Future Cities and Environment

The Other Side of the Urban Densification 'Coin': Impacts on Social Sustainability in Redeveloped Urban Sprawled Communities in United Arab Emirates

TECHNICAL ARTICLE

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ABSTRACT

Urban sprawl has been a persistent sustainability impediment caused by its associated low urban density that led to heavy reliance on private cars. To overcome this problem, urban densification, as a sustainable planning approach, has been widely advocated. Al Ain, one of the most affected cities by urban sprawl in the United Arab Emirates, has recently adopted an urban densification process through its Al Ain Plan 2030 and started applying it by 2010 in a pioneering redevelopment project in Bida Bin Ammar neighborhood. This research aims at studying the impacts of the applied urban densification measures and tools on social sustainability in this neighborhood. The research adopts a qualitative case study method utilizing field observations as the main source of primary data collection, while the analysis of CAD drawings, census data, land-use plans, and Google Earth maps forms a secondary source of data for this study. Based on the results of the study, it is concluded that urban densification through its two applied measures, the Intensification and the Infill Development, have enhanced social sustainability in Bida Bin Ammar neighborhood but with various degrees of success for each of the social sustainability principle and indicators. While mixed use and accessibility principles have been partially enhanced in the study area, density, mobility, social capital, quality of life, sense of belonging, and safety and security have been weakly enhanced. Accordingly, a proposed set of guidelines have been initiated to inform decision-makers in the city, and maybe in other cities in the UAE and the Arabian Gulf region, to help them revise the applied urban densification process in a way that helps achieve more socially sustainable urban communities.

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1. INTRODUCTION

A balanced sustainable development is ideally supported over equally considered triple pillars of environment, society, and economy (Klarin, 2018). While environmental aspects are dominating the scholarly work about sustainable development, social aspects of sustainability have not received similar attention yet (Pitarch-Garrido, 2018; Zainol *et al*, 2018). Socially sustainable built environment is characterized with promoting wellbeing through achieving the real needs of people in their living spaces and workplaces. Social sustainability integrates the physical realm with the social infrastructure required to support social life and social amenities in one design (ADEC Innovations, 2020). Social sustainability aims also at improving the safety and security of individuals regardless of their origin, culture, color, or socio-economic status (Eizenberg and Jabareen, 2017). Bramley and Power (2009) stated two recognizable measures of social sustainability on the urban community level. First is an equitable access to various local services, job opportunities, and housing types. Second is the design considerations of the neighborhood itself to promote people interaction, community participation, sense of belonging, safety, and security. When carefully tackled, these integrated physical and social considerations in the built environment can certainly achieve a socially sustainable neighborhood (Karuppannan and Sivam, 2011).

On the other hand, urban sprawl is perceived as unsustainable growth with inefficient utilization of resources causing adverse impacts on social sustainability of local urban communities (Bhatta *et al*, 2010). Going against the measures of the compact urban form including high density, centralized development, and spatial mix of functions (Chin, 2002), urban sprawl is characterized by low density and car-dependent development, which spreads out over a large area of land and creates large distances between homes and community facilities. This leads to poor accessibility especially for elderly residents who have limited mobility and it therefore detrimentally affects the level of social interaction and social capital on the local community level (Everything Connects, 2014; Brueckner and Largey, 2008; Rinkesh, 2016; Pendola, 2017). The resulting car-dependent urban forms of urban sprawl development have destructive effects on human health including higher rates of obesity, high blood pressure, hypertension, and chronic diseases (Everything Connects, 2014). Accordingly, current growth management policies all over the world are struggling to encounter these socially unsustainable consequences by adopting more compact urban forms and defining physical limits to urban development through growth boundaries and land preservation (Bhatta *et al*, 2010).

Urban densification has been proposed as an efficient strategy for combating urban sprawl and its socially and environmentally unsustainable urban forms. Through the application of various densification measures and their associated tools, urban densification contributes to achieving more socially sustainable and environmentally friendly urban development. The applied measures of urban densification usually improve accessibility to social and commercial facilities and make neighborhoods safer through natural urban surveillance (Weinschenk, 2017; HaskoningDHV, 2013; Attia, 2015). While urban densification is usually implemented in places that have good access to infrastructure, social services, and public transportation, the application of urban densification would also differ from one urban context to another as per the applied standards and regulations. For example, in the United States low density is defined as the development of two to four houses per acre while in the United Kingdom low density compromises eight to twelve houses per acre (Chin, 2002). Increasing density in an urban sprawled area is by no means a straightforward process due to the conflict between the private and public interests concerning the preferred density of urban living. Many people might prefer to live in less dense urban areas, which goes against the notion of sustainable urban development. On the other hand, while increasing density, a balance between economic, environmental, and social aspects should be preserved. For example, low-income people could be affected by densification because they may be pushed away from the central areas, with lower opportunities to access inner-city jobs. This gentrification process also decreases the social mix within the urban community (URBACT, 2019).

Locally in the United Arab Emirates (UAE), urban sprawl has been a common and chronic urban development problem in many cities especially in Al Ain city, that might be considered as a model for an urban sprawl city. In accordance with the global trend to utilize urban densification as a solution for urban sprawl problems, the Plan Al Ain 2030 (ADUPC, 2009) was developed as an Urban Structure Framework Plan that provides conceptual solutions to shape the growth of Al Ain city over the next quarter of this century. The recommended policies for urban densification have been embedded in this long-term urban redevelopment Plan that has started in 2010.

Located approximately 150 kilometers east of Abu Dhabi city, the capital city of the UAE, and 150 kilometers south of Dubai city, Al Ain is the fourth largest city in the UAE with an estimated metropolitan population of approximately 600,000 residents in 2021 (Population Stat, 2021). The Plan Al Ain 2030 (ADUPC, 2009) shows areas appropriate for urban densification development while respecting the environmental and

social considerations of the city (Figure 1a). The urban densification process in the Plan Al Ain 2030 relies on two urban strategies, first, redeveloping brownfield sites and second, developing more limitedly some new greenfield sites in a way that meet urban growth demand but does not harm the sensitive ecosystem of the city. In this Plan, urban infill development, as a main measure for urban densification, is prioritized in low density neighborhoods that are usually distinguished with existing abounded houses and obsolete uses. As shown in the Land-use Plan in Figure 1a, by 2030 Asharej district will join the Central District in accommodating the bulk of the population of Al Ain city. Starting 2010, Bida Bin Ammar neighborhood in Asharej district has been the pioneering model of neighborhoods with urban sprawl forms that have experienced urban densification transformation as per the Plan Al Ain 2030 (Figure 1b).

The Plan has preserved the currently applied urban regulation of keeping the maximum height of residential buildings at 2 floors and at 5 floors for other types of public and service buildings. This meant to preserve Al Ain city's character as a human-scale city (ADUPC, 2009). It has been expected that urban densification is the right strategy for improving the attainment of social sustainability in Bida Bin Ammar neighborhood, but during the more than a decade after the start of implementing the urban densification process in the neighborhood no assessment has been undertaken for the impact of this process on sustainability aspects, especially social sustainability as the focus of this research. Accordingly, the research studied the pioneering application of urban densification measures and their related tools in this neighborhood, since its launch in 2010 until early 2020, with the aim to assess the impacts of these applied urban densification measures on social sustainability in the neighbourhood. Ultimately, it is hoped that the results of this study will help suggest some strategies to enhance the application of urban densification processes, not only in this neighborhood, but also in many other urban sprawled contexts in the UAE as needed.

