

Zheng W., *Shen G.Q.P., Wang H., Lombardi P. (2015). Critical issues in spatial distribution of public housing estates and their implications on urban renewal in Hong Kong, *Smart and Sustainable Built Environment*, Vol. 4 Iss: 2, 172–187, June.

Critical Issues in Spatial Distribution of Public Housing Estates and their Implications on Urban Renewal in Hong Kong

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Abstract

Purpose:

Public housing in Hong Kong plays an essential role in accommodation supply to people of low income. Access to social resources and rent levels of nearby private residential housing are two critical issues impacting the well-being of residents living in public housing estates. However, previous research has rarely focused on the spatial distribution of public housing estates through exploring these two critical issues. On the other hand, Hong Kong is currently experiencing an urban renewal process. It would be beneficial to consider these critical issues for spatial allocation of public housing in urban renewal decision-making. This paper aims at investigating these two critical issues in relation to the spatial distribution of public housing estates in Kowloon, Hong Kong.

Methodology:

Seven spatial variables were selected to reflect these critical issues. Spatial analysis in Geographic Information System was conducted to process the data required. Multiple logistic regression was employed to analyse the relationships between the spatial location of public housing estates and the seven selected variables.

Findings:

Based on the analysis results, several problems as well as geographical advantages of the current location of public housing estates were discovered, which can be valuable references for decision-making by government authorities for public housing development in the future.

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Originality:

This research is a pilot study on the spatial distribution of public housing estates and the critical influencing factors in Hong Kong, undertaken by applying both spatial analysis and statistical methods. It can help relevant decision-makers deal with current problems of public housing location and make informed decisions on where to locate new housing projects in an urban renewal process, which can increase the equal distribution of social resources and improve the well-being of people living in public housing.

1. Introduction

Hong Kong, as one of the densest cities in the world, is restricted by the severe shortage of land supply. Although Hong Kong experiences economic prosperity, it is always facing serious inequalities and income disparity (Delang & Lung, 2010). With limited land resources and inequalities, the price/rent of housing in Hong Kong is unsurprisingly expensive for a large part of the population. Thus, these circumstances have led to the significant intervention of the Hong Kong government, by providing public housing¹ for low-income residents.

The development of public housing in Hong Kong can be traced back to 1953, occurring through direct funding and indirect subsidies of land. Currently, about six decades later, public housing has become a large proportion of the housing supply in Hong Kong, and thus affects a large proportion of the population. Based on the statistics of the Hong Kong Housing Authority in 2010, 29% of the households were tenants in government-provided housing and 18% owned subsidised housing through the Home Ownership Scheme and relevant programs (Lui & Suen, 2011). Internationally, public housing plays a crucial role in supplying housing to people of low income. Issues relating to public housing attract much interest and cover a wide range, including a spatial decision support system for public housing (Barton et al., 2005), the liveability of high-rise public housing (Yuen et al., 2006), factors influencing the quality of public housing (Chan et al., 2006), public rental policies (Jie, 2010), and the effects of public housing on residential segregation (Oakley et al., 2010). In the context of Hong Kong, related research covers the origin of the public housing sector (Smart, 1989), welfare costs and redistributive effects (Wong & Liu, 1988), specific housing policies (e.g. La Grange & Lee, 1999; Yip & Lau, 2002),

¹ Public housing in Hong Kong is a set of mass housing programmes with the purpose of providing affordable housing for lower-income residents by the Government. Most projects are high-rise buildings, and the recent buildings usually have 40 or more storeys.

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privatisation of public housing (Grange, 1999; Ho, 2004), and the effects of public housing on poverty concentration (Delang & Lung, 2010).

Since the annual demand for public housing is great, some new public housing estates are provided through the development of vacant land or in redevelopment projects. When deciding the location of public housing development in an urban renewal process, several key issues such as the surrounding facilities, convenience of households, nearby transportation, and the financial feasibility of the government must be taken into account. Equal access to services and facilities for residents of public housing is crucial for the well-being of the underprivileged people living in public housing (Apparicio & Séguin, 2006). Accessibility to public resources is also closely related with poverty (Séguin & Divay, 2002), which is what the government is always trying to balance through public housing provision. When the government considers the location of public housing, lower property prices nearby may reduce the financial pressure on the government. Thus, new public housing developments may be provided in cheaper locations, even though this may also lead to social segregation by tenants being remote from their places of employment. However, research relating to this issue is rare. A better understanding of the relationships between spatial variables and public housing location will help relevant decision-makers deal with current problems of public housing location and make informed decisions on where to locate new housing projects, with the aim of increasing the equal distribution of social resources and improving the well-being of people living in public housing.

