Environmental Sustainability Comparative Assessment of Low-Rise and High-Rise Neighbourhoods based on People's Lifestyle Preferences: The Case of Doha, Qatar

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Abstract

The urban form of Doha city has undergone numerous changes owing to rapid economic growth during the past few decades. The Qatar National Vision 2030 highlights Environmental Sustainability as one of the key sectors of Qatar's First National Development Strategy. Achieving Environmental Sustainability requires analysis from meso and micro scales. This study selected a high-rise neighbourhood (West Bay) and a low-rise neighbourhood (Onaiza) in Doha city to be analysed. The study objectives are to, a) investigate environmental factors based on two levels: meso and micro scales and, b) develop planning strategies to enhance Environmental Sustainability in both low-rise and high-rise neighbourhoods. The research tools include content analysis, observation study and open-ended interviews. The results revealed similarities in lifestyle preferences for meso parameters, walkability and waste segregation, and micro parameters, surroundings and green infrastructures. Backyard farming is preferred by the low-rise neighbourhood while high-rise neighbourhood residents choose more sustainable alternatives for mobility. The study emphasizes the importance of public awareness and participation in formulating urban policies due to the changing dynamics of the city's population.

Keywords: Environmental Sustainability; High-Rise and Low-Rise neighbourhood; Urban Planning; Meso and Micro environmental factors; Public participation

1 Introduction

The growing urban population and increased exhaustion of natural resources demand sustainable development to counter the environmental impacts. The sustainable development of cities requires planners to continuously engage and intervene at different scales - city, neighbourhood and household or macro, micro, and meso (Al-Thani et al., 2018). Qatar's National Vision 2030, established within Qatar National Master Plan, aims to recognize Qatar as a sustainable nation within the global community. Sustainable development is imperative for Qatar as about 60% of its GDP relies on a single resource, and the population relies on imported goods (The World Bank, 2021). While Doha was primarily characterised by low-rise mixed-use suburban neighbourhoods, several sustainable development initiatives have added high rises to Doha's urban form (Khalil & Shaaban, 2012).

Jacobs (1961) portrayed high-rise denser urban developments as the poster image for sustainability while associating low-rise sprawl with unsustainability. In support, Bakker (2020) compared Atlanta city (U.S.) to Barcelona (Spain) pointing out poor air quality, pollution, and congestion, in Atlanta city which is dominated by suburbs. In contradiction, Brown (2017), argued high-rise compact urban form as the ideal

generated by European and American urban theorists that was not applicable to the Middle East and Asian countries. Qatar's urban form is a mix of low-rise and high-rise urban forms; therefore, both must contribute to achieving the goal of being sustainable. Postulating that both arguments, that is, low-rise and high-rise can have the potential to be sustainable, the urban planning policies and action plans prioritise improving the quality of the built environment and hence, focus on the tangible elements of urban planning. The psychological aspects such as personal preference, motivation and attitudes are overseen resulting in an overestimation of the built environment's efficiency (Kim et al., 2014). It is, therefore, vital to investigate people's preferences at the meso and the micro-scales to intervene at the city scale.

2 Research Methods and Tools

This study employs the following research tools:

- **Literature Review and Content Analysis**: A related literature review develops an assessment framework for investigating meso and micro-scale parameters.
- **Observation Study:** Aimed to examine the neighbourhoods' physical features and the residents' activities. The neighbourhoods were observed between 15th October to 15th November 2022, one hour during the day and one hour during the evening on weekdays and weekends. The observations were not recorded in any specific hour ensuring non-repetition of activities and apprehending the necessary information needed to make inferences.
- **Questionnaire Survey**: Aimed to analyse residents' perception and behaviour toward environmental sustainability. A questionnaire survey form was drawn with "satisfied" and "unsatisfied" choices, the answer to which was investigated further with follow-up questions. A total of eighty interviews were conducted (forty residents of each neighbourhood) based on random sampling. The interviews were conducted in person that consisted of open-ended questions associated with the meso and micro-scale parameters of Environmental Sustainability.
- **Analytical Study**: A qualitative assessment of responses to address the differences in lifestyle preferences between the residents of a low-rise and a high-rise neighbourhood.

