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# Exploring the Relationship Between Gentrification and Vulnerability in Taipei City

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## 1 ABSTRACT

Gentrification is a process of urban development in which an area undergoes redevelopment, which raises the cost of housing, rent, and standard of living, attracting middle-class and other higher-income earners to move in, which in turn leads to the displacement of lower-income residents, changing the composition of neighborhoods and generating population replacements. This study takes Taipei City as the study area, utilizing Multiple Criteria Decision Making (MCDM) to synthesize the data on socioeconomic indicators and overlapping them into a Geographic Information System (GIS). The overlapping results identify the areas that meet the screening criteria of each indicator to recognize the gentrification areas in Taipei City and analyze the characteristics of the areas. The results were used to indentify gentrification area in Taipei City and explore relationship between gentrification and social vulnerability.

Keywords: Planning, social vulnerability, Geographic Information System (GIS), Multiple Criteria Decision Making (MCDM), gentrification

## 2 INTRODUCTION

Gentrification is a process of urban development in which an area undergoes redevelopment, which raises the cost of housing, rent, and standard of living, attracting middle-class and other higher-income earners to move in, which in turn leads to the displacement of lower-income residents, changing the composition of neighborhoods and generating population replacements[1], [2], [3], [4], [5], [6], [7]. In addition to changing the physical environment, gentrification also affects the existing social structure, culture, economy, and industries. Many scholars have put forward different research explanations on gentrification, such as “New-Build Gentrification”, “ Rural Gentrification”, “Greentrification”, “Studentification”, “Commercial Gentrification”.

According to the research on gentrification, the change in the physical environment will generate suction and thrust, which will make the existing residents move out and the new residents move in. This will lead to the replacement of social classes in gentrification areas and change the composition of residents in these areas. In order to cope with the population replacement caused by gentrification, the current strategy is to minimize the displacement of disadvantaged groups such as low-income households. To this end, relevant measures include rent control to avoid excessive rents and eviction restrictions to protect tenants from forced evictions. Regulating land ownership and development through taxation provides public or affordable housing and promotes the regeneration of local communities. [10], [11].

An effective gentrification strategy should be based on a certain understanding of the development of gentrification. Therefore, the results of gentrification analysis should be used as an important reference for the formulation of various mitigation strategies. The government should be able to assess the impact of gentrification on different regions and provide the relevant departments with the necessary information to formulate a response to the specific situation. The development of tailor-made mitigation strategies [12] can effectively mitigate the potential negative impacts of gentrification, especially in the protection of disadvantaged groups.

The application of quantitative analyses to explore neighborhood changes derived from gentrification is still much debated. For example, Rent Gap is often applied to compare actual and potential rent differences [13], [14], or the application of census data to study socioeconomic changes [15], [16]. Huynh & Maroko (2014) used 1990 Census data and 2005 to 2009 American Community Survey (ACS) estimates to assess changes in economic status across communities. Three variables were chosen to construct indicators of community economic status: the number of people over the age of 25 with a college degree, the number of residents living below the federal poverty line, and Median Household Income (MHI). The study examines the association between gentrification and preterm birth (PTB) and analyzes the effects of maternal race and educational attainment. Millard-Ball (2002) used income and residential mobility to study gentrification

using Stockholm as the study area. Many communities have experienced significant changes in their economic and social structures that may have impacted the health of their residents, with particular differences in the impact on different ethnic groups (e.g., low-income groups, and minority groups).

Vulnerability refers to the propensity and predisposition to negative impacts. The United Nations Office for Disaster Risk Reduction (UNISDR) points out that vulnerability is a disaster-sensitive characteristic formed under the interaction of natural, social, economic and environmental factors; the United Nations University – Institute for Environment and Human Security (UNU-EHS) points out that vulnerability is a disaster-sensitive characteristic formed under the interaction of natural, social, economic and environmental factors; UNU-EHS points out that vulnerability is a disaster-sensitive characteristic formed under the interaction of natural, social, economic and environmental factors. UNU-EHS, on the other hand, recognizes that vulnerability is determined by the interaction of natural, social, and environmental factors that determine the expected loss from a disaster.

The Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) states that the level of risk will depend on the latest trends in vulnerability, exposure, socio-economic status, and adaptive capacity, with vulnerability being an important factor affecting human and socio-ecological systems, and age, Vulnerability is an important factor affecting human and social ecosystems, while age, medical resources, and social deprivation, as well as working and living conditions combine to determine human vulnerability [19].