This paper will examine two key questions: (1) whether public housing estates in Hong Kong have good access to public resources such as public transportation, facilities and green space; as well as (2) whether rents of surrounding private residences are relatively low. Its focus has therefore been on the spatial distribution of public housing from a rarely investigated angle, that is, by exploring the relationships between spatial distribution of public housing estates and the critical issues relating to the distribution of urban resources and the surrounding rental market price. Seven variables that can reflect these critical issues were selected. Multiple logistic regression (MLR) was applied to conduct statistical analysis of the relationships, since it is recognised as an effective method of examining functional relationships between driving factors and possible land use (Huang et al., 2009). Geographic Information System (GIS) was used to process spatial data and conduct spatial analysis. Kowloon district was selected as the case study area, since a large proportion of public housing is located there.

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The paper is structured as follows: Section 2 reviews relevant research work; Section 3 presents the case study, the data and the methodology used; the results from this application are illustrated in Section 4, and in Section 5 discussion is given whilst the implications on urban renewal are further discussed; conclusions and further steps are provided in Section 6.

2. Literature Review of Previous Research

Since little research is directly related to the spatial distribution of public housing, this section reviews relevant research. One part is from a broader perspective focusing on factors affecting land development, since housing development not only involves constructing new housing estates, but also refers to a process of developing the whole site on which estates are located. Another part focuses on spatial analysis of housing development and also public housing.

2.1 Factors affecting land development

Factors affecting the location of development or redevelopment are complex. These factors have evolved over time as land management itself has increased in complexity. For example, housing development was firstly determined mainly by physical conditions, especially in earlier times when technology was not developed. With social development, economic and social factors have become more influential. In different contexts, specific influencing factors are varied. In the present day, however, these factors can be classified into several groups on the basis of related literature, namely bio-physical, economic, social, political and locational factors.

DEM and slope are two common physical variables influencing urban land development (e.g. Duan et al., 2004; Huang et al., 2009; Liao et al., 2014). Certain research may take water condition (e.g. Maria de Almeida et al., 2003), soil condition (e.g. van Vliet et al., 2013) and vegetation (e.g. Wang et al., 2013) into account. Economic factors play a key role in urban land use development, as economic value is regarded as one of the most important values for land resources (Zhang et al., 2002). In particular areas, where land resource is limited and land use is dynamic, the land uses are more likely to be converted to those with more economic power (Torrens, 2011). For example, due to high profit, new urban development projects often occur on agricultural land, even though the soil is very fertile and productive in the land. Specific economic factors mentioned in the literature always include GDP, investment, employment, income and land price or rent (e.g. Deng et al., 2009; Huang et al., 2009;

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Jjumba & Dragićević, 2011; Wang et al., 2014). Another influential variable for the location of urban land is a social factor comprising demographic factors, human attitude and values, cultural factors, and the availability of services (e.g. Huang et al., 2009; Jjumba & Dragićević, 2011; Wang et al., 2014). City growth is often associated with population increase whilst residential land will appear in areas with enough facilities and commercial centres (Huang et al., 2009). Given that urban land development is spatial-related and greatly influenced by the neighbourhood environment, location/accessibility and neighbourhood factors are considered as the most important variables. These factors can also be interpreted as neighbourhood effects, which reflect the attraction or repulsion of surrounding land uses (Anas et al., 1998; van Vliet et al., 2013), and they are often represented in terms of their distance to neighbourhood elements such as water bodies, roads, town centres, facilities, and commercial centres (Haller, 2014; van Vliet et al., 2013; Huang et al., 2013; Feng & Liu, 2013; Maria de Almeida et al., 2003; Huang et al., 2009). For instance, most agricultural land being converted into urban land is located on the edge of existing urban land. Industrial land is always far away from residential land use. Additionally, political factors cannot be ignored (van Vliet et al., 2013; Torrens, 2011). Table 1 summarises influencing factors for urban land development.

