in Busan and Ulsan, it is necessary to consider not only compactness at the living sphere level but also compactness at the metropolitan scale (Kamata and Nam, 2024). To achieve a compact city, it can be argued that a compact city strategy targeting wider regions should be developed in collaboration with neighboring municipalities.

Ⅵ. Conclusions

This study aimed to derive compact city strategies suitable for the characteristics of local regions in South Korean cities experiencing population decline and aging, focusing on the BUG metropolitan area. To this end, the study examined the types of inducement measures adopted in Japan's LOPs according to urban typology. It also conducted a typological classification of cities in the BUG region based on their features—specifically, population attributes, urban structure, and challenges arising from population decline—and derived compact city strategies for each type by referring to the results of the LOP analysis.

The analysis of Japan's LOP revealed that a variety of inducement measures have been applied to promote compact city formation, and these measures vary according to demographic characteristics and urban challenges. Notably, cities experiencing population decline—regardless of their size—commonly face issues, such as an oversupply and aging of public facilities. In response, they actively implement not only economic incentives for housing acquisition within inducement zones, but also a wide range of measures, such as environmental improvements and effective utilization of vacant houses.

Based on the cluster analysis of cities in the BUG metro-

politan area, the cities were classified into five types: "declining inner city areas," "underserved small cities," "suburban growth areas," "vulnerable local cities," and "compact urban centers." Based on the findings from the LOP investigation, appropriate cluster strategies were derived for each classification.

The insights gained through this study are as follows. First, when aiming to develop compact cities to address the challenges posed by population decline in domestic cities, it is necessary to understand regional characteristics not only through demographic profiles and urban compactness, but also through indicators representing urban issues. In this study, indicators reflecting urban challenges were set based on materials provided by MLIT and the South Korean government, and cluster analysis was conducted for the BUG metropolitan area. The analysis revealed that despite the widespread population decline in the BUG metropolitan area, cities exhibit diverse attributes.

Second, regions classified as "underserved small cities" in this study, in particular, need to advance compact city policies proactively and as a priority. This type, which includes seven municipalities in GN, is characterized by an oversupply of educational facilities, poor access to SOC facilities, and insufficient public transportation, raising concerns about deteriorating public health. Strategies centered on providing economic incentives to encourage residents to relocate to appropriate areas are required. In this context, small municipalities may require technical and human resource support to formulate effective compact city strategies.

Finally, regardless of population size, municipalities experiencing population growth should apply compact city strategies that include land-use regulations in suburban areas to accommodate future changes in population structure.

This study proposes strategic directions for compact city formation based on the typology of cities in the BUG region. The MLIP (2024) report emphasizes the importance of central government guidance in compact city policy. This is because in Japan, it has been pointed out that in municipalities where the objectives of the LOP are not well understood, inducement measures tend to focus excessively on attracting large-scale commercial facilities or constructing public infrastructure. From this perspective, the findings of this study can contribute to helping local governments to develop more effective compact city strategies. Nevertheless, as mentioned at the beginning, the aim of this study was not to apply Japan's LOP inducement measures directly to South Korean municipalities. Rather, based on the typological compact city strategies presented in this study, each municipality should formulate more specific policies that reflect local conditions. In Japan's LOP system, municipalities have incorporated not only common inducement measures, but also independently developed strategies tailored to their specific contexts. In this respect, final strategy design should be grounded in context-specific needs at the local level. In doing so, as Tamura and Kwon (2019) suggested, it is essential to take into account the structural differences between Japanese and Korean cities.

Since Japan's LOP is a long-term plan with a 20-year horizon, it is still too early to assess the effectiveness of compact city strategies based on the LOP at this stage. After 10 years of LOP formulation, some municipalities may conduct intermediate evaluations. As a future challenge, it will be important to consider adapting strategies based on the effectiveness of LOP to cities in South Korea. As Kamata and Nam (2024) pointed out, compact cities need to be discussed at different scales, including the living sphere and larger urban areas. Future research should focus on examining urban typology at the macro scale and investigating compact city strategies for wider regions. It is hoped that the results of this study will serve as valuable material for evaluating the application of compact city strategies in domestic cities.

Note 1. Although the LOP was originally intended for areas designated as urban planning zones, raising questions about whether eup or myeon regions in Korea should be included as targets of such plans, this study focused on methods of urban consolidation rather than defining the scope of areas to be consolidated. Therefore, this issue is beyond the scope of discussion here.

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