The existence of vulnerability is widely recognized by various international organizations, and many studies have pointed out that vulnerability is often expressed in a negative and passive form, that is, the degree of sensitivity to disasters. Past research on vulnerability can be divided into three main orientations: (1) vulnerability is a condition that exists before a disaster occurs; (2) vulnerability is a key factor affecting the ability to adapt and respond to a disaster; and (3) vulnerability can have a certain degree of impact on a specific site. Turner et al. (2003) defined “vulnerability” as a condition consisting of natural hazards, including exposure, resistance, and vulnerability to natural hazards. Turner et al. (2003) defined “vulnerability” as being caused by natural hazards, including Exposure, Resistance and Resilience. With the development of disaster-related research, more and more studies have shown that different traits and capabilities reflect the degree of impact after an environmental shock [21], [22].

Over the past 30 years, vulnerability has become a fundamental concept in local, national, and international disaster research and the development of mitigation strategies [23], [24]. In this context, social vulnerability refers to the analysis of factors that are known or unknown to produce certain outcomes of an event. Yiing-Jenq et al. (2004) analyzed the social vulnerability of different segments of society based on the characteristics of age, gender, health, social welfare, and economy, as well as the coping strategies of social groups in response to emergencies. The study showed that children, the elderly, the sick, and the disabled may react to risk quite differently from the young and healthy. Evans & Kantrowitz (2002) also pointed out that characteristics such as income level, occupation, and household size determine socioeconomic status, which in turn determines the place of residence, its quality of life, and infrastructure, and ultimately the impact of risk.

Social vulnerability is recognized as a consequence of existing social inequalities, and many studies have shown that poor health, physical and mental impairments, and poverty are strongly associated with vulnerability [27], [28], [29]. In addition, social inequality determines an individual's living space and the nature of that living space. The vulnerability of the living space (including the means and empowerment of the dwelling, the neighborhood, and the infrastructure of neighborhood) can also effectively determine socio-economic vulnerability, which is closely related to the characteristics of the individual. Factors such as the degree of urbanization, population growth and density can further increase the vulnerability of living space.

The northern part of Taiwan has been developing rapidly in the past few decades, however, there is a relative lack of research on gentrification in Taiwan. As urban development accelerates, real estate prices continue to rise. Many areas with low socio-economic status have gradually attracted middle-class and high-income groups, leading to the replacement of social classes and changes in local characteristics. It is worthwhile to discuss how to reduce or even avoid the impact of gentrification on communities and disadvantaged groups. Therefore, this study is expected to take Taipei City as the research field and use socioeconomic indicators to identify gentrification areas and explore the relationship between gentrification and social vulnerability.

## 2.1 Conceptual Model

This study is divided into two parts. First, the socio-economic indicators were integrated using a multi-criteria decision-making approach based on the key factors related to gentrification. This was then overlaid onto the GIS to identify areas that met the screening criteria for each indicator. The social vulnerability indicators were organized to create a vulnerability map. Next, this study attempts to analyze the spatial correlation between gentrification and social vulnerability variables and explore the relationship between gentrification and vulnerability (fig. 1).

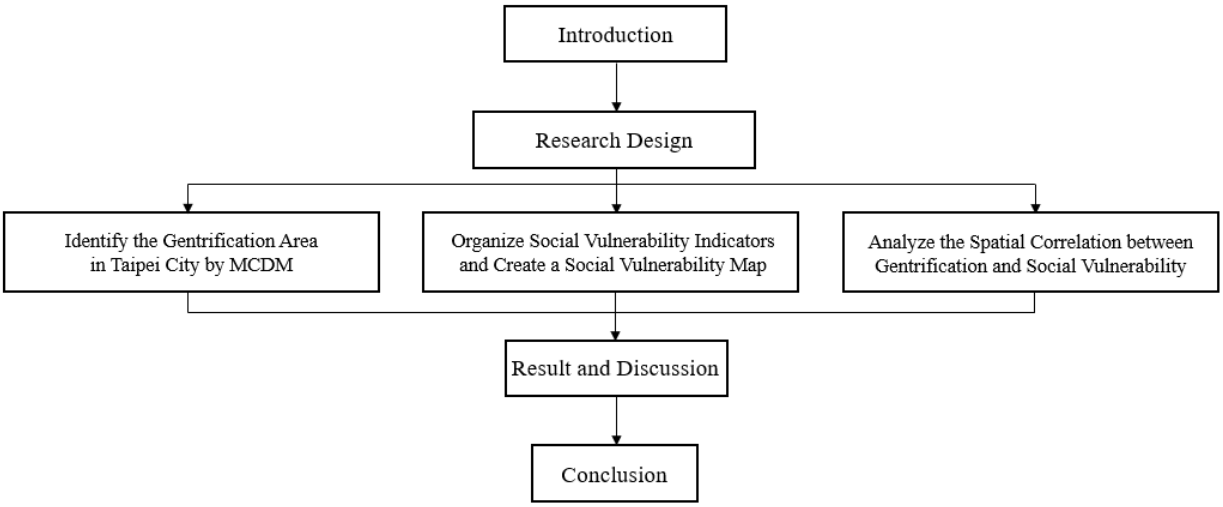


Fig. 1: Conceptual framework.


