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ORIGINAL ARTICLE

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ASSESSMENT OF SUSTAINABLE HOUSING AFFORDABILITY: A COMPARATIVE STUDY BETWEEN TWO PLANNED RESIDENTIAL AREAS OF KHULNA CITY

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Abstract

'Sustainable housing affordability' is a relatively new concept where housing affordability is assessed in context of sustainability. It is becoming an important concern in the context of sustainable urban planning due to growing housing demand and increasing housing costs. With the rapid urbanization rate, sustainable housing affordability is becoming a concern in Bangladesh as well. Being the third-largest city of Bangladesh, Khulna is also suffering from housing affordability issues. Planned residential areas also have sustainable housing affordability concerns, which have been revealed through this research. For this research, Sonadanga and Nirala residential areas are selected for sustainable affordability issues identification, assessment, and comparison. This paper reveals that the addition of social and environmental criteria along with the economical in the housing affordability assessment can bring a vital change in the outcome. The complex proportional assessment (COPRAS) of the multi-criteria decision-making method has been used to run the assessment and comparison. The methodology includes existing criteria selection and assessment in the study area through normalized weighted values based on the local people's perception. The outcome reveals that an assessment of housing affordability in a sustainable manner can identify the affordability issues in different housing locations more accurately than the method which includes the economic criteria only.

Keywords: Affordable housing, Sustainable housing, Affordability criteria

Introduction

Housing cost to income ratios are widely applied to measure affordability. Housing affordability is defined through the ratio approach universally and often unarguably in international housing policies. The popularity of ratio approach is not surprising as it is very easy to compute with a few variables which are easily accessible. Nevertheless, the ratio approach has been criticized by several authors, too. The primary reason for the criticism is the inability of this approach to include the issues of housing quality (Whitehead et al., 2009; Stone, 2006; Bogdon & Can 1997; Rea et al., 2008). Housing identified as affordable might not be sustainable considering the design and locational issues. To provide sustainable and affordable housing, housing initiatives must be socially acceptable, economically viable, environmentally friendly and technically feasible (Choguill, 1993). It is not enough to simply provide more homes, there must also be a strong focus on creating sustainable communities (Maliene & Malys, 2009). In this context, 'Sustainable housing affordability' is a newly developed concept where housing affordability is assessed in context of sustainability. It is becoming an important concern in the context of sustainable urban planning due to growing housing demand and increasing housing costs

With the rapid urbanization rate, sustainable housing affordability is becoming a concern in Bangladesh as well. Being the third-largest city of Bangladesh, Khulna is also suffering from sustainable housing affordability issues. Planned residential areas also have sustainable housing affordability concerns. In Khulna city there are eleven planned residential areass including Nirala and Sonadanga which are known as high-income residential areas. A large number of high-income people live there having a sufficient level of income, still cannot afford sustainable houses not only for economic reasons, rather due to several social and environmental factors. Using Sonadanga (2nd Phase) and Nirala RAs as study areas, the research identifies the criteria for assessing sustainable housing affordability which can be applied in the other regions to assess and compare housing affordability in Bangladesh through a

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sustainable manner. No such research to delineate sustainable housing affordability has been done in Bangladesh yet. In context of Khulna, the previous researches related to housing affordability mostly focus the affordability issues in slum areas in terms of economic criteria like savings, access to loans, income in relation to the house price and rent, expenditure level, etc. But the housing affordability condition is very important to be assessed from the social and the environmental perspectives to satisfy the accuracy level. This research is different from existing researches related to housing affordability in context of the geographical, socio-economic, and methodological perspectives.

The research can contribute to policymaking regarding the provision of sustainable and affordable housing in the study area or any other similar residential areas. To fulfil the research aim, the fundamental research objective is to delineate the criteria for sustainable housing affordability in context of Khulna or similar cities in Bangladesh and to assess and compare the results of sustainable housing affordability between Nirala and Sonadanga second phase RAs.

