Heliyon 9 (2023) e20933

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

What keeps urban areas from declining? Comparison of before and after effects of the urban regeneration project for the Busan city in South Korea

Youngeun Kang [a], Taelyn Kim [b], Eujin-Julia Kim [c,*]

[a] Department of Landscape Architecture, College of Construction Engineering, Gyeongsang National University, Republic of Korea
[b] Department of Tourism Development, College of Administration, Sangji University, Republic of Korea
[c] Department of Environmental Landscape Architecture, College of Life Science, Gangneung-Wonju National University, Republic of Korea

ARTICLE INFO

Keywords:
Government-led urban regeneration
Urban regeneration decline index
Performance analysis
Urban sustainability

This study aims to comparing the degree of change in the decline index and finding out the variables that influenced this through a regression model (OLS) focused on the 21 urban project sites in Busan city. The comparison of urban decline index was analyzed based on normalized population, industry, and physical indicators. On the OLS model, this urban decline indicator was set as the dependent variable, and the independent variables were set as the project area size, project budget, project type, population size, major urban infrastructure access, and transportation (Subway station) access. As a result of the study, it was found that the degree of improvement in urban decline in the outlying areas away from the center of the city was higher than that in the areas where the old downtown was concentrated. In the regression model I, in which only endogenous variables were input, it was significant that the higher the project budget, the higher the degree of urban regeneration improvement. In Model II, which included both endogenous and exogenous variables, transportation access was derived as the only variable in increasing the degree of urban regeneration improvement. The results of this study are expected to contribute significantly to the monitoring of urban regeneration projects and to establish macro- and micro-directions of urban regeneration projects for urban sustainability.

1. Introduction

Recently, most cities in Korea have been suffering from a decrease in urban growth engines due to lack of urban infrastructure, delay in maintenance of old facilities, decline of local industries and relocation, deterioration of local communities and decline of local assets [1–5]. Moreover, the potential of urban regeneration projects is rapidly declining due to stagnant population growth and rapid aging. This urban regeneration project is a government-led project that the Korean government implemented extensively to physically (e.g., new building improvement and remodeling), demographically (e.g., population inflow policy), and economically (e.g., industrial and commercial support) in various local governments across the country, starting in 2017. The background of the urban regeneration

* Corresponding author. Juk hun-gil 7, Gangneung-si, Ganwon-do, 25457, Republic of Korea.
E-mail address: ejkim@gwnu.ac.kr (E.-J. Kim).

https://doi.org/10.1016/j.heliyon.2023.e20933
Received 2 March 2023; Received in revised form 10 October 2023; Accepted 11 October 2023
Available online 16 October 2023

project was that it was difficult to effectively promote the existing private-led urban development projects due to limitations in quantitative urban growth. Accordingly, the government tried to strengthen the role and support of the public, and lay the foundation for autonomous urban regeneration by rebuilding the function of the decaying city including the original downtown and restoring the local community. Although it is quite encouraging that the urban regeneration project is actively promoted, each project has various visions, goals, and values, and consists of an excessive planning system, which raises questions about whether the project is achieving its goals.

Given this context backdrop, the study devised the following sequential research questions: (1) “How successful has the government-led urban regeneration project been in regenerating Busan city and reversing the trends of urban decline in terms of urban decline in terms of population, industry, and physical aspect?”, (2) “what are the key factors that contribute to the positive or negative changes observed in the urban decline index as a result of the regeneration initiative?”. Consequently, this study aimed to assess the level of change in population, industry, and physical index set as the initial goal of the government-led urban regeneration project from the perspective of the intermediate monitoring of the project. Furthermore, we intend to propose a direction of urban regeneration project for urban sustainability by determining and analyzing endogenous and exogenous variables influencing the improvement of urban decline index.

2. Literature review

2.1. Urban regeneration

Urban regeneration has received a lot of attention from academia, policy makers, and government officials in recent decades, and its demand among residents is also increasing [6,7]; [8]. The concept of urban regeneration has come to prominence because of urban decay and deterioration worldwide [9], and it can be also used as a viable means to ensure long-term urban sustainability (H [10]. Urban regeneration which is similar to an ‘urban rehabilitation’, ‘urban renewal’, and ‘urban transformation’ is a process that includes the improvement of existing building and areas, and the reuse of urban land [9,11]. Unlike conventional urban redevelopment projects, it aims to revitalize urban neighborhoods by encouraging resident participation, while minimizing the possible negative influence of revitalization [1]. Since the existing urban redevelopment was implemented radically to supply new housing or ignored the urban context in many cases, the expectation and necessity of the urban regeneration project as an alternative was emphasized by researchers. Naturally, initial urban regeneration endeavors encountered challenges akin to early urban redevelopment initiatives. However, the current trajectory of urban regeneration projects centers on cultivating urban resilience by shifting the initial paradigm towards sustainable development [12,13]. As a major flow of recent urban regeneration projects, the United States and Europe announced a Green Deal proposing programmatic provisions to achieve terriotorial sustainability by redeveloping brownfield land into sustainable industrial areas (SIAs) [14]. [15] insisted that the importance of providing public services and improving their accessibility to residential areas as a physical context of urban regeneration is increasing.

Korea’s urban regeneration project took shape with the enactment of the Urban Regeneration Act in 2013. After the enactment of this law, the government-led urban regeneration project was activated, but since the late 1960s, urban regeneration projects have been carried out in the form of ‘public redevelopment’ and ‘joint relocation’. Subsequently, a new-urban regeneration policy took off in the late 2000s [2]; a representative sample of this is the Cheonggyecheon restortation project in 2002. Urban regeneration as defined by the government is a concept that includes demographic, physical, social, cultural, and economic regeneration on degraded areas across the country [16–18]. Based on this concept, urban regeneration projects are trying to increase the sustainability of sites by improving various conditions through goals such as strengthening the community and the capacity of residents, and creating jobs, as well as physically improving the city [19]; l [1,20].

In Korea, the general steps for implementing the urban regeneration project consists of four phases: i) developing an urban regeneration master plan, ii) determining the project promoter, iii) developing an urban regeneration project implementation plan, and iv) implementing the urban regeneration project [1]. One of the main issues of the urban regeneration project in this step is that after the strategic plan (master plan) for urban regeneration is carried out, an activation plan can be made with the implementation project. The core of this strategic plan is to identify the site for the urban regeneration project within the scope of the project and set the spatial boundary for the project site [3]. ‘Demographic’, ‘social’, and ‘physical’ indicators should be set to identify the site for urban regeneration projects, and scores for the indicators should be derived for each site. If the results are confirmed, it is considered that the minimum criteria for selection as an urban regeneration project site have been achieved. For this urban regeneration project, competition among local governments to receive the order (projects) is inevitable as the selection and budget scale of the local government are decided in the public offering project led by the state. The type of urban regeneration project is determined according to the characteristics of the sites or the size of the site, and the functions (‘economic revitalization type’, ‘commercial district revitalization type’, ‘residential area regeneration type’, etc.) and the budget of each type of urban regeneration project vary. Various projects are carried out by synthesizing the analysis of local conditions and the needs of experts and local residents in the target area selected as an urban regeneration revitalization area. Here, the project is largely divided into a project for improving the physical environment and software programs such as empowerment and education for residents. Typical project examples include buiding community halls, creating a start-up support center, painting a mural of a village, and creating rental houses for vulnerable social groups [3]. insisted that these urban regeneration initiatives are common in revitalization projects in an attempt to help communities identify the unique values and characteristics of a region and utilize local resources to promote economic, social, and cultural vitality. There are systems and benefits that can be linked and supported with regard to the projects once they have been selected. In case of the urban regeneration project, the qualification to receive additional sub-project support is generated only in the selected target site, and representative examples include projects such as 'smart city response type', and 'carbon neutral response type'. In addition, one of the major trends in the recent urban regeneration project in Korea is the emphasis on the accessibility of 'social infrastructure' (Living SOC) to residential areas; in other words, the importance of qualitative indicators (accessibility) in addition to the need to satisfy quantitative indicators for social infrastructure installation (schools, parks, parking lot, etc.).

