THE IMPACT OF ROOF GARDENS AT HIGH-RISE RESIDENTIAL BUILDINGS ON PROPERTY VALUES

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ABSTRACT

As population increases in the cities, so does the demand for houses in fulfilling the basic requirement of shelter. The high demand for residential units in urban areas has resulted in saturated places to live because the land in such areas becomes limited. Meanwhile, green areas must be maintained to serve the population. A green roof is one of the solutions as it fulfils 10% of the requirements for providing green areas. Besides, the roof garden can be used as an open space for the high-rise residents. This study aimed to intensify the application of roof garden outdoor space to the property value. The study used a quantitative survey that involved 30 residents of an apartment with a roof garden (ARG) and 30 residents of an apartment without a roof garden (ANRG). Creating a nice view seems to be the primary function of a roof garden for both ARG and ANRG. Besides, roof gardens are considered most valuable as they provide pleasurable feelings. In fact, all the price ranges for ARG are higher compared to ANRG. Not only that, but the differences in rent rate fall between 48% and 60%. Purchase price even ranges from 50% to 56%, whereas the current price is between 67% and 70%. For maintenance fees, the costs range between 60% and 67% monthly. The findings from this study can be used as a benchmark in providing monetary values and benefits to the future developers and buyers. Besides that, knowledge and information about roof garden outdoor space can be drawn from this study too.
Keywords: green area high-rise residential building, outdoor space, property value, roof garden.

1 INTRODUCTION

Population in urban areas continues to increase every year, resulting in the rising demand for houses. As the demand for houses increases, it causes limited land sources in urban areas. Noor et al. [1] mentioned that as population increases, the number of demand for residential areas will increase as well. As stated by Downton [2], the scenario happens when the demand for houses is more than the existence of land sources. The limited land sources will result in insufficient land area for ground residential areas. Consequently, high-rise residential structures are built to fulfil the demand of residential areas.

Roof gardens are the green elements on the topmost levels of residential structures. The first roof garden known as Hanging Garden of Babylon was built around 600 BC. It covered an area of 2000 m^2 and consisted of a watertight foundation, asphalt panels, bricks, and mortar on top of a column structure [3]. Generally, roof gardens can be divided into two types which are extensive and intensive. Comparing both types of the roof garden, extensive roof gardens involve minimal maintenance and have limited features. However, intensive roof gardens contain heavy features and allow human activities [4]. Not only the many functions of a roof garden include an area to grow produce, provide play space, give shade and shelter, or simply as a living green area, but also to create an aesthetic value which will increase the value of the structure [5]. This study involved an in-depth survey on functions and values that may influence people in buying a house with a roof garden. This study also revealed the price differences between the Apartment with Roof Garden (ARG) and the Apartment without Roof Garden (ANRG). The price list has shown that the market price of the ARG is more expensive compared to ANRG.

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2 LITERATURE REVIEW

Residential development in Malaysia is based on the Town and Country Planning Act 1976 (Act 172) by which developers are required to provide a minimum 10% of green area. As for high-rise residential buildings, the roof gardens act as an alternative solution in fulfilling the 10%–20% requirements (1 resident/population equal to 5 m^2) [6]. However, the problem faced at present is the limited area in providing green space. In previous research by TBLC [7], the issues related to the open space network is limited land available for the creation of green space. Because of that, landed green area cannot be provided and green roof becomes one of the solutions in high-rise development industries to solve this problem. As reported by UF [8], a green roof which is specially designed landscape at the top of buildings not only can provide a solution to such problem, but also enhance the quality of life for urban residents.

2.1 Functions and benefit values of roof gardens

The purpose of providing green area is to soften the environment at high-density residential buildings, especially in urban areas. Without green space, the environmental health will increasingly disrupt. As a consequence, people in urban areas nowadays become more aware of the green space. The European Commission (EC) [9] reported that residents are more likely to say that the environmental impact of the construction of buildings will be important to their decisions in buying a house or an apartment. Therefore, green roof is utilised for more practical purposes as the soil and plants are found to provide effective insulation from the high pollution in developed central cities. This shows that environmental impacts is one of the values of roof gardens as they help to soften the impacts aside from influencing people's decision in buying a house. Roof gardens can offer open space functions and values to high-rise buildings. Green roofs are usually created as a meeting point to foster a sense of community among the people and the surrounding environment. This sense will bring relaxation and joy to them. As stated by Korpela [10], engagement with the natural environment includes pleasurable feelings, joy, relaxation, comfort, and calmness. In addition, The Green Roof Alliance (GRA) [11] stressed that roof gardens also help people to create pleasing, vigorous, sustainable native, and naturalise plant communities. Green roofs are also one of the most exciting developments in sustainable building design which offer a number of sustainable advantages on an otherwise empty, unused space.