2. RESEARCH METHOD

To achieve its defined aim the research first undertook a relevant literature review for the principles and indicators of social sustainability on the urban community level, as well as the measures and tools

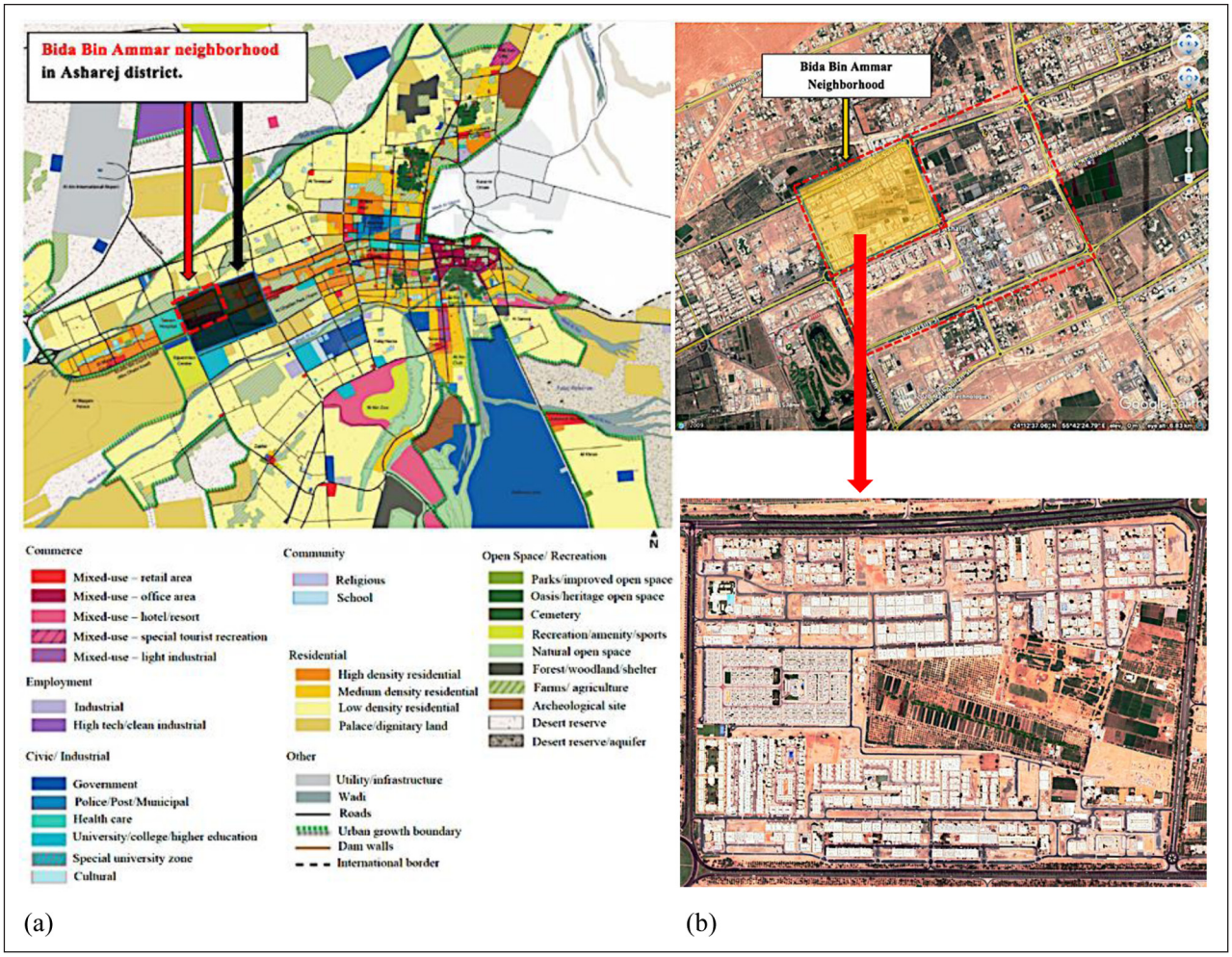

Figure 1 a) Land-use Framework Plan for Al Ain City in 2030, and **b)** Bida Bin Ammar neighborhood in Asharej District (Google Earth and ADUPC, 2009).

of urban densification process. Second, it investigated how the urban densification measures and tools have been applied in Bida Bin Ammar neighborhood as the pioneering case study. Third, it assessed the impacts of the applied urban densification measure and tools on the attainment of social sustainability principles on the neighborhood level. Finally, this assessment helped to suggest a revised application of urban densification processes and recommend some actions to enhance the impact of urban densification implementation on social sustainability.

To undertake the defined research investigations, a qualitative case study method was adopted in Bida Bin Ammar neighborhood. Originally developed in 2000 as a public housing neighborhood for Emirati citizens with only single-family housing type, Bida Bin Ammar neighborhood occupies an area of 211.30 hectares. It is bounded by two main roads, Shakhboot Bin Sultan Street from the north, and Sheikh Khalifa Bin Zayed Street from the south (Figure 2a). As stated in Al Ain region 2030 demographic forecasts, the total population in 2010 for both the Emirati and expatriate residents in Bida Bin Ammar neighborhood reached 2,973 person, while the expected total population in 2030 is 4,797 person (ADUPC, 2009). Along the 10 years of urban densification process from 2010 to early 2020, the neighborhood has largely been transformed from a mono-use public Emirati housing neighborhood to a mixed-use market-housing neighborhood.

To ease the investigation and analysis processes, the case study neighborhood was divided into its five homogenous urban form Zones (A, B, C, D, and E) (Figure 2). Each zone was explored and then analyzed according to the established study framework for both the applied urban densification measures and tools, then the impacts of this application on a set of defined social sustainability principals and indicators. The 10-year time span of the urban densification process was traced through the 'historical imagery' tool in Google Earth, which helped link the collected data with the observed spatial changes. Afterwards, the obtained results from the case study analysis were analyzed and interpreted in response to the defined research objectives.

While the collected and analyzed secondary data included literature, official statistics, and governmental documents, especially those obtained from Al Ain city municipality, the primary data was collected through field observations and map analysis. Field observations were conducted in the period between late 2019 and early 2020, by taking hand notes and photographs about the applied urban densification tools and their observed impacts on social sustainability of the studied area. Despite the reliance on the qualitative and descriptive investigation of urban densification tools as well as the assessment of their impacts on social sustainability, it is worth mentioning that there are some limitations of the research outcomes related to some unavoidable subjective interpretation of findings by the researchers, as experts in the field of the study. Furthermore, social sustainability itself is hard to be precisely defined, so, some principles and/or indicators might be missing from the reviewed literature in the coming section. The emergence and spread of COVID 19 pandemic made interviewing the professionals and the community members not possible due to the applied lockdown procedures at the time of conducting the field work.

In the following two sections the theoretical framework of the 'Principles and Indicators of Socially Sustainable Urban Communities' and the 'Urban Densification Measures and Tools', are briefly discussed. This theoretical framework guided the field work in the case study and helped facilitate the assessment of the applied urban densification tools on social sustainability in Bida Bin Ammar neighborhood.