Sustainable Housing Affordability

"Housing affordability" is frequently defined in terms of "affordable housing" (Stone, 2006). The term "affordable housing" is also used interchangeably with "housing affordability" by policymakers (Whitehead et al., 2009). The most simplified meaning of "housing affordability" is the ability to afford the house. For example, in case of dual-income households, if the house price is 3.5 times the annual household income or in case of single –income household, if it is 2.9 times the annual income, it is considered affordable (CLG, 2006). According to U.S. Department of Housing and Urban Development, a house is considered affordable when 30 per cent or lower of the gross income is spent as housing expenses (Dacquisto & Rodda, 2006).

In recent times, the academicians have started to rethink about the traditional definitions and are trying to develop a broader perspective of the housing affordability concept (Sivam & Karuppannan, 2009; Pullen at al., 2010; Mulliner & Maliene, 2011; Mulliner, et al., 2013; Mulliner & Maliene, 2015, Mulliner, et al., 2016; Jamaluddin, et al., 2018; Shama & Motlak, 2019). The interaction between housing and location as well as environmental sustainability are suggested to be considered along with traditional housing affordability concept to get 'true' housing affordability scenario. As the continuous focus on the housing price may lead to inaccuracy of the affordability of different areas, further indicators may need to be considered to determine 'true' housing affordability (Fisher et al., 2009). When a comprehensive range of sustainable housing indicators are considered in the assessment, the result indicates 'sustainable housing affordability' (Mulliner & Maliene, 2011).

According to Brundtland Report, sustainability is the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". More recently, sustainability is defined as the synchronization of 'environmental protection', 'economic development', and 'social equity' (Drexhage & Murphy, 2010). In a broader aspect, sustainability also encompasses social attributes, human values, and ecological balance (Kates et al., 2005). A place should be considered as sustainable when it's social, economic and buit environment includes sustainability indicators (Medineckiene et al., 2010). In the same way, the housing, which are well available and economical and simultaneously are of high quality, with aesthetic design, comfortable, cozy, and above all ensure ecological balanced, are considered and sustainable housing (Maliene & Malys, 2009).

Mulliner and Maliene (2011) first introduced the concept of 'sustainable housing affordability' wherein initial system of indicators for sustainable housing affordability has been developed. The indicators are related to price and quality of the house, and its proximity to work, health and entertainment facilities etc. They also argue that the economic, social, and environmental sustainability indicators of housing should not be isolated from housing affordability.