The aesthetic of a roof garden is one of the important elements in the appearance of the high-rise buildings. Jim and Chen [12] mentioned that the aesthetic of roof garden is one of the elements that can increase the value of the property. People are actually willing to pay a house with green design because they prefer green attributes. As stated by Woolley et al. [13], public landscape increases house price. At the same time, roof gardens can also be a solution to the unhealthy environment, especially in urban areas. In the context of giving benefits to the environment, roof gardens can help in saving energy, reduce urban heat island effects, reduce greenhouse effects [14], [15]. A study by Liu [16] revealed that if rooftop gardens were widely adopted, they can reduce the urban heat island, which will decrease smog episodes and problems associated with heat stress and further lower energy consumption.

2.2 Monetary value

Ghobadian [17] has mentioned that high-rise buildings with a roof garden may have a higher price or value compared to buildings without one. His completed survey in Manchester,

Connecticut revealed that the addition of green space and trees to a property increases its value up to 6%. Dinsdale et al. [3] also found that the increase of property value is between 6 and 15% for homes with green roofs. This proves that roof gardens are used as an added green/aesthetic/natural and monetary values to the properties.

Table 1: Four types of gated community – apartments buildings.

No.	*Types of building*	*Details of building*
1.	Baiduri Apartment 	Floor: 10 floors Block: 4 blocks Size of house: 1100 sqf Quantity of bedrooms: 3 Price psqf: MYR 258.22 Current price: MYR 220,000–300,000 Facilities: badminton courts, meeting room, retail, hall, launderette, barbecue pit.
2.	Danaumas Apartment 	Floor: 8 floors Block: 4 blocks Size of house: 1200 sqf Quantity of bedrooms: 3 Price psqf: MYR 258.22 Current price: MYR 220,000–300,000 Facilities provided: playground, cafeteria, retail.
3.	Kristal Heights Apartment 	Floor: 9 floors Block: 4 blocks Size of house: 1003 sqf Quantity of bedrooms: 3 Price psqf: MYR 258.22 Current price: MYR 220,000–300,000 Facilities: swimming pool, playground, laundry, multipurpose hall, day care centre, cafeteria, gymnasium.
4.	Kristal View Apartment 	Floor: 14 floors Block: 2 blocks Size of house: 1100–1200 sqf Quantity of bedrooms: 3 Price psqf: MYR 391–427 Current Price: 450000 MYR and above Facilities: swimming pool, playground, launderette, multipurpose hall, day care centre, cafeteria, gymnasium.

3 METHOD

This study was conducted to examine how far the existence of roof gardens gives impact to the property value. The existence of roof gardens was measured by the functionality, benefits, and values. The primary data was obtained through quantitative and qualitative methods (questionnaire and observation). The observation was made to record the current location and situation of houses, types of activities and facilities provided surrounding the open spaces/roof gardens, and to be familiar with the type of residents who live in these houses.

The questionnaire survey technique was employed using semi-structured questions which were divided into five parts; the price of houses, general aspects of the roof garden, functions and benefits of the roof garden, and values of the roof garden. Close-ended questions were used in the early part of the questionnaire. Likert scale scaling response ranged from five fixed choice formats (from strongly agree to strongly disagree) and were designed to measure respondents' attitudes or opinions about roof garden/open space functions and its green/aesthetic/natural (benefits) values. In this study, 4 apartments were chosen as case study areas. All are located in Section 7, Shah Alam, Selangor, Malaysia, (3°N latitude, 101°E longitude with an average elevation of 7 m). The well-developed area is surrounded by institutional, commercial and other types of residence such as terrace, semi-detached, single-family houses and apartments.

One of the apartments is categorised as ARG and the other three are ANRG. All are medium-cost and medium-sized apartments in the range of 1003–1200 sqf floor areas. Sixty targeted residents were randomly selected; 30 respondents are residents from the Kristal View Apartment (ARG) while the rest are from 3 ANRG apartments which consist of Danaumas Apartment, Baiduri Apartment, and Kristal Height Apartment with 10 respondents, respectively. Data were analysed using Statistical Package Social Science (SPSS) and presented in tabular form and graphs.