3 Literature Review

3.1 Background and Context

This study considers three parameters at meso and micro scales each. For the meso scale, that is the household scale, people's lifestyle preferences towards walkability, urban farming and waste management are investigated. While cities work and invest in developing sustainable public transportation, walkability is perceived as the core urban design parameter for Environmental Sustainability. People's preference for walking to work, leisure and daily activities depend on accessibility to places of interest, climate, pedestrian pathway infrastructure and an individual's desire to walk (Baobeid, et al., 2021). Given the positive environmental impact of urban farming, the lifestyle preference for urban farming depends on the climate, size of the house, availability of agricultural materials and willingness of an individual (Patel et al., 2021). To begin waste management at the city level requires waste segregation at the household scale, as a first step. People's preference to segregate waste depends on their awareness, the infrastructure for it and essentially the willingness to do it (Nwofe, 2013).

A study by Grenni et al. (2020) confirmed that a sense of place and location drive an individual in contributing to the environment. One of the factors that help people prefer walking over automobiles is proximity. Therefore, the surroundings, a neighbourhood offers to individuals are significant to

achieving Environmental Sustainability. Another important parameter is the choice of mobility. The choice between carpooling, public transportation and using an individual automobile depends on the destination, time of travel and an individual's preference (Kim et al., 2021). Last, introducing green infrastructures bridges the gap between environmental and economic sustainability. At the micro-scale, green infrastructure comprises instruments and mechanisms in the neighbourhood that run on solar or wind energy. The desire to invest in green infrastructures depends on awareness, availability of appropriate technology, affordability, and an individual's willingness (Khoshnava et al., 2020). While the factors influencing the various parameter are distinct, the common factor is people's preference and willingness to act. This study, therefore, aims to investigate people's preferences for a low-rise and a high-rise neighbourhood of Doha city to recommend and implement policies and regulations at meso and micro scales addressing environmental sustainability.

3.2 Environmental Sustainability Assessment Framework

The assessment framework for this study is categorized into two scales: meso and micro for a low-rise and a high-rise neighbourhood. The mesoscale parameters, walkability, urban farming and waste management and the micro-scale parameter, location, surroundings, mobility and green infrastructures are associated with indicators assessed by observation and survey studies. For meso parameters, the preference to walk is associated with pedestrian satisfaction which includes walking space, connectivity, and availability of pedestrian furniture such as benches, bus stops, and plants (Cambra, 2012). The challenges in the low-rise neighbourhood are connectivity and maintenance and walking space is a challenge in the high-rise neighbourhood. The indicators for urban farming are the availability of space, motivation and availability of materials and equipment (Swanepoel et al., 2018). The availability of land is an advantage for the low-rise and a challenge for the high-rise neighbourhood. The indicators for waste management selected are awareness, segregation and existing facilities (Ferdinan et al., 2022). Waste management challenges are similar for the low-rise and the high-rise neighbourhood in Doha, that is lack of awareness and facilities.