Fig. 2: Study Area (Source: generated by the authors).

## 2.2 Intro of Study Area

The northern part of Taiwan has developed rapidly over the past few decades and is the economic capital of Taiwan. It has many job opportunities, well-developed transportation facilities, abundant education and medical resources, and the most significant commercial development. As urban development accelerates,

real estate prices continue to rise. Many areas with low socioeconomic status are gradually attracting middle-class and high-income groups, leading to a shift in social class and a change in the character of the area. Therefore, the scope of this study was chosen to be Taipei City (fig. 2), and the village was used as the unit of statistics and analysis. Multiple criteria decision aking (MCDM) was used to synthesize the socio-economic indicators and apply them to the GIS. To identify the areas that meet the screening criteria of each indicator, we identified the areas of gentrification in Taipei City and explored the relationship between gentrification and social vulnerability.

## 2.3 Methods

### 2.3.1 Multiple Criteria Decision Making (MCDM)

In this study, Multiple Criteria Decision Making (MCDM) was adopted for the first time for the gentrification indicators and the subsequent field screening. MCDM is an analytical tool used to measure multiple criteria or to make decision choices for multiple scenarios. MCDM is widely used by the planning community to solve problems in various fields because of its ability to consider multiple functions, attributes, criteria, objectives, and problems simultaneously [30], [31], [32]. Seo & Sakawa (2012) categorized the process into six stages: identifying decision objectives, determining decision preferences, evaluating alternatives, selecting weighting methods, aggregating, and making decisions. In this process, the broad and abstract objectives are transformed into more specific goals, and the weights of each factor are evaluated to compare the advantages and disadvantages of the alternatives so that the most suitable and practical alternatives can be selected to effectively help solve the decision-makers problem. In this way, the most suitable and practical solution can be selected to help the decision-maker solve the problem effectively. Different objectives and weights may affect the solution.

### 2.3.2 Spatial Autocorrelation Statistics

The purpose of spatial autocorrelation statistics is to examine the similarity between spatial units based on spatial distance. This approach is summarized in the “First Law of Geography”: everything is related, but proximity is more related [33]. If there is significant positive spatial autocorrelation, spatial units with similar spatial properties tend to be close to each other. In addition, spatial autocorrelation can also be used to measure geographic proximity between units or binary events [34]. Spatial autocorrelation statistics apply to the whole region (global) or neighboring regions (local). While global spatial autocorrelation explores whether there is spatial clustering among spatial units, local spatial autocorrelation explores the spatial variability of spatial autocorrelation at the local scale [35]. In this study, we will explore the degree of similarity between objects in the space, examine the aggregation or dispersion of spatial phenomena in the space due to different attributes, and analyze the correlation between the two variables (gentrification & social vulnerability) to explore the spatial correlation between the two variables.

## 2.4 Measurement Indicators of the Survey

This study focuses on the relationship between gentrification and vulnerability. Based on the literature review, five socioeconomic indicators of gentrification were selected: income, working-aged population, high degree population (university education or above), real estate sales, and house rent. The rate of change from 2012 to 2021 was used to identify gentrification areas. Based on the literature review, three indicators of social vulnerability were selected from 2021: the proportion of the elderly population, the proportion of the low-income population, and the proportion of disability (table 1). The indicators of gentrification and vulnerability were then standardized to obtain a map of gentrification and a map of social vulnerability.

| Type | Indicators | Period |
|---|---|---|
| Socioeconomic | Income | 2012 to 2021 |
| | Working-aged population | 2012 to 2021 |
| | High degree population | 2012 to 2021 |
| | Real estate sales | 2012 to 2021 |
| | House rent | 2012 to 2021 |
| Social vulnerability | Proportion of aged population | 2021 |

| | |
|---|---|
| Proportion of low-income population | 2021 |
| Proportion of disability | 2021 |

Table 1: Indicators of this study.

