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Analysis of Vacant House Occurrence Characteristics according to Vacant House Dense Areas in Residential and Commercial Areas*

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Abstract

The vacant house problem, which is being discussed by various local governments, requires an appropriate response. Therefore, in this study, Cheonjeon-dong, Seongbuk-dong, Jungang-dong, and Sangbong-dong, which are the old downtown areas of Jinju-si, were selected as target areas, and the factors for the occurrence of vacant houses in general residential areas and central commercial areas were analyzed using a rare event logistic regression model. Results suggested that there are common factors that cause vacant houses in special-purpose areas; however, there are factors that indicate opposite results. In addition, the ratio of the aged population, the ratio of old buildings, and the time of occurrence of vacant houses were found to have a significant effect in general residential areas however, not significantly in central commercial areas. Moreover, it was found to have an impact, however, not in general residential areas. In a situation where solutions must be sought from various directions to solve vacant houses problem, this study will contribute to indicate the relationship between special-purpose areas and the occurrence of vacant houses, thereby providing a basis for policy analysis and response in the future.

Keywords Special-purpose Areas, Influencing Factors of Vacant Houses, Firth's Logistic Regression with Rare Events, Old Downtown of Jinju-si

주제어 용도지역, 빈집 발생 요인, 희귀사건 로지스틱 회귀분석, 진주시 구도심

Ⅰ. Introduction

1. Background and Purpose of Research

Having emerged as an issue in contemporary society, the occurrence of vacant houses has established itself as a chronic and difficult problem in not only large cities but also rural areas and small and medium provincial cities. Vacant houses threaten the socioeconomic stability of cities and accelerate urban decay, thus bringing about a vicious cycle where they lead, once more, to an increase in vacant houses.

With the Population and Housing Census by Statistics Korea as the standard, the number of vacant houses across South Korea amounted to approximately 1.5 million 18 thousand in 2019, an increase by approximately 980 thousand houses in comparison with the previous year, which took up approximately 8.4% of the total number of houses. In addition, according to data from the Ministry of Land, Infrastructure and Transport (MOLIT), it is possible to observe a phenomenon where vacant houses continuously

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emerge, with a focus on old downtown areas. In a situation where such a trend is predicted to continue, the estimated ratio of vacant houses in South Korea is expected to amount to approximately 13% in 2025 (Park, 2018).

The fact that vacant house increase rates are high in small and medium provincial cities other than the Seoul metropolitan area and large cities must be understood from a perspective identical to that on issues such as the extinction of provincial communities due to underpopulation or depopulation (Jang and Kwon, 2021). With the exception of the Seoul metropolitan area, Gyeongsangnam-do (South Gyeongsang Province) is the region with the second largest number of vacant houses. When the current status of old and poor detached houses in Gyeongsangnam-do other than houses for transactions including unsold houses is examined, the following areas have the largest numbers of vacant houses, in this order: 1,394 houses in Goseong-gun (Goseong County); 1,278 houses in Tongyeong-si (Tongyeong City); 1,250 houses in Changwon-si (Changwon City); and 1,180 houses in Jinju-si (Jinju City).

Because the causes of vacant houses are so diverse that they cannot be conclusively attributed to one particular characteristic, they must grasped with a focus on the characteristics of the area in question. The study by Silverman et al. (2013) cites as a cause of vacant houses socioeconomic or housing market deterioration such as a rise in the poverty rate or areas with businesses that exhibit high long-term absence rates. A study by Molly (2014) points out an oversupply of housing and a low housing demand as causes of vacant houses. Unlike in the present, in the past, there was no interest in the problem of vacant houses itself because their occurrence was seen as one of the physical phenomena arising due to problems such as urban decay (Accordino and Johnson, 2000).

To this day, many cities worldwide have failed to break the vicious cycle of urban decay due to a method of presuming development and growth and experienced difficulties resolving diverse ensuing problems (Kabisch et al., 2006). Decline due to continued urban congestion gives rises to a population decrease along with a long-term economic recession in the area in question and to changes in the physical environment of urban spaces (Olsen, 2013; Pallagst, 2010).

A broader understanding of the problem of vacant houses becomes possible only when the occurrence of vacant houses is grasped in a complex manner together with demographic, economic, and social circumstances instead of being viewed through a single cause (Glock and Hartmut, 2004). At present, vacant houses occur in nearly all areas in South Korea regardless of population increase or decrease. Consequently, continuously under way is research to determine the causes of vacant houses and to devise responses to the problem (Lee and Lee, 2017).

Due to an increase in vacant houses, efforts have been made to improve policies and systems for managing vacant houses on the levels of both the central government and local governments. Though support was provided to the use and management of vacant houses in farming and fishing villages through the Agricultural and Fishing Villages Improvement Act legislated in 1994 and the Act on the Promotion of Amelioration of Housing in Agricultural and Fishing Villages legislated in 1995, the relevant law was amended as the Building Act in 2016 due to the spread of vacant houses into urban areas. Subsequently, the Act on Special Cases Concerning Unoccupied House or Small-scale Housing Improvement was legislated in 2017, leading to local governments' legislation of ordinances related to vacant houses. In particular, the Act on Special Cases Concerning Unoccupied House or Small-scale Housing Improvement is the first law created to construct a vacant house management system systematically and has the policy significance of perceiving vacant houses as an urban problem and seeking to maintain or repair them efficiently. According to elucidation by Kim et al. (2020), however, this law focuses on resolving the problem of vacant houses through demolition in implementing small-scale housing maintenance/repair projects and therefore is limited in fundamentally resolving the problem of vacant houses. Consequently, *ex post* and passive policy responses and a situation that makes a planned management of vacant house-dense areas difficult have been pointed out as problems.

Against such a backdrop, this study seeks to grasp the current status of the occurrence of vacant houses on the regional level and to compare the characteristics of the occurrence of vacant houses according to special-purpose areas. In accordance with these, it seeks to explore the characteristics of vacant house concentrations in residential and commercial areas and to analyze the influencing factors of vacant houses, thus proposing the direction for

effective vacant house management. In other words, the goal of this study is to present ex ante planned activities necessary for managing vacant houses per special-purpose area positivistically.

2. Scope and Methods of Research

The spatial scope of this study was Jinju-si in Gyeongsangnam-do. Currently, Jinju-si exhibits the doughnut effect and the decline of its old downtown area due to the large-scale development of its outskirts such as Innovation Cities and station catchment areas. As of 2020, a total of 11,436 vacant houses existed in Gyeongsangnam-do, out of which 1,180 (approx. 10.3%) were possessed by Jinju-si, thus ranking fourth in areas with high occurrences of vacant houses in the province after Goseong-gun (approx. 12.2%), Tongyeong-si (approx. 11.2%), and Changwon-si (approx. 11%). As can be seen in 〈Figure 1〉, according to investigations, there were a total of 580 vacant houses in the urban area, or center, of Jinju-si and a total of 600 vacant houses in the non-urban area, or outskirts, of the city, respectively:

In order to establish the scope of this study, the degree of the density of vacant houses in Jinju-si was analyzed. According to the results, as in 〈Figure 2〉, there was a concentration of 45 to over 134 vacant houses even in the urban area of Jinju-si, with a focus on the old downtown area. Consequently, out of the city's old downtown area, which matches the definition of a vacant house-dense area that this study seeks to grasp, the Cheonjeon-dong (Cheonjeon Neighborhood), Seongbuk-dong (Seongbuk Neighborhood), Jungang-dong (Jungang Neighborhood), and Sangbong-dong (Sangbong Neighborhood) areas were selected