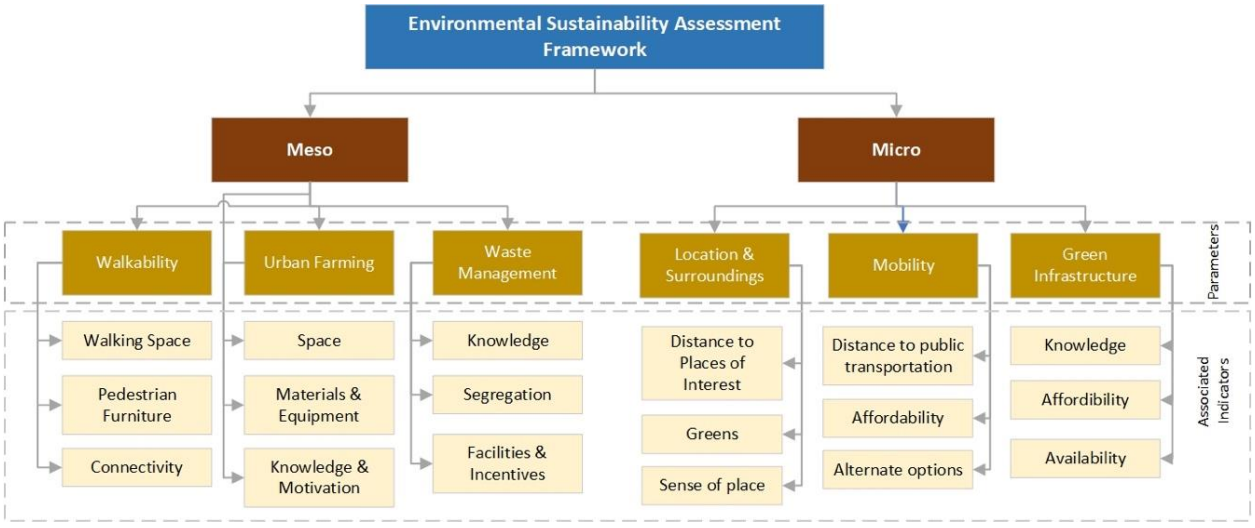

Fig. 1: Environmental sustainability assessment framework for Doha city (meso and micro-scale parameters)

The indicators for location, and surroundings, are distance to places of interest, availability of greens and sense of place. Distance to places of interest determines a person's preference for walkability, the availability of greens assures a pleasant living experience, and a sense of place determines a person's willingness to contribute to the environment. The indicators for preference for mobility are

distance to public transport, affordability, and other alternatives (Gillis et al., 2015). The indicators for choosing green infrastructure are knowledge, facilities, and availability (Pakzad & Osmond, 2015). Implementing green infrastructures is an important parameter aligning with Qatar's Sustainability Goals, Figure 1.

4 Case Studies: Low-Rise and High-Rise Neighbourhoods

Two adjacent neighborhoods, Onaiza comprising 80% of low-rise urban form and West Bay comprising 80% of high-rise urban form, are selected for the case study. Onaiza is situated in the northeastern part of Doha city and West Bay (the central business district) is situated on the northeastern coastline of Doha city, Figure 2.

4.1 Environmental Sustainability Assessment based on Observation Study of Onaiza and West Bay Neighbourhoods

The observation study investigates the physical characteristics of neighbourhoods and people's lifestyle preferences about the selected parameter.

Walkability: The observation of pedestrian pathways in Onaiza shows obtrusions in walking space such as a fallen tree, garbage spill and disconnected pedestrian pathway. The pedestrian pathways in Onaiza are observed to be unused due to poor connectivity and poor maintenance. A lack of street furniture, shading devices and landscaping are rectified as reasons for unused pedestrian pathways. In contradiction, the walking space in West Bay is interrupted by bikes, bicycles and construction materials. While the pedestrian pathways in West Bay are well-connected and maintained and harbour street furniture, the illegal car parking on pedestrian pathways makes walking unsafe, Figure 3 (A,B).

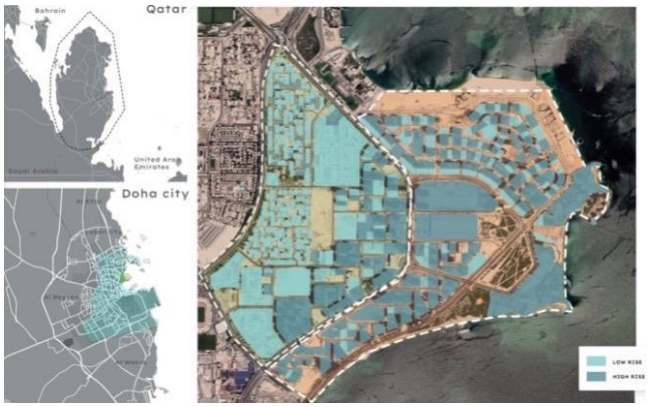

Fig. 2: The selected case studies: Onaiza (low-rise) and West Bay (high-rise) neighbourhoods

Urban Farming: Onaiza neighbourhood is characterised by single-family residences (villas) and multi-family residences (a group of small villas). Both types of residences show ample courtyard, backyard or front lawn space. West Bay neighbourhood is characterised by high-rise residential apartments, office buildings, hotels and mixed-use buildings. The plot space around the building footprints is occupied by parking and utilities, which leaves no space for urban farming. However, there seldom are buildings that bear space for landscaping around the plot, where urban farming is a possibility, Figure 3 (C, D).