## 3 RESULT AND DISCUSSION

### 3.1 Socioeconomic Features of Gentrification in Taipei City

The rate of change in high degree has the highest value (1.08%) in Sanchong Vil., Nangang Dist., and the lowest value (-0.15%) in Xuefu Vil., Daan Dist. (fig. 3). The Rate of change in working-age has the highest value (0.35%) in Sanchong Vil., Nangang Dist., and the lowest value (-0.38%) in Longfu Vil., Zhongzheng Dist. (fig. 3). The rate of change in income has the highest value (16.68%) is located in Chongyang Vil., Nangang Dist., and the lowest value (-0.99%) in Laoquan Vil., Wenshan Dist. (fig. 3). The highest value of rate of change in real estate sales (2.18%) was found in Daan Dist., while the lowest value (0.25%) was found in Nangang Dist. (fig. 4). The highest value of rate of change in house rent (0.22%) was found in Wenshan Dist., while the lowest value (-0.11%) was found in Datong Dist. (fig. 4). The Gentrification map is obtained by standardizing and adding up the values of the above indicators. The highest value (15.15) is distributed in Sanchong Vil., Nangang Dist., while the lowest value (-8.48) is distributed in Longfu Vil., Zhongzheng Dist. (fig. 4).

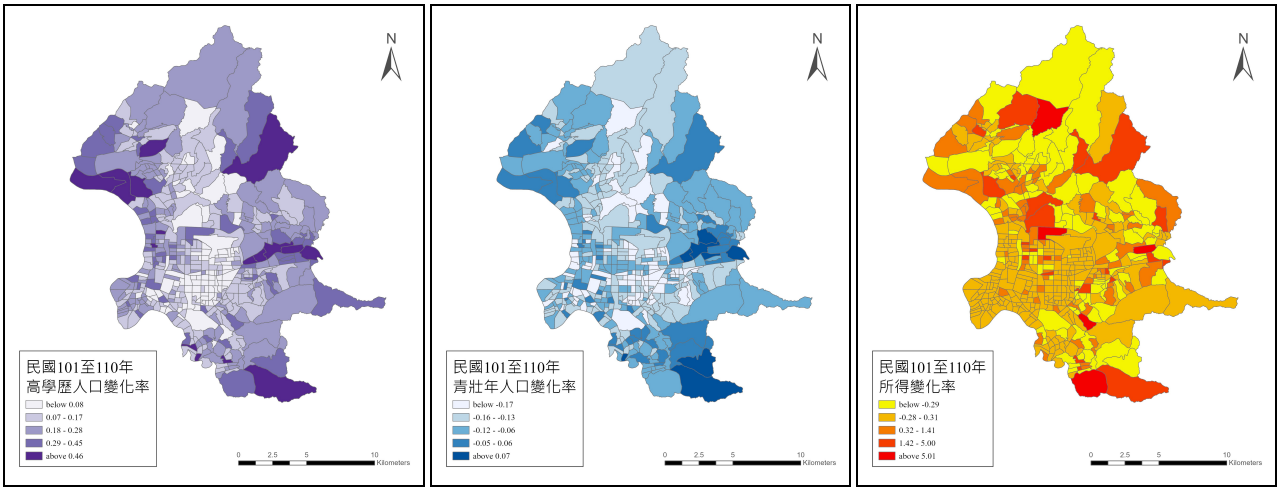


Fig. 3: Rate of change in high degree/Rate of change in working-age/Rate of change in income.