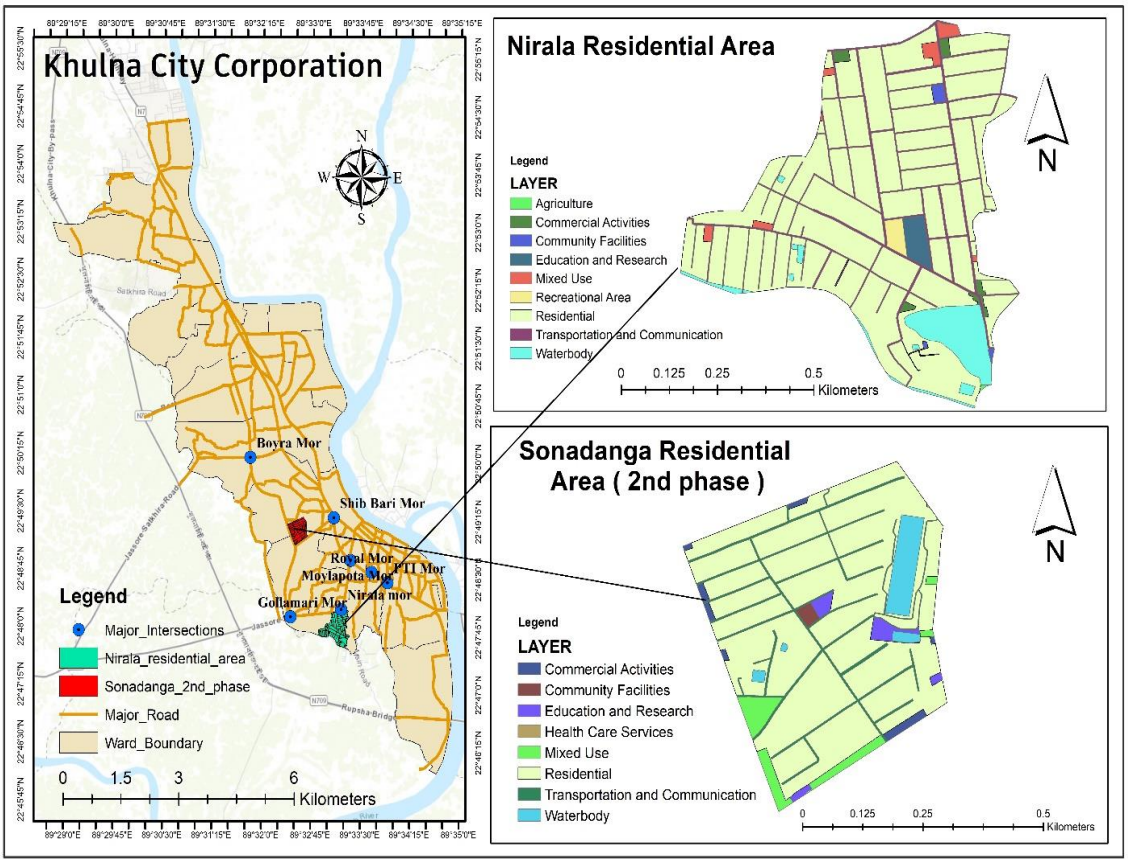

Figure 1. Map of Khulna City showing the study areas.

Methodology and Results

All the multi-criteria decision-making (MCDM) methods follow some specific steps. Those are: -

- Determining the existing criteria and setting relevant alternatives
- Attaching the numerical measurements to the relative importance of criteria and the impacts of the alternatives on them
- Determining the ranking of each alternative

In this study, the same approaches were used to determine the rank of alternatives in a complex proportional assessment. Here Nirala and Sonadanga Second Phase RAss have been considered as alternatives. Both areas are very popular to higher-middle and high-income people for residing because of the high land price, house price and rent, locational advantages and because of the quality of civic services. Figure 1 shows the location of both residential areas in respect of Khulna city and the central business district of the city. The research explores the existing sustainable housing affordability situation the study areas and compares the areas in terms of sustainable housing affordability.

To identify the indicators of sustainable housing affordability in context of the study area, a list of general criteria has been developed based on literature review and the interviews with planners and architects working in Khulna City Corporation and Khulna Development Authority which are responsible for the management, development and planning of the city. The criteria and their description are given in Table 1.