Waste Management: For single-family and multi-family residences in Onaiza, solid waste is first collected in a common bin at the residence and then transferred to a community bin common between a group of residences and streets. No waste segregation or decomposing activities within the

compounds were observed. Following a similar organization in West Bay, the garbage chute collects solid waste from each floor of a high-rise building and is then transferred to a common bin. Waste is not segregated at any level in the process, Figures 3 (E, F).

Fig. 3: Observation study of meso scale parameters for Onaiza and West Bay

Location and Surroundings: There are about 14 restaurants/ coffee shops, 1 mall, 6 public parks, 5 grocery supermarkets and 4 pharmacies in West Bay. Most of the high-rise towers in West Bay have their private park and children's play area, which are well-used and enjoyed by the residents. In the case of Onaiza, which is approximately the same area as West Bay, there are 2 restaurants, 2 public parks, 1 grocery supermarket and 2 pharmacies. Imperatively, the streets, parks and public places are more crowded in West Bay compared to Onaiza.

Mobility: There are 12 bus stops and 2 metro stations (the West Bay metro station and the Doha Exhibition and Convention Center (DECC) metro station) added to well-connected and maintained pedestrian pathways that make public transportation accessible to West Bay residents. However, Onaiza has 10 bus stops and no metro stations, which makes it uncommon for residents to choose public transportation. However, the difference in choice of mobility from both neighbourhoods is also due to the ownership of homes. The probability of a homeowner in Onaiza investing in a private automobile is more than expats obliged to relocate after the contracted term.

Green Infrastructure: In early 2022, the "West Bay Beautification" retrofitting project was implemented that improved pedestrian connectivity and parks and installed energy-saving streetlights and other infrastructures. High-rise residential towers badge certificates that ensure energy efficiency leaving a minimum carbon footprint, Figure 4. In the case of Onaiza, no energy-saving equipment on the streets is observed. No green building certified badge was observed on individual homes.

Fig. 4: Observation study of micro scale parameters for Onaiza and West Bay

4.2 Environmental Sustainability Assessment based on Questionnaire Survey of Onaiza and West Bay Neighbourhoods

A follow-up question was asked for initial questions to investigate future aspirations, Figure 5.

Walkability: Only 30% of Onaiza residents are satisfied with available walking space while 80% of West Bay residents are satisfied with walking space and pedestrian pathway connectivity. West Bay residents (95%) are also satisfied with pedestrian furniture that makes the neighbourhood friendly to walkers. Less than 50% of Onaiza residents are satisfied with pedestrian connectivity and furniture. However, residents of both neighbourhoods (above 90%) are willing to change lifestyle preferences if proper facilities are given.

Urban farming: 80% of Onaiza residents are satisfied with the available space and have the knowledge to practice urban farming. However, the cost of materials and equipment is challenging as 75% of Onaiza residents are uncomfortable investing in urban farming. In the case of West Bay, only 5% of residents are satisfied with the available space and 95% of residents are uncomfortable investing in materials and equipment. Residents of both neighbourhoods (above 80%) are willing to practice and participate in urban farming when proper guidance and incentives are given.

Waste Management: Only 5% of Onaiza and West Bay residents segregate waste and are provided with the necessary facilities. Less than 50% of residents from both neighbourhoods possess knowledge of waste management. However, over 80% of Onaiza and West Bay residents are willing to improve waste management practices in homes with proper facilities, knowledge and incentives.

Location and Surroundings: Only 40% of Onaiza residents were satisfied with the distance to places of interest around the neighbourhood while the number increased to 85% in the case of West Bay. More than 80% of West Bay residents are satisfied with the green spaces around the neighbourhood and are willing to relocate for a better location. Only 30% of West Bay residents hold a sense of place, while in the case of Onaiza, more than 70% of residents hold a sense of place.

Mobility: Only 40% of Onaiza residents are satisfied with the distance of the nearest public transportation from their homes, while 85% of West Bay residents are satisfied with the distance to public transportation. While both the neighbourhood residents are satisfied with the cost of using public transportation, 85% of Onaiza residents and 55% of West Bay residents are satisfied with the alternatives of public transport that is walking, biking and carpooling. However, more than 90% of Onaiza and West Bay residents showed a willingness to use public transportation more often in future with improvements in the facilities.