4 RESULTS AND DISCUSSION

These gated housing communities provide basic and common facilities such as open space area, multipurpose hall, gymnasium space, laundry and retail shops, children's daycare, cafeteria, and 24-hour security guard. The open space is located at ground level and roof top level.

Figure 1: Location of Section 7, Shah Alam, Selangor, Malaysia (3°N latitude, 101°E longitude with an average elevation of 7 m).

Figure 2: Roof garden/outdoor space facilities are provided such as swimming pool, plaza, playground and gazebo for residents of all ages.

4.1 Demographic

Table 2 shows 60 respondents' demographics. More than half of the respondents are males with 52% and the other 48% are females. Majority of the respondents living in the chosen apartments are from the age range of 35–65 which fall into the category of middle-aged adults with the percentage of 42%. They are followed by residents with the age range of 18–35 which represent 30%, and the lowest amount is residents whose ages range from 65 and above. 52% residents own their houses and another 48% are renting. Majority of the respondents have lived there for almost 5 years (25%), while the rest of them for a year or less.

4.2 Roof garden visits

The majority of the residents in ARG (77%) visit the roof garden for their daily leisure activities by which 53% of them do so once a week, 10%, twice a week, while the rest (3%) go there every day (Table 3).

Basically, the roof garden is attractive by its scenery, design, open space, accessibility, and view. Majority of the residents (50%) agreed that the scenery attracted them to the roof garden, while 13% agreed it was the design. Meanwhile, 7% of the residents agreed that they were attracted by the open space facilities provided and that the view is one of the attractions of the roof garden. From the researchers' observation, the roof garden in ARG is located at level 4 which is a strategic location that provides a nice scenery with green features of the garden. Thus, most residents agreed that the scenery is the biggest attraction to the roof garden.

Table 2: Respondent's demographic profile.

Item	*Variables*	*Frequency (n)*	*Percentage (%)*	*Total (n)*
Gender	Male	31	52	60
	Female	29	48	
Age	18–35	17	28	60
	35–65	25	42	
	65 and above	18	30	
Ownership	Purchase	31	52	60
	Rent	29	48	
Duration of Stay	3 Months	7	12	60
	6 Months	7	12	
	9 Months	12	20	
	1 year	13	22	
	3 Years	3	5	
	5 years	15	25	
	6 years	3	5	

Table 3: Respondents visiting the roof garden.

Items	*Variables*	*Frequency (n)*	*Percentage (%)*	*Total (n)*
Visiting roof garden	Yes	23	76.7	30
	No	7	23.3	
Frequency of visiting	Once a week	16	53.3	30
	Twice a week	10	33.3	
	Every day	1	3.3	
	If needed	3	10.0	
Attractive elements of the roof garden	Scenery	15	50.0	30
	Design	13	10.0	
	Accessibility	4	13.3	
	Open space	2	6.7	
	View	2	6.7	
	Other	4	13.3	

4.3 Benefits of roof garden/outdoor space for ARG

Generally, residents from both types of apartments agreed with the benefit values of the roof garden as an outdoor space and as a symbol of attraction of the buildings. The measure of the benefit value for ARG is the roof garden which has the value of creating a pleasant viewpoint, with the highest, average score of 4.13. This is an evidence of the significant value of roof garden which has solely been designed and constructed to create a pleasant viewpoint to the upper floors and surrounding buildings. Following this is the value of roof garden design in fulfilling the needs of leisure areas for people in this building. This was agreed upon by residents with 4.07 mean scores. The roof garden serves as a social and recreational focal point for residents. However, residents, with 3.57 mean score, show that they agreed the value of roof garden can be a landmark in giving directions to their apartments.

The highest mean score for ANRG is 4.10 which indicates a strong agreement among the residents that the roof garden has values of creating pleasurable open space and green areas as well as bringing a sense of calmness to them. The engagement with the natural environment induces pleasurable feelings including joy, comfort, and calmness. Table 3 also shows the same mean score of 4.0 where residents agreed that the roof garden creates a pleasant viewpoint to the building, especially for the upper floor residents and surrounding buildings. 3.17 mean scores show that the residents agreed that the design of a roof garden is one of its values which can be an attraction of the building. Overall, the average mean score is 3.85 which shows that the majority of residents at ARG agreed with all the benefit values of a roof garden outdoor space (Table 4). The average score of ANRG is 3.77. This shows that residents of ARNG too agreed that people can choose to buy a house because of the roof garden element which provides a significant value.