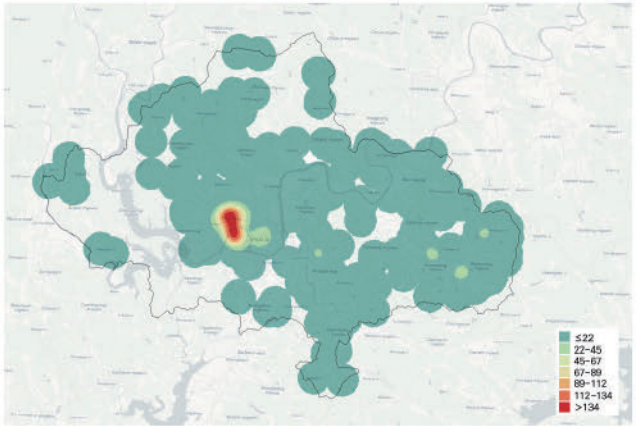

Figure 2. Density of vacant houses in Jinju-si

as the target areas, and their characteristics were analyzed:

The temporal scope of this study was 2019-2021. Based on data on vacant houses in Jinju-si investigated in 2019, field surveys were conducted on a total of three occasions. The actual circumstances were investigated during May 8-23, 2020 on the first occasion and during September 3-27, 2020 on the second occasion, respectively. The third investigation was conducted during July 8-21, 2021, thus concluding the investigations of the reality of vacant houses.

The scope of the contents of this study was to classify special-purpose areas in the target areas into residential and commercial areas, to extract the number of vacant houses, to analyze factors influencing the occurrence of vacant houses, and to prepare plans for vacant houses per area. As for the data on vacant houses used in this study, basic analysis was conducted by using data on vacant houses investigated by civil servants of Jinju-si.

Before field surveys, 〈Figure 3〉 shows the derivation of a vacant house-dense area, with a part of Cheonjeon-dong in

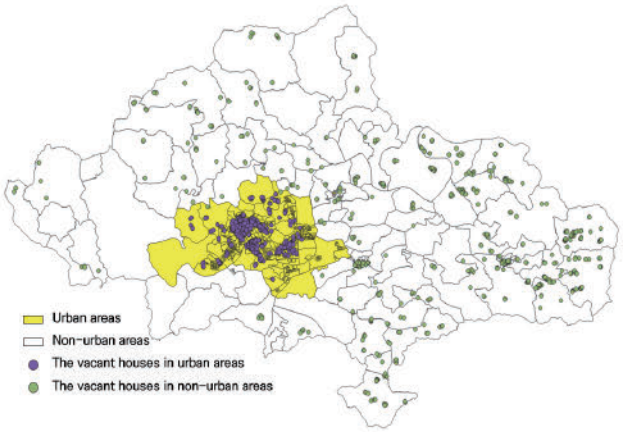

Figure 1. Status of vacant houses in Jinju-si

Figure 3. Examples of density discrimination

the old downtown area of Jinju-si as an example. Vacant houses were considered to be concentrated when 2-3 or more of them existed on a single parcel. When vacant houses were outside parcels or existed independently, they were considered not to be concentrated. Subsequently, based on the second field survey, physical characteristics, individual structure characteristics, demographic characteristics, geographical characteristics, and environmental characteristics were added to concretize the data.

This study proceeded in this process: first, the identification of the distribution of vacant houses in the target areas and current status surveys; second, the construction of analysis methods and variables; and third, the analysis of the occurrence of vacant houses in the target areas and of the characteristics of these areas. To achieve this, literature review, field surveys, geographic information system (GIS) analysis, and vacant house occurrence influencing factor analysis through SPSS (v. 28) and Process Macro for SPSS (4.0) were performed. The detailed process of this study was as in 〈Figure 4〉.

At stage 1, GIS was used to confirm the general current status of and the vacant house distribution in Jinju-si. In addition, through field surveys of the four dong (neighborhoods) in the old downtown area of Jinju-si, the general characteristics of vacant houses in residential and commercial areas were derived. At stage 2, through a review of earlier research, the causes of the occurrence of vacant houses were constructed as the variables, and analysis methods were established. At stage 3, the characteristics of the occurrence of vacant houses in residential and commercial areas were analyzed, and a conclusion was derived. At stage 4, based on the causes of the occurrence of vacant houses derived, plans for using vacant houses per type were derived.

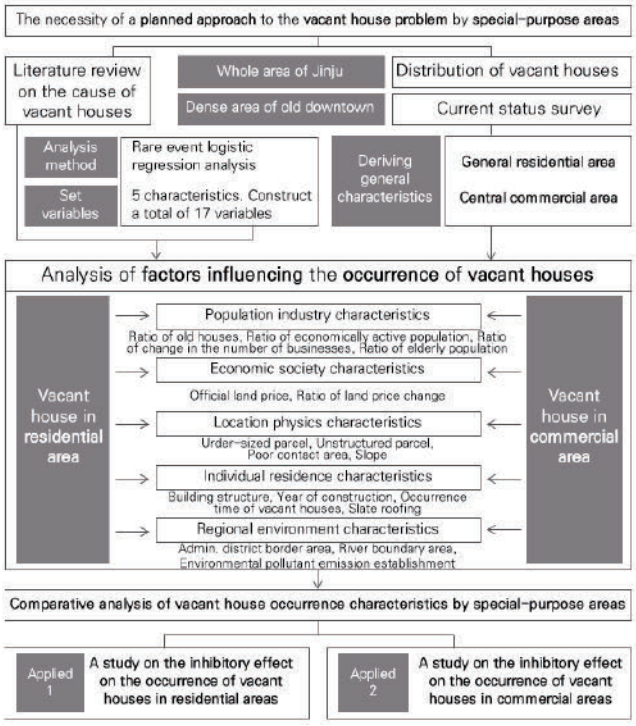

Figure 4. Description of the research flow

II. Review of Theories and Earlier Research

1. Earlier Research Related to the Occurrence and Formation Processes of Vacant Houses

In relation to the occurrence and formation of vacant houses, research grasping the causes of the occurrence of vacant houses has been conducted in multifaceted ways: housing market characteristics (Park and Oh, 2018; Kim and Kim, 2019); sociodemographic characteristics (Basset et al., 2006; Molly, 2016; Lim and Na, 2020; Park and Lim, 2020); physical characteristics (Mallach, 2006; Lee, 2020); and spatio-structural characteristics (Wilson et al., 1994; Morckel, 2013; Kim et al., 2020; Lee and Kim, 2021).

Examining the causes of the occurrence of vacant houses in terms of the housing market, Park and Oh (2018) used data on individual structures to analyze the factors behind the occurrence of vacant houses in Daegu-gwangyeoksi (Daegu Metropolitan City). Unique physical characteristics of individual structures having significant influence on the occurrence of vacant houses were the structures' areas, numbers of stories, and degree of deterioration. The smaller the areas, the fewer the numbers of stories, and the further in the past the years of the construction of houses were, the higher was the likelihood of the occurrence of vacant houses. In terms of the regional characteristics, the number of adjacent vacant houses, the presence or absence of maintenance areas, and the population growth rate and the aged population ratio in the last five years were grasped as important variables, and the greater the number of adjacent vacant houses, the more within maintenance areas houses were located, the lower the areas' population growth rates were, and the lower the aged population ratios were, the higher was the likelihood of the occurrence of vacant houses. In conclusion, the occurrence of vacant houses implies that the

additional occurrence of vacant houses in adjacent areas can be brought about. With Gwangju-gwangyeoksi (Gwangju Metropolitan City) as the target area, Kim and Kim (2019) analyzed vacant houses per housing type. Using data provided by Statistics Korea, analysis was conducted after classification into houses that were vacant due to other reasons and vacant houses that had not been used or inhabited for one year or more. Derived from the results was the fact that vacant houses occurred the most with detached houses and apartments. Subsequently, regression analysis was conducted to elucidate that vacant house ratios increased due to population migration to adjacent areas, an increase in the aged population, and a decrease in the economically active population. In addition, the decline of local industries and infrastructures rather than urban decay were pointed out as causes of an increase in vacant house ratios.

