Review of Spatial Model to Assess Suitability of Affordable Housing Based on Demand Criteria

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Abstract. Affordable housing has become essential, especially in developing countries, to cater the people needs on house. Most of the affordable housing focus is on providing house at affordable prices, but the locations of these affordable housing often not suitable with demand of people. Several initiatives were conducted to identified the demand of people, and the suitability of their houses with their demand. These model has different purpose, and lack of spatial element. Some model defining the people preference in order to choose a suitable for their house, while other model focusing on goals that relate to the site suitability of house that involve several cities. This study focus on integrating spatial information and analysis to assessing the suitability level of affordable housing in Malaysia. The assessment model consists of four main indicators; suitable site of affordable house, demographic factor, suitability house according neighbourhood context, and commute distance. With proper assessment, a better location can be defined, or more suitable facilities can be implement in the future in surrounding area of these affordable housing.

1. Introduction

Housing becomes one of essentials of people beside food, education, and clothes. A comfortable house is a one of important part in order to find a happiness and productive life [1]. However, every person has their preference in order to earn their own house. According to the [2], housing does not only provide a shelter however it represents the largest single investment of a lifetime. The affordability of individuals depends on the incomes and relatives price of house [2]. Thus, affordable housing established by government and private sectors in Malaysia could help most Malaysian to buy a house. Affordable housing is a concept to explain connection between housing and people also include socioeconomic and development environments. It is related to customer ability in order to own or buy houses. According to Affordable Housing Action Plan of Western Australia (2017) it defines affordable house as what people can afford relative to the citizen's income, particularly households in the lowest two income bands. Housing is considered affordable when it costs no more than 30% of gross household income.

Through *Dasar Perumahan Mampu Milik Negara* (National Affordable Housing Policy, DRMM), Government has established an agency and introduced a programme to enable category of M40 to earn a house. In level of Federal, there are 1Malaysia People's Housing Programme (PR1MA), Federal Territory Affordable Housing Policy (RUMAWIP), *Rumah Mesra Rakyat* (RMR), and Civil Servant

Housing Programme (PPAM).1Malaysia People's Housing Programme (PR1MA) is housing development programme in Malaysia as it was launched on 4 July 2011. PR1MA is under Ministry of Federal Territories. Civil Servant Housing Programme (PPAM) is an approach by the Government of Malaysia and agreed by Cabinet on January 30, 2013. The purpose of PPAM is to help civil servants own a house. On the other hand, *Rumah Mesra Rakyat* is a development project handled by *Syarikat Perumahan Negara Berhad* (SPNB) that established to help low income groups. Whilst in state level, there are *Rumah Selangorku, Rumah Mampu Milik* Johor, and PR1MA Pahang. Lastly, *Rumah Selangorku* is a programme to provide affordable house for low and middle – income groups in the Selangor region [1].

Through the DRMM initiates by Government of Malaysia, there are several factor requirements need in order to purchase when buying a house. According to [3], through descriptive analysis and statistical analysis that they done which is using Statistical Package for Social Science (SPSS) and others. It shows that factors affecting the demand of housing affordability in ascending order is quality, location, public facilities, safety and security, and price.

Through DRMM that established by Department of Housing under Ministry of Housing and Local Government of Malaysia, it can help citizen to earn their own houses. However, aside of housing price, the other demand criteria to own affordable housing was less emphasis, especially the location of affordable housing. Previous study stated that current practices are less emphasis about the relationship between affordable housing with the other factors such as location suitability, relation with safety and security, public facilities, public transportation and many more. Even though, this factor is one of the important in order for homebuyers to earn house. Besides that, the studies that carried out by other researchers such as [4]. They focusing on determining the factors affecting demand of affordable housing in Klang Valley by using questionnaire and statistical analysis not spatial analysis.

The aim of this study is to enhance current indicators to assess suitability level of affordable housing in aspect of demand criteria around Selangor by using spatial information and analysis. The scope of study focused on the indicators to assess from several aspects, and use the affordable housing scattered in Selangor State, Malaysia.

2. Affordable Housing and Suitability

To assess the suitability locations of affordable housing, it need to understand on the definition of affordable housing, housing suitability, and the relation between housing suitability and demand factor.