Table 1 Summarised influencing factors for urban land development

Category	Sub-category
Bio-physical factors	DEM
	Slope
	Water
	Vegetation
	Solar condition
Economic factors	GDP
	Investment
	Employment
	Income
	Land price/rent
Social factors	Population
	Human attitude and values
	Cultural factors
	Availability of services
Political factors	Land use regulations (e.g. zoning)

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	Land ownership (e.g. tenure)
Neighborhood factors	Distance to water bodies
	Distance to roads
	Distance to town centres
	Distance to facilities
	Distance to commercial centres
	Distance to nuisance (noise, light pollution, air pollution)

2.2 Spatial analysis of housing development

In terms of research specifically focusing on spatial analysis of housing development, most research has paid attention to accessibility. The accessibility to public resources including services, facilities and amenities is considered as an influential factor for assessing potential sites of housing development (Sénécal, 2002). It is commonly accepted that residents should have sound accessibility to public facilities whilst noxious facilities should be avoided when planning housing development (Meng et al., 2010). Another perspective is applying accessibility to evaluate transport and land-use strategies in development (e.g. Wang et al., 2015; Zondag et al., 2015). It is often interpreted as distance to public transportation (e.g. Zheng et al., 2015; Shen et al., 2014). Some literature focuses on public transport since it can reduce the gap between groups with different income levels (Welch, 2013). Groups lacking private transport, especially vulnerable groups, must have access to high quality public transport for equality (Welch, 2013).

GIS-based methods are always applied to analyze the accessibility (de Jong & van Eck, 1996; Nicholls, 2001; G. Shen, 2002). Multi-criteria decision methods are always integrated in a GIS environment to conduct analysis. For example, accessibility patterns of housing development sites in Canmore, Alberta, were mapped by using a GIS-based multi-criteria decision analysis approach (Meng et al., 2011). Similarly, accessibility analysis for public housing development in the Choa Chu Kang/Bukit Panjang area of Singapore, was conducted by combining GIS and multi-criteria analysis (Zhu et al., 2006). Public facilities chosen for analysis are various in different contexts. For instance, when measuring accessibility, Apparicio and Seguin (2006) categorised public facilities into cultural services, educational services, health services, sports and recreational facilities, banking facilities and other facilities. Meng et al. (2011) categorised facilities into education facilities, emergency facilities, recreation facilities, flammable facilities and noisy facilities when analysing

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the accessibility. Accessibility to public transport, shopping centres, health care services, banks, schools, community centres, post offices, and parks were chosen as criteria when investigating housing development in Singapore (Zhu et al., 2006). A limited number of studies paid attention to accessibility analysis in public housing (Apparicio & Séguin, 2006; Apparicio et al., 2008).

As for public housing development, the location choice of public housing sometimes has the characteristics of “residual space”, which represents areas with undesirable physical environment, few public facilities, scarce employment opportunities, and low land prices (Dang et al., 2014; Apparicio et al., 2008). For example, an empirical study on affordable housing units in the urban fringe in Chinese cities shows that affordable housing development has a lower possibility of being located in sub-districts with a higher land price, a higher ratio of old houses, and greater subway accessibility (Dang et al., 2014). These kinds of location choice for public housing projects have raised issues of poverty concentration and residential segregation (Dang et al., 2014; DeKeseredy et al., 2003). As a result of the problems associated with public housing, some studies have explored issues relating to these problems, such as the effects of affordable housing on property values (Nguyen, 2005), the effects of public housing on gentrification (Thorsnes et al., 2015), and transit accessibility among affordable housing units (Welch et al., 2013). However, few studies have been conducted with a focus on spatial location of public housing, using spatial data.