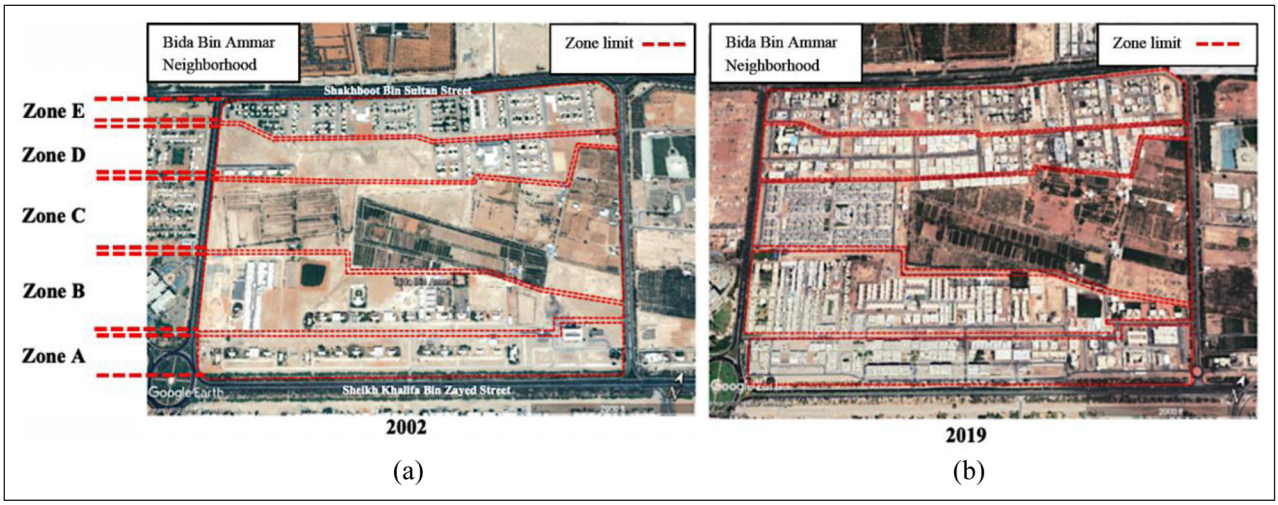

Figure 2 Timeline of the urban densification process in Bida Bin Ammar Neighborhood (Google Earth).

3. PRINCIPLES AND INDICATORS OF SOCIALLY SUSTAINABLE URBAN COMMUNITIES

Through reviewing relevant literature, eight main principles of socially sustainable communities were identified including Appropriate Population Density, Accessibility, Diverse Modes of Mobility, Mixed Land-use and Housing Types, Quality of Life Considerations, Design for the Sense of Belonging, Safety and Security Measures, and Community Participation. For each of these principles a set of indicators were briefly defined as follows: First is *Appropriate Population Density*. It is usually expressed in the ratio of population to a given area of land. Appropriate population density enhances social sustainability in urban areas because it provides viability and economic feasibility to local facilities and social services. Appropriate population density also supports public transport and local jobs (Dave, 2011; Grosvenor and O'Neill, 2014; HaskoningDHV, 2013; Clarke and Callaghan, 2007). Generally, a gross population density of 40 to 50 persons per hectare (pph) is considered appropriate for supporting the provision of these services and facilities (Barton, 2000).

Second is *Mixed Land-use and Housing Types*. An appropriate mix of different land uses in an area including a variety of residents' activities like living, shopping, and leisure, enhances social sustainability because it promotes walkability and social inclusion, while the presence of people in the streets in mixed-use areas provide more sense of safety and security (Pendola, 2017). Also, the provision of job opportunities enhances the social well-being for residents as it secures them regular income (Chan and Lee, 2008). In addition, mixed-use communities provide more dwelling diversity in types, such as apartment buildings, stacked apartments, attached/detached single-family housing, etc., as well as diversity in tenure types including tenancy, owner-occupancy, public housing, etc. (Bahadure and Kotharkar, 2012; Kruger, 2017).

Third is *Accessibility*. It has positive impacts on social sustainability as it means accessible social infrastructure and community facilities that meet the residents' needs in a social equity manner irrespective of age, gender, or income. Accessibility reduces the travel distance, which makes the place more vivid. It also promotes a healthier lifestyle by encouraging people to walk or cycle instead of using their private cars. The local catchment areas for pedestrian access to the nearest daily services and facilities, such as retail shops, clinic, primary school, offices, bank, open spaces, and local job opportunities should be considered in designing sustainable communities. Generally, this catchment area is determined by an average threshold walking time (5 or 10 minutes) or an average distance (around 400–800 m) depending on both the type of user and the type of use (Chan and Lee, 2008). Barton (2000) assumes that at least 80% of the houses in a certain neighborhood should achieve the catchment distance standards through easy access to the destinations. Furthermore, to reduce the reliance on private car use and the amount of car parking lots within neighborhoods, a proper access to public transport nodes, usually bus stops, is required (Jeekel, 2017).

Fourth is *Diverse Modes of Mobility*. Ease of access to local services, employment, and leisure activities, requires that walking, cycling, and public transport be considered as different available options for mobility in local communities, besides private cars (European Federation for Transport and Environment, 2003). For encouraging walkability and cycling, as the most sustainable modes of mobility, several design principles need to be considered, such as traffic-calmed streets, permeability of pathways and cycling lanes networks, variety of streetscape, effective urban surveillance, and the creation of activity hubs along the mobility networks. While pedestrians and cyclists can share the same route, more safety measures should be considered in this case to avoid the conflict with the more vulnerable pedestrians. Minimum widths of 1.2 m and 1.5 m are recommended for dedicated pedestrian and cycle lanes, respectively. Such well-designed local mobility networks would reduce social exclusion as they provide public realms for social connectedness and shared activities (Han *et al*, 2016; Shirazi and Falahat, 2012).

Fifth is *Quality of Life Considerations*. Quality of life is an important principle of social sustainability because it makes urban areas more attractive for people to live, work, study, and spend leisure time. Besides the positive impact of reducing vehicular gas emissions, quality of life could also be achieved through the application of energy-efficiency strategies in buildings and adopting appropriate waste recycling systems. The preservation of green spaces, the enhancement of local habitat diversity, and the provision of local food production, where people can grow their fruits and vegetables in their homes' and neighborhoods' gardens, are all essential indicators for realizing the quality of life in urban communities (Popovic and Kraslawski, 2018; Zainol *et al*, 2018).

Sixth is *Design for the Sense of Belonging*. The sense of belonging is a significant principle of socially sustainable communities because it helps people to be attached to their community and hence feel more socially secure. It is associated with the presence of social interaction and social capital among neighborhood residents (Yoo and Lee, 2016). As mentioned by Menconi *et al* (2018) the sense of belonging is a variable of perception that comes from the combination of features that

community members identify in the place in which they live. It consists of several parameters such as the period of residence, the physical dimensions, and the activities that take place within the local community over a lifetime. To achieve the sense of belonging in a neighborhood design, Chan and Lee (2008) recommend that the heritage of the place should be preserved. Local characteristics such as daily activities, customs, and ways of living should be respected and conserved through urban design to enhance the feeling of residents that they are part of their local communities. Additionally, the design should be responsive to the local natural and cultural contexts, including climate, home terrain, landmarks, architectural style, landscape, urban morphology, and local building materials. Accordingly, each neighborhood will have its own character with a personalized image that would help residents and visitors find their way around, with key nodes marked by distinctive public spaces, buildings, vistas, and public art (Barton, 2000).