As for research from the sociodemographic perspective, a study by Basset et al. (2006) is representative. In the study by Basset et al. (2006), the causes of the occurrence of vacant houses in Flint were analyzed on a macroscopic level. According to the results, factors such as race, school closures, process of changes in neighborhoods, and large-scale debts were derived to cause vacant houses. In relation to this, a study by Molly (2016), too, demonstrated positivistically that an increase in unemployment rates, an increase in impoverished household ratios, and an increase in seized house ratios were related to the occurrence of vacant houses, thus confirming that changes in population structures and lifestyles increased the number of vacant houses in an area. In a study by Lim and Na (2020), with Incheon-gwangyeoksi (Incheon Metropolitan City) as the target, the types and influencing factors of the occurrence of vacant houses were analyzed. When the area was analyzed after being classified into the inner city type, mixed type, insular type, and expandable type, the density of vacant houses was high, in this order: inner city type; mixed type; expandable type; and insular type. In the inner city type, the degree of the deterioration of vacant houses was the highest due to lots with low accessibility to the Seoul metropolitan area and a failure to guarantee economic feasibility in reconstructions and redevelopments, and the correlation between population decrease and the occurrence of vacant houses was the highest. In the mixed type, the ratio of vacant houses with a comparatively low degree of deterioration was high. The insular type had this characterized: though the proportion of vacant houses was small, the risk of vacant houses was very high due to the natural occurrence of vacant houses brought about by the departure of young people and the deaths of senior citizens. The expandable type had this characteristic: Incheon-gwangyeoksi expanded because of aspects such as innovative industries so that the quality of housing was fair and vacant house density and deterioration were low but vacant houses occurred in the old downtown area inside the city due to population migration to new cities. In the study by Park and Lim (2020), data on vacant houses in Jeonju-si (Jeonju City) were used to analyze the characteristics of the distribution of vacant houses. In order to analyze the characteristics of hot spots where vacant houses were concentrated, the following were used: as regional characteristic variables, housing benefit beneficiaries, population increase rates, aged population ratios, aged house ratios, and average actual transaction prices; as physical characteristic variables, the numbers of years elapsed since the construction of houses, structures' gross floor areas (GFAs), and widths of the closest roads; and, as land use planning variables, the National Land Planning and Utilization Act and other laws. The results of analysis presented as an implication a close relationship between the excessive regulation of land use, an absence of physical changes to de facto houses, housing prices, and aged population ratio and the occurrence of vacant houses.

As for research from the physical and environmental perspectives, in the study by Mallach (2006), environmental defects such as small areas for use and outdated infrastructures, too, were causes of the occurrence of vacant houses in addition to the fact that the physical aging and structural risks of houses impeded the use of the houses so that the owners stopped managing the houses and neglected them as a result. Lee's study (2020) analyzed the major influencing factors of the occurrence of vacancy among detached houses, with the old downtown area in Incheon-gwangyeoksi as the target area. The influencing factors of the occurrence of vacant houses were the sites' scales, shapes, and contact with adjoining roads on the level of houses and the slopes and designation as maintenance areas on the neighborhood level, respectively. The ratio of solitary aged households influenced the occurrence of vacant houses on the regional level, thus demonstrating that the residents' socioeconomic vulnerability acted as a cause of the occur-

rence of vacant houses. In conclusion, the implication was that, under a condition where the housing demand did not increase, the supply of new housing could act as a triggering factor for the occurrence of vacant houses.

Also reviewed were studies examining the occurrence of vacant houses from the spatio-structural and geographical perspectives. Kim et al. (2020) analyzed the influence of regional characteristics on the occurrence of vacant houses. According to the results of the study, vacant houses tended to occur with an increase in distances to neighborhood living facilities such as primary schools and amenities. Lee and Kim (2021) elucidated site characteristics according to the characteristics of the spatial distribution of vacant houses and accessibility to major life social overhead capital (SOC) facilities in small provincial cities. The results of analysis yielded the fact that: the greater accessibility to medical, welfare, and cultural life SOC facilities was, the lower was the distribution of vacant houses; and, on the contrary, accessibility to administrative and educational life SOC facilities did not much influence the distribution of vacant houses. The study by Wilson et al. (1994) on Cleveland analyzed patterns in spatial changes to the ratio of neglected houses over ten years, positivistically analyzing that the phenomenon of the neglect of houses spread outside the central area. As for similar results, Morckel's study (2013), which analyzed the relationship between the causes of the occurrence of vacant houses and gentrification in Columbus and Youngstown, likewise confirmed that geographical characteristics and gentrification characteristics influenced the neglect of houses.

According to the results of such reviews of earlier studies, it is apparent that vacant houses occur not from a single cause but from complex causes and through diverse channels in multifaceted ways.

2. Earlier Research Related to the External Effects of the Occurrence of Vacant Houses

Studies on the external effects of the occurrence of vacant houses have mainly analyzed vacant houses' relationships with social problems such as crimes and housing prices.

First, a representative accomplishment in the study of the relationship between vacant houses and criminal and socially deviant acts is the broken windows theory announced in 1982 by criminologists James Q. Wilson and George L. Kelling. According to this theory, when broken windows are left alone, crime begins to spread, with a focus on places where broken windows are neglected.

As for related studies, Immergluck (2016) confirmed a positive relationship between seized vacant houses and the crime rate in the area, with Chicago as the target area. As for similar research conducted in South Korea, Yeom (2019) positivistically demonstrated the relationship between vacant houses and theft/violent crimes. In the results of analysis, it was estimated that the crime of theft per 1,000 people increased by 0.128 case when the degree of the concentration of vacant houses increased by 1%.

Next, Seo and Lim (2022) conducted a study estimating the value decline rates of vacant houses in Gunsan-si (Gunsan City) in Jeollabuk-do (North Jeolla Province) through expert investigations. The results of estimations of value decline rates due to internal and external depreciation positivistically demonstrated that the more vacant houses' grades rose or the poorer were the states of vacant houses, the greater were gaps in value decline rates, and the greater the degree of the concentration of vacant houses was, the more the value of vacant houses dropped. From this, it was apparent that, in terms of external effects of the occurrence of vacant houses, emphasized were connections according to houses' physical characteristics, regional characteristics, and owners' characteristics. Likewise, the study by Cho et al. (2020) confirmed that the owners' actions could influence vacant houses such as cases in urban areas where the owners purchased houses for investment purposes and left them vacant even when rental demands existed. In addition, when vacant houses were neglected, surrounding houses could turn into vacant houses and the entire area could turn into a slum in the end, thus raising the need for active measures to mitigate vacant houses that had already occurred.

3. Uniqueness of the Study

According to the results of reviews of earlier studies, it was important to understand the causes of the occurrence of vacant houses and spatial characteristics on the regional level. However, it was confirmed that existing studies mostly analyzed vacant houses from a macroscopic perspective and that studies analyzing the causes of the occurrence of vacant houses in relation to spatial characteristics were insufficient.