3. Data and Methods

3.1 Study Area

Kowloon is located north of Hong Kong Island and south of the mainland part of the New Territories. Its borders include Tate’s Cairn and Lion Rock in the north, Victoria Harbour in the south, the Lei Yue Mun Strait in the east, and Mei Foo Sun Chuen and Stonecutter’s Island in the west. It comprises five administration districts: Kowloon City, Kwun Tong, Sham Shui Po, Wong Tai Sin, and Yau Tsim Mong. The area is approximately 47 km². It had a population of 2,108,419 in 2011 (Census and Statistics Dept, 2012). The main land utilisation types in this region are comprised mainly of residential, commercial, industrial, open and vacant spaces, and government, institutional and community facilities (G/IC). There are 77 public housing estates in the Kowloon district, accounting for a large proportion of public housing in Hong Kong. Figure 1 shows the location of public housing estates in Kowloon district, mainly located at Wong Tai Sin (32 housing estates), Kwun Tong (22 housing estates) and Sham Shui Po (15 housing estates).

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Table 2 General information about Kowloon

Location	<ul style="list-style-type: none"> ✧ North of Hong Kong Island ✧ South of the mainland part of the New Territories
Area	Approximately 47 km ²
Population	2,108,419
Administration districts included	<ul style="list-style-type: none"> ✧ Kowloon City ✧ Kwun Tong ✧ Sham Shui Po ✧ Wong Tai Sin ✧ Yau Tsim Mong
Land use types	<ul style="list-style-type: none"> ✧ Residential ✧ Commercial ✧ Industrial ✧ Open space ✧ Government, institutional and community facilities (G/IC) ✧ Vacant ✧ Others
Number of public housing estates	<ul style="list-style-type: none"> ✧ Wong Tai Sin: 32 housing estates ✧ Kwun Tong: 22 housing estates ✧ Sham Shui Po: 15 housing estates

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collected from the Lands Department of Hong Kong. The information on rental prices was collected on the basis of 2014 data from the Central Map of Hong Kong. The spatial location of public housing and open space was digitalised based on land utilisation data of Hong Kong. All spatial data were processed and analysed in ArcGIS Desktop 10.2 and converted to raster layers with grid cells on a 20 m× 20 m pixel basis. Raster layers of land sites and selected influencing factors were then converted to ASCII format, in which the values for every cell can be obtained respectively.

3.3 Method

Multiple logistic regression (MLR) is used for a multivariate explanatory model with dichotomously dependent variables and continuously/categorically independent variables (Serneels & Lambin, 2001). This method can calculate coefficients for each independent variable based on a set of data and these coefficients represent weights in an algorithm that can generate a map, which displays the probability of a specific category of land use change (Huang et al., 2007). It has been widely used in many fields including urban growth modelling (Allen & Lu, 2003; Hu & Lo, 2007), agriculture (Serneels & Lambin, 2001), the loss of ecosystem (Williams et al., 2005) and deforestation (Geoghegan et al., 2001). Since dichotomous status is the nature of land occurrence on a cell or not and several variables explain the binary variable, MLR was applied in this research to explore the relationships between public housing location and selected variables. All the data layers were processed as grid cells with a common spatial resolution of 20 m. The nature of land sites is to have dichotomous status. Binary values 1 and 0 represent public housing and other sites respectively. Selected factors influencing location are continuous or categorical parameters. The general form of logistic regression is depicted as follows:

$$\log\left(\frac{P_i}{1-P_i}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m$$

In this equation, X_1, X_2, \dots, X_m represent selected factors that may have relationships with the location of public housing. $\beta_1, \beta_2, \dots, \beta_m$ are the regression coefficients, which depict the direct relationships between spatial distribution of public housing and variables. β_i can be calculated through logistic regression analysis by applying the actual land use configuration as a dependent variable and selected factors as independent variables. Since the preference of allocating a particular piece of land into public housing or other sites is unable to be observed or gained directly, it is calculated as a probability by further using a logistic model. P_i refers to the probability

³ Commercial centres in this research include both markets and commercial centres in the digital topographic map of Hong Kong.

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of a grid cell for the occurrence of public housing or not on location i (Braithmoh & Onishi, 2007; Hu & Lo, 2007; Overmars & Verburg, 2005).

The goodness of fit of the logistic regression analysis is usually estimated by the relative operating characteristic (ROC), which is based on comparing a probability image displaying the probability of a certain event occurring and a binary image depicting the observed values (Hu & Lo, 2007). The range of values for ROC is between 0.5 (completely random) and 1 (perfect discrimination) (Braithmoh & Onishi, 2007; Hu & Lo, 2007; Lin et al., 2007). MLR analysis and evaluation were conducted by using the software package of SPSS.