Seventh is *Safety and Security Measures*. Security is an essential component that needs to be achieved in any neighborhood to be socially sustainable. Residents need to know what is going around their houses and to have the spaces under their surveillance to feel secured. Effective 'natural' surveillance of streets and walkways is essential for achieving security in neighborhoods as it reduces the fear of crime within the neighborhood during daytime and after dark. Furthermore, the fear of accidents is the biggest barrier to walking and cycling, especially for children. The street is considered crowded in a way that hinders safe pedestrian crossing if vehicles are present at a particular location for more than the time needed for a pedestrian to cross the street at a walking speed of 1.39 m/s (Atanda and Öztürk, 2018).

Eighth is *Community Participation*. It is widely believed that residents' participation in both the design process of their urban community and its management are important aspects of social sustainability because they make the design meet the real local needs of the residents and allow the people to adapt and manage their built environment according to their changing needs (Karuppannan and Sivam, 2011; Galal Ahmed and Parry, 2001).

Finally, Table 1 concludes the above-defined set of principles and indicators of a socially sustainable community that, as explained later, were used in assessing the impact of the application of urban densification measures on social sustainability in the case study of Bida Bin Ammar neighborhood.

NO.	PRINCIPLES	INDICATORS	
1	Appropriate Population Density	1	Gross population density of 40–50 pph.
2	Mixed Land-use and Housing Types	1	Provision of various facilities and amenities satisfying the local needs.
		2	Availability of various job opportunities.
		3	Presence of mixed housing types and tenure.
3	Accessibility	1	Appropriate local catchment distance to local services and transportation nodes (bus stops).
4	Diverse Modes of Mobility	1	Well-designed networks of pedestrian walkways and cycling routes.
		2	Presence of fast, efficient, and affordable public transport (buses).
		3	Provision of a vehicular network with traffic-calmed streets and less private car permeability.
5	Quality of Life Considerations	1	Attractive places for living, working, shopping, and entertainment.
		2	Pollutant-free environment.
		3	Presence of locally based energy supply and waste management systems.
		4	Enhancement of local habitat diversity, preservation of green land, and local food production.
6	Design for Sense of Belonging	1	Personalization of the neighborhood design based on site context.
		2	Responsiveness to local culture in terms of materials, built form, architectural style, landscape, and urban morphology.
7	Safety and Security Measures	1	Provision of measures for reducing the fear of crime within the neighborhood during daytime and after dark.
		2	Provision of measures enabling effective 'natural' surveillance of streets and walkways.
		3	Provision of measures reducing the chance of vehicular and pedestrian accidents.
8	Community Participation	1	Residents' participation in the design and management of their neighborhoods.

Table 1 A Summary of the Principles and Indicators of a Socially Sustainable Community.

4. APPLIED URBAN DENSIFICATION MEASURES IN BIDA BIN AMMAR NEIGHBORHOOD

Bida Bin Ammar neighborhood has experienced an urban densification process since 2009 following the strategies adopted in the Plan Al Ain 2030. 'Intensification' and 'Infill Development' have been the two main applied measures of this urban densification process, each with some dedicated application tools, as explained below.

4.1 APPLICATION OF INTENSIFICATION

The first tool for applying Intensification process is 'property subdivision' in which a plot of land or a building is divided into two or more parcels while the land use is kept the same (Neptis Foundation, 2013; Quality Planning, 2017; Manitoba Indigenous and Municipal Relation, 2016). Besides the widely applied standard subdivision, property subdivision is usually conducted through various processes including minor subdivision and bare land condominium subdivision which produces separate units encompassing buildings that are not entirely covering these units (Manitoba Indigenous and Municipal Relation, 2016; Gudes *et al*, 2018). The second tool for applying Intensification is 'property consolidation' in which two or more properties are combined to form one property (Kruger, 2017; Bartoszczuk and Delnicki, 2018). The third tool is 'vertical extension' which is considered as a challenge if violating the applied regulations of the maximum height, the street aspect ratio, and/or the façade architectural style (Artés *et al*, 2017). The fourth tool is the horizontal extension through increasing the 'bulk rights'. In this case, extra area(s) is added to a certain building or a house. It could be also done through developing an entire second attached or detached housing units within the same plot (Attia, 2015). The applied regulations should be followed while horizontally expanding including the Floor-Area-Ratio (FAR) and setbacks (NYC, 2020; Kolarik, 2020; Washington County, 2020; Brian, 2020).

For the case study neighborhood, the Intensification through the tool of 'subdivision of property' was not applied in any of its defined five urban Zones. The 'consolidation of properties' as the second tool for implementing Intensification was observed in a number of cases in the Zones A, B and D of the neighborhood. In these cases, two single-family housing plots, each with as less as 30% plot coverage ratio, were joined to form a new large plot developed as an apartment building with a 100% plot coverage ratio. In the neighborhood, many of these apartment buildings contained 16 apartments instead of the previous two single family houses. These apartments are accommodating 80 persons in average instead of around 14 persons in the case of the single-family houses, on the same plot. Moreover, the 'vertical extension' as the third tool of Intensification has not been officially permitted and consequently was not applied in Bida Bin Ammar neighborhood. This is because the existing houses are already 2 floors-high and hence, there is no room for increasing the number of floors vertically.

In Bida Bin Ammar neighborhood, 'horizontal extension' by increasing bulk rights as a tool of Intensification was applied through converting some balconies into internal habitable spaces to be used for increasing an internal space or even adding a complete 'small' room, depending on the area of the sealed balcony. The application of this tool was observed in all Zones of the neighborhood with different concentrations except in Zone C where it was not noticed. In another form of application of this tool, the mass of a single-family house was extended in the front, rear, and/or side setback spaces of the house plot. This tool was observed in some houses in all Zones except Zone B. On the other hand, some additional attached/detached dwellings were constructed in some front and/or back yards of the plots of the single-family houses, in a form of horizontal extension, in all Zones except Zone C.

All-in-all, based on the above analysis, it could be claimed that 'Intensification' urban densification measure has been 'weakly' applied in the whole Bida Bin Ammar neighborhood.

4.2 APPLICATION OF INFILL DEVELOPMENT

The second urban densification measure is 'Infill Development', which is usually performed through, first, 'developing vacant lots' within already constructed neighborhoods to make use of the existing infrastructure while introducing additional service and facilities needed for the exiting local communities (The Institute for Public Policy and Economic Development, 2013; Alfirević and Simonović-Alfirević, 2015; Kamal, 2014). The 'demolition and reconstruction' is the second tool for applying 'Infill Development' measure especially in neighborhoods with old and dilapidated buildings. Through this tool, modern houses and buildings replace the outdated ones (Attia, 2015; Xu *et al*, 2019). Being costly and harmful for the existing community networks, the demolition and reconstruction' might not be a much-favored Infill Development tool (Trabucco and Fava, 2013). While applying the Infill Development tools, the architectural and urban design characteristics of the exiting community should be preserved (Aliyu, 2018).