Table 1. General criteria for sustainable and affordable housing

Criteria for sustainable and affordable housing	Source	Description
House price to income ratio	Interview with KDA and KCC personnel, 2019; Whitehead et al. (2009); CLG (2006)	Housing price or rent to income ratio is the most popular indicator of housing affordability. Higher ratios indicate unaffordability.
Rent to income ratio	Interview (KDA, KCC) (2019); CLG (2006); Whitehead et al. (2009).	
Availability of Affordable Mortgage	Pullen et al. (2010); Interview (KDA, KCC) (2019).	Housing ownership affordability depends on the availability of mortgage with low affordable interest rates
Crime rate	Winston (2010); ODPM (2005a; 2005b); Fisher et al. (2009); Interview (KDA, KCC) (2019).	Has been identified as an important criterion to make an area a good place to live. High crime rate causes extra cost for ensuring security.
Access to employment opportunities	Interview (KDA, KCC) (2019); Fisher et al. (2009); ODPM (2005a; 2005b); Winston (2010).	Essential to make residential areas sustainable as long commuting to work affect income as well as residents' lives
Access to public transport	Interview (KDA, KCC) (2019);, Winston (2010); CLG (2006); ODPM (2005a; 2005b); CTOD and CNT (2006)	Access to public transport affects housing affordability by influencing transportation costs
Access to schools	CLG (2006); Fisher et al. (2009); ODPM (2005a; 2005b); Zhu et al. (2005); Interview (KDA, KCC) (2019).	Access to good quality schools is an important characteristic households consider when decide about living in any area.
Availability of shops and bazars	Interview (KCC) (2019); Zhu et al. (2005); Samuels (2005); ODPM (2005a; 2005b)	Shopping facility is an essential criterion to make a thriving community.
Access to health services	Interview (KCC) (2019); CLG (2007); Zhu et al. (2005).	Availability of health services is essential to make an area good place to live.
Availability of day care	ODPM (2005a; 2005b).	With growing trend of working women, availability of day care has been identified as a necessary service to be available in a residential area.
Availability of leisure facilities	Interview (KCC, KDA) (2020); ODPM (2005a; 2005b).	Recreational facilities for both children and adults are important to make housing sustainable.
Access to open spaces	Interview (KDA, KCC) (2019); Maliene and Malys (2009); ODPM (2005a; 2005b);	Open spaces with playgrounds and walking facilities for elderly people are necessary for making an area a good place to live in.
Housing Quality	Interview (KDA) (2019); Winston (2010); Maliene and Malys (2009); CLG (2006a)	In assessing housing affordability, housing quality should be considered as a sub-standard housing might be affordable but not sustainable.
Access to waste management	Interview (KCC) (2019), ACF and VCOSS (2008); Maliene and Malys (2009); Winston (2010).	Availability of solid waste management system is must to make a residential area livable.

Source: Adapted from Interview and Literature Review, 2019

MCDM procedures were used to choose criteria from the general list developed from literature review and interviews with planners and architects working in KDA and KCC. The criteria were selected and prioritized based on interview with the residents of the study areas. Interviewees were asked to give score against the criteria. For example, on a scale of 1 to 10, where 1 means "not important" and 10 indicates "most important," criterion to be considered for assessing sustainable housing affordability. By dividing by the sum of mean scores and multiplying by

100, the mean importance ranking for each criterion was turned into weight. The procedure enables the exclusion of criteria that do not exist in the study area according to the interviewees' opinion (Zavadskas at al., 1994).

Table 2. Selected Criteria of Sustainable Housing Affordability

Sustainable Housing Affordability Criteria	Mean Scores	Weight
1. House Price in Relation to Income	8.56	6.85
2. Rental Cost in Relation to Income	8.24	6.56
3. Access to Employment Opportunities	7.93	6.23
4. Access to Public Transport Facility	7.88	6.15
5. Access to Shop	7.35	6.02
6 Safety (Crime Rate)	5.46	4.9
7. Access to School	6.78	5.42
8. Access to Health Service	6.49	5.22
9. Access to Open Green Public Space	6.34	5.15
10. Present Environmental Problems	6.31	5.10
11. Availability of Waste Management Facilities	6.15	5.05

Source: Field Survey, 2019

The second phase of methodology stands for determining the existing criteria based on the local people's perception. All the data have been collected through a questionnaire survey using kobo toolbox software. In this section, Nirala and Sonadanga 2nd phase RAs have been considered as alternatives, where A_1 is for Sonadanga RA, and A_2 is for Nirala RA. After setting the alternatives, the criteria for both areas have been determined and converted to the ultimate scores.

The investigation requires the attachment of numerical measurements at this level. The measurement units are separated into three categories: ratio, percentage, and numeric. The bigger (+)/ lower (-) value, which signifies the maximizing and minimizing values satisfy the sustainable housing affordability requirements, is indicated by the "Z" value with the measurement units. For example: For the positive criterion (access to public transportation), the closer the score is to 10, the better the sustainability will be satisfied; for the negative criterion (home price in relation to income), the converse is true.