Green infrastructure: The questions investigated residents' knowledge and awareness of the energy efficiency systems in the infrastructure around them. Only 35% of Onaiza residents and 60% of West Bay residents are knowledgeable about energy-efficient infrastructures in their neighbourhoods. Onaiza residents showed more enthusiasm (more than 90%) for investing in green infrastructures in the future as compared to West Bay residents. However, it is important to note that West Bay residents are more (95%) satisfied with the availability of green infrastructures in their neighbourhood as compared to Onaiza residents.

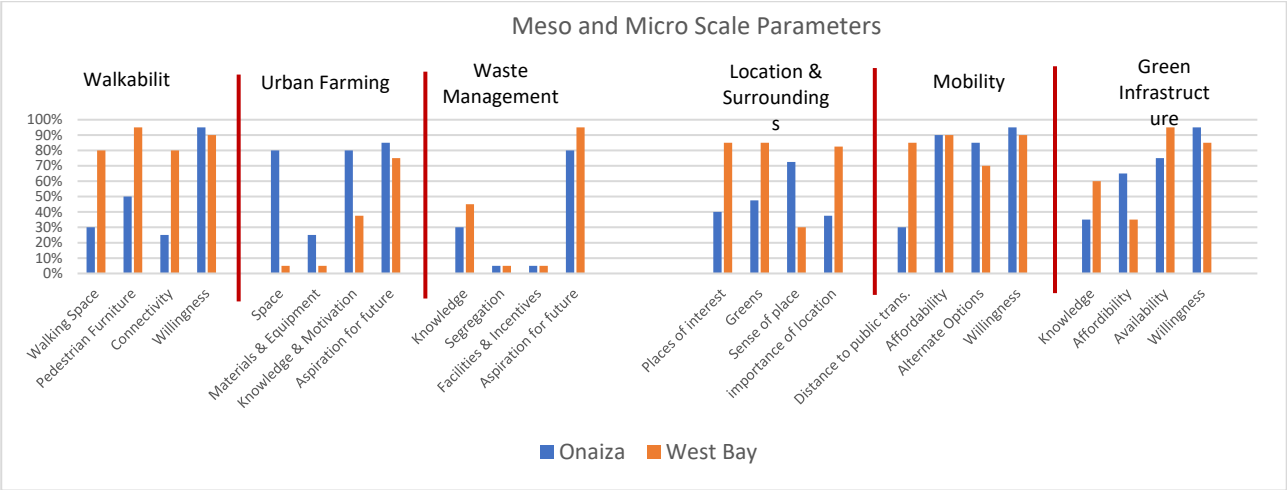

Fig. 5: Responses of residents' lifestyle preference to meso and micro-scale parameters

5 A Cumulative Analysis of Environmental Sustainability in Onaiza and West Bay Neighbourhoods

A qualitative assessment of environmental sustainability was performed through observation study and structured open-ended interviews, making a comparison between the lifestyle preferences of people residing in a low-rise neighbourhood (Onaiza) and a high-rise neighbourhood (West Bay) in Doha city.

5.1 Meso Scale Analysis

Walkability: The responses revealed that residents of Onaiza and West Bay rarely prefer to walk, even though the high-rise urban form of West Bay provides more opportunities for walking and using public transportation. This might be because of the general lifestyles of expatriates and the geographies they come from. Due to unfavourable weather conditions in Doha city, most expatriates take private vehicles as their preferred mode of transportation. While the lack of availability of places of interest is the reason for Onaiza residents, West Bay residents feel walking unsafe due to illegal parking. Onaiza residents unanimously agreed that pedestrian walkways in their surroundings are not well maintained and not well connected.

Urban Farming: West Bay and Onaiza residents are not involved in urban farming and lack knowledge of the concept. However, upon investigation, it was found that Onaiza residents are occasionally involved and interested in backyard/kitchen farming to grow certain spices and herbs. The lack of space is a major challenge for West Bay residents. All residents revealed a willingness to participate in community farming when proper knowledge and incentives are given.

Waste Management: Households in Onaiza and West Bay do not segregate waste and lack knowledge and awareness. The community bin at Onaiza and the garbage chute in the high-rise towers of West Bay are single units with no separation for different types of waste. This is the main reason people choose not to segregate waste at home as all the waste is eventually dumped into the same bin. Therefore, a regional-level policy is needed to promote waste management.