4.4 Functions of roof garden/outdoor space

Generally, residents from both types of apartments agreed to all of the function values of the roof garden as a recreational and social space. The highest mean score of 4.40 for ARG indicates their agreement to the primary function of roof garden as a social space for the residents to rest and relax, especially after office hours and during weekends. The strategic location as a sky garden on level 4 also encourages all residents to use this space. They also use this space as a place to meet friends, with the score of 4.10. Green areas are a suitable place for such social activity.

The maximum mean score of ARNG is 4.20, where majority of the residents agreed that roof gardens function to relieve the stress in their daily life activities. The garden elements consist of many soft landscapes in green colour which can provide calmness and comfort as well as can relieve stress for the residents who usually work hard and face many difficulties in their everyday lives. Similarly, residents in ANRG also agreed that the roof garden is a place for them to meet friends, with a mean score of 3.93. Both apartments also agreed that the roof garden is a safe place to use. These apartments are gated and have 24-hour security to guarantee all residents in the safest conditions. Overall, Table 5 shows that the ARG average score for function value of roof garden is 4.06. All residents in ARG agreed that the roof garden provides function value to them hence they were willing to buy this type of house even though the price is expensive.

Table 4: Benefit value of roof garden outdoor space design for ARG.

No.	*Benefit value of roof garden design*	*Mean*	
		ARG	*ARNG*
1.	The design of the roof garden is the main attraction of the building	3.67	3.17
2.	The design of roof garden as a landmark for the building	3.57	3.70
3.	The design of roof garden fulfil the needs of leisure area for residents in the building	4.07	4.00
4.	The roof garden creates a pleasant viewpoint for the residents	4.13	4.00
5.	The roof garden creates pleasurable open space and green areas as well as brings a sense of calmness for the residents	3.90	4.10
Average		3.85	3.77

Table 5: Functions of roof garden/open space.

No.	*Functions of roof garden/open space*	*Mean*	
		ARG	*ARNG*
1.	Roof garden/open space helps people feel safe and comfortable to visit	3.80	3.20
2.	Roof garden/open space as a recreational area for the residents	3.93	3.80
3.	The roof garden/open space as a social space such as to meet friends/neighbours	4.10	3.93
4.	The roof garden/open space is a place to rest and relax	4.40	3.87
5.	The roof garden/open space can help residents to relieve stress in their daily life activities	4.07	4.20
Average		4.06	3.80

4.5 House price range

Table 6 shows that the current rental price for ARG is higher than ANRG. The rental price is higher by 1500 to 2000 MYR for ARG and only 900 to 950 MYR for ANRG per month. The rental price difference between both apartments is 48% to 60%. Most of the houses were built 5 years ago. The purchase price between ARG and ANRG during that time was almost doubled, where the price of ARG started at 400,000 to 450,000 MYR while ANRG started at 200,000 to 250,000 MYR. The difference of the purchase price for ARG and ANRG were around 50%–56%. Similarly, the current market price for ARG is at 450,000 to 500,000 MYR and for ANRG at 300,000 to 350,000 MYR. The difference of current house price between ARG and ANRG is between 67% and 70%.

Table 6: House price range.

House price range	*Variables (MYR)*	*ARG*		*ANRG*		*Total*
		No.	*Percentage (%)*	*No.*	*Percentage (%)*	
Rent price	850–900	0	0	12	40	60
	900–950	1	3	14	47	
	950–1000	2	7	4	13	
	1000–1500	5	17	0	0	
	1500–2000	18	60	0	0	
	2000–2500	4	13	0	0	
Purchase price	150,000–200,000	0	0	6	20	60
	200,000–250,000	0	0	15	50	
	250,000–300,000	0	0	9	30	
	300,000–350,000	6	20	0	0	
	350,000–400,000	7	23	0	0	
	400,000–450,000	17	57	0	0	
Current price	250,000–300,000	0	0	10	33	60
	300,000–350,000	0	0	16	53	
	350,000–400,000	1	3	4	13	
	400,000–450,000	10	33	0	0	
	450,000–500,000	19	63	0	0	

The maintenance fee is a monthly charge that will be collected at the beginning of the month. This maintenance fee is intended to pay the charges for facilities in the apartment. The facilities include three sections, which are reserving funds, cyclical expenses, and day-to-day expenses. In this study, the range of the maintenance fees for ARG is from 250 to 300 MYR and for ANRG is from 100 to 200 MYR. The difference of maintenance fees for ARG and ANRG is between 60% and 67%. Residents are willing to spend a large amount of the maintenance fee in ARG because their facilities include the roof garden. All three price ranges show the price of the ARG is higher than ANRG. Majority of the respondents rent or purchase the house apartments at a higher price because of the primary facilities such as a roof garden at the apartment building. The findings prove that the medium-income residents are interested and can afford to buy a house apartment with roof garden/outdoor space facility because of its aesthetic function and green benefits similar to other open spaces. Besides, it can be used as recreational and social spaces. The existence of roof gardens can act as added function and benefit value for the property as well as monetary value.