Table 3. Initial Matrix for MCDM

Criteria, i	Mean Score	Z	Determine Unit	Weight, q	Alternatives, J	
					A_1	A_2
House Prices in Relation to Income	8.56	−	Ratio	6.85	8.21	8.38
Rental Costs in Relation to Income	8.24	−	Percentage	6.56	24.53	24.35
Access to Employment Opportunity	7.93	+	Numeric	6.23	6.05	7.39
Access to Public Transport Service	7.88	+	Numeric	6.15	6.93	7.32
Access to Shops	7.35	+	Numeric	6.02	5.81	7.7
Access to School	5.46	+	Numeric	4.9	5.38	5.91
Access to Health Service	6.78	+	Numeric	5.42	7.76	6.76
Safety(Crime Rate)	6.49	−	Numeric	5.22	4.24	3.96
Access to Open Green Public Space	6.34	+	Numeric	5.15	6.69	7.39
Waste Management Facility	6.31	+	Numeric	5.10	7.06	7.48
Presence of Environmental Problems	6.15	−	Numeric	5.05	5.26	5.56

Source: Authors, 2019

This is the initial MCDM matrix (Table 3) developed for the determined values, including the alternatives of the area. The people ranked the house price and rent the most important criterion as 8.56 and 8.24 for the housing affordability purpose from the analysis. The access for the several social equities has been figured out according to their importance and access to them. The less importance has been conducted for availability for waste management 6.05 means the people feel less importance for the criterion.

Multi-criteria analysis initiates with the normalization of the decision-making matrix (Table 4). Normalization allows direct comparison by converting data measured in different units such as numeric/points, percentage, and ratio into weighted variables.

The formula that has been used is

$$d_{ij} = \frac{q_i}{\sum_{j=1}^{n} x_{ij}} x_{ij} \qquad \ldots\ldots(1)$$

Where, x_{ij} is the value of the i-th criterion of the j-th alternative. For example:

$$d_{21} = \frac{6.85}{8.21 + 8.38} \times 8.21$$
$$= 3.39$$

Therefore, the value means that for the 1st alternative, the normalized value of the 2nd criterion is 3.39 here. Therefore, each of the values for the alternatives has been measured through this way to form a normalized decision matrix D.

Table 4. Normalized Decision Matrix, D

Criteria, i	**Z**	**Alternatives, j**	
		A_1	**A_2**
House Prices in Relation to Income	−	3.39	3.46
Rental Costs in Relation to Incomes	−	3.02	3.00
Access to Employment Opportunity	+	2.66	3.24
Access to Public Transport Service	+	2.99	3.16
Access to School	+	2.33	3.09
Access to Shops	+	2.33	2.58
Access to Health Service	+	2.73	2.38
Safety (Crime Rate)	−	2.36	2.20
Access to Open Green Public Space	+	2.91	3.21
Availability of Waste Management Facility	+	3.03	3.20
Presence of Environmental Problems	−	2.23	2.35

Source: Authors, 2019

Positive (maximizing) and negative (minimizing) criteria have been summarized and denoted as S_j^+ and S_j^- respectively for each alternative (see Table 5). The higher the positive (maximizing) values are, such as 'Access to Health Service,' the better the sustainable housing affordability is. The lower the negative (minimizing) values are, such as 'Safety (Crime Rate)', the better the sustainable housing affordability is. The significance (priority) of the comparative alternatives has been determined based on describing positive (+) and negative (-) qualities that characterize the alternative areas. The greater the value Qj, the higher the priority (significance) of the alternative.

Table 5. Sums of Weighted Normalized Criteria

	Sums of Weighted Normalized Criteria	
Values	Alternatives, j	
	A_1	A_2
Positive Value S_j^+	18.98	20.86
Negative Value S_j^-	11.00	11.01

Source: Authors, 2019

The significance (priority) of the relative alternatives has been determined based on describing positive and negative qualities that characterize the alternative residential areas. The relative significance Qj of each alternative Aj is determined according to:

$$Q_j = S_j^+ + \frac{S_{min}^- \sum_{j=1}^{n} S_j^-}{S_j^- \sum_{j=1}^{n} \frac{S_{min}^-}{S_j^-}} = S_j^+ + \frac{\sum_{j=1}^{n} S_j^-}{S_j^- \sum_{j=1}^{n} \frac{1}{S_j^-}} \qquad (2)$$