In Bida Bin Ammar neighborhood, Infill Development was remarkably applied in all its five Zones as shown in Figure 3. The 'development of vacant parcels' was a frequently applied tool in all Zones. In Zone A, several multi-story (G+4) mixed-use buildings were developed with their ground floors utilized for retail and commercial activities, the first floors were allocated for office uses and health facilities, and the last two floors were residential apartments. In addition, some brownfield

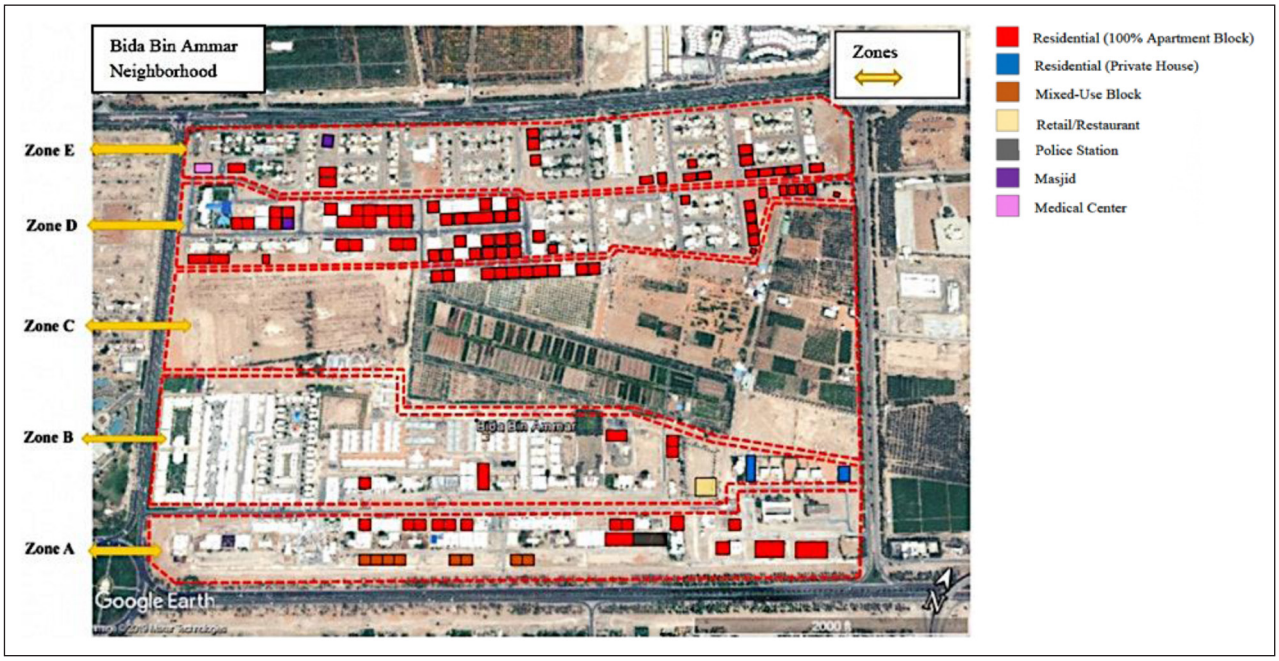

Figure 3 Transformation through Infill Development from 2010 to 2019 in all Zones (Google Earth).

sites have been redeveloped on the full plots as residential and other activities buildings in all Zones. A two floors-high apartment building and a police station were constructed on brownfield sites in Zone A. While in Zone B, apartment buildings, a limited number of single-family houses, and a restaurant were constructed on brownfield sites. In both Zones C and E, some apartment buildings have been constructed on the brownfield sites with a 100% plot cover ratio (Figure 3).

The second applied tool for the Infill Development urban densification measure in Bida Bin Ammar neighborhood was the 'Demolition and Reconstruction'. According to this process, several old single-family houses and some limited numbers of old service buildings were demolished and replaced, in many cases, with apartment buildings and with 100% plot cover ratios. Besides these similar initiated actions in all Zones, some exceptions have been observed. For example, in Zone B, a single-family house built on a large plot was demolished and a 'small' gated community was built on the plot. Also, a large parcel of a private farm with its ancillary buildings in Zone C was demolished and a gated community was constructed along with some single-family houses. While in Zone D, an old facilities building was demolished, and a new hospital was constructed on its site.

In conclusion, Infill Development has been an actively applied urban densification measure in Bida Bin Ammar neighborhood, resulting in added mixed use facilities and more housing units (apartments) in the five defined Zones of the case study neighborhood. In the following section, the results of the assessment of the impacts of the two applied urban densification measures and their tools in Bida Bin Ammar neighborhood on the attainment of the social sustainability principles are presented.

5. RESULTS: ASSESSMENT OF THE IMPACTS OF THE APPLIED URBAN DENSIFICATION MEASURES AND TOOLS ON SOCIAL SUSTAINABILITY

5.1 IMPACTS ON APPROPRIATE POPULATION DENSITY

Indicator 1: Gross population density of 40–50 pph: According to Al Ain region 2030 demographic forecasts, the total population in 2010 for both Emirati and foreign people in Bida Bin Ammar neighborhood in Asharej district was 2973 persons, where after applying the urban densification as per the Plan Al Ain 2030 the expected total population will be 4797 persons in 2030. As the area of Bida Bin Ammar neighborhood is about 211.30 hectare, the gross population density of the neighborhood in 2010 was equal to 14.07 pph, and in 2030 is expected to reach to only 22.70 pph. This makes the gross density in Bida Bin Ammar neighborhood considerably low, even after the application of the urban densification plan.

5.2 IMPACTS ON MIXED LAND-USE AND HOUSING TYPES

Indicator 1: Provision of various facilities and amenities satisfying the local needs: The transformed land use analysis of the neighborhood in early 2020 contained a mixture of various community facilities such as residential and community facilities (mosques, retail, restaurants, a school, nurseries, a hospital, medical clinics, health clubs, and a police station). Most of the newly introduced community facilities are concentrated in the mixed-use buildings that were only developed in Zone A. It has

been noticed that some single-family houses, especially in Zone E, had their function changed into commercial and service activities such as kindergartens, and offices. As the provision of these various facilities and amenities could satisfy most of the different local needs, therefore this indicator is considered significantly achieved in the neighborhood.

Indicator 2: Availability of various job opportunities: By analyzing the early 2020 transformed land-use map of Bida Bin Ammar neighborhood, it could be realized that job opportunities were introduced through the newly introduced various community facilities such as retail, restaurants, school, nurseries, hospital, medical clinics, health clubs, and the police station. Office facilities were mainly introduced in Zone A on a limited scale, where they occupied the first floors of the mixed-use buildings in this Zone. Houses that have been transformed into commercial and office activities also added some job opportunities in the neighborhood. Therefore, availability of job opportunities in Bida Bin Ammar could be considered moderately achieved.

Indicator 3: Presence of mixed housing types and tenure: the applied Intensification and Infill Development tools helped provide mixed housing types in the neighborhood including various sizes apartments in walk-up buildings, town houses, single-family houses, residential compounds, etc. But, on the other hand, the prevailing housing tenure type is only tenancy, where most of the introduced housing units are built for investment by Emirati individuals or real estate companies.