Diverse viewpoints about the urban regeneration project encompass both positive and negative perspectives. Particularly, there has been a strong focus on in-depth discussions regarding the negative aspects of urban regeneration for urban sustainability [21–23]; Shen et al., 2021; [24]. This discourse serves as a mean of shaping the forthcoming course of such project, both directly and indirectly, by means of process of correcting negative aspects. The negative facets of urban regeneration project can primarily be categorized into three key dimensions: 'superficial redevelopment,' 'social inequality,' and 'effectiveness deficiency.' Firstly, the concept of superficial redevelopment encompasses various aspects, including the erasure of urban culture through extensive demolition and reconstruction, the emergence of homogeneous urban landscapes, inefficient resource allocation, and the exacerbation of environmental pollution [13]. [13] stated that urban regeneration that overly focuses on indiscriminate demolition was found to jeopardize the city's long-term sustainability despite significant investments in terms of human, material, and financial resources. Notably, studies highlighting adverse effects of urban regeneration associated with renowned architects also warrant attention [25]. pointed out an unintended consequence whereby designs by international firms or star architects appeared to influence a city's future. The achievement of successful urban regeneration by specific individuals often deviates from the local reality, potentially impeding a systematic understanding of the genuine requirements and urban impacts of such projects [23,25]. Placing exclusive emphasis on simplistic development and promotion without accounting for regional idiosyncrasies raises the likelihood of diminishing the effectiveness of initially conceived urban regeneration efforts. This risk engenders the potential for perpetuating the detrimental cycle of pre-existing urban redevelopment, ultimately eroding urban equilibrium [10,26]. As pointed out in many studies, the problem of 'gentrification' wherein the original residents are driven out as a lot of capital is concentrated in the target area due to the implementation of the urban regeneration project, cannot be overlooked [18,27]. In the case of Korea, the gentrification issue is also reported as a serious social pathology, and as a response to this, public intervention such as preferential purchase of land by government and agreement between landlord and tenant is continuing. Another negative aspect is the question of effectiveness of the urban regeneration project itself, which has recently been the center of controversy. As mentioned above, the urban regeneration project is a government-led project of a public project led by the government, and the aspect of 'publicity' has been emphasized more significantly than 'profitability' [5]. Therefore, even though it is related to the improvement of the convenience of the residents, if publicity is poor or the it is a structure the project operator benefits from, it has been the subject to criticism or sanctions [1]. In urban regeneration projects, complex interrelated interests between various stakeholders appear, and potential conflicts can be minimized when the public and the private interests of the stakeholders are pursued in a balanced way [20,28]. [21] criticized the system of this project by opining that it may be difficult to guarantee sustainability as it depends deeply on government finances. This problem can ultimately lead to dissatisfaction of local residents, who are the subjects of this project, and threaten the sustainability of urban regeneration project. Therefore, it is necessary to discuss the issue of private intervention in future urban regeneration projects [29], and studies comparing the effects of various types of urban regeneration projects should be continued.

2.2. *Indicators of decline and performance in urban regeneration*

The urban regeneration decline in this chapter acts as a clue to estimate the degree of physical, demographic, and social decline in a specific area. In other words, it is used as a major basis when selecting a target site for an urban regeneration project. In fact, in Korea, three criteria for decline indicators to be selected as an urban regeneration project target in the urban regeneration revitalization plan are presented, which are divided into demographic, industrial, and physical factors. The criteria to diagnose the decline in the three indicators are stipulated in the Enforcement Ordinance of the Urban Regeneration Act. If two or more of the following three fields are met, it becomes the minimum standard for selection as a target site for an urban regeneration project. In the demographic category, either 'a site with a decrease in population by at least 20% compared to the most populous period in the last 30 years' or 'a site with a decrease in population for at least three consecutive years in the last five years' must be satisfied. The industrial sector is also divided into two areas: 'a site where the total number of businesses has decreased by more than 5% compared to the period when the number of businesses was the highest in the last 10 years', and 'a site where the total number of businesses has decreased for there of more consecutive years in the last five years.' Lastly, the age of buildings is the main criterion for the indicator in the physical sector. Specifically, there is a standard that the site must be in an area where the proportion of buildings that have been built for 20 years or more among all the buildings in the boundary of the site is 50 % or more. These legal standards are only the minimum standards for the justification necessary to select the target site for the urban regeneration project, and various indicators are being developed to actually select the suitable site or to measure the after effect of the project.

During the mid-20th century, urban decline studies gained momentum in response to the consequences and exogenous results stemming from the observed urban decline worldwide. Relevant studies have especially centered on comprehending the cause of physical, economic, and social decline in urban areas, which are characterized by population decline, disinvestment, devastated areas, and increase in crime [30–32]; Wang & Fukuda, 2019; He et al., 2023). The macro-level influence of urban decline is predominantly by economic globalization, particularly through deindustrialization, suburbanization, etc. (Hartt, 2018; [33,34]. At the micro level, factors such as population decline, vacant land, decaying infrastructure, and the decline of industrial activities have been identified as contributing variables (Hartt, 2018 [35,36]; Zhang et al., 2023). Specifically, vacant lots and abandoned building have been highlighted for their direct role in urban decline, as they can create unfavorable perceptions within the community [37]. [38] employed 'empty land' as a prominent proxy variable for delineating urban decline, uncovering its correlations with several triggering factors of urban deterioration. In this context, the principal independent variables were analyzed through the lenses of ‘economy,’ ‘inequality,’ ‘housing,’ ‘persistent poverty,’ and ‘land use.’ The finding of this study demonstrated a positive correlation between larger water surface areas and agricultural land areas and the acceleration of urban decline. Moreover, the study underscored the significance of highly educated individuals in expediting urban decline. Notably, the issue of urban decline was discussed as an extension of the urban sprawl challenge [39]. investigated the impact of urban sprawl on urban decline within the Tehran metropolitan region. This research outcome indicated as the city expands, urban decline experiences heightened acceleration. The argument was put forth that countering rapid urban decline and decreasing growth rates necessitates a departure from haphazard urban expansion, advocating for a transition to a more compact urban model. Meanwhile, diverse variables and methodologies are being explored to quantify urban decline [40]. utilized night light data to gauge the extent of urban decline, juxtaposing the degrees of decline across cities at the county level in China. As a whole, the full scope of urban decline becomes evident as we observe a continuous drop in population, a surplus of vacant housing, unused land, and decrease in industrial activity. To better understand this phenomenon, researchers also use indicators such as vacant land and light data in nighttime [41]. applied the decline in industrial diversity as a key variable in urban decline and found a positive correlation between them. The investigation into urban decline seeks to answer questions about the complex interactions among various urban factors that lead to its emergence, ultimately guiding efforts to improve urban sustainability.

The following studies analyzed the performance of urban regeneration projects or the prerequisites for sustainable urban regeneration projects. The reason for reviewing this content is that it can be used as the inverse of the decline indicator, and it facilitates the identification of the endogenous and exogenous detailed factors of why the areas declined [26]. extracted the planning elements for sustainable urban regeneration in Dubai. As a major result of the study, it demonstrated that the most important factor for a sustainable urban regeneration is the improvement of the current underdeveloped physical environment. Here, environment-specific elements that can effectively promote physical improvement refer to urban landscape, open space, park, and waterfront [42]. also emphasized the importance of sustainable urban regeneration and derived 20 detailed indicators in social, economic, and environmental sectors for sustainable urban regeneration in Turkey. As a result of the study, four significant indicators were found for the sustainable urban regeneration project: provision of local services, increase in employment within the project area, maximization of energy efficiency, and increase in the provision of green spaces). In this context [43],’s study has extended the concept of sustainability in urban regeneration to the environmental aspect. For example, in addition to social aspects such as accessibility to social infrastructure and economic aspects, building energy efficiency, waste disposal and recycling rates were added as sustainability indicators for urban regeneration. As another study highlighting the environmental aspect of urban regeneration [7], argued that ecosystem services should be integrated into the urban regeneration framework, and ‘quality of place’, ‘quality of life’, and ‘good governance’ should be