Where S_{min}^- – the minimum value of S_j^- - cancels. The first term of Qj increases for higher positive criteria S_j^+, while the second term of Qj increases with lower negative criteria S_j^-. Thus, a higher value of Q_j indicates more sustainable housing affordability. So using the value of S_j^+ and S_j^- of Table 5 in this formulae (equation 2), we can get the Q_1 for A_1 as follows:

$$\boldsymbol{Q_1} = S_1^+ + \frac{S_1^- + S_2^-}{S_1^- + \left(\frac{1}{S_1^-} + \frac{1}{S_2^-}\right)} = 18.98 + \frac{11.00 + 11.01}{11.00 + \left(\frac{1}{11.00} + \frac{1}{11.01}\right)} = 31.1$$

Table 6. Relative Significance of Alternatives

Criteria, i	Relative Significance of Alternatives	
	Alternatives, j	
	A_1	A_2
S_J^+	18.98	20.86
S_J^-	11.00	11.01
Q_J	31.01	32.93

Source: Authors, 2019

From the relative significance of the alternatives (Table 6), the 2nd alternative, thus Nirala RA has got the higher Q_J. According to residents' opinion based on criteria, Nirala RA is better in context of sustainable housing affordability. Therefore, the 2nd alternative has a higher chance to be selected as the prioritized alternative between the two.

The final stage is the prioritization of the alternatives in terms of the sustainable housing affordability. the prioritization will be based on the degree of utility where the highest utility of an area indicates its higher level of acceptance in respect of sustainable housing affordability. The degree of utility Nj of the alternative Aj has been determined according to the following formula:

$$N_j = \frac{Q_1}{Q_{max}} \times 100 \qquad (3)$$

$$N_1 = \frac{Q_1}{Q_{max}} \times 100 = \frac{31.01}{32.93} \times 100 = 94.17\%$$

$$\text{Again, } N_2 = \frac{Q_2}{Q_{max}} \times 100 = \frac{32.93}{32.93} \times 100 = 100\%$$

Therefore, from the prioritization of the alternatives, the 2nd alternative has been determined as the more sustainable and affordable housing location, as it satisfies the highest utility degree from 0% – 100%.

Discussion

The research has identified that the most important criteria for sustainable housing affordability is economic factors like housing cost to income ratio followed by the commuting facilities which is also an economic factor as it reduces commuting costs and affects affordability (Table 4). The finding match with that of the research done by Sivam and Karuppannan (2009) on K2 Apartments in Victoria of Australia where cost reduction through connectivity with employment centers is prioritized. King (2008) has also revealed that reducing commuting cost is vital for sustainable housing affordability. However, some other studies have put sustainability issues like quality of housing (Mulliner & Maliene, 2011) and safety (Mulliner & Maliene, 2012) before access to employment in the priority lists of sustainable housing affordability criteria.

In this study, two alternative residential areas of Khulna city have been compared based on 11 weighted decision criteria. A ranking of the existing criteria prioritization has been assembled for comparison. The comparison has identified Nirala Residential Area (alternative A2) as the better alternative. Alternative A2 did not have the lowest house prices; still, it has been determined as the best satisfying alternative based on weighted criteria. A1 (Sonadanga residential area 2nd phase) has been determined as the lower performing area after measuring the utility degree. If the affordability was assessed based on only the housing price or costs in relation to income, Sonadanga residential area would have been prioritized as the optimal alternative.