5.3 IMPACTS ON ACCESSIBILITY

Indicator 1: Appropriate local catchment distance to local services and transportation nodes (bus stops): Catchment distances to local services (5 to 10 minutes walking within a distance of 400–800 m) were measured through the developed CAD drawings of the neighborhood. Figure 4 demonstrates an example for the CAD map analysis of the catchment distances for four types of facilities in Bida Bin Ammar neighborhood: retail shops (400–800 m), clinics and health centers (800–1000 m), mosques (400–800 m), and the play field (800–1000 m). Through the analysis of the catchment of all the introduced and the existing local services and facilities in the neighborhood, it has been realized that most of these services are not evenly distributed in the neighborhood, except mosques, and thus their appropriate catchment distances are not achieved for all houses, albeit in various degrees. For example, the school and the nurseries are located northwest of Bida Bin Ammar neighborhood, and their appropriate catchment distances (400–600 m for the school and 200–300 for the nursery) only cover

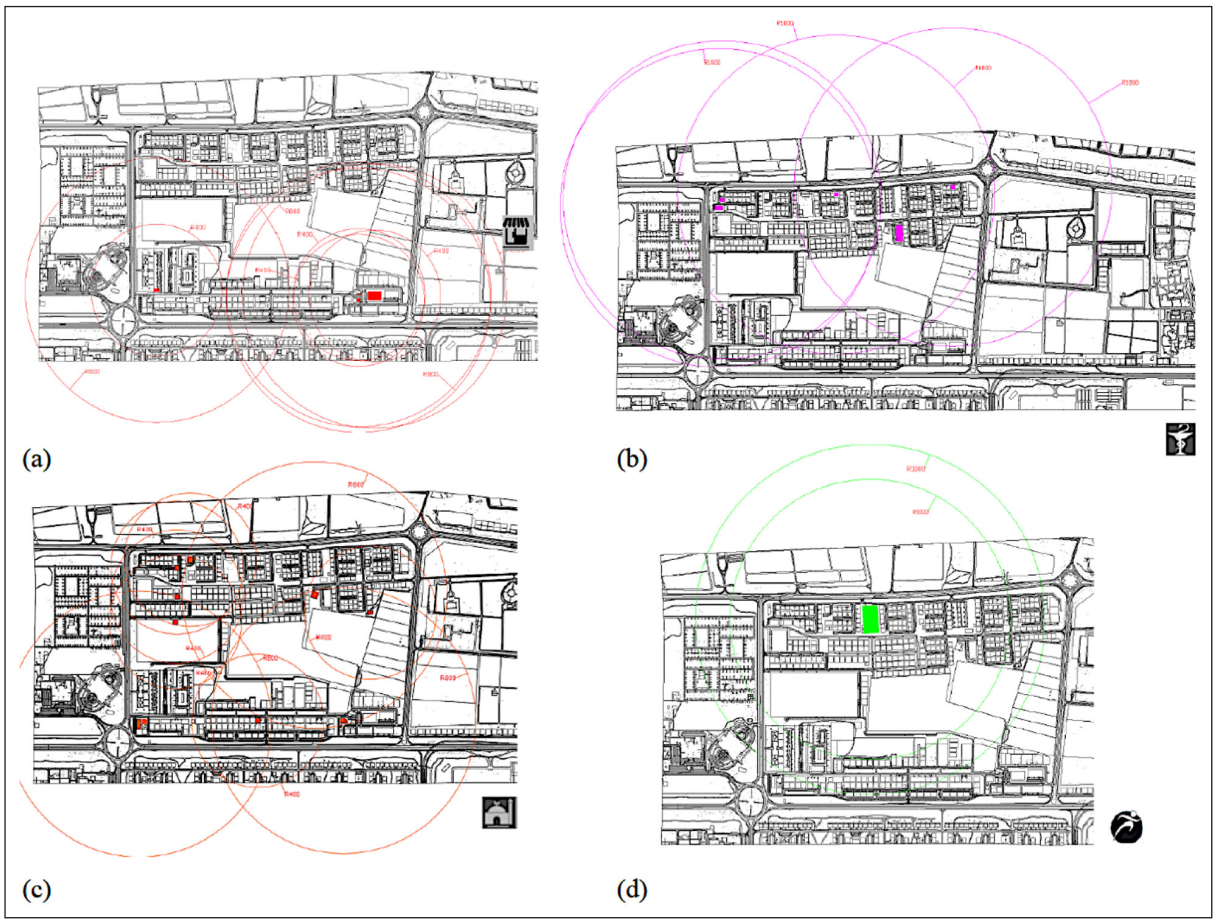

Figure 4 Average catchment distances to **a)** Local retail shops (400–800 m). **b)** Clinics and Health Centers (800–1000 m), **c)** Mosques (400–800 m), and **d)** Play Field (800–1000 m).

around 25% of the development area. Only mosques were found well-distributed, where they cover the whole neighborhood within the designated catchment distance of 400–800 m (Figure 4c). The only play field in the neighborhood is located to the north (Figure 4d) and with a designated catch distance of 800–1000 m that managed to cover most of the neighborhood.

On the other hand, the public transportation nodes (bus stops) for one bus service line were partially distributed on only three of the outer main roads of the neighborhood. This makes them mostly outside the average walkable distance (300–400 m) from more than half of the houses in Bida Bin Ammar neighborhood.

5.4 IMPACTS ON THE DIVERSE MODES OF MOBILITY

Indicator 1: Well-designed networks of pedestrian walkways and cycling routes: From the field observations, it was noticed that there is still a dominant reliance on private car use in the neighborhood without the proper provision of safe, shaded, pleasant, and well-maintained pedestrian walkways and footpaths. There are no dedicated lanes for cycling except very limitedly in the southern part facing the main road under the newly introduced mixed-use buildings in Zone A. While introducing mixed use residential buildings in Zone A, on the one hand, enhanced natural surveillance in the adjacent streets, it, on the other hand, sometimes caused interruption for pedestrian movement. For example, Figure 5 shows a restaurant located in a mixed-use building in Zone A blocking the pedestrian walkway by its outside seating area. In addition, delivery motorcycles in front of restaurants and cafeterias in the same Zone made walking not safe (Figure 5a). Similar situations were noticed in Zone B as well.

Allocated pedestrian walkways or *sikkas* are playing an important role in developing a well-connected pedestrian network to link houses with various local destinations in all Zones of the neighborhood. Unfortunately, despite the presence of these *sikkas*, they are not maintained as most of them have dusty unfinished floorings and are usually banked with high and dull fences. Some of these *sikkas* are even used as car parking spots! (Figure 6).