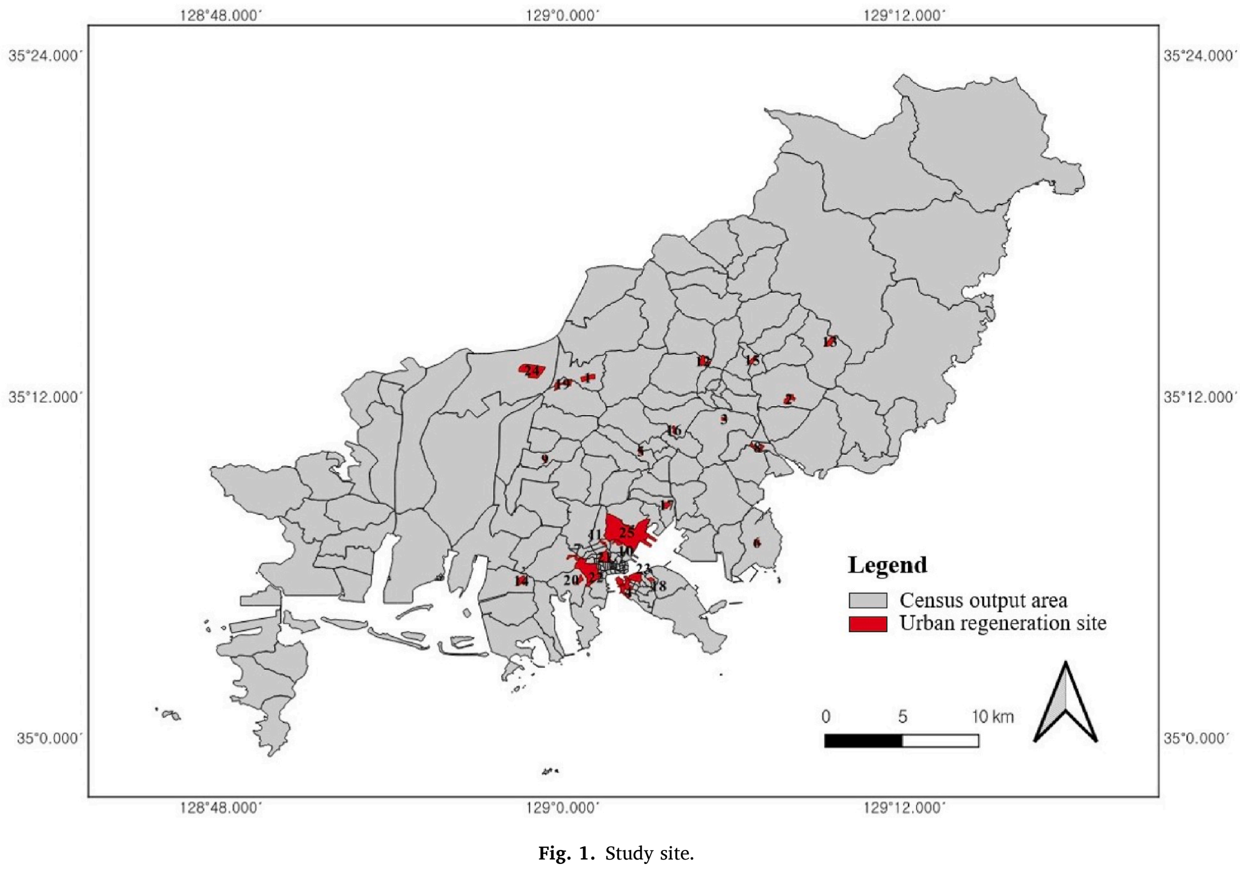

Fig. 1. Study site.

considered for sustainable urban regeneration.

As a study that measures or predicts the direct or indirect performance of urban regeneration, l [20] presented a method to spatially quantify the benefits of urban regeneration. In their study, the benefits of urban regeneration were analyzed by dividing them into ‘reduction of seismic risk exposition’, ‘increased access to urban functions’, ‘increased of mixed land uses’, and ‘effects of different configurations of regeneration areas’. Some results of the study indicated that the linear effect was significant depending on the policy input. In particular, the variables that majorly impacted performance were attributed more to population density, presence of urban services, and land use diversity than the area of project implementation [15]. reviewed one of the positive effects that can be achieved through urban regeneration: the improvement of ‘walkability’, and compared accessibility between the current and designed situations using a GIS-based time-space analysis. For a quantitative analysis of the social value of urban regeneration project [44], explored the methodologies combined CV (contingent valuation), and HP (hedonic pricing) to assess the value of the urban regeneration project in Milan, Italy. As one of the main clues in the results of the study, people showed that even if it is not worth using immediately, it is worth paying additionally due to the improved urban environment and increase of urban public infrastructures, which can be critical factors in measuring the outcomes of urban regeneration projects henceforth. As another study result, one of the major achievements of urban regeneration was increasing job creation and social relations [9]; Y [43]. For [45]’s study, variables such as population growth and housing price increase, as well as income and other relevant outcomes were compared before and after the project to analyze the economic effect of the urban regeneration projects in Italy. The results showed the short-term economic effect after the project was insufficient, but there were some mid- and long-term effects. As in the above research flow, various spatial, economic, and social performance indicators have been developed to measure the performance of urban regeneration projects. In addition to this, effects such as the improvement of urban living environment [46], improvement of public services [15,47], modernization of urban infrastructure [48], increase of energy efficiency [49], quality of life and health [50], and rising demand for housing and land prices [45]; Glaeser, 2008) have been demonstrated as the positive effects of urban regeneration projects. These results need to be used both in terms of ‘effectiveness’ and ‘equity’ in the selection of future urban regeneration project sites.

3. Material and methods

3.1. Study location

The study site was limited to the urban regeneration sites in Busan, which is known as the second most populous city in Korea after Seoul, with a population of about 3.3 million. The reason why this city was selected as the main study site is that it has one of the local governments with the highest number of government urban regeneration project selected and proceeded, and a certain degree of geographical similarity between the target sites must be ensured. In addition, while the physical aging of the city is relatively high, it is also has many characteristics of industrial base and cultural heritage (See Fig. 1).

A total of 25 urban regeneration project sites, that were selected and proceeded after the enforcement of the Urban Regeneration Act (2013), were analyzed in this study. The target site consists of those selected in 2014 to those recently selected in 2020, and the project execution period is usually 3–5 years. There are total of five types of projects, divided into ‘economic-based type’, ‘central city area type’, ‘general neighborhood type’, ‘residential support type’, and ‘our neighborhood revitalization type’ depending on the purpose of the project. However, this study simplified these into three; ‘residential revitalization type’, ‘commercial revitalization type’, and ‘industrial revitalization type’ for further analysis. The decision to restructure was driven by the realization that the initial categorization of the five project types was primarily based on project volume and lacked effectiveness in accurately classifying project types. Consequently, three distinct classification frameworks were introduced, focusing on substantive differences. “General neighborhood type,” “residential support type,” and “our neighborhood type” focusing on residential regeneration were classified into "residential revitalization type." The second classification pertains to the retail-oriented ’central city area type,’ which has been reclassified as the "commercial revitalization type." Lastly, the type centered on economic objectives aimed at industrial rejuvenation is classified as the "industrial revitalization type."

3.2. Data selection and collection

Since this study aims to analyze the effects of improving the decline of the target sites due to the urban regeneration projects, the types of variables are largely divided into ‘endogenous variable’, depending on the characteristics of the project itself; ‘exogenous variable’ depending on the characteristics of the site; and dependent variables affected by these variables. Endogenous variable assumes that the project itself affects the dependent variables, and exogenous variable assumes that the locational or environmental characteristics affects the dependent variable regardless of project initiation. The dependent variable is intended to be identified as the increase or decrease of the decline index, which was the criterion when selecting the urban regeneration project.

Overall, the process of choosing variables for this study were twofold: first, the potential impact of these variables on urban decline was assessed through existing studies; second, feasibility of obtaining pertinent data was taken into account. The following is an explanation of the basis and process of for selecting the dependent and independent variables in this study.

3.2.1. Urban decline index change

In this study, the urban regeneration decline index is defined as an object that can be objectively compared to the degree of change in population, industry, and physical decline (i.e., building age) of an urban area based on a specific point in time. The primary factor to be set to recognize the increase or decrease of the urban regeneration decline index is the time range in which the magnitude of change can be compared. The time range to grasp the effect compared to the input of the project can usually be divided into initial and mid- and long-term effects after project initiation. In this study, since the proportion of projects that proceeded recently is relatively high, data from 3 years after the initial effect can be verified as a comparison target. Meanwhile, the data before the implementation of the project was set as data just one year before the year in which the project was initiated.

As with the three minimum criteria for the selection of urban regeneration projects stipulated in the Urban Regeneration Act, the change in the total population size in the demographic index, the change in the total number of businesses in the industrial index, and the change in the proportion of buildings older than 30 years in the site boundary in the physical index were finally analyzed. Here, the spatial boundary for demographic and industrial indexes were not based on the project site boundary, but the census output area, which is the minimum unit of living space announced annually by the Korea National Statistical Office. In the case of physical index, data was acquired based on the actual project site boundary, and this data was extracted from the yearly GIS building integrated information provided by the public data portal site (https://www.data.go.kr/).

3.2.2. The characteristics of each project

This variable belongs to endogenous variables, and can be divided into project cost, project area, and project type. Although it can be predicted that the project cost and area have a high linear relationship, the actual project cost was differentiated because the use of systemic budgets such as education or other programs in addition to the improvement of the physical environment being different for each project. Moreover, project types were divided into 'residential revitalization', 'commercial revitalization', and 'industrial revitalization' type. This is from the items classified into five ('economic-based type', 'central city area type', 'general neighborhood type', 'residential support type', and 'our neighborhood revitalization type') in the overview of the study site according to the clear purpose of the project.

All data for this chapter were obtained from public data portal site (https://www.data.go.kr/) and urban regeneration comprehensive portal site (https://www.city.go.kr/index.do).