Consequently, this study is differentiated in that: first, it added environmental characteristic variables in the areas in question, which were not reflected in earlier research; and, second, it elucidated the causes of the occurrence of vacant houses on the basis of field surveys of individual vacant houses and presented measures for using vacant houses. In relation to special-purpose areas, the study by Choi et al. (2013) used the areas of special-purpose areas as independent variables, and the study by Cho et al. (2022) grasped the floating population change ratio per special-purpose area. The study by Jang and Kwon (2021) used special-purpose areas as regional environmental variables influencing the occurrence of vacant houses. Most studies included special-purpose areas among variables for analysis. Consequently, this study is differentiated in analyzing vacant house concentration factors per special-purpose area. Related earlier studies described above implied differences per special-purpose area, and this study, likewise assuming differences in special-purpose areas would influence the occurrence of vacant houses, conducted research after distinguishing between residential and commercial areas. Analyzing the characteristics of vacant houses on the basis of distinction between residential and commercial areas from such a perspective, this study will be able to contribute to the construction of a vacant house management system per special-purpose area that takes into consideration the characteristics of the lots.

Ⅲ. Framework of Analysis

1. Current Status and Characteristics of the Distribution of Vacant Houses in the Target Area

1) Current Status of the Distribution of Vacant Houses in the Target Area

The total number of vacant houses in Jinju-si, the target area of this study, has increased steadily, from 903 in 2017 to 967 in 2018 to 1,180 in 2019. Unless the problem of preexisting vacant houses is resolved, vacant houses are expected to increase continuously. The current status of the distribution of all vacant houses in both special-purpose areas and the old downtown area in Jinju-si is as in 〈Figure 5〉. Approximately 40% of vacant houses in Jinju-si are concentrated in the old downtown area, and, according to the results of complete enumeration, there was a total of 419 vacant houses in the old downtown area. According to the results of analysis per special-purpose area, there were 228 vacant houses in residential areas and 191 vacant houses in commercial areas, respectively.

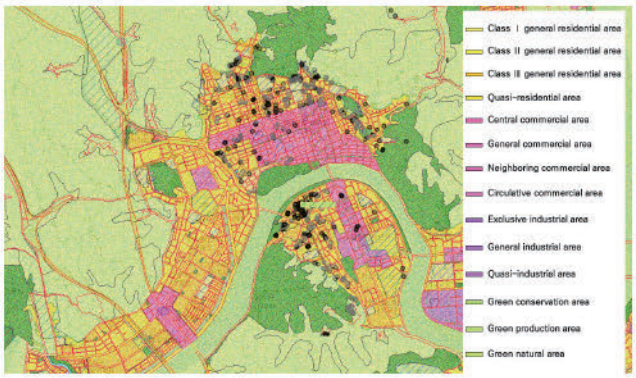

Figure 5. Vacant houses in special-purpose areas

2) Characteristics of the Distribution of Vacant Houses in the Target Area

Field surveys were conducted in order to confirm the locations of vacant houses per special-purpose area through GIS and to grasp the general characteristics of and differences among vacant houses in residential and commercial areas.

Areas where buildings for residence (houses) are more numerous than are commercial buildings, residential areas are areas designated to protect the residential function in everyday life. Vacant houses in residential areas were numerous in places concentrated with houses. As in 〈Figure 6〉, most of the vacant houses were in poor conditions, and many vacant houses were confirmed, in particular, in places with parcels that were undersized or irregularly shaped.

Relationships to adjoining roads, too, were observed to

Figure 6. Status of vacant houses in residential areas

influence the occurrence of vacant houses. As in 〈Figure 7〉, cases where houses were either located on landlocked lots and therefore could not easily be entered from roads or adjacent to roads with widths of 3 m or less and therefore could not easily be accessed by vehicles likewise influenced vacant houses. Such vacant houses seemed to have poor daylight conditions as well, and vacant houses in residential areas seemed to be neglected for such reasons.

The states and locations of houses, too, seemed to influence vacant houses. In many cases, houses that were either insufficiently managed or located in steep places and therefore could not be accessed easily likewise were left vacant. In the end, accessibility decreased due to steep slopes, and either grass and trees proliferated or infrastructures deteriorated due to a lack of management (Figure 8). According to the results of interviews of the residents on their perceptions of vacant houses, many had lived for a long time, for 10 years or more, and were not only emotionally attached to the areas but also highly interested in the use of vacant houses.

Commercial areas are designated mainly for the functions of commerce and work and consist of multi-purpose buildings along with residential buildings. As in 〈Figure 9〉, vacant houses in commercial areas combined shops and homes, most of them actively engaged in retail activities, located on level land, and fairly accessible in terms of transportation.

However, as shown in 〈Figure 10〉, vacant houses in commercial areas occurred mostly on the second floor, and often observed were cases where even houses adjacent to roads were left vacant. Apart from convenient access, it is apparent that noise and other inconveniences regarding the environment could act as causes of vacant houses in commercial areas:

Through this, it could be inferred that, in commercial areas, the presence or absence of vacant houses was determined by the influence of commercial activities such as the degree of the activation of commercial activities in individual buildings rather than geographical locations. In addition, while commercial areas had more floating population than did residential areas, the residents' interest in the use of vacant houses was weaker in the former than in the latter.

Figure 7. Vacant houses and roads in residential areas

Figure 9. Status of vacant houses in commercial areas

Figure 8. Location of vacant houses in residential areas

Figure 10. Vacant houses and roads in commercial areas

2. Establishment of Analysis Methods and Variables

1) Analysis Methods

In order to confirm the influencing factors of the occurrence of vacant houses, with vacant houses concentrated in residential and commercial areas in the old downtown area of Jinju-si as the samples, this study used rare event logistic analysis. The reasons for making estimations based on a rare even logistic model were as follows. First, the situation is that most positivistic studies on the current status of vacant houses and their occurrence in South Korea merely stop at macroscopic analysis through statistical indices or, even when they make use of microscopic data from field surveys, are limited due to restrictions to the construction of data. Specific periods are established and serial data for them are used to conduct statistical analysis at times, and the model must be constructed to be simple even when complete data such as the Population and Housing Census are used. Second, as can be confirmed in 〈Figure 3〉 and the current status of the distribution of vacant houses, vacant houses concentrated in residential and commercial areas, respectively, out of the 419 vacant houses in the target area were smaller in number than vacant houses in areas not concentrated with vacant houses, thus exhibiting a characteristic where observed events, with the occurrence of vacant houses and concentration after their occurrence as the standards, were very rare. In other words, the probability of the occurrence of vacant houses was distributed with a great bias to one side instead of being divided, with 0.5 as the standard. In such cases, when general logistic models are applied, the probability of the occurrence of biases in estimates increases.

As for resolving the problem of biases in logistic regression analysis models, there are two methods, presented by King and Zeng (2001) and Firth (1993), respectively. In the case of the rare event logistic analysis method by King and Zeng, there are the strengths that: in estimating predictive probability, potential biases are removed, biases in dependent values in terms of the proportion are corrected through the use of the exogeneous stratified sampling method, and the model's explanatory power is raised with the addition of new, better independent variables through the use of the advantage of reduced sample sizes. However, unlike the method by King and Zeng, where the size of the data is arbitrarily reduced in constant term bias correction, Firth's method is one where the information from the entire original data is used but a kind of weighted value is assigned in accordance with the proportion of the observed value in the estimation stage of the function.

Theoretically, both methods are known to remove biases from maximum likelihood estimators (MLEs) in logistic regression models, thus expected to be similar in performance. When applied to actual rare event data, however, Firth's method yields far better results in terms of the stability of algorithms (Kim et al., 2014).