Affordable housing is an approach used in order to explain socioeconomic and development environments in one country, and which aims to confirms if housing provided for families can be afforded by each income – earner cluster. Income – earner cluster classify as low, middle, or high income – earner cluster [5]. Affordable Housing (AH) also defined in multiple terms which are a measure of expenditure on housing to income of the household. The terms of " Affordable housing (AH) refers to any housing that meets some form of affordability criterion, which could be income level of the family, size of the dwelling unit or affordability in terms of EMI size or ratio of house price to annual income" is accepted by the Indian Government [6]. In Malaysia, several type of affordable housing has been introduced, including RUMAWIP (*Rumah Wilayah Persekutuan*), PR1MA (*1Malaysia Housing Program*), RMR (*Rumah Mesra Rakyat*), and *Rumah Selangorku*.

Housing suitability can be defined from [7] as private household is living in a suitable accommodation as it will refer to National Occupancy Standard (it more refers to private household). National Occupancy Standard is a comprised of the common elements of provincial / territorial occupancy standards which according to NOC, it determines the number of bedrooms a household. It depends on its composition and size of house. Housing suitability in Canada will assess the required number of bedrooms for one household and it depends on age, sex and relationship among household members. Canada Mortgage and Housing Corporation (CMHC) develop Housing Suitability and the National Occupancy Standard (NOS) through consultations with provincial housing agencies.

The location of affordable housing is crucial in certain aspect, especially the distance with working area. In order to define housing suitability, demand criteria become one of the important significances

as there are many studies show the important of it towards housing suitability. The demand factors involve many significant variables. Affordability of housing will determine the issue and supply, and where the availability complement market demand [8]. The affordability variables also supported by [9] as the housing affordability are the attribute of house price, household income, and housing choice in the housing market. Besides, the limitation of affordable housing also mentioned by [9]. The availability of affordable housing become one of the factors pf housing suitability become one of the factors of housing suitability in terms of demand criteria. The affordability of house has its relationship with demographic factors. The different demographic background shows different level of housing affordability. However, marital status, number of households, monthly income, and education level have strong relationship with affordability housing price [2]. Besides, the other factor such as location, accessibility, house type, cost of owning over renting, and service of facilities[4] become one of the preference in order to choose a suitable house. Through the framework developed by Housing Education and Research Association (HERA, 2006) mentioned three main factors; type of households, social class, and value of housing. However, it differing from [10] as it gives attention on surrounding and neighbourhood as it divided into four characteristics as a preference to choose a suitable house which are physical environment, social environment, location and public facilities and location and transportation.

3. Previous study on Indicators of Housing Suitability and Demand Criteria

The ability of household in buying a house categorized into two which are the household who can afford to buy a house from open market and a household who need helps from government to earn a house. Government form Standard of Quality Housing (*Piawaian Perumahan Berkualiti*, PBB) in order to evaluate the quality of available housing while existing housing standard will be reviewed in aspect of culture, demography, climate, demography and local material [11]. Through analysis carried out from DRN (2018 – 2025), there are gap in data which it limits ability of government to satisfy needs of people in planning a housing due to no data, inaccurate data and inaccessible data. Thus, in period of execution, there are indicators and methods to determine guideline of Housing Demand and Needs Assessment (HDNA) [11]. Analysis spatial done from DRN in achieving Quality Housing Standard are divided into 2 as shown in Table 1.

Table 1. The analysis spatial of housing scenario [11].

No	Analysis Spatial	Aspect
1	Neighbourhood Context	- Ensuring the quality maintenance is carried out continuously for public facilities. - Neighbourhood physical planning supported by community element such as culture, economics, and privacy. - Emphasize the sense of ownership and sense of belonging in neighbourhood.
2	Housing location	- Mobility pattern annotations from the settlement center to the work center are based on the individual set of travel times, which is 30 minutes, 45 minutes, and 60 minutes

3.1. Studies on Factors of Affordable Housing Suitability in Klang Valley

The first study done by [4] that assessing housing requirements as it important to analyse the housing demand. Housing Demand is the combination of what buyer want and what they are prepared to pay. Data collection done by the researcher are based on questionnaire survey from middle – income group

in Klang Valley. A structure questionnaire has four main sections; Section A (Respondent profile), Section B (Current residence), Section C (Housing preference), and Section D (Housing Scheme).

Through this study they summarize the importance of factors influencing the decision making. The factors that influence the decision making is include in questionnaire. It is importance to determine the most important factor decide by respondent at Klang Valley. They use five – point likert scale; 1 as a Not Important, 2 as a Slightly Important, 3 as a Moderately Important, 4 as an Important and 5 as a Very Important. Based on the scale, the average index of each factor was calculated [4] as shown in table 2.