3.2.3. Population size

Maintaining an appropriate population size has been known to affect 'perceived neighborhood safety' [51], 'increased neighborhood happiness' [52], 'sense of community' [53], and 'urban sustainability' [54,55]. [45] used the population variable as one of the variables to prove the impact of urban regeneration programs on the local economy. Furthermore, it has been reported that a decrease in population or an increase in vacant houses further accelerates the migration of current residents [56,57]. Therefore, the population variable can be regard as one of the important variables to analyze the impact of urban regeneration projects.

3.2.4. Access to urban infrastructure

Urban infrastructure, recently called living SOC in Korea, has been emphasized for a sustainable city worldwide [26,58,59], and typical examples include schools, libraries, parking lots, clinics, etc. In the past, the importance of the total amount of urban infrastructure in the city was emphasized, but recently, the importance of accessibility, that is, the distance of urban infrastructure from

Table 1
Survey participants' background.

No.	Sigungu (location)	Start year	Type	Area (m²)	Population (census output area, 2022)
1	Buk-gu	2021	Residential Area Regeneration Type	203,900	
2	Haundae-gu	2021	Residential Area Regeneration Type	410,100	
3	Yeonje-gu	2021	Residential Area Regeneration Type	41,377	
4	Youngdo-gu	2020	Economic Revitalization Type	487,000	
5	Busanjin-gu	2019	Residential Area Regeneration Type	50,000	652
6	Nam-gu	2020	Residential Area Regeneration Type	54,000	485
7	Saha-gu	2019	Residential Area Regeneration Type	98,900	642
8	Suyoung-gu	2019	Residential Area Regeneration Type	136,000	565
9	Sasang-gu	2020	Residential Area Regeneration Type	56,549	425
10	Jung-gu	2019	Residential Area Regeneration Type	99,000	432
11	Seo-gu	2019	Residential Area Regeneration Type	49,000	528
12	Dongrae-gu	2019	Commercial District Revitalization Type	168,000	730
13	Haeundae-gu	2019	Residential Area Regeneration Type	150,000	506
14	Saha-gu	2019	Residential Area Regeneration Type	149,000	353
15	Gumjeoung-gu	2019	Residential Area Regeneration Type	82,000	526
16	Yeonje-gu	2019	Residential Area Regeneration Type	52,000	584
17	Dong-gu	2018	Residential Area Regeneration Type	113,000	592
18	Youngdo-gu	2018	Residential Area Regeneration Type	47,000	499
19	Buk-gu	2018	Commercial District Revitalization Type	244,000	449
20	Saha-gu	2018	Residential Area Regeneration Type	112,000	502
21	Jung-gu	2016	Residential Area Regeneration Type	420,000	452
22	Seo-gu	2016	Residential Area Regeneration Type	1,166,199	548
23	Youngdo-gu	2016	Commercial District Revitalization Type	312,000	677
24	Gangseo-gu	2016	Residential Area Regeneration Type	780,000	505
25	Dong-gu	2014	Economic Revitalization Type	3,120,000	519

Note: The shaded areas are the final analysis target (3 years or more after project initiation).

major residence units, is being emphasized and related projects have increased in Korea. These urban infrastructure accessibility variables are also reported to have a significant impact on residents' satisfaction, commercial revitalization; another significant result is that if major urban infrastructure locates in town, the eviction rate will decrease and house prices will rise [60–62].

This study used the study by Auri (2019) to measure urban infrastructure accessibility. They measured the degree of accessibility of major urban infrastructures in the city and graded them into 10 levels (see Table 2). In other words, the higher the grade, the better the accessibility of the residential area and urban infrastructure. The standard for calculating the grade was set as the standard data based on the distance of urban infrastructure from residential areas distributed throughout the country, and results derived were reflected by public surveys and expert surveys regarding the appropriate distances of each urban infrastructure. The final eight urban infrastructures used in this study were 'day care center', 'kindergarten', 'elementary school', 'library', 'public sports facility', 'silver hall', 'parking lot', 'retail store', and 'park'. As demonstrated in the figure below (Fig. 2), for accessibility grading, the grid overlapping with the target sites was extracted using 200 m by 200 m grid, and final accessibility value was calculated as a grid average value within the project boundary using QGIS calculation function.

The urban infrastructure data of Busan was acquired through a public data portal site (https://www.data.go.kr/), and the grid creation suitable for the site boundary and the linear distance accessibility analysis were analyzed using the QGIS program.

3.2.5. *Transportation accessibility*

Transportation accessibility is known not only as a meaningful variable for improving the convenience and satisfaction of living, but also as a significant variable for economic aspects such as industrial revitalization and job creation [19,63–65]. Although the target transportation method for accessibility measurement can be varied, the transportation was limited to only the subway considering the regional characteristics of Busan, which has excellent accessibility and high use rate of the subway compared to other cities in South Korea. There are four subway lines passing through Busan, with 114 stations.

Each subway station location was obtained from a public data portal site (https://www.data.go.kr/), and the data was proceeded using a straight-line distance function that measures the nearest distances from the study site and subway station using the QGIS program.

Table 3 presents the chosen variables for this study, along with the relevant supporting literatures. Within the category of independent variables, endogenous variables encompass three distinct types: area size, budget, and project type. As previously suggested, endogenous variables are related to inherent attributes of the urban regeneration project itself. Past studies (Wang & Fukuda, 2019 [35,36,40,66]; have mainly concentrated on establishing the link between exogenous variables, as defined in this study, and urban decline. For example, population change is a commonly employed variable in urban decline investigations, serving as both an independent and dependent variable (Hartt, 2018 [35,41,67]; He et al., 2023). In this study, we chose population size as an independent variable based on previous studies [45,56,57], which indicate that population size or density can exhibit direct and indirect correlation with urban decline. Additionally, variables such as site accessibility, urban infrastructure, and transportation significantly influence the extent of urban decline impact. Drawing from prior studies (Ji and Gao, 2009 [59]; Auri, 2019; [19,26,58,63,65], we included accessibility to urban infrastructure and transportation as independent variables.

On the other hand, existing studies have primarily relied on variables such as vacant land, vacant houses, and nighttime lighting levels when selecting dependent variables to analyze urban decline [38,40,57]. The utilization of these variables as proxy data for urban decline may introduce substantial errors, particularly in varying regions, especially suburban areas. Furthermore, in the context of South Korea, the urban regeneration legislation itself outlines criteria for assessing the extent of urban decline. Consequently, this study constructed the urban decline index based on 'population', 'industry', and 'physical' variables, aligning with these guidelines.

3.3. *Regression modelling*

The OLS model is one of the regression models traditionally used in urban planning worldwide [68]. In this study, multivariate OLS regression was developed to explore the relationship between the urban decline index and endogenous and exogenous variables of urban regeneration projects (i.e., project budget, population size, transportation accessibility). The form of regression model is expressed as:

Table 2
Distance range based on 10 grades by urban infrastructure (unit: meter).

Division	grade 1	grade 2	grade 3	grade 4	grade 5	grade 6	grade 7	grade 8	grade 9	grade 10
Daycare center	71	96	121	148	178	213	257	312	404	405~
Kindergarten	128	184	233	283	335	395	468	571	771	772~
Elementary school	154	205	253	302	351	405	471	561	731	732~
Library	253	448	758	1275	1909	2637	3494	4625	6522	6523~
Public sports facility	150	280	518	932	1418	2163	3006	4146	6169	6170~
Silver hall	58	75	92	112	137	169	215	289	492	493~
Parking lot	252	515	931	1535	2268	3135	4234	5779	8290	8291~
Retail store	71	115	203	372	632	964	1380	1938	2844	2845~
Park	156	265	438	761	1266	1914	2734	3845	5656	5657~

Note: Auri(2018), p. 12 reconstruction.

Fig. 2. Concept of the accessibility to urban living infrastructure.

Table 3
List of variables used in this study.

Division	Variables	Unit	Source (year)	Reference
Endogenous Variable (The characteristics of each project)	Area size	㎡	2022	–
	Budget	$	2014~2019	–
	Project type	–	–	–
Exogenous Variable	Population size	n	2022	[45,56,57]
	Access to urban infrastructure	meter	2022	[26]; Auri, 2019 [58,59];
	Transportation accessibility	meter	2022	[63]; Ji and Gao, 2009 [19,65];
Dependent Variable	Urban decline index change	Normalized value	2022	Urban Regeneration Act of Korea

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots + \beta nXn + \xi \tag{1}$$

Where Y is the dependent variable, X1,X2 … Xn are explanatory variables, β is the estimated coefficient, and ξ is the random error. We selected our dependent variable, urban decline index, and independent variables endogenous variables of urban regeneration project and exogenous variables of urban regeneration project (shown in Table 3). In particular, a normalization index was used to understand the relative importance of each variable and avoid negative values since the value of the dependent variable was a change value in the urban decline index compared to the past. When running the regression model, we additionally analyzed the regression model in which only the endogenous variable was selected as the independent variable to compare the influence of each endogenous and exogenous variables.