3.4 Dependent Variables and Independent Variables

The dependent variable in this research is the land site, which may be for public housing or other uses. The data were prepared as a set of 20 m×20 m raster cells. 1 refers to the occurrence of public housing estates while 0 represents other land uses. Variables influencing the location of public housing estates are various and complex. Different contexts have different features, which may then have their own influencing factors. For the context of Kowloon in Hong Kong, several critical factors, reflected as seven variables, were assumed to relate with the spatial distribution of public housing estates. One is rental price of nearby private residences. Since the rent of public housing is low, the cost of constructing public housing must be controlled to a comparatively low level for financial viability. Whether residential rents in the surrounding area negatively correlate with the occurrence of public housing is to be investigated. Accessibility to public transportation is also important for the well-being of residents living in public housing estates. Therefore, distance to bus station and distance to MTR station were taken into account in MLR analysis. Open space in Hong Kong represents both green space in urban area and recreation facilities like playgrounds. The coverage of open space within a region was also considered, because it reflects not only whether the environment is favourable or not, but also whether the provision of public facilities is sufficient or not. The provision of public facilities is one necessary aspect for the well-being of residents living in public housing estates. Markets and commercial centres are of great importance for the convenience of residents' daily lives, since they provide residents with consumer requirements. The density of commercial centres (including both markets and commercial centres in digital topographic map of Hong Kong) in the surrounding area of public housing was therefore added as an independent variable in MLR analysis. Schools and health care centres (hospitals and clinics are included) nearby also

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influence residents living in public housing estates. Thus, distance to school and distance to health care facilities are another two variables. Table 3 shows variables in MLR analysis.

Table 3 Variables of multiple logistic regression analysis

Variable	Meaning	Nature of variable
<i>Dependent</i>		
<i>Y</i>	1: public housing 0: other land uses	Binary
<i>Independent</i>		
<i>X₁</i>	Distance to MTR station	Continuous
<i>X₂</i>	Distance to bus station	Continuous
<i>X₃</i>	Number of commercial centres and markets in the surrounding area (500 m buffer)	Continuous
<i>X₄</i>	Open space coverage in the surrounding area (500 m buffer)	Continuous
<i>X₅</i>	Average residential rent in the surrounding area (500 m buffer)	Continuous
<i>X₆</i>	Distance to school	Continuous
<i>X₇</i>	Distance to health care facility	Continuous

4. Results

4.1 Multiple Logistic Regression Analysis

Multiple logistic regression was applied in this research to explore the interrelationships between the *location* of public housing estates (the dependent variable) and the independent variables. Significance levels for variables to enter and stay in the model were set to 0.01. Table 4 shows the regression result for the occurrence of public housing estates. Significance values of all independent variables are less than 0.01, which shows that these variables can explain the location of public housing estates. Estimated coefficients of variables show the specific relationships between the dependent variable and independent variables. The coefficient of “*distance to MTR station*” indicates that it shows a positive correlation with the location of public housing while “*distance to bus station*” has a negative relation with the dependent variable. The coefficients of these two variables (close to 0) also show that their influence is comparatively small. The independent variable “*open space coverage*” has a positive and obvious influence on the occurrence of public housing with the significance value less than 0.01 and coefficient value of 4.169283. Both

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“*density of commercial centres*” and “*average residential rent in the surrounding area*” have negative relationships with the appearance of public housing estates. “*Distance to school*” and “*distance to health care facility*” also show negative relationships with the location of public housing estates. Among these seven variables, Wald values are large except that of “*density of commercial centres*”.