Table 2. The factors influencing decision making.

No.	Factor	Rate					Average Index	Rank
		1	2	3	4	5		
1	Price	0	1	1	22	36	4.55	1
2	Design	1	0	14	31	14	3.95	6
3	Location	0	1	12	28	19	4.08	4
4	Quality	0	1	14	30	15	3.98	5
5	Developer's success on previous project	0	1	26	27	6	3.63	7
6	Number of projects done by developer	0	3	38	14	5	3.35	9
7	Developer's popularity	0	4	34	15	7	3.42	8
8	Public facilities	0	0	2	31	27	4.42	3
9	Safety and security	0	0	3	26	31	4.47	2

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3.2. Housing Suitability Model by Shimberg Center

Housing Suitable Model (HSM) is a Geographical Information System (GIS) based – tool. These tools is to analyse the suitability of locations for the development of preservation of affordable housing which is can be combined with other data elements to seeks the interaction of other housing policy objectives. Housing Suitability Model (HSM) developed by Shimberg Center for Housing Studies at the University of Florida. These tools derived from the Land Use Conflict Identification Strategy (LUCIS) as it developed by Margaret Carr and Paul Zwick. Both of them from the University of Florida's School of Landscape Architecture and Planning. To create Housing Suitability Model (HSM), there are map layers that been combine which are Site and Land Use Characteristics, Accessibility to Neighbourhood Services, Transit Accessibility to Jobs and Cost of Driving [12] as shown in table 3.

Table 3. The factors influencing decision making.

No.	Goals, Objective and Sub - objective
1	**Identify locations with suitable site and land use characteristics for housing** Objective: Identify locations with suitable physical site characteristics. Sub – objective: 1) Identify locations distant to noise generating land uses.

2) Identify locations distant to air – polluting land uses.

3) Identify locations distant to hazardous sites.

4) Locations proximal to major transportation routes.

5) Locations with soils suitable for residential development.

6) Locations not prone to flooding.

Objective: Identify locations with suitable land use characteristics.

Sub – objective:

1) Identify locations proximal to existing residential land uses.

2) Identify locations with suitable land uses.

3) Identify locations that have shown residential growth in past 10 – 30 years.

2 **Identify locations with suitable accessibility to neighbourhood services.**
Objective:

1. Identify locations with suitable accessibility to healthcare opportunities.
2. Identify locations with suitable accessibility to education opportunities.
3. Identify locations with suitable accessibility to childcare opportunities.
4. Identify locations with suitable accessibility to retail opportunities.
5. Identify locations with suitable accessibility to entertainment and recreation opportunities.

3 **Identify locations with accessibility to concentrations of low and moderate wage jobs using public transit.**

4 **Identify locations with low cost of driving to work**

3.3. Affordable Housing Demand Projection and Site Selection in Malaysia

Another study was done by [13] that aim to establish a framework in order to estimate local demands for affordable housing by reviewing the theoretical and modelling framework if Artificial Neural Network Model (ANN). Through the previous study, they highlight demographic and economic factor also including birth rate, GDP rate, housing stack, income rate, population growth, poverty rate, and unemployment rate as the demand for housing can be assess as shown in table 4.

Table 4. Demand Criteria in affordable housing [13].

Indicators	Sub-Indicators
Demographic and Economic factors	Birth Rate
	GDP Rate
	Housing Stack
	Income Rate
	Population Growth
	Poverty Rate
	Unemployment Rate

3.4. Housing Mismatch Model in Suburban Areas

The other model was developed by [14] that focus to review on the factors that adding in existence of housing mismatch and defining the contribution aspect as well. From the previous study that been review, the framework of housing mismatch phenomenon highlighted three aspects to the existence of housing mismatch in suburban areas such as in Kuala Lumpur which are Regulatory, Affordability and Spatial Geographical Location. The details indicators show in table 5.

Table 5. The domain of framework of housing mismatch.

Framework of Housing Mismatch Model (Domain)	Indicator
Regulatory	1. Income Level
	2. Demographic Factors
	3. Housing Schemes
	4. Supplier
	5. Housing Loan Financial Institution
Affordability	1. Availability
	2. Housing Price
	3. Affordability of income.
Spatial Geographical location	1. Speculation
	2. Oversupply of housing
	3. Misallocation.