Before performing regression modeling, multicollinearity between independent variables was carried out with the coefficient of variance expansion (VIF). The reliability of each mode was expressed as R square and the adjusted R square value, and T-statistic was used to reflect the significance of the correlation between urban decline index and each independent variable. Finally, in the OLS model result, the independent variable with a high absolute value of the coefficient was interpreted as having a relatively high degree of influence on the dependent variable in this study.

4. Results

4.1. Urban regeneration index change pattern

In this chapter, the overall change caused by the urban regeneration project was analyzed through demographic, industrial, and physical changes and the combined score. Tables 4 and 5 demonstrates each value for 21 of the 25 project sites, which were limited to sites where the project initiation has passed at least 3 years. As a result of the analysis, it was found that the performance index of each (demographic, industrial, and physical changes) and combined were reduced in most of the urban regeneration project sites.

Table 4 shows the rate of change of present values compared to the past for each of the population, industry, and physical indicators. Among the urban regeneration indicators, the decrease in the population sector was analyzed to be the highest. Specifically, it was found that the population of the sites decreased by an average of 8.80 % compared to the past, including areas where the population decreased by about 40 %. On industrial indicator, the number of businesses was increased by 37.56 % on average. The increase in industrial indicator can be interpreted as the main reasons for the small number of existing businesses in the sites and the direct impact of business subsidies within the urban regeneration project. For physical indicators, a comparison of percentage values of buildings older than 30 years was carried out, and the overall result was that the percentage of buildings older than 30 years decreased slightly. However, it is worth noting that there were several sites where no changes were found at all.

In the relative comparison by normalizing the change index result, the site with the highest degree of improvement was found to be an area in Gangseo-gu (no. 24 in Table 5). The corresponding area demonstrated a higher degree of improvement compared to other project sites in all the sections (population increase, industrial increase, and new builing expansion). On the other hand, the site with the least improvement was an area in Busanjin-gu (no. 5 in Table 5), which had the most rapid population decline and the lowest level of physical index. The change in the number of businesses in this site showed a slight increase compared to other sites. In addition to this, the site with a relatively high rate of increase in the population was found to be located in Nam-gu (no. 6 in Table 5), and the relative improvement in the industrial sector was found to be located in Seo-gu (no. 22 in Table 5). Since this site is located close to Gamcheon Cultural Village, one of Busan's representative tourist destinations, it is interpreted as a result of the creation of many tourism-related businesses within the site. Lastly, the site located in Sasang-gu scored relatively high in the physical index (i.e., new building increase). It is judged that this is because the project site is located near the railroad tracks, and the pressure for development as a commercial area is relatively high in the 'use district'. Table 5 indicates the values for each site in more detail.

4.2. *Urban decline index change depending on environmental variables*

Regression model (OLS) was performed in this chapter to analyze the effect of environmental variables on the degree of urban decline by project site. Table 6 shows the descriptive statistics for each variable used in this regression analysis. The first process in this analysis was correlation analysis (Pearson's correlation) to determine the correlation between variables (see Table 7). The final variable used in this analysis was analyzed as a total of six variables (i.e., area size, budget, population size, access to urban infrastructure, transportation accessibility, and urban decline index change), excluding 'project type', which is a qualitative variable. As a result of the analysis, correlations with proven significance were found to be between project budget and area size ($r = 0.549^*$, $p = .01$) and between population size and project area ($r = 0.696^{**}$, $p = .000$). Furthermore, when comparing the relationship between the urban regeneration index, which will be used as a dependent variable in the regression model, and other environmental variables, the significant relationships were found to be the relationship with project budget ($r = .566^{**}$, $p = .007$), population size ($r = 0.438^*$, $p = .047$), living SOC accessibility ($r = 0.577^*$, $p = .006$), and transportation accessibility ($r = -0.552^{**}$, $p = .009$). Therefore, it can be interpreted that the variables that had a positive correlation with the change in the urban decline index have a tendency to increase the

Table 4
Change rate by sector.

Site No.	Demographic			Industrial			Physical		
	Past	Present	Rate of Change (%)	Past	Present	Rate of Change (%)	Past	Present	Rate of Change (%)
5	652	403	−38.19	6	13	116.67	80.64	80.64	0.00
6	485	488	0.62	14	3	−78.57	86.41	86.41	0.00
7	642	597	−7.01	9	3	−66.67	84.18	84.18	0.00
8	565	551	−2.48	8	8	0.00	70.29	70.29	0.00
9	425	406	−4.47	8	6	−25.00	54.76	47.24	−13.73
10	432	417	−3.47	13	17	30.77	82	80.39	−1.96
11	528	471	−10.80	8	16	100.00	73.64	73.07	−0.77
12	730	688	−5.75	6	9	50.00	70.45	69.92	−0.75
13	506	455	−10.08	19	18	−5.26	42.85	42.45	−0.93
14	353	352	−0.28	9	11	22.22	40.59	40.59	0.00
15	526	445	−15.40	11	8	−27.27	63.15	63.15	0.00
16	584	555	−4.97	13	16	23.08	8.1	8.1	0.00
17	592	566	−4.39	9	11	22.22	62.66	58.67	−6.37
18	499	435	−12.83	9	11	22.22	84.76	82.79	−2.32
19	449	403	−10.24	16	9	−43.75	54.11	50	−7.60
20	502	414	−17.53	9	9	0.00	96.22	96.22	0.00
21	452	391	−13.50	13	16	23.08	38.55	29.57	−23.29
22	548	492	−10.22	3	17	466.67	88.59	88.49	−0.11
23	677	669	−1.18	9	12	33.33	23.17	19.51	−15.80
24	505	516	2.18	8	15	87.50	46.92	35.1	−25.19
25	519	442	−14.84	8	11	37.50	56.93	55.22	−3.00
Mean	531.95	483.62	−8.80	9.90	11.38	37.56	62.33	60.10	−4.85

Table 5
Change in urban decline index (Normalized results).

Site No.	Demographic index	Industrial index	Physical index	Total
5	0.0000	0.9365	0.0000	0.9365
6	0.9763	0.0000	0.0000	0.9763
7	0.8487	0.3712	0.0000	1.2199
8	0.9269	0.8166	0.0000	1.7435
9	0.8934	0.7424	0.7826	2.4184
10	0.9104	0.8690	0.4508	2.2302
11	0.7773	0.9279	0.1162	1.8215
12	0.8711	0.8908	0.0967	1.8587
13	0.7913	0.8042	0.0382	1.6337
14	0.9622	0.8571	0.0000	1.8193
15	0.6819	0.7331	0.0000	1.4150
16	0.8849	0.8584	0.0000	1.7433
17	0.8948	0.8571	0.5301	2.2819
18	0.7365	0.8571	0.6285	2.2221
19	0.7881	0.6434	0.4513	1.8828
20	0.6341	0.8166	0.0000	1.4507
21	0.7226	0.8584	0.7001	2.2810
22	0.7886	1.0000	0.0477	1.8363
23	0.9479	0.8723	0.2497	2.0699
24	1.0000	0.9205	1.0000	2.9205
25	0.6941	0.8773	0.2097	1.7811

Table 6
Descriptive statistics.

Variables	N	Max	Min	Mean	STD
Area size (m^2)	21	3,120,000	47,000	358,417	689,763
Budget ($)	21	78,450,586	7,655,209	26,618,249	20,545,818
Project type	21	–	–	–	–
Access to urban infrastructure (grade)	21	4.80	2.34	3.56	0.72
Transportation accessibility (meter)	21	4068	201	1101	846
Urban decline index change (normalized value)	21	2.92	0.94	1.84	0.48

Note: For more information on numbering, refer Table 1.

Table 7
Correlations between variables.

		(a)	(b)	(c)	(d)	(e)	(f)
Area size (a)	correlation	1					
	Sig.	–					
Budget (b)	correlation	.549*	1				
	Sig.	.010					
Population size (c)	correlation	.696**	.442*	1			
	Sig.	.000	.045				
Access to urban infrastructure (d)	correlation	−.308	−.265	−.241	1		
	Sig.	.174	.245	.293			
Transportation Accessibility (e)	correlation	−.024	.080	.222	.187	1	
	Sig.	.917	.730	.333	.416		
Urban decline index change (f)	correlation	.566**	.438*	.577**	−.552**	.183	1
	Sig.	.007	.047	.006	.009	.427	

*$p < .05$, **$p < .01$.

Table 8
Coefficients of model I.

Model I	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.563	.160		9.756	.000**
Budget	.001	.000	.439	2.128	.047*

*$p < .05$, **$p < .01$.

degree of demographic, industrial, and physical improvement of the urban area as the value of each variable increases. On the other hand, the meaning of transportation accessibility, which is inversely proportional to the urban decline index change, is that the closer the distance between the subway station and the site, the lower the level of urban decline.