In sum, this study introduced the principle of reducing the influence of the probability of the occurrence of non-concentrated vacant houses (0) at the likelihood function estimation stage through weighted value while making maximal use of the entire data on the occurrence of vacant houses. In addition, though rare event logistic regression is restricted to binary logit models, it seems to be a model worth considering because of the concreteness of the interpretation of the results and an analytical technique that can be refined into a more intricate model. Accordingly, a rare event logistic model was constructed on the basis of Firth's method, which reduces the influence of probability on vacant houses in non-concentrated areas (0) during likelihood estimation while maintaining the number of data events regarding the original data on concentrated vacant houses to be identical, and is expressed as follows:

$$\ln\left(\frac{\tilde{\pi}_{i,q}}{1-\tilde{\pi}_{i,q}}\right)=\beta_0+\beta_{i,j}X_{i,j,q}+\gamma_i \mathrm{Ln}LP_{i,q-1}+\cdots+\mu_{i,j,q} \quad (1)$$

In the equation above, $VH_{i,q}$ is a binary variable that has the value of 1 when a vacant house in the area in question is one in a space concentrated with vacant houses and of 0 when a vacant house is one in a space not concentrated with vacant houses. $X_{i,j,q}$ indicates explanatory variable j regarding vacant house i at the time q used in the analysis, and this is applicable to the influencing factors of the occurrence of vacant house reviewed in earlier research. $\mathrm{Ln}LP_{i,q}$ is a value where a logarithm has been taken to the official land price of vacant house i at the time q and is a variable controlling the influence of real estate values. $\tilde{\pi}_{i,q}$ represents the conditional probability that the variable $VH_{i,q}$ will have a value of 1 when an

explanatory variable and a control variable are given. Accordingly, the analytical model here analyzes the influence of each variable on the probability of the occurrence of vacant houses, and when coefficient $\beta_{i,j}$ in the equation above has a significant positive (or negative) value, it is possible to interpret that the larger (or smaller) the value of explanatory variable j, the larger is the inducement for the occurrence of vacant houses in the area in question. Analysis was conducted by using SPSS (v. 28) and Process Macro for SPSS (4.0) packages.

2) Establishment of Variables

In this study, the variables were selected on the basis of literature review and a review of earlier research, and the 17 variables selected are as in 〈Table 1〉.

Table 1. Definition of variables

Variables		Description of variables		Type	Sources
Dep. variable	A vacant house in a dense area	1: Vacant house in the corresponding special-purpose areas	0: Vacant house not in the corresponding special-purpose areas	Dum	Based on data collection of vacant houses in Jinju-si
Indep. variable	Official land price (Won/m^2)	Ln (individual official land price designated in 2019)		Num	Ministry of Land, Infrastructure and Transport, Individually announced land price (2019)
	Ratio of land price change (%)	Rate of change in the median price of individual official land prices for 2017-2019		Num	
	Poor contact area	1: Facing a road where vehicles cannot pass	0: Facing a road where vehicles can pass	Dum	Based on data collection of vacant houses in Jinju-si & field survey
	Under-sized parcel	1: Parcel area of less than 90 m^3	0: Land parcel area over 90 m^2	Dum	
	Unstructured parcel	1: Irregular parcel shape	0: Regular parcel shape	Dum	
	Ratio of economically active population (%)	(Number of employed people aged 15-64 in 2019 / Population aged 15-64 in 2019)×100		Num	KOSIS, Regional statistics, Eup, Myeon, dong (2019)
	Ratio of elderly population (%)	(Population over 65 years old in 2019 / Total population in 2019)×100		Num	
	Slope (°)	Median slope		Num	Korea National Spatial Data Infrastructure Portal
	Building structure	1: Wooden structure	0: Brick, Concrete structure	Dum	Based on data collection of vacant houses in Jinju-si & field survey
	Ratio of old houses (%)	(Number of detached houses 31 years from the date of construction/ Total number of detached houses)×100		Num	KOSIS, Housing statistics, Eup, Myeon, dong (2019)
	Year of construction	1: Buildings built before 1970	0: Buildings built after 1970	Dum	Based on data collection of vacant houses in Jinju-si & field survey
	Slate roofing	1: Slate roof	0: Not the slate roof	Dum	Based on data collection of vacant houses in Jinju-si & field survey
	Ratio of change in the number of businesses (%)	(Number of businesses in 2018/ Number of businesses in 2019)×100		Num	KOSIS, Economic statistics, Eup, Myeon, dong (2019)
	Occurrence time of vacant houses	1: Vacant house that occurred before 2010	0: Vacant house that occurred since 2010	Dum	Based on data collection of vacant houses in Jinju-si & field survey
	Admin. district border area vacant houses	1: Vacant houses within 400m of administrative district	0: Vacant houses outside 400m administrative district	Dum	GIS Buffer analysis (based on 400m)
	River boundary area vacant houses	1: Vacant houses within 400m of the river	0: Vacant houses outside 400m of the river	Dum	GIS Buffer analysis (based on 400m)
	Environmental pollutant emission sites	1: Vacant houses within 400m of environmental pollution discharge facility	0: Vacant houses outside 400m of environmental pollution discharge facility	Dum	GIS Buffer analysis (based on 4,000m)

The dependent variables entered in the analytical model were selected on the basis of whether or not a vacant house was one in a vacant house-dense space per special-purpose area. The following distinction was made: when a vacant house was one in a concentrated space, it had the value of 1; and when a vacant house was not one in a concentrated space, it had the value of 0. Meanwhile, independent variables were factors influencing the occurrence of vacant houses, explanations regarding for what reasons vacant houses, after occurring on the level of points, spread and increased, failing to be used. As confirmed from earlier research and field surveys, a poor physical environment directly influences vacant houses. Accordingly, official land prices and official land price fluctuation rates, which directly reflect housing demands in the areas in question, were selected. In addition, demographic factors such as economically active population ratios and aged population ratios (Lee, 2019; Jung and Jun, 2019; Lee and Lim, 2018) and social factors such as aged house ratios and the fluctuation rates of the number of businesses (Yoko, K and Kang, 2020; Kim et al., 2020; Kim and Kim, 2019), all of which indirectly reflect housing demands, were selected. Studies by Mallach (2006) and Lee (2020) elucidated that architectural structures and forms were important factors in determining the usability of houses. A house's usability decreases when its structure and form are poor, and a vacant house with lowered usability is highly likely to generate yet another vacant house, thus leading to a concentration. Consequently, this study used poor contact parcels, undersized parcels, and irregularly shaped parcels as independent variables. In addition, on the basis of the contents of many earlier studies that the longer a vacant house was neglected, the more it had negative influence on the surroundings, aspects such as the buildings' structures, years of construction, and presence or absence of slate roofs were used as independent variables. In the case of the year of construction, whether a structure had been built before or after 1970, the year which the old downtown area of Jinju-si had been covered, was constructed and used as an independent variable.

In addition, in the case of the presence or absence of vacant houses within river boundaries and administrative district boundaries, areas 200 m inside and outside river boundaries and administrative district boundaries were established as buffers. As for sections in which buffers were established, the scope of 400 m from boundary areas were established in accordance with Clarence A. Perry's neighborhood unit theory, and the presence or absence of vacant houses nearby was grasped.