Indicator 2: Presence of fast, efficient, and affordable public transport (buses): As indicated by Al Ain City Bus Service Network Map and the field visits there are only three bus stops in the outer main roads, one to the south, one to the east, and one to the north. Only one bus line passes on these bus stops. They are apart from each other by more than 800 m, so as mentioned above, they are not

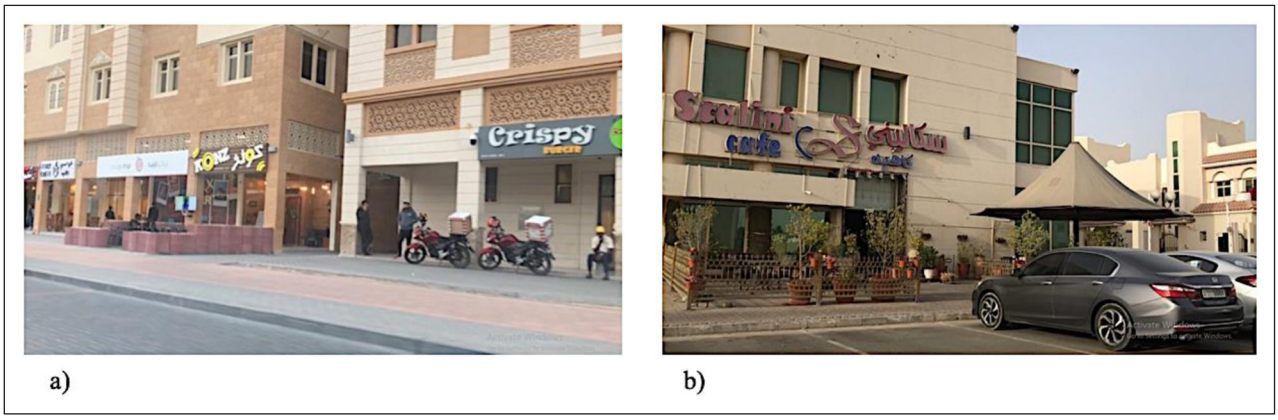

Figure 5 Enhanced natural surveillance but the outside seating areas of the restaurants and café shops hinder walkability, and delivery motorcycles decrease safety of pedestrians.

Figure 6 Two of the pedestrian walkways (*sikkas)* with their lack of maintenance making them unpleasant walkability network connectors in all Zones of the neighborhoods.

easily accessible by many houses in the neighborhood. Therefore, despite the affordable bus ticket price, air-conditioned busses, and the reasonable bus speed, the availability of efficient public transportation nodes within a walkable distance (300–400 m) is not achieved in Bida Bin Ammar neighborhood.

Indicator 3: Provision of a vehicular network with traffic-calmed streets and less private car permeability: From the analysis of the CAD drawings of Bida Bin Ammar neighborhood, it was realized that the street network is spatially organized to have internal roads and cul-de-sacs that are less permeable for private cars (Figure 7a). This internal local street network linking the housing plots and services is generally equipped with street calming measures such as street humps and speed limits signals (40 km/hr) to create a safer pedestrian environment. From the field observations, it was recorded that street calming in Zone A includes the provision of pedestrian crossing signs, flat car bumps, car bumps signs, and fixed steel bollards (to prevent cars from parking above the sidewalks). All these measures helped reduce the speed of private cars and thus has given priority to pedestrians to safely cross the streets. Similar measures were considerably missing in the other four Zones in Bida Bin Ammar neighborhood (Figure 7b). Overall, the street network only relies on T or cross intersections (roundabouts) without light signals.

5.5 IMPACTS ON THE QUALITY OF LIFE CONSIDERATIONS

Indicator 1: Attractive places for living, working, shopping, and entertainment: The newly introduced facilities and job opportunities in Bida Bin Ammar neighbourhood, especially in Zone A, managed to attract a lot of business in both retail shops, branches of major banks, and several other office and commercial activities. This had enhanced the attractiveness of the neighborhood for the people to live and work there. However, based on the field observations and the analysis of the developed land-use map of the neighborhood, there is lack of open spaces, public realms, and entertainment facilities, which could be the main attraction of a new destination in the neighborhood that boosts a high-quality lifestyle.

Indicator 2: Pollutant-free environment: The lack of the friendly means of mobility and commuting in the neighborhood, including walking and cycling networks, as well as the lack of an efficient public transportation system, compromised the chance to widely abandon using private cars and hence did not help reduce emitted gas pollutants from the private cars.

Indicator 3: Presence of locally based energy supply and waste management systems: Through the field observations in Bida Bin Ammar neighborhood, it is realized that there is an absence of locally based energy supply systems and waste management systems including local recycling of organic and solid waste and refuse.

Indicator 4: Enhancement of local habitat diversity, preservation of green land, and local food production: There is a lack of green spaces and public realms in the neighborhood. Therefore, the enhancement of local habitat diversity is limited. However, some private farms have been preserved especially in Zone C (Figure 3). On the houses level, no local food production is considered

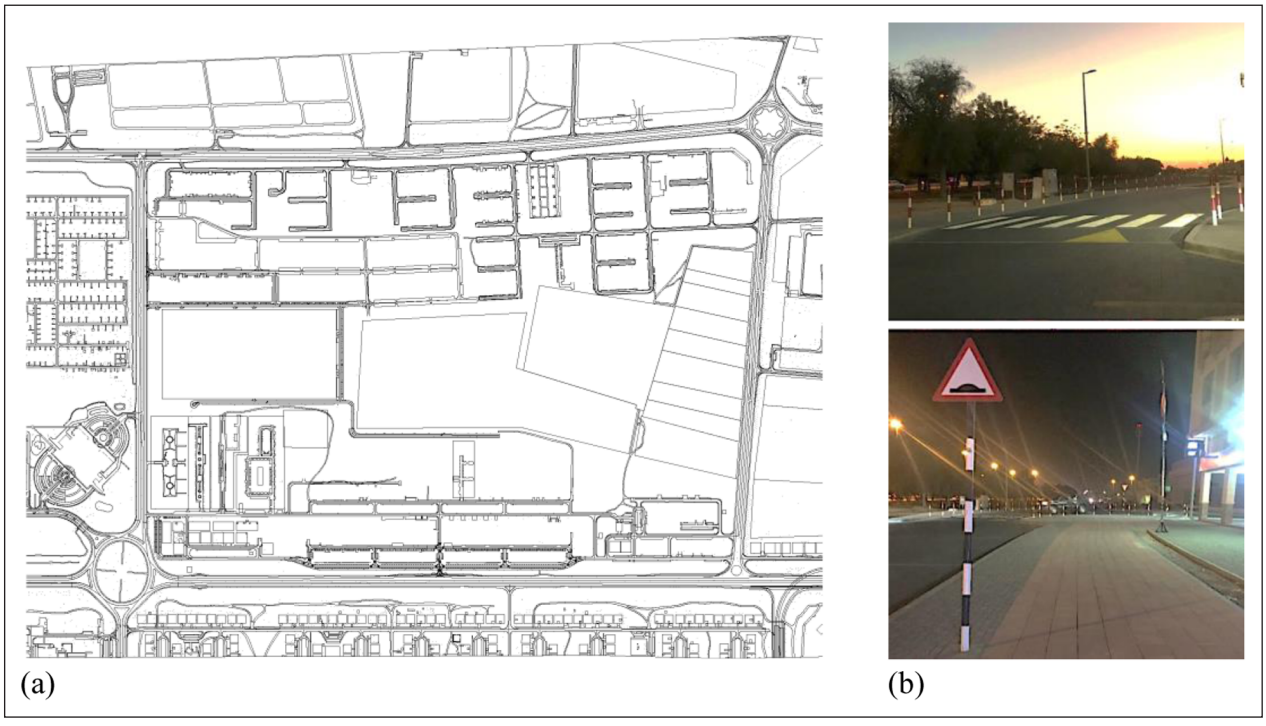

Figure 7 The street network of Bida Bin Ammar neighborhood and an example of the street flat humps and signs in Zone A.

either within the houses plots or in the shared urban space, with some few expectations in the inner Zones.