Table 4 Multiple logistic regression result for public housing showing the relationship between *Location* and the seven Independent Variables

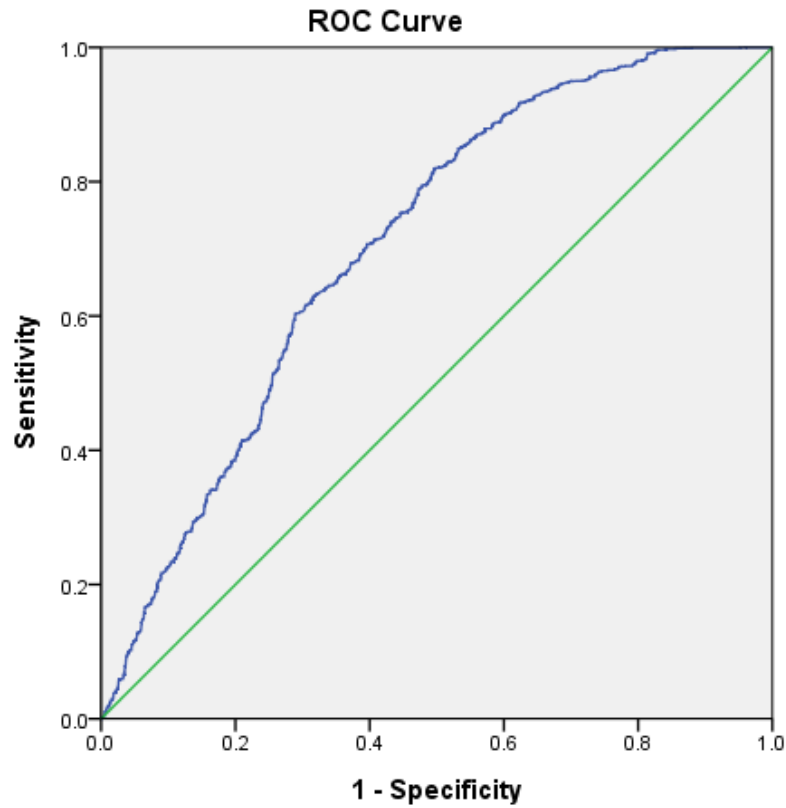
Independent variables	B	S.E.	Wald	df	Sig	Exp(B)
X₁: Distance to MTR station	0.000645	0.000046	194.203177	1	0.000000	1.000645
X₂: Distance to bus station	-0.001041	0.000058	317.811878	1	0.000000	0.998959
X₃: Density of commercial centres	-0.008488	0.003917	4.697186	1	0.030212	0.991548
X₄: Open space coverage	4.169283	0.291905	204.004109	1	0.000000	64.669057
X₅: Average residential rent in the surrounding area	-0.071954	0.004072	312.194051	1	0.000000	0.930574
X₆: Distance to school	-0.005418	0.000134	1623.75599	1	0.000000	0.994596
X₇: Distance to health care facility	-0.000521	0.000052	100.124783	1	0.000000	0.999479
Constant	3.431905	0.123747	769.127211	1	0.000000	30.935520

Note: *B* represents the estimated MLR coefficient for each variable. *S.E.* represents the standard errors of the individual regression coefficients for the model estimated. *Wald* is the Wald chi-square test that tests the null hypothesis. The column of *df* lists the degrees of freedom for each of the variables included in the model. *Sig.* means the significance level of each independent variable.

4.2 Validation of Multiple Logistic Regression Analysis

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The significance values of independent variables display the effectiveness of the regression analysis. To better explain the goodness of fit of the MLR result, the ROC value is further applied for validation. Figure 2 shows the ROC curve. The ROC value is 0.707, indicating the MLR analysis is reliable. Table 5 is the description of the statistical figures relating to the ROC calculation.



Diagonal segments are produced by ties.

Fig.2 ROC Curve

Table 5 Statistics relating to the ROC curve

Area Under the Curve				
Test Result Variable(s): Predicted probability				
Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
0.707	0.003	0.000	0.700	0.714

The test result variable(s): The predicted probability has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

5. Discussion

This research has explored the spatial distribution of public housing estates in Kowloon, Hong Kong, by focusing on several issues, which are: (1) access to public transportation; (2) access to education and health care facilities; (3) convenience of daily life; (4) surrounding environment; and (5) nearby private residential property rent. Therefore, seven independent variables (see Table 3) reflecting these aspects were selected for analysis, based on their relationships with their public housing location.