The roof garden is one of the added values provided by the developer. The house price will be increased in accordance with the rise in profit of the company/developer while bringing many functions and benefit values to the residents. The developer can markup the house price because of the uniqueness of the roof garden design provided on top of the building. The location of roof garden at the top of the building is also another added value as well as a point to markup the house price.

5 CONCLUSION

All findings revealed that the roof garden/outdoor space in high-rise residential buildings gives an impact to the property value. Pleasant viewpoint is the most important value that influences people to buy the ARG. Respondents agreed that roof gardens can create pleasurable feelings such as joy, comfort, and calmness. This study clearly proved that the price of the ARG has definitely increased the house price. This study has also proven that all prices including rental, purchase, current, and maintenance fee of the ARG are higher than ANRG within the range of 48%–70%. The result shows that the rental price is different, i.e. between 48% and 60%, followed by 50%–56% of the purchase price, and 67–70% of the current market price. Meanwhile, the maintenance fee also shows a similar difference which is between 60% and 67%. All the price of the ARG is higher than ANRG where the medium-income residents can afford to buy this type of house. The findings of this research will provide benefits to the developers and buyers in the future as well as become a benchmark for them to compare the current market price difference and other added values of the ARG and ANRG.

REFERENCES

[1] Noor, M., Aizuddin, N. & Eves, C., *Malaysia high-Rise Residential Property Management: 2004-2010 Trends and Scenario*, 2011.
[2] Downton, P., Green roofs and walls, 2013. http://www.yourhome.gov.au/materials/green-roofs-and-walls. Accessed on: 2 May 2016.
[3] Dinsdale, S., Pearen, B. & Wilson, C., *Feasibility study for green roof application on queen's university campus*, Queens University, 2006.
[4] Kurland, J. & Harris, S., *Rooftop Gardens: Project Promotion and Implementation*, The Corolado College, 2011.
[5] Kurland, J., Hall, S. & Harris, S., *Rooftop Gardens, Project Promotion and Implementation*, 2001.

[6] JPBD, *Planning Guideline for Open Space and Recreational Areas* 2013, Jabatan Perancangan Bandar dan Desa, Semenanjung Malaysia, Kementerian Perumahan dan Kerajaan Tempatan: Kuala Lumpur, Malaysia.
[7] TBLC, *Yarra Open Space Strategy 2006*, Thampson Berrill Landscape Design: Australia.
[8] UF, *Green Roofs for Urban Areas, Growing Better Buildings*, 2012.
[9] European Commission (EC), *Rooftop Garden could Grow Three Quarters of City's Vegetables*, 2015.
[10] Korpela, K., *Handbook of Environmental Psychology*, John Wiley: New York, pp. 363–373, 2002.
[11] Green Roof Alliance (GRA), Benefits of greenroofs, 2013. http://greenroofalliance.com/. Accessed on : 15 Feb. 2015.
[12] Jim, C. & Chen, W.Y., Consumption preferences and environmental externalities: A hedonic analysis of the housing market in Guangzhou. *Geoforum*, **38**(2), pp. 414–431, 2007.
[13] Woolley, H. et al., *The Value of Public Space: How High Quality Parks and Public Spaces Create Economic, Social and Environmental Value*, CABE Space Strategic Partners: London, 2004.
[14] Misni, A. & Allan, P., *Sustainable Residential Building Issues in Urban Heat Islands – The Potential of Albedo and Vegetation* in *Sustainable Building New Zealand Conference (SB10)*, Wellington, 2010.
[15] Misni, A., *The Effects of Surrounding Vegetation, Building Construction and Human Factors on the Thermal Performance of Housing in a Tropical Environment*, Victoria University of Wellington: Wellington, 2012.
[16] Liu, K., Energy efficiency and environmental benefits of rooftop gardens. Construction Canada, **44**(2), pp. 17–23, 2002.
[17] Ghobadian, V., *Climatic Analysis of the Traditional Iranian Buildings*, Tehran, 1998.
[18] UF, *Green Roofs for Urban Areas, Growing Better Buildings*, University of Florida: Florida, 2012.