5.2 Micro Analysis

Location and Surroundings: West Bay residents have more opportunities and better facilities to walk to nearby places while Onaiza residents either carpooled or drove individually for leisure and shopping away from their neighbourhood. Onaiza residents preferred to go to far away parks rather

than neighbourhood parks, while West Bay residents chose to go to far away parks only during the weekends.

Mobility: West Bay residents more frequently use public transportation than Onaiza residents due to proximity and better connectivity. The feeder buses that commute between metro stations and bus stops in Onaiza have less frequency due to which Onaiza residents find it convenient to use private vehicles.

Green Infrastructures: While some of the Onaiza and West Bay residents are already using energy-efficient appliances, it is observed that residents do not prioritize user-friendliness, performance and convenience over energy efficiency when buying an appliance for their home. Onaiza residents showed more interest in investing in energy-efficient systems, which could be because of their ownership status. However, most of the residents were unaware if their neighbourhood has a green infrastructure or not, Table 1.

Table 1: Meso and Micro scale challenges for Onaiza (low-rise) and West Bay (high-rise) neighbourhoods

Scale	Parameters	Onaiza (Low-rise) Neighbourhood	West Bay (High-rise) Neighbourhood
Meso Scale	Walkability	Walking space, connectivity, quality of pedestrian pathways	Illegal parking
	Urban Farming	Cost of materials & equipment	Available space, facilities
	Waste Management	Lack of facilities & incentives	Lack of facilities & incentives
Micro Scale	Location & Surroundings	Proximity to places of interest and public parks	Too crowded
	Mobility	Proximity to metro stations, frequency of feeder buses	Connectivity
	Green Infrastructures	Lack of knowledge and availability	Lack of knowledge and availability

6 Conclusions and Recommendations

Beyond the anticipated FIFA 2022 World Cup, the Urban Planning Department of the Ministry of Municipality is expected to face several challenges. The oversupply of housing needs to be reappraised in response to the possible migration after the World Cup; rather than building new cities and neighbourhoods, planners must think of strategies to revive and retrofit old neighbourhoods. With a smaller population after the 2022 World Cup, amalgamated with continued sprawl, it will be a challenge to make the existing neighbourhoods environmentally sustainable. The following urban policies, strategies and interventions are recommended for low-rise and high-rise neighbourhoods to be environmentally sustainable, based on the findings of this study (Table 2).

Table 2: Proposed urban planning policies, strategies and interventions for meso and micro scale

Parameter	Proposed Urban Planning Policy	Proposed Strategies and Interventions
Walkability	Improving pedestrian walkway environment to enhance walkability at the neighbourhood scale in accordance with participatory approach.	• The street redesign should consider making it walkable by back-fitting connectivity. • Strict policies to maintain and monitor the quality of pedestrian pathways must be regulated. • Involve public participation to enhance small-scale pop-up infrastructures, parks and community spaces, promoting liveliness.

Parameter	Proposed Urban Planning Policy	Proposed Strategies and Interventions
Urban Farming	Promote urban farming to improve the environment and public health.	• Allot land for urban farming (a) within the plot area of low-rise development (b) within the common space in the plot area of high-rise developments (c) within public parks encouraging participation. • Strategies to incentivize urban farming must be regulated.
Waste Management	Spread awareness regarding low-cost strategies to manage domestic waste to support regional scale waste management	• Waste segregation at meso and micro scales must be mandatory and incentivized. • Composting green waste must be mandatory on-site and incentivized. • Technology for recycling 100% of the waste at regional level must be financed.
Location & Surroundings	Action plan to integrate urban development, green spaces and climate changes for improving public health	• Existing green spaces must be integrated with new green spaces to create approachable and health public space. • Promote mixed use neighbourhood. • Install mobile green elements through participatory approach.
Mobility	Action plans to improve efficiency of public transportation	• Focus on providing last mile connectivity to all neighbourhoods. • Create "only pedestrian" streets to increase the demand to use public transportation.
Green Infrastructure	Action plan to promote and finance energy efficient systems	• Spread awareness about energy-efficient systems that must be installed in homes and neighbourhoods. • Incentivize the usage of energy efficient appliances.

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