As for detailed physical zones determining the scope of neighborhoods, researchers present disparate standards. When studies defined according to researchers' operational definition methods are examined, they are as follows. As for appropriate distances for commutes to and from educational facilities and the physical scope forming regional communities, studies by Barton (2000) and Boarnet (2011) defined the scope of 400-800 m as the generally referenced walking distance in residential areas. In particular, the study by Kim et al. (2014) elucidated that, in order to raise satisfaction with the living environment, it was necessary to establish spatial plans focusing on the characteristics of the physical environment of the scope of neighborhoods in walking zones within 400 m. With environmental pollutant emission sites, distances from data on vacant houses were measured as well, and the results of a review of earlier research conducted to establish the radii of the spheres of influence surrounding environmental pollutant emission sites before the measurement of the distances are as follows. According to the report on the results of detailed investigations of environmental measurements of the Seokpo Smelter under Young Poong Co., Ltd. conducted by the Daegu Environmental Branch Office, a national environmental impact investigating organ, investigations were conducted in 2014 and 2015 on the area within a 2-km radius of the surrounding area, but the difficulty of securing related data led investigations to be conducted on farmland and schools within a 4-km radius starting in 2016. Though decades have passed, problems with Young Poong's Seokpo Smelter including forests, vegetation, water quality, and soil contamination have yet to be resolved. In fact, in 2018, the contamination of 335,636 m^3 of soil on 560,845 m^2 of 277 parcels including 40,696 m^3 of soil on 21,059 m^2 of the site of smelter employee housing and farmland and primary school sports fields within a 4-km radius of the surrounding area was confirmed. Likewise, in a study by Park et al. (2020), in order to elucidate the causes of damages to forests near the Seokpo Smelter, a 4-km radius was established, and damages to vegetation and soil contamination were analyzed. Accordingly, this study likewise established 4-km radii of environmental pollutant

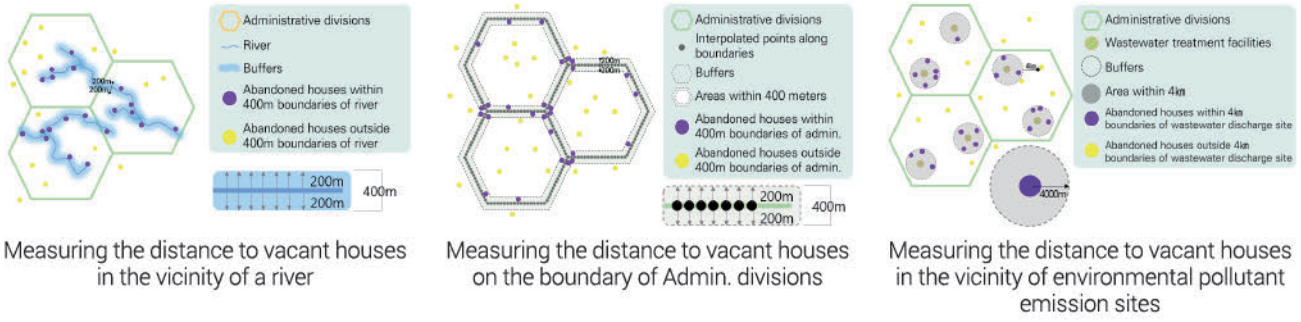

Figure 11. Method of data measurement

Note: Joo and Lee (2021) p.10 as cited in and re-writing

emission sites, conducted distance analysis, and discerned the presence or absence of vacant houses. Consequently, in this study, as in examples of the measurement of the variables in 〈Figure 11〉, the physical environmental characteristics of houses near administrative districts and rivers were measured under the restriction of 400 m, which was the minimal distance out of the diverse limit distances, and the restriction of 4 km was applied to environmental pollutant emission sites, reflecting all of this in positivistic analysis.

Ⅳ. Results of Model Estimation

1. Basic Statistics

〈Table 2〉 shows the basic statistics of variables used to derive factors behind the concentration of vacant houses in the old downtown area in Jinju-si, which consist of the average, standard variation, minimal value, and maximal value of or for each variable. As for whether or not a vacant house was concentrated, a dependent variable of this study, the figure was 24.8% when the vacant house was one in an area concentrated with vacant houses and 75.2% when the vacant house was one outside an area concentrated with vacant houses, respectively. Because vacant houses located in dispersion instead of being concentrated were far more numerous, it will be possible to find the causes of the concentration of vacant houses.

When the basic statistics of the independent variables were examined, the average of individual official land prices amounted to 12.9 won/m^2, thus being higher than 10.8 won/m^2, the average official land price fluctuation rate. Cases of parcels in the old downtown area of Jinju-si with poor contact with adjoining roads or small scales were fewer than parcels that were otherwise, in a ratio of approximately 4:6. However, irregularly shaped parcels were distributed more than were regularly shaped parcels, in a ratio of approximately 7:3. The average economically active population ratio was 11.1%, smaller than the average aged population ratio of 19.7%. This showed that the aged population in the old downtown area of Jinju-si was relatively larger than the economically active population. The average slope of parcels in the old downtown area of Jinju-si where vacant houses were located was approximately 10°, and, as for individual parcels, there were cases of vacant houses located on parcels with gentle slopes measuring approximately 5° at a minimum and those of vacant houses located on parcels with steep slopes measuring approximately 42° at a maximum, thus confirming deviation among vacant houses per parcel. In the case of the structures, wooden and brick/concrete structures amounted to a ratio of approximately 2:8, thus confirming that vacant houses in the old downtown area of Jinju-si consisted mainly of brick/concrete structures. The average aged house ratio was 13.7%, and buildings constructed before and after 1970 amounted to a ratio of approximately 6:4, thus confirming that buildings constructed before 1970 were more numerous. In the case of slate roofs, they and cases of non-slate roofs amounted to a ratio of approximately 3:7, thus being smaller in number than the latter. The average fluctuation rate of the number of businesses decreased by −0.4%, and, in the case of the time of the occurrence of vacant houses, vacant houses occurring before 2010 were more numerous than those occurring after 2010, in a ratio of approximately 6:4. In the cases of vacant houses within 400 m from administrative district boundaries and river boundaries and vacant houses within 4,000 m from environmental pollutant emission sites, they were derived to be smaller in number than those not thus located, in a ratio of approximately 4:6.

Table 2. Descriptive statistics-reconstruction

Variables	Obs.	Mean, %	S.D	Min.	Max.
A vacant house in a dense area	419	(0) 75.2 (1) 24.8	-	0	1
Official land price	419	12.845	.908	8.678	13.96
Ratio of land price change	419	10.795	6.335	-3.100	26.304
Poor contact area	419	(0) 61.1 (1) 38.9	-	0	1
Under-sized parcel	419	(0) 63.2 (1) 36.8	-	0	1
Unstructured parcel	419	(0) 30.1 (1) 69.9	-	0	1
Ratio of economically active population	419	11.103	2.247	-0.622	4.818
Ratio of elderly population	419	19.658	3.213	17.436	26.114
Slope	419	10.059	9.032	5.000	42.500
Building structure	419	(0) 48.9 (1) 51.5	-	0	1
Ratio of old houses	419	13.687	2.549	10.940	17.350
Year of construction	419	(0) 43.2 (1) 56.8	-	0	1
Slate roofing	419	(0) 55.1 (1) 44.9	-	0	1
Ratio of change in the number of businesses	419	-0.406	3.412	-4.000	4.400
Occurrence time of vacant houses	419	(0) 57.3 (1) 42.7	-	0	1
Admin. district border area vacant houses	419	(0) 62.8 (1) 37.2	-	0	1
River boundary area vacant houses	419	(0) 63.5 (1) 36.5	-	0	1
Environmental pollutant emission sites	419	(0) 62.3 (1) 37.7	-	0	1

2. Validity and Reliability Analysis

Next, after distinguishing among the characteristics through a process of exploratory factor analysis (EFA), the reliability of each variable was verified. In order to measure the appropriateness of the selected variables, Kaiser-Meyer-Olkin (KMO) normed fit and the Bartlett value were used. When the results of EFA in 〈Table 3〉 are examined, the KMO value, which indicates the degree to which correlation among variables is explained by (an)other variable(s), amounted to 0.812, thus showing that the selection of vacant house occurrence factor variables was appropriate. The χ^2 value, which indicates the appropriateness of the model, was 2089.637, and the significance probability value of Bartlett's rectangularity test was 0.000 ($P<0.001$), thus showing the existence of a common factor. The Eigen value, which signifies the degree of variance that can be explained by a factor, amounted to 1 or above for all factors, thus showing that a factor could explain the variance of at least one variable.