Nirala has been identified as better alternative based on the accessibility to employment opportunities and availability of amenities and facilities, safety, and availability of green and open spaces. It is argued by several studies that only economic criteria are not sufficient to identify a better place to live or explain the sustainable housing affordability. Mulliner, Smallbone, and Maliene (2013) compared three housing wards of Liverpool in context of sustainable housing affordability where the ward with lowest housing cost has been identified as worst alternative considering all twenty weighted criteria. A study on six areas of the state Sabah of Malaysia has also revealed that the best alternative is not the area with lowest housing cost rather it is with high accessibility and low density (Said et al., 2016). So, the finding of this study is not an exception by selecting Nirala residential area as the optimal alternative where the house prices or rent-related to income is higher than Sonadanga. The result indicates that the availability

of and accessibility to civic services, access to employment opportunities, public transport services, shops, and schools are important in context of sustainable housing affordability.

Residents of Nirala RA feel safer in the area as there is a police station within the boundary and the crime rate is lower (3.96) whereas, in Sonadanga (2nd phase) RA, it is 4.24. Access to green space is better too in Nirala. There are eight waste dumping stations in Nirala residential area, whereas; in Sonadanga, there is a lack of dustbins. The waste disposal system is excellent in Nirala (7.48), whereas in Sonadanga (7.06) disposal system is not eco-friendly.

Therefore the results describe how a more comprehensive and sustainable analysis of affordability can be done considering the social and environmental criteria which encompasses locational factors, housing quality, and community sustainability along with housing costs and income issues.

Limitations

The study has measured the criteria values in context of two different RAs based on residents' opinions only. Further study could be done where criteria might be evaluated based on real scenario like distance ranges from employment centers, schools or any other civic services.

The relative significances of two alternative RAs are not very distinctive. It is 31.1 for Sonadanga RA and 32.93 for Nirala RA. If the study could cover all the residential areas of Khulna city, the results would show much more variations and would reveal more precisely the factors that are more important for ensuring sustainable housing affordability.

Conclusion

The findings of the research show that the affordability measurement based on only economic criteria such as income to rent or price ratio is not sufficient to reflect the livability sustainability of housing. To make housing sustainably affordable, environmental and social criteria should be included to better reflect the housing quality, locational suitability, and community sustainability. An assessment of two alternative residential areas in Khulna city has been made an example of the MCDM approach; however, this approach can also be utilized in all residential areas of Bangladesh to assess sustainable housing affordability. The methodology would benefit several interested parties, such as local authorities, government officials, investors, developers, and consumers, by providing the information required to build a comprehensive and sustainable decision regarding housing affordability. Such a decision can also help the local authorities as a potential planning indicator for housing provisions. This approach is also potential for site selection of affordable housing development between the near or far locations.

Sustainable housing affordability can also assist in identifying potential areas suitable for developing affordable housing along with the areas which require reinvestment to enhance affordability sustainability to be attractive olive in. Through this process, providing and monitoring affordable housing promotes sustainable communities for ensuring a high quality of life. Only housing cost to income ratio based assessment can identify an area as of affordable housing but inaccessibility to civic services and employment can increase non housing costs and make the area unaffordable to live in. Hence to identify an area as sustainably affordable, multidimensional criteria should be included in the assessment.

Conflict of Interests

The authors declare no conflict of interest.

References

Bogdon, A. S., & Can, A. (1997). Indicators of Local Housing Affordability: Comparative and Spatial Approaches, *Real Estate Economics*, *25*(1), 43-80.

Choguill, C. L. (1993). "Housing Policy Trends in Bangladesh: Meeting the Needs of a Low-income population", *Cities*, *10*(4), 326-336.

CLG. (2006). *Delivering Affordable Housing*. CLG (Communities and Local Government), London.

Dacquisto, D.J., & Rodda, D.T. (2006). *Housing Impact Analysis*, U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

Drexhage, J., & Murphy, D. (2010). *Sustainable Development: From Brundtland to Rio 2012*. Background Paper for High Level Panel on Global Sustainability Meeting, September 2010, New York.

Fisher, L. M., Pollakowski, H. O., & Zabel, J. (2009). Amenity-based housing affordability indexes. *Real Estate Economics, 37*(4)*,* 705–46.