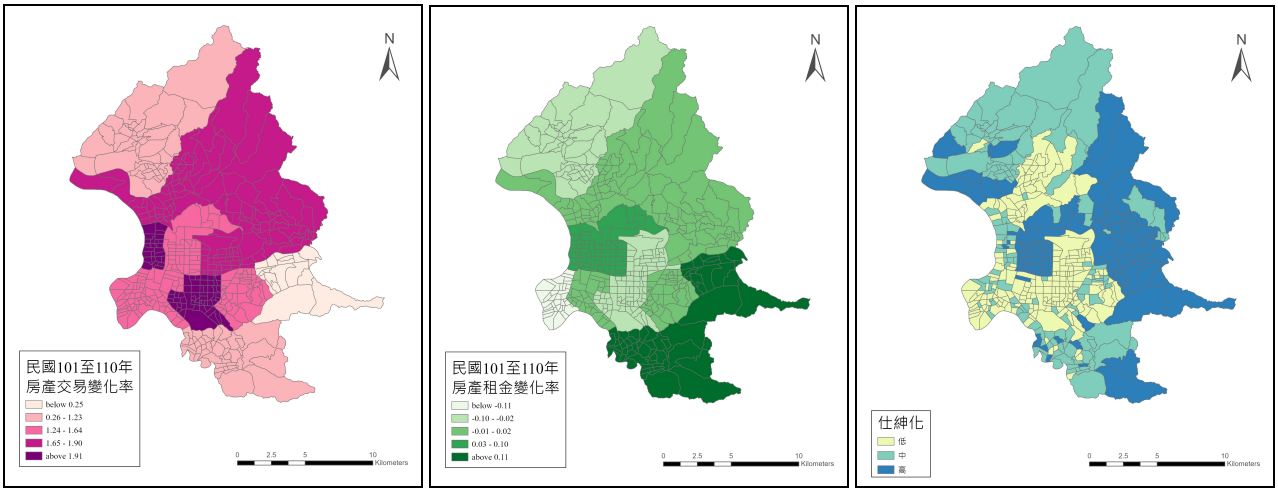


Fig. 4: Rate of change in real estate sales/Rate of change in house rent/Gentrification map.

### 3.2 Distribution of Social Vulnerability in Taipei City

After standardizing and adding up the values of the social vulnerability indicators (proportion of aged population, proportion of low-income population, and proportion of disability), the highest value (3.42) was

found in Changlong Vil., Daan Dist., while the lowest value (-3.63) was found in Chongyang Vil., Nangang Dist. (fig. 5).

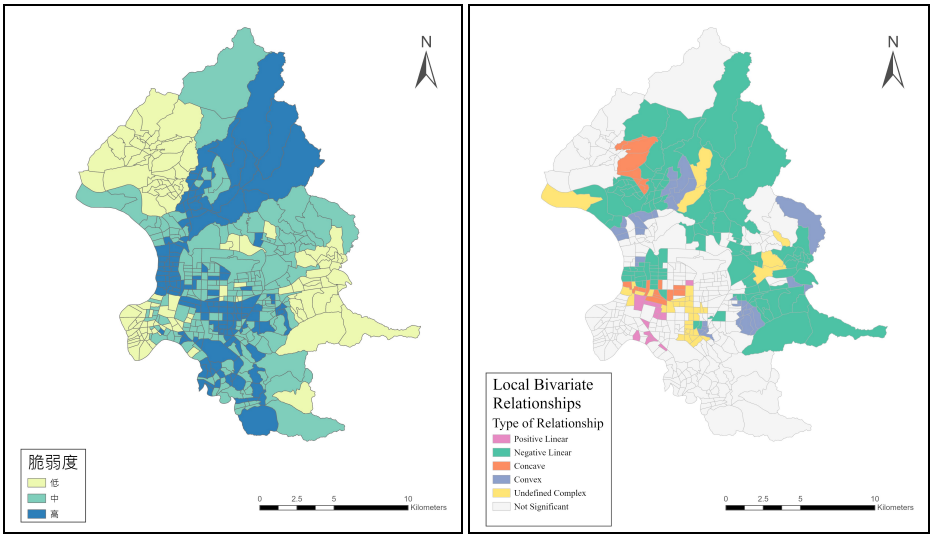


Fig. 5: Social vulnerability map/Result of Local Bivariate Relationships.

### 3.3 Relationship between Gentrification and Social Vulnerability

Positive linear is mostly found in ZhongZheng Dist., probably due to the fact that it has a smaller population of highly educated and young adults. The rate of change also shows a negative growth trend. The vulnerability level is more in the middle to high range, which results in a positive correlation between gentrification and social vulnerability. 11 of features are not significant, about 2.41%. The negative linear is mostly distributed in Nangang, Shilin, and Beitou Dist. The higher degree of gentrification and lower degree of vulnerability in Nangang District resulted in a negative correlation between the degree of gentrification and the degree of social vulnerability in this district (fig. 5). 107 of features are not significant, about 23.46%. Not significant means that the relationship between two variables are not significant or other explanatory factors need to be considered. 257 of features are not significant, about 56.36%.

## 4 CONCLUSION

This study synthesizes the relevant literature on the definition, causes, and observable characteristics of gentrification, and identifies the key influencing factors as the basis for analysis. Using Taipei City as the study area, this study utilized a multi-criteria decision-making approach to synthesize the socio-economic indicators. This was then overlaid onto the GIS to identify areas that met the screening criteria for each indicator. To identify the areas of gentrification in Taipei City and to explore the relationship between gentrification and social vulnerability. Provide references for the government to formulate follow-up policies. This study suggests that the government can target the less vulnerable areas and provide substantial social welfare to reduce the impact of gentrification in these areas.

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