In addition, the cumulative variance explanatory power, which examined how valid it was to classify the 17 indices selected in this study into five characteristics, amounted to 77.082%. While factor loading for the observed variables per

Table 3. Result of factors and reliability analysis

Factors	Variables	Factor analysis					Reliability
		Factor loadings	Communalities	E,V	% Var	Cumulative %	Cronbach's α
Population industry characteristics	Ratio of old houses	0.937	0.918	3.91	17.34	17.34	0.858
	Ratio of economically active population	0.904	0.902				
	Ratio of change in the number of businesses	0.828	0.805				
	Ratio of elderly population	0.800	0.616				
Economic society characteristics	Official land price	0.976	0.941	3.84	16.92	34.26	0.771
	Ratio of land price change	0.793	0.742				
Location physics characteristics	Under-sized parcel	0.919	0.903	3.76	16.52	50.78	0.826
	Unstructured parcel	0.938	0.880				
	Poor contact area	0.813	0.768				
	Slope	0.799	0.725				
Individual residence characteristics	Building structure	0.938	0.915	3.52	16.19	66.96	0.819
	Year of construction	0.843	0.835				
	Occurrence time of vacant houses	0.753	0.620				
Regional environment characteristics	Admin. district border area vacant houses	0.892	0.835	2.53	10.12	77.08	0.843
	River boundary area vacant houses	0.852	0.793				
	Environmental pollutant emission sites	0.824	0.778				

Note: Cumulative var (%)=77.082%, KMO=0.812, Bartlett's rectangularity test significant p-value=0.000, χ^2=2089.637, df=119

index mostly amounted to 0.4 or above, the factor loading for the presence or absence of slate roofs was yielded to be less than 0.4 and therefore excluded from the independent variables. According to the results of reliability analysis of the five factors derived, the Cronbach's were yielded to be 0.858, 0.771, 0.826, 0,819, and 0.843, respectively. Consequently, with them exceeding the general baseline of 0.6, internal consistency was judged to exist.

3. Analysis of the Influencing Factors of the Occurrence of Vacant Houses per Special-purpose Area

While the dependent variables of this research model were discrete variables divided according to whether or not a vacant house was in an area concentrated with vacant houses in the special-purpose area in question, they constituted cases where the probability of the occurrence of events was extremely low. Because linear models could not be used for such a model, a rare event logistic regression model based on the random utility theory was used to make estimations. The results of the estimation of intercepts and regression coefficients of the rare event logistic model are interpreted by recalculating log odds values with exponential functions. In other words, in accordance with the characteristics of the occurrence of vacant houses reviewed in earlier research, an odds ratio of the occurrence of a vacant house in a space not concentrated with vacant houses against the possibility of the occurrence of a vacant house in a space concentrated with vacant houses in the special-purpose area in question is obtained and interpreted. The odds ratio is obtained by taking the reciprocal of the logarithmic function for each coefficient value. When that value amounts to 1 or above, then, with other conditions being equal, this can be interpreted as: by how many times the influence of a vacant house in an area concentrated with vacant houses will increase to cause the concentration of vacant houses in an area not concentrated with vacant houses because of a change to a single factor.

According to the results of model estimation in 〈Table 4〉, the aged housing ratio, economically active population ratio, and aged population ratio out of demographic indus-

Table 4. Firth logistic regression results. Significant factors associated with the occurrence of vacant houses

Variables \ Special-purpose areas		Residential areas (N=228)			Commercial areas (N=191)		
		B	S.E.	Exp (B)	B	S.E.	Exp (B)
Intercept		-1.103	0.183	0.271	1.213	0.156	0.250
Population industry characteristics	Ratio of old houses	0.011***	0.390	0.187	-0.025***	0.059	1.092
	Ratio of economically active population	-0.026**	0.009	0.654	0.074***	0.408	0.274
	Ratio of change in the number of businesses	0.003	0.007	0.798	-0.093***	0.068	0.183
	Ratio of elderly population	0.042**	0.012	0.240	-0.007*	0.009	0.081
Economic society characteristics	Official land price	0.062**	0.022	1.214	-0.037***	0.015	0.792
	Ratio of land price change	-0.314	0.074	0.080	0.133***	0.076	0.113
Residential physics characteristics	Under-sized parcel	0.183**	0.063	0.789	0.079	0.069	1.044
	Unstructured parcel	0.023	0.045	0.532	-0.047	0.042	1.037
	Poor contact area	-0.024***	0.051	0.200	0.006***	0.057	1.073
Individual building characteristics	Building structure	-0.239	0.059	1.009	-0.064	0.046	1.021
	Year of construction	0.024**	0.051	0.065	-0.006	0.057	0.300
	Occurrence time of vacant houses	0.247	0.050	0.569	-0.075	0.093	0.040
Location geography characteristics	Slope	0.022**	0.029	0.041	-0.047	0.013	1.058
	Admin. district border area vacant houses	0.172	0.071	0.390	0.081**	0.071	1.073
	River boundary area vacant houses	-0.142***	0.063	1.325	0.021**	0.083	1.252
	Environmental pollutant emission establishment	0.101***	0.053	1.057	0.083	0.088	0.213

Note: B: Regression coefficient, S.E.: Standard error, Exp (B): Odds ratio, statistically significant ***p<0.01, **p<0.05, *p<0.1

trial factors yielded significant results in terms of the concentration of vacant houses in residential and commercial areas alike. In the case of the fluctuation rate of the number of businesses, it yielded significant results only in commercial areas and did not do so in residential areas. It was yielded that the probability of the concentration of vacant houses increased by 1.21 times when the aged house ratio in residential areas increased by 1%, decreased by 1.92 times when the economically active population increased by 1%, and increased by 1.27 times when the aged population ratio increased by 1%, respectively. In the case of commercial areas, the probability of the concentration of vacant houses decreased by 2.98 when the aged house ratio increased by 1%, increased by 1.32 times when the economically active population ratio increased by 1%, and decreased by 1.08 times when the aged population ratio increased by 1%, respectively. As for the fluctuation rate of the number of businesses, it was derived to be a significant variable only in commercial areas. When the fluctuation rate of the number of businesses increased by 1%, the probability of the concentration of vacant houses decreased by 1.2 times.

In the case of official land prices out of socioeconomic factors, it was a variable yielding significant results in terms of concentration after the occurrence of vacant houses in residential and commercial areas alike, and the land price fluctuation rate yielded significant results only in commercial areas. It was derived that the probability of the concentration of vacant houses increased by 3.37 times when official land prices increased by 1 in residential areas and decreased by 2.21 times when official land prices increased by 1 in commercial areas, respectively. In addition, in the case of the land price fluctuation rate, when it increased by 1%, the probability of the concentration of vacant houses in commercial areas increased by 1.12 times.