Multicollinearity test was performed, and one dependent variable and six independent variables were used in the regression model. The two OLS regression models that are finally analyzed are divided into a model that analyzes only the impact relationship on the urban regeneration project itself (Model I) (Table 8) and one that analyzes all environmental variables such as location, in addition to the project's own variables (Model II) (Table 9).

The significance of Model I was verified by ANOVA validation ($p = .047^*$), and the model reliability (r square, adjusted r square) was recorded at a relatively low level as 0.193 and 0.150 each. As a result of analyzing the coefficients for the model, only the variable of the project cost was found to be significant among the variables for the project budget, area size, and project type; the higher the project cost among the project sites, the higher the project effect.

Model II was also verified for its statistical significance ($p = .031$), and the level of reliability (r square = 0.584, adjusted r square = 0.406) was analyzed to be higher than that of Model I. For estimating the coefficient of Model II, only the variables for transportation accessibility were found to be significant variables. In other words, it can be interpreted that urban decline reduced with increased access to the subway station.

5. Discussion

As the government pursued the setting of a large-scale direction for the urban area as 'regeneration', support for urban regeneration projects and public interest in local governments and the government itself increased. Accordingly, a large-scale urban regeneration project was carried out under the public initiative, and relatively vulnerable sites benefited from it. Although the purpose of the project was to improve the degree of urban decline, its effects in relevant aspects (population increase, industrial increase, and new building increase) was relatively low. The following factors explain why the project's impact remained relatively low, even in the face of ongoing urban decline after its implementation. Initially, this is primarily because there has been some amelioration in contrast to the initial trend of urban decline. To clarify, the urban regeneration project sites chosen by both national and local governments were initially displaying a declining pattern in all aspects that originally assessed urban regeneration decline. However, as a result of executing this project, a slight improvement was detected in population, industry, and building decline compared to the pre-existing trends. In other words, it is necessary to make clear that the effect of the project in this study is not to improve the literal urban regeneration effect, but to restore the tendency to decline. Furthermore, it is too early to assert that the performance of the project was poor because, in addition to the performance of these quantitative indicators, the effect on local residents' capacity improvement, satisfaction, and improvement of the settlement environment cannot be overlooked. Furthermore, it is judged that the urban regeneration project contributed greatly to protecting the vulnerable and improving the capacity of local residents within the existing quantitative development centered on redevelopment and social polarization. Existing studies [69,70] asserted the side effects of social conflicts that occurred in the existing redevelopment process, and a recent study [71] has suggested that urban regeneration projects are being subdivided from government-led to local government-led according to the importance of social consensus and private cooperation on the urban regeneration project.

In order to closely observe the effect on the project, this study analyzed the regression model by dividing the urban decline index change as a dependent variable, the endogenous index of the urban regeneration project itself, and the exogenous index regarding overall site characteristics. From the analysis, we inferred that relatively, the variable on the project itself (i.e., budget, area size) did not influence the improvement of urban decline in the short term. In other words, variables such as transportation accessibility, urban infrastructure (living SOC) accessibility, or population size, that are the exogenous indexes of this study, may be more critical for project performance.

The main purpose of urban regeneration projects is to revitalize cities, but the government tends to focus on the factors of urban decline when deciding on a site for these projects. Although the premise of the urban regeneration project itself is to target the declining areas, the reality is that there are many national urban projects with short sustainability due to the chronic structure of evaluating performance after the project. Existing research on urban decline has mainly focused on the factors of decline [72], but now it is necessary to pay attention to how to further improve the performance of the urban project. In this context, it is necessary to select and proceed the government-led urban regeneration project by separating the two perspectives of 'equity' and 'efficiency'. From the perspective of 'equity', urban regeneration is to maintain physical and program support by selecting areas that are in decline according to the existing government's promotion method. On efficiency perspective, it is necessary to consider the major variables that affect the project performance derived in this study and utilize it in the project site selection and project promotion process [20]. also revealed that it is important for the regeneration project to be in an urban environment that can maximize its potential benefits for it to perform well. Specific examples of such an urban environment include urban infrastructure accessibility, transportation accessibility, and surroundings derived from this study. However, we consider that performance indicators in terms of equity and efficiency should be differentiated when comparing project performance in the future. For example, policy makers are required to consider the qualitative indicators such as attachment to settlement, safety, and comfort in addition to comparing existing quantitative indexes. Furthermore, it would be meaningful to evaluate tourism and commercial district vitality beyond residence-related factors as indicators in terms of urban regeneration project effectiveness.

Table 9
Coefficients of model II.

Model II	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(constant)	1.418	.730		1.943	.072
Budget	.000	.000	.136	.683	.506
Subway	.000	.000	−.467	−2.467	.027*
Population size	.001	.001	.380	1.774	.098
Access to urban infrastructure	.113	.140	.171	.810	.432
Use Type_residential	.108	.418	.080	.257	.801
UseType_commercial	.221	.455	.139	.486	.635

*p < .05, **p < .01.

6. Conclusion

This study was initiated with the objective of assessing the effectiveness of an actively promoted urban regeneration project. Consequently, the primary focus of this study was to uncover the extent to which the urban regeneration project contributed to improvements in demographic, industrial, and physical aspects, as well as identify the variables influencing its impact.

The study revealed that the urban regeneration project, while yielding varying results across different study areas, did have a modest positive effect in mitigating the existing trend of urban decline. Among the demographic, industrial, and physical dimensions, the population aspect showed the least improvement, while the industrial aspect exhibited the most significant positive effect. Despite the active promotion of urban regeneration projects, it was evident that significant population growth could not be anticipated in areas already experiencing decline.

The analysis of variables impacting the reduction of urban regeneration decline involved a comparison between the urban regeneration project itself and other variables. Regarding the variables within the urban regeneration project, it was found that project budget directly contributed to the urban regeneration effect, albeit to an insignificant extent. However, when conducting a regression model analysis by incorporating exogenous variables, it became evident that variables related to the urban regeneration project itself had no discernible impact on urban decline reduction. Conversely, the distance variable from the subway, which is one of the exogenous variables emerged as a significant factor directly influencing the effectiveness of urban regeneration projects. This implies that greater accessibility to transportation leads to slower rates of urban decline and, consequently, enhances the effectiveness of urban regeneration efforts.

This study is considered meaningful as it can present detailed criteria that can be useful in selecting urban regeneration sites. Furthermore, in terms of comparing and predicting the direct effects of urban regeneration projects, it can make a direct contribution when considering the justification for project promotion. In addition, when selecting regions to enhance the effect of urban regeneration in the future, the government and the local governments will be able to provide direct guidelines in terms of 'location' and 'scale' selection. Nevertheless, limitations are pointed out that the number of samples analyzed in this study was relatively small and that the degree of improvement in decline could not be analyzed from a long-term perspective. Moreover, when gauging the extent of urban decline within designated areas concerning factors like population, industry, and physical attributes, it is essential to recognize that limitations persist due to variances in spatial coverage. However, as data accessibility in smaller geographic units improves in the future, it is anticipated that a more structured analysis of urban decline will become feasible. In future studies, if we compare the performance of projects in areas that were urban regeneration projects with those that are not, it is expected that a more in-depth analysis will be possible beyond the relative comparisons performed in this study.

Funding

This paper was supported by the Institute of Agricultural and Life Sciences, Gyeongsang National University.

Data availability

Data will be made available on request.

CRediT authorship contribution statement

Youngeun Kang: Conceptualization, Funding acquisition, Methodology, Writing – original draft. **Taelyn Kim:** Conceptualization, Methodology, Validation. **Eujin-Julia Kim:** Conceptualization, Investigation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

We would like to thank Editage (www.editage.co.kr) for English language editing.