3.5. Suitability of Housing based on Commute Distance

This study was done in Toronto and Vancouver by Moose et al. [15] to examine the impacts of suitability of housing based on commute distance, especially to working place. The researcher uses the Montreal, Toronto, and Vancouver Census Metropolitan Areas (CMAs) as their case study. Their primary analysis is by using weighted multiple linear regression model that consists of four separate variables. From this study, they summarize the measurement of housing suitability based on distance to working places, which are [15];

1. Rooms per dwelling ratio: An average number of rooms at place of work or current number of rooms of commuter.
2. Housing mix: Percentage of different types of housing at place of work.
3. Percentage of respondent's current housing type available at place of work.
4. Share of housing at the place of work meeting CMHC's definition of suitability, based on number of bedrooms and commuter's household composition.

A logistic model is construct by using 2011 Statistics Canada data. The logical model is use to predict the likelihood of experiencing housing suitability. The housing suitability concern is into commute distance, income, immigration status and period of immigration for renters and owners. Table 6 show the housing suitability concern by [15].

Table 6. The housing suitability concern.

No.	Housing suitability concern	Standard adopted
1	Commute distance	Less than 5 km
		5 to 9.9 km
		10 to 14.9 km
		15 to 19.9 km
		20 to 24.9 km
		25 to 29.9 km
		Greater or equal to 30km
2	Income	In income
3	Status of Immigrants	Naturalized citizen
4	Period of immigration for renters and owners	Immigrated 1981 to 1990
		Immigrated 1991 to 2000

| | Immigrated 2001 to 2005 |
| | Immigrated 2006 to 2011 |

4. Conceptual Model to Assess Suitability of Affordable Housing

The previous studies on the framework, indicators, models, and policies from various researchers and government have their own goals and objectives. [4] defining the people preference in order to choose a suitable for their house while [12] focusing on four goals that relate to the site suitability of house in United States that involve several cities. *Dasar Perumahan Negara* (DRN) is define the housing scenario and spatial analysis that have been carried out in order to ensure that the social provision of the housing sector is enjoyed by qualified households. [13] focusing on demographic and economic factor in order to establish framework that involve in affordable housing demand projection and site selection in Malaysia. In contrast, [14] investigated the problems regarding of housing mismatch in Malaysia. In this study they produce a conceptual of housing mismatch model that involve supply factor, spatial geographic location, affordability, requirement and qualification and demand factor (migration). In Matara, Sri Lanka there are research involve in order to analyse the suitability location of a house. [16] analyse the suitable location of house with two factors which are site suitability and demographic factors such as population density while in Vancouver, Montreal, Toronto, Canada research on impact of housing suitability on commute distance done by [15]. There are many housing suitability variables mentioned by [15] such as the commute distance, the status of immigrants, housing income, and period of renters and owners.

Based on previous study or model that have been developed by government of Malaysia and various researcher, there are 30 sub – indicator listed. However, not all indicators and sub-indicators are suitable to be stored and analysed using spatial information. From the previous study, the optimum indicators that should be included to analyse the suitability level of affordable housing can be divided into 4 main indicators, as shown in table 7.

Table 7. The propose model to include indicators and sub-indicators to assess the suitability level of affordable housing in Malaysia.

No.	Indicator	Sub-indicator
1	Suitable site of Affordable house	- Distance from noise generating land use. - Distance to air – polluting land use. - Distance to hazardous site - Locations with soil suitable.
2	Demographic factor	- Birth rate - GDP rate - Income rate - Population growth - Poverty rate - Unemployment rate.
3	Suitability house according neighbourhood context	- Accessibility to healthcare - Accessibility to education - Accessibility to childcare - Accessibility to entertainment and recreation
4	Commute distance	- Distance from public transportation - Mobility distance from workplace.

5. Conclusion

Affordable housing has become priority to serve people's need for shelter. One of the aspect for good

location of affordable housing is it suitability area. People not only need an affordable housing, but also the suitable surrounding. Several models, indicators, and framework has been design and studied. These indicators have different purposes, and lack of spatial information to assess the suitability level of affordable housing. This study conducted to enhance current assessment, with integrating spatial information to assess the affordable housing suitability level. With proper assessment, future planning in enhancing surrounding area of affordable housing can be made, and besides that, the new locations of affordable housing can be located based on demand criteria to improve the suitability level of affordable housing.

Acknowledgement

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