Out of lots and physical factors, undersized parcels and slopes were derived to be variables having influence only on residential areas; and, as for the case of poor contact with adjoining roads, it yielded significant results in terms of the

concentration of vacant houses in residential and commercial areas alike. In residential areas, the probability of the concentration of vacant houses increased by 2.20 times on when parcels were small rather than otherwise, increased by 1.12 times when contact with adjoining roads was poor rather than otherwise, and increased by 1.04 times when the slope increased by 1°, respectively. Likewise, in commercial areas, the probability of the concentration of vacant houses increased by 2.92 times when contact with adjoining roads was poor rather than otherwise.

Out of individual housing factors, the structures of buildings and the time of the occurrence of vacant houses had no significant influence on concentration after the occurrence of vacant houses in residential and commercial areas alike, and the years of construction had significant influence on the concentration of vacant houses only in residential areas. In residential areas, the probability of the concentration of vacant houses increased by 1.07 times for detached houses built before 1970 rather than those built after the year.

In the case of the regional environmental factor, in residential areas, the presence or absence of vacant houses near environmental pollutant emission sites alone yielded significant results in terms of concentration after the occurrence of vacant houses, and the probability of the concentration of vacant houses increase by 2.88 times when there were vacant houses within 400 m from environmental pollutant emission sites in residential areas. In commercial areas, the presence or absence of vacant houses on the boundaries of administrative districts alone yielded significant results in terms of the concentration of vacant houses, and it could be confirmed that the probability of the concentration of vacant houses increased by 3.04 times when there were vacant houses within 400 m from administrative districts. The presence or absence of vacant houses near river boundaries yielded significant results in terms of concentration after the occurrence of vacant houses in residential and commercial areas alike. When there were vacant houses within 400 m from river boundaries, the probability of the concentration of vacant houses decreased by 3.76 times in residential areas but increased by 3.50 times in commercial areas.

V. Conclusions

Because of the very close relationship between the residential site environment and regional characteristics, necessary are efforts to understand vacant houses occurring naturally in houses' process of becoming idle in the regional context. Currently, diverse local government are engaged in continued discussions on the problem of vacant houses, and this is a point when appropriate responses to the problem of vacant houses accordingly are needed. Against such a backdrop, this study analyzed factors leading to the occurrence of yet other vacant houses, with vacant houses in residential and commercial areas in Cheonjeon-dong, Seongbuk-dong, Jungang-dong, and Sangbong-dong in the old downtown area of Jinju-si as the objects. From the results of analysis, this was derived: while there are common factors whereby vacant houses give rise to other vacant houses in concentrated areas per special-purpose area, there also are factors that exhibit mutually opposite results.

As for vacant houses in residential areas in the old downtown area of Jinju-si, the more aged housing ratio, aged population ratio, or official land prices increased, the more contact with adjoining roads was poor, the smaller parcels were, the further in the past the years of construction were, the higher the slopes were, or the more vacant houses were located within 400 m from environmental pollutant emission sites, the greater was the probability of the concentration of vacant houses. It was derived that the greater the economically active population ratio and the more there were vacant houses within 400 m around river boundaries, the smaller was the probability of the concentration of vacant houses. As for vacant houses in central commercial areas, the greater the economically active population ratio was, the greater the land price fluctuation rate was, the poorer contact with adjoining roads was, the more vacant houses there were within 400 m from administrative district boundaries, or the more vacant houses there were within 400 m from river boundaries, the greater the probability of concentration after the occurrence of vacant houses was. It was derived that the greater the aged house ratio and the fluctuation rate of the number of businesses were, the greater the aged population ratio and the official land prices were, the probability of the concentration of vacant houses decreased. In addition, it was derived that: with the excep-

tion of poor contact with adjoining roads, derived as significant according to the results of model estimation, all remaining variables exhibited opposite results in residential and commercial areas; undersized parcels, poor contact with adjoining roads, slopes, and presence or absence vacant houses near environmental pollutant emission sites had significant influence only on residential areas; and the fluctuation rate of the number of businesses, land price fluctuation rate, and presence or absence of vacant houses on the boundaries of administrative districts had significant influence only on commercial areas.

When, based on the results above, vacant houses are classified per special-purpose area and interpreted, they are as follows. First, in residential areas, vacant houses occur and concentrate under conditions where the physical environment such as the conditions of buildings and the characteristics of land is poor. Such vacant houses have negative influence on the physical states of the surrounding detached houses and on the neighborhood environment as well, thus making possible the repetition of a vicious cycle where aggravated settlement conditions lead the residents to leave the areas in question and vacant houses to increase once more. Meanwhile, in commercial areas, the influence of socioeconomic circumstances such as commercial districts, floating population, people's accessibility, and transportation convenience rather than of the physical conditions of individual buildings can lead to a concentration of vacant houses. Consequently, when there is little economically active population or floating population in places disadvantaged in access to commercial facilities and in the transportation environment, this has negative influence on the formation of commercial districts and leads to an increase in vacant houses, and a large number of aged houses limits the use or accessibility of the buildings for commercial purposes, thus turning these houses into vacant houses as a result of neglect.

Based on the research results above, when urban planning alternatives for preventing or inhibiting the occurrence of vacant houses in residential and commercial areas are searched for, they are as follows.

First, in the case of residential areas, necessary are the maintenance/repair of aged houses for the improvement of settlement conditions in accordance with residential purposes and the improvement of the environment to adjacent roads such as an increase in houses' contact rates with adjoining roads. In particular, because there are difficulties in maintaining or repairing individual houses in the case of houses located on parcels that are small and difficult to access, it is necessary to apply a method where adjacent plots are combined and developed. In addition, because many people with reduced mobility including senior citizens live in places with roads with complex structures or with vacant houses concentrated on slopes, it is necessary simultaneously to implement infrastructure maintenance/repairs such as securing roads connected to individual houses and installing stairs on slopes. It is necessary to take into consideration the fact that such environment improvement methods have been partly applied to the Saetteul Village Project jointly pursued by the Presidential Committee on Regional Development, Ministry of Land, Infrastructure and Transport, and Ministry of Agriculture and Forestry under the South Korean government since 2015.

Second, parcel shapes and building characteristics in commercial areas have little influence on the concentration of vacant houses but are highly likely to concentrate vacant houses in places with little transportation and low accessibility and places with little floating population. Consequently, if deteriorated or old houses are remodeled into unique buildings and switched to commercial purposes, then this will lead to the activation of commercial districts and an increase in the floating population, thus having positive influence on the decrease of vacant houses to a certain degree. Such methods can be confirmed also in cases of urban renewal at home and abroad, and, in order to prevent vacant houses actively, socioeconomic support programs will be necessary together with the improvement of the physical environment.

The significance of this study is as follows. First, it will be possible to use this study as a basic material on measures to prevent vacant houses. Because this study promotes an understanding of vacant house-dense areas and elucidates differences among concentration factors per special-purpose area after the occurrence of vacant houses, it will become possible to prepare measures against urban decay and regional slumization. Second, it will be possible to present the direction of efficient vacant house management. This is significant because it will become possible to present vacant house management plans where the improvement of the value of residences/residential areas and vacant house main-

tenance/repairs and regional plans can be interlocked from the perspective of urban planning. In contrast, this study has the structural limitations of data where the causes of the occurrence of vacant houses have been grasped on the basis only of the results of the analysis of data for a single year. When panel data are constructed in the future, it will become possible to determine the causes of the concentration of vacant houses more concretely, thus preparing effective solutions. In addition, because the influencing factors of the concentration of vacant houses can differ per the characteristics of vacant houses even within special-purpose areas, it will become possible to present even more detailed analysis results in the future when a structural equation model (SEM) is constructed and influence among variables is tested.

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