References

[1] J.H. Yu, H.R. Kwon, Critical success factors for urban regeneration projects in Korea, Int. J. Proj. Manag. 29 (7) (2011) 889–899, https://doi.org/10.1016/j.ijproman.2010.09.001.
[2] B.K. Seo, Y.M. Joo, Innovation or episodes? Multi-scalar analysis of governance change in urban regeneration policy in South Korea, Cities 92 (2019) 27–35, https://doi.org/10.1016/j.cities.2019.03.010.
[3] G.H. Cho, J.H. Kim, G. Lee, Announcement effects of urban regeneration plans on residential property values: evidence from Ulsan, Korea, Cities 97 (2020), https://doi.org/10.1016/j.cities.2019.102570.
[4] Y. Baek, C. Jung, H. Joo, Residents' perception of a collaborative approach with artists in culture-led urban regeneration: a case study of the Changdong art village in Changwon city in Korea, Sustainability 13 (15) (2021), https://doi.org/10.3390/su13158320.
[5] C. Oh, J. Sim, Effectiveness of public partnerships in non-urban regeneration projects in Korea: seeing through place-keeping theory, Sustainability 14 (8) (2022), https://doi.org/10.3390/su14084845.
[6] B. Manganelli, S. Tataranna, P. Pontrandolfi, A model to support the decision-making in urban regeneration, Land Use Pol. 99 (2020), https://doi.org/10.1016/j.landusepol.2020.104865.
[7] A. Lak, A. Sharifi, M. Khazaei, R. Aghamolaei, Towards a framework for driving sustainable urban regeneration with ecosystem services, Land Use Pol. 111 (2021), https://doi.org/10.1016/j.landusepol.2021.105736.
[8] B. Zheng, Francis, Masrabaye, Sustainable Brownfield Redevelopment and Planning: Bibliometric and Visual Analysis, Heliyon, 2023, e13280, https://doi.org/10.1016/j.heliyon.2023.e13280.
[9] C.D. Ince, B. Aslan, Monitoring the effects of land sizes on private property transformation in an urban regeneration project by regression analysis: erenler Cedit case study, Kocaeli, Sustain. Cities Soc. 50 (2019), https://doi.org/10.1016/j.scs.2019.101632.
[10] H. Wang, Y. Zhao, X. Gao, B. Gao, Collaborative decision-making for urban regeneration: a literature review and bibliometric analysis, Land Use Pol. 107 (2021), https://doi.org/10.1016/j.landusepol.2021.105479.
[11] H. Wang, Q. Shen, B.S. Tang, M. Skitmore, An integrated approach to supporting land-use decisions in site redevelopment for urban renewal in Hong Kong, Habitat Int. 38 (1) (2013) 70–80, https://doi.org/10.1016/j.habitatint.2012.09.006.
[12] N. Frantzeskaki, V. Castán Broto, L. Coenen, D. Loorbach, Urban Sustainability Transitions, Routledge, Abingdon, UK, 2017.
[13] Y. Liu, L. Shen, Y. Ren, T. Zhou, Regeneration towards suitability: a decision-making framework for determining urban regeneration mode and strategies, Habitat Int. 138 (2023), 102870, https://doi.org/10.1016/j.habitatint.2023.102870.
[14] M.R. Sessa, A. Russo, F. Sica, Opinion paper on green deal for the urban regeneration of industrial brownfield land in Europe, Land Use Pol. 119 (2022), https://doi.org/10.1016/j.landusepol.2022.106198.
[15] M. Carra, S. Rossetti, M. Tiboni, D. Vetturi, Can urban regeneration improve walkability? A space-time assessment for the tintoretto area in brescia, Transport. Res. Procedia 60 (2022) 394–401, https://doi.org/10.1016/j.trpro.2021.12.051.
[16] Y.D. Figueiredo, S. dos, M.A. Prim, G.A. Dandolini, Urban regeneration in the light of social innovation: a systematic integrative literature review, Land Use Pol. 113 (2022), https://doi.org/10.1016/j.landusepol.2021.105873.
[17] T.H. Jung, J. Lee, M.H.T. Yap, E.M. Ineson, The role of stakeholder collaboration in culture-led urban regeneration: a case study of the Gwangju project, Korea, Cities 44 (2015) 29–39, https://doi.org/10.1016/j.cities.2014.12.003.
[18] F. Leccis, Regeneration programmes: enforcing the right to housing or fostering gentrification? The example of bankside in London, Land Use Pol. 89 (2019), https://doi.org/10.1016/j.landusepol.2019.104217.
[19] H.Y. Jin, Y. Kwon, S. Yoo, D.H. Yim, S. Han, Can urban greening using abandoned places promote citizens' wellbeing? Case in Daegu City, South Korea, Urban For. Urban Green. 57 (2021), https://doi.org/10.1016/j.ufug.2020.126956.
[20] D. la Rosa, R. Privitera, L. Barbarossa, P. la Greca, Assessing spatial benefits of urban regeneration programs in a highly vulnerable urban context: a case study in Catania, Italy, Landsc. Urban Plann. 157 (2017) 180–192, https://doi.org/10.1016/j.landurbplan.2016.05.031.
[21] H.R. Kim, Y. Jang, Lessons from good and bad practices in retail-led urban regeneration projects in the Republic of Korea, Cities 61 (2017) 36–47, https://doi.org/10.1016/j.cities.2016.11.004.
[22] S. Martinat, J. Navratil, J.B. Hollander, J. Trojan, P. Klapka, P. Klusacek, D. Kalok, Re-reuse of regenerated brownfields: lessons from an Eastern European post-industrial city, J. Clean. Prod. 188 (2018) 536–545, https://doi.org/10.1016/j.jclepro.2018.03.313.
[23] F. Camerin, From "Ribera Plan" to "Diagonal Mar", Passing through 1992 "Vila Olímpica". How Urban Renewal Took Place as Urban Regeneration in Poblenou District (Barcelona). *Land Use Policy*, vol. 89, 2019, https://doi.org/10.1016/j.landusepol.2019.104226.
[24] F. Simon, J. Gironás, J. Rivera, A. Vega, G. Arce, M. Molinos-Senante, H. Jorquera, G. Flamant, W. Bustamante, M. Greene, I. Vargas, F. Suárez, P. Pastén, S. Cortés, Toward sustainability and resilience in Chilean cities: lessons and recommendations for air, water, and soil issues, Heliyon 9 (7) (2023), https://doi.org/10.1016/j.heliyon.2023.e18191.
[25] D. Ponzini, Transnational Architecture and Urbanism: Rethinking How Cities Plan, Transform, and Learn, Routledge, 2020.
[26] J. Awad, C. Jung, Extracting the planning elements for sustainable urban regeneration in dubai with AHP (analytic hierarchy process), Sustain. Cities Soc. 76 (2022), https://doi.org/10.1016/j.scs.2021.103496.
[27] R. Jang, C.J. Yoon, Building a diagnostic model for the development phase of gentrification in the original city centers of the provinces in Korea, Sustainability 14 (7) (2022), https://doi.org/10.3390/su14073804.
[28] Ö. Güzey, The last round in restructuring the city: urban regeneration becomes a state policy of disaster prevention in Turkey, Cities 50 (2016) 40–53, https://doi.org/10.1016/j.cities.2015.08.010.
[29] P.V. De Paula, R. Cun Marques, J.M. Gonçalves, Public-private partnerships in urban regeneration projects: a review, J. Urban Plann. Dev. 149 (1) (2022), https://doi.org/10.1061/JUPDDM.UPENG-4144.
[30] D. Haase, A. Haase, D. Rink, Conceptualizing the nexus between urban shrinkage and ecosystem services, Landsc. Urban Plann. 132 (2014) 159–169, https://doi.org/10.1016/j.landurbplan.2014.09.003.
[31] C. Deng, J. Ma, Viewing urban decay from the sky: a multi-scale analysis of residential vacancy in a shrinking U.S. city, Landsc. Urban Plann. 141 (2015) 88–99, https://doi.org/10.1016/j.landurbplan.2015.05.002.
[32] A. Radzimski, Changing policy responses to shrinkage: the case of dealing with housing vacancies in Eastern Germany, Cities 50 (2016) 197–205, https://doi.org/10.1016/j.cities.2015.10.005.
[33] Z. Du, L. Jin, Y. Ye, H. Zhang, Characteristics and influences of urban shrinkage in the exo-urbanization area of the Pearl River Delta, China, Cities 103 (2020), https://doi.org/10.1016/j.cities.2020.102767.
[34] Z. Liu, S. Liu, Y. Song, Understanding urban shrinkage in China: developing a multi-dimensional conceptual model and conducting empirical examination from 2000 to 2010, Habitat Int. 104 (2020), https://doi.org/10.1016/j.habitatint.2020.102256.
[35] W. Peng, Z. Fan, J. Duan, W. Gao, R. Wang, N. Liu, Y. Li, S. Hua, Assessment of Interactions between Influencing Factors on City Shrinkage Based on Geographical Detector: A Case Study in Kitakyushu, Japan. Cities, 2022, p. 131, https://doi.org/10.1016/j.cities.2022.103958.
[36] Y. Tong, W. Liu, C. Li, Y. Rong, J. Zhang, Y. Yang, Q. Yan, S. Gao, Y. Liu, County town shrinkage in China: identification, spatiotemporal variations and the heterogeneity of influencing factors, J. Rural Stud. 95 (2022) 350–361, https://doi.org/10.1016/j.jrurstud.2022.09.029.
[37] T.J. Sugrue, The Origins of the Urban Crisis: Race and Inequality in Postwar Detroit, Princeton University Press, Princeton, New Jersey, 2005.