Jamaludin, S. Z. H. S., Mahayuddin, S. A., & Hamid, S. H. A. (2018). Challenges of Integrating Affordable and Sustainable Housing in Malaysia, *IOP Conf. Series: Earth and Environmental Science*, *140,* 012001, doi:10.1088/1755-1315/140/1/012001

Kates, R. W., Parris, T. M., & Leiserowitz, A. A. (2005). What is Sustainable Development? Goals, Indicators, Values, and Practice. *Environment: Science and Policy for Sustainable Development*, *47*, 8-21.

King, L. A. (2008), Housing Affordability, Sustainable Community Development Code, Research Monologue Series: Healthy Neighborhoods, Housing, Food System, The Rocky Mountain Land Use Institute.

Maliene, V., & Malys, N. (2009). High-quality Housing- A Key Issue in Delivering Sustainable Communities. *Building and Environment*, *44*(2), 426–30.

Medineckiene, M., Turskis, Z., & Zavadskas ,E.K. (2010). Sustainable construction taking into account the building impact on the environment. *Journal of Environmental Engineering and Landscape Management*, *18*(2), 118-127.

Mulliner, E., & Maliene, V. (2011). Criteria for sustainable housing affordability. In Environmental Engineering. *Proceedings of the International Conference on Environmental Engineering. ICEE* (Vol. 8, p. 966). Vilnius Gediminas Technical University, Department of Construction Economics & Property.

Mulliner, E., & Maliene, V. (2012). What Attributes Determine Housing Affordability? *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 6*(7), 1833-1838.

Mulliner, E., & Maliene, V. (2015). An Analysis of Professional Perceptions of Criteria Contributing to Sustainable Housing Affordability. *Sustainability, 7*, 248–270.

Mulliner, E., Malys, N., & Maliene, V. (2016). Comparative analysis of MCDM methods for the assessment of sustainable housing affordability. *Omega*, *59*, 146–156.

Mulliner, E., Smallbone, K., & Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision making method, *Omega*, *41*, 270-279.

ODPM (Office of the Deputy Prime Minister). (2005a). Sustainable communities: people, places and prosperity. London: The Stationery Office.

ODPM (Office of the Deputy Prime Minister). (2005b). Sustainable communities: homes for all. London: The Stationery Office.

Pullen, S., Arman, M., Zillante, G., Zuo, J., Chileshe, N., & Wilson, L. (2010). Developing an Assessment Framework for Affordable and Sustainable Housing. *Australasian Journal of Construction Economics and Building (AJCEB), The, 10*(1/2), 60-76

Rea, W., Yuen, J., Engeland, J., & Figueroa, R. (2008). The dynamics of housing affordability. *Perspectives on Labour and Income*, *20* (1), 37–48.

Said, R. et al. (2016), Sustainable housing affordability in Sabah, *Journal of the Malaysian Institute of Planners Special Issue,* V: 65 – 76.

Shama, Z. S., & Motlak, J. B. (2019). *IOP Conference Series: Materials Science and Engineering*, 518 022009, DOI: 10.1088/1757-899X/518/2/022009

Sivam, A., & Karuppannan, S. (2009). The Sustainability of Affordable Housing, ISST, University of South Autralia.

Stone, M. E. (2006). What is Housing Affordability? The Case for the Residual Income Approach. *Housing Policy Debate*, *17*(1), 151–84. DOI:10.1080/10511482.2006.9521564

Whitehead, C., Monk, S., Clarke, A., Holmans, A., & Markkanen, S. (2009). *Measuring Housing Affordability: A Review of Data Sources*. Cambridge Centre for Housing and Planning Research; Cambridge.

Zavadskas, E. K., Kaklauskas, A., & Sarka, V. (1994). The new method of multicriteria complex proportional assessment of projects. *Technological and Economic Development of Economy*, *1*(3), 131–9.

Zhu, X., Liu, S., & Yeow, M.-C. (2006). Accessibility analysis for housing development in Singapore with GIS and multi-criteria analysis methods. Applied GIS*, 2*(2), 13.11-13.12.