The results depict the interrelationships between the spatial distribution of public housing estates and possible influencing factors. When the surrounding residential rent is lower, there is a higher probability of the occurrence of public housing estates. The result is consistent with Apparicio et al. (2007), who mentioned that the location choice of public housing may be driven by low land prices. This phenomenon may be a result of financial consideration of the government. Public housing is provided by the government and rent/sold at very low prices. In order to reduce the cost for public housing, for new housing estates being planned, the area with lower rent has more potential to be chosen as the target area. However, as previous research pointed out, this may lead to a dilemma of social exclusion (Randolph & Judd, 2000) and poverty concentration (Crump, 2002). Achieving the balance between financial feasibility and social inclusion is essential for sustainable development. Higher open space coverage is associated with more public housing estates, indicating that the provision of open space near public housing estates may be felt by residents to be satisfactory. Enough open space implies a comfortable and convenient environment for nearby residents with the provision of green space and public facilities, like playgrounds. The results also suggest the provision of education and health care facilities is satisfactory near public housing estates.

Based on the results, problems of current spatial distribution of public housing estates can also be found. Firstly, access to public transportation does not show obvious positive or negative correlation with public housing location, which means that decision-making on the location of public housing with access to public transportation is not greatly considered. For distance to MTR stations, there is a higher probability for the occurrence of public housing when the distance to MTR stations is further

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away. Access to public transportation has a great influence on residents' daily life, including their commuting time and their convenience to other regions within the city. Additionally, the provision of public transportation represents accessibility of the community, which is closely related with social fairness and sustainability (Dempsey et al., 2011; Bramley et al., 2009). In the future, the decision-making of new public housing locations requires higher attention given to its distance to nearby stations of public transportation. Secondly, density of nearby commercial centres shows a negative relationship with public housing location, which further indicates the need for more commercial centres nearby, since commercial centres can provide daily goods and services for residents and thus further contribute to economic prosperity.

Hong Kong, with its urban decay problem, is experiencing urban renewal process. For those old districts with mass public housing estates, it is better to consider revitalising them by taking these critical issues into consideration. Specifically, public transit networks can be improved by adding more points and connections. This would be especially beneficial with regard to MTR stations. Diverse commercial points should be established within these districts for the convenience of residents. Due to the fact that the supply of public housing estates is limited, there are still many people on the waiting list. There is a trend of locating new estates in the suburban area like the New Territories. Some sites may have worse access to public resources. Therefore, it is suggested that there be some public housing development included in urban redevelopment projects of downtown areas like Kowloon, where the distribution of public resources is comparatively even in space. When selecting vacant land as a development site, relevant services and facilities must be associated for the well-being of those residents living in public housing estates.

Previous research relating to public housing has rarely focused on its spatial distribution and influencing variables. From a theoretical perspective, the investigation into this issue is a new angle of explaining the factors affecting decisions on the location of public housing by combining spatial analysis and a statistical approach. In practice, the analysis can improve site selection for public housing in a case study area. If it is applied in other cases, it can also facilitate identifying current problems, improving decision-making on site selection of future public housing estates and facilities, and further enhance social cohesion and sustainability. The significance values of validation show that the results are reliable. These variables can explain the location characteristics of public housing.

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6. Conclusions

This research has presented a pilot study on the spatial distribution of public housing estates and critical influencing factors in Hong Kong, by applying both spatial analysis and statistical methods. All data were prepared and processed as spatial data and were analysed by using multiple logistical regression. Although the seven selected variables cannot fully explain public housing location, they still represent several necessary concerns for location selection of public housing. This study exposed several problems with current locations with the results of the multiple logistic regression. They are a comparatively long distances to public transportation and limited commercial centres for residents' daily life. Meanwhile, some geographical advantages of current public housing location can be reflected. Open space coverage around the current location of public housing is relatively high whilst access to education and health care services is adequate, which is an illustration of equal access to certain public facilities and green environment. It is suggested that more variables should be included for further analysis in future study. In order to validate the interrelationships, spatial data could be prepared on another pixel basis, which would enhance the reliability of analysis. In addition, other statistical methods could be used to analyse the inherent relationships between independent variables and dependent ones. Finally, there is a need for analysis of other districts of Hong Kong, to give an overall picture of spatial distribution of public housing estates.

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