[38] T. Lokhande, Y. Xie, Spatial spillover effects of urban decline in Southeast Michigan, Appl. Geogr. 158 (2023), https://doi.org/10.1016/j.apgeog.2023.103031.
[39] H. Talkhabi, K.J. Ghalehteimouri, M.S. Mehranjani, A. Zanganeh, T. Karami, Spatial and temporal population change in the Tehran Metropolitan Region and its consequences on urban decline and sprawl, Ecol. Inf. 70 (2022), https://doi.org/10.1016/j.ecoinf.2022.101731.
[40] Y. Zhou, C. Li, W. Zheng, Y. Rong, W. Liu, Identification of Urban Shrinkage Using NPP-VIIRS Nighttime Light Data at the County Level in China. *Cities*, vol. 118, 2021, https://doi.org/10.1016/j.cities.2021.103373.
[41] J. Wang, Z. Yang, X. Qian, Driving factors of urban shrinkage: examining the role of local industrial diversity, Cities 99 (2020), https://doi.org/10.1016/j.cities.2020.102646.
[42] C. Korkmaz, O. Balaban, Sustainability of urban regeneration in Turkey: assessing the performance of the north ankara urban regeneration project, Habitat Int. 95 (2020), https://doi.org/10.1016/j.habitatint.2019.102081.
[43] Y. Peng, Y. Lai, X. Li, X. Zhang, An alternative model for measuring the sustainability of urban regeneration: the way forward, J. Clean. Prod. 109 (2015) 76–83, https://doi.org/10.1016/j.jclepro.2015.06.143.
[44] I. Mariotti, P. Riganti, Valuing Urban Regeneration Projects: the Case of the Navigli, vol. 26, Culture and Society, Milan. City, 2021, https://doi.org/10.1016/j.ccs.2021.100415.
[45] G. Albanese, E. Ciani, G. de Blasio, Anything new in town? The local effects of urban regeneration policies in Italy, Reg. Sci. Urban Econ. 86 (2021), https://doi.org/10.1016/j.regsciurbeco.2020.103623.
[46] C. Alpopi, C. Manole, Integrated urban regeneration – solution for cities revitalize, Procedia Econ. Finance 6 (2013) 178–185, https://doi.org/10.1016/s2212-5671(13)00130-5.
[47] G. Pellicelli, S. Rossetti, B. Caselli, M. Zazzi, Urban regeneration as an opportunity to redesign sustainable mobility. Experiences from the emilia-romagna regional call, Transport. Res. Procedia 60 (2022) 576–583, https://doi.org/10.1016/j.trpro.2021.12.074.
[48] S. Huston, R. Rahimzad, A. Parsa, 'Smart' sustainable urban regeneration: institutions, quality and financial innovation, Cities 48 (2015) 66–75, https://doi.org/10.1016/j.cities.2015.05.005.
[49] M. Deakin, F. Campbell, A. Reid, The mass-retrofitting of an energy efficient-low carbon zone: baselining the urban regeneration strategy, vision, masterplan and redevelopment scheme, Energy Pol. 45 (2012) 187–200, https://doi.org/10.1016/j.enpol.2012.02.019.
[50] N. López-Contreras, V. Puig-Barrachina, A. Vives, P. Olave-Müller, M. Gotsens, Effects of an urban regeneration program on related social determinants of health in Chile: a pre-post intervention study, Health Place 68 (2021), https://doi.org/10.1016/j.healthplace.2021.102511.
[51] B. Sun, J. Lin, C. Yin, Impacts of the built environment on social capital in China: mediating effects of commuting time and perceived neighborhood safety, Travel Behaviour and Society 29 (2022) 350–357, https://doi.org/10.1016/j.tbs.2022.08.005.
[52] K. Mouratidis, A. Yiannakou, What makes cities livable? Determinants of neighborhood satisfaction and neighborhood happiness in different contexts, Land Use Pol. 112 (2022), https://doi.org/10.1016/j.landusepol.2021.105855.
[53] E. Douglas, Examining the Relationship between Urban Density and Sense of Community in the Greater Vancouver Regional District. *Cities*, vol. 130, 2022, https://doi.org/10.1016/j.cities.2022.103870.
[54] A. Malah, H. Bahi, Integrated multivariate data analysis for Urban Sustainability Assessment, a case study of Casablanca city, Sustain. Cities Soc. 86 (2022), https://doi.org/10.1016/j.scs.2022.104100.
[55] X. Song, Q. Feng, F. Xia, X. Li, J. Scheffran, Impacts of changing urban land-use structure on sustainable city growth in China: a population-density dynamics perspective, Habitat Int. 107 (2021), https://doi.org/10.1016/j.habitatint.2020.102296.
[56] J. Nam, J. Han, C. Lee, Factors contributing to residential vacancy and some approaches to management in Gyeonggi Province, Korea, Sustainability 8 (4) (2016), https://doi.org/10.3390/su8040367.
[57] Y. Park, G.D. Newman, J.E. Lee, S. Lee, Identifying and comparing vacant housing determinants across South Korean cities, Appl. Geogr. 136 (2021), https://doi.org/10.1016/j.apgeog.2021.102566.
[58] F. Gaglione, C. Gargiulo, F. Zucaro, C. Cottrill, Urban accessibility in a 15-minute city: a measure in the city of Naples, Italy, Transport. Res. Procedia 60 (2022) 378–385, https://doi.org/10.1016/j.trpro.2021.12.049.
[59] Z. Huang, X. Du, Assessment and determinants of residential satisfaction with public housing in Hangzhou, China, Habitat Int. 47 (2015) 218–230, https://doi.org/10.1016/j.habitatint.2015.01.025.
[60] F. Dell'Anna, M. Bravi, M. Bottero, Urban Green infrastructures: how much did they affect property prices in Singapore? Urban For. Urban Green. 68 (2022) https://doi.org/10.1016/j.ufug.2022.127475.
[61] S. Narayanan, A.T. Rajan, P. Jebaraj, M.S. Elayaraja, Delivering basic infrastructure services to the urban poor: a meta-analysis of the effectiveness of bottom-up approaches, Util. Pol. 44 (2017) 50–62, https://doi.org/10.1016/j.jup.2017.01.002.
[62] D. Stadelmann, Which factors capitalize into house prices? A Bayesian averaging approach, J. Hous. Econ. 19 (3) (2010) 180–204, https://doi.org/10.1016/j.jhe.2010.07.002.
[63] Y. Chen, K.W. Chau, M. Zhang, L. Yang, Institutional innovations from state-dominated to market-oriented: price premium differentials of urban redevelopment projects in Shenzhen, China, Cities 131 (2022), https://doi.org/10.1016/j.cities.2022.103993.
[64] J. Ji, X. Gao, Analysis of people's satisfaction with public transportation in Beijing, Habitat Int. 34 (4) (2010) 464–470, https://doi.org/10.1016/j.habitatint.2009.12.003.
[65] R. Olfindo, Transport accessibility, residential satisfaction, and moving intention in a context of limited travel mode choice, Transport. Res. Pol. Pract. 145 (2021) 153–166, https://doi.org/10.1016/j.tra.2021.01.012.
[66] X. Qin, W. Yuan, J. Li, X. Qi, Identification and analysis of urban Shrinkage risk based on residential property values, Habitat Int. 106 (2020), https://doi.org/10.1016/j.habitatint.2020.102265.
[67] S. Döringer, Y. Uchiyama, M. Penker, R. Kohsaka, A meta-analysis of shrinking cities in Europe and Japan. Towards an integrative research agenda, Eur. Plann. Stud. 28 (9) (2020) 1693–1712, https://doi.org/10.1080/09654313.2019.1604635.
[68] L. Li, Y. Zha, J. Zhang, Spatially non-stationary effect of underlying driving factors on surface urban heat islands in global major cities, Int. J. Appl. Earth Obs. Geoinf. 90 (2020), https://doi.org/10.1016/j.jag.2020.102131.
[69] Z. Gu, X. Zhang, Framing social sustainability and justice claims in urban regeneration: a comparative analysis of two cases in Guangzhou, Land Use Pol. 102 (2021), https://doi.org/10.1016/j.landusepol.2020.105224.
[70] H. Zhang, C. Cong, A. Chakraborty, Exploring the Institutional Dilemma and Governance Transformation in China's Urban Regeneration: Based on the Case of Shanghai Old Town. Cities, vol. 131, 2022, https://doi.org/10.1016/j.cities.2022.103915.
[71] N. Zhao, Y. Liu, J. Wang, Network governance and the evolving urban regeneration policymaking in China: a case study of insurgent practices in enninglu redevelopment project, Sustainability 13 (4) (2021) 1–18, https://doi.org/10.3390/su13042280.
[72] S. Park, J. Lee, Y. Park, Analysis of residential satisfaction changes by the land bank program using text mining, Sustainability 14 (18) (2022), https://doi.org/10.3390/su141811707.