5.6 IMPACTS ON THE DESIGN FOR THE SENSE OF BELONGING

Indicator 1: Personalization of neighborhood design based on site context: The only distinctive characteristic of the site context is the presence of farms in the middle of the neighborhood at Zone C. Unfortunately, this local character has not been reflected in the transformed urban form of the neighborhood.

Indicator 2: Responsiveness to local culture in terms of materials, built form, architectural style, landscape, and urban morphology: By analyzing the study area of the neighborhood, it is realized that there is a shortage of distinctive public open spaces that could accommodate local public arts. Also, there is a lack of landmarks, which could help residents and visitors find their way easily around and let them experience the place conveniently on foot. These issues resulted in absence of local distinctive urban spaces. But, on the other hand, a mostly unified 'local' architectural style, as expressed in the architectural motives and colors, appeared in the newly constructed mixed-use buildings in Zone A (Figure 8). This has created some distinctiveness and therefore expected to enhance the sense of belonging among the residents.

Furthermore, all the mixed-use buildings in Zone A are designed to form a continuous arcade in the ground floor with the aim to work as a continuous shaded pedestrian walkway. Unfortunately, many cafes, and restaurants are using these arcades spaces as external seating areas where chairs and tables are practically blocking the pedestrian mobility (Figure 9).

5.7 IMPACTS ON SAFETY AND SECURITY MEASURES

Indicator 1: Provision of measures for reducing the fear of crime within the neighborhood during daytime and after dark: While there is a sense of security in the whole city of Al Ain and in the neighborhood, as supported by statistics (Numbeo, 2021), still, it was observed in almost the whole neighborhood, that there are no proper streetlights except in the external main roads (Figure 10). This could certainly increase the fear of crime.

Indicator 2: Provision of measures enabling effective 'natural' surveillance of streets and walkways: As mentioned earlier, the newly developed mixed-use buildings in Zone A and some other introduced activities in the other four Zones created active street frontages, which in return significantly enhanced the natural surveillance in the public realm. Also, in many introduced houses and buildings, windows are facing the streets not the *sikkas*. The less active Zones (B, C, D) lack effective natural surveillance for the streets and walkways. Moreover, except in Zone A, there is a lack of active street frontages where fences of the residential plots and the farms in Zone B are considerably high and dull (Figure 11).

Indicator 3: Provision of measures reducing the chance of vehicle/pedestrian accidents: As previously discussed, traffic calming is partially considered in the transformed neighborhood and many internal streets are not having street lighting posts. Besides these measures, it was noticed in Zone A that it is not fully safe to walk in the

Figure 8 Examples of local architectural style of mixed-use buildings in Zone A.

Figure 9 Arcades in the mixed-use buildings in Zone A in Bida Bin Ammar neighborhood.

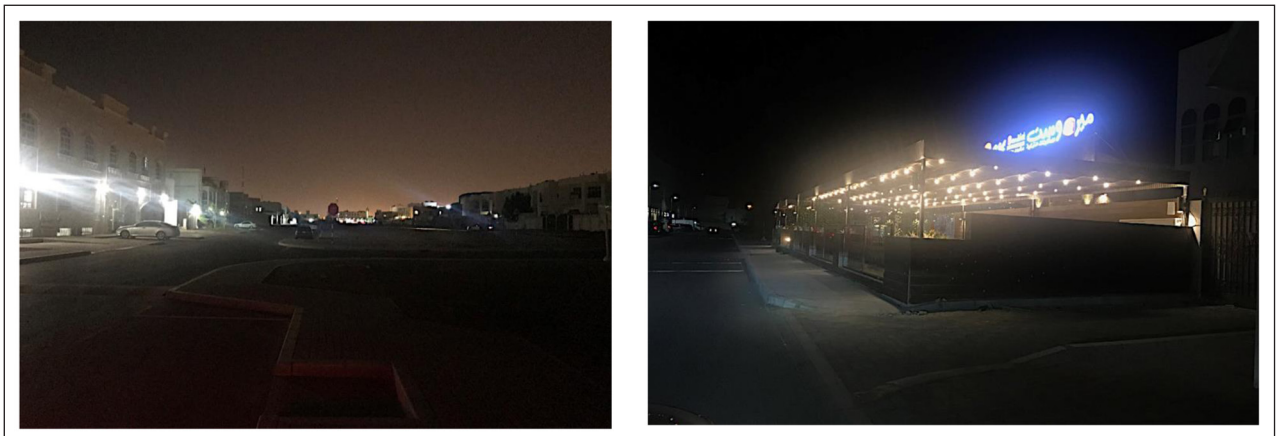

Figure 10 The poor provision of street lighting at night in Bida Bin Ammar neighborhood.

Figure 11 The lack of natural urban surveillance of the streets and *sikkas* in some internal locations in Bida Bin Ammar neighborhood.

area adjacent to the newly built mixed-use buildings because the street is significantly crowded. Many drivers temporarily park their cars to buy take-away food and beverage from the cafes and restaurants. It was observed also that the car drivers usually do not get out of their cars. Rather, they order food and beverage while they are stayed in the cars and waiting for the order to be delivered to them. They sometimes park their cars in a second row of the existing parallel parking which eventually block the traffic in the street and lead to the lack of safety in it (Figure 12).

5.8 IMPACTS ON COMMUNITY PARTICIPATION

Indicator 1: Residents' participation in the design and management of their neighborhoods: Based on the casual communications with Al Ain city municipality representatives, they confirmed that community participation in the urban densification development of the whole Asharej district including Bida Bin Ammar neighborhood was absent and the whole urban densification process was designed and led by the assigned professionals. This also applies to public participation in the design and management of the transformation process in the neighborhood. The only exception was allowing the owners of single-family housing to expand their houses horizontally by increasing the bulk rights after getting a permission from Al Ain Municipality.

6. DISCUSSION

The two main applied measures of the urban densification process as per the Plan Al Ain 2030 in Bida Bin Ammar neighborhood, the 'Intensification' and the 'Infill Development', with their application tools, have significantly impacted social sustainability in the neighborhood. The contribution of each of the two urban densification measures in attaining the principles of the socially sustainable community could be perceived as follows. First, the Intensification, as a main applied urban densification measure, has significantly contributed to increasing the built-up area in Bida Bin Ammar neighborhood especially for houses. The main utilized Intensification tools were the consolidation and horizontal extension via the increase of bulk rights and the attached/detached second dwelling. The consolidation of housing plots yielded the construction of new two-floors high apartment buildings instead of single-family houses. This resulted in the noticeable increase in the population density. The Intensification through increasing the population density has enhanced social interaction in the community which supports social sustainability as claimed by Yoo and Lee (2016). But on the other hand, the Intensification process has only focused on residential uses by developing more housing units rather than contributing to developing other mixed-use facilities. This also did not help enhance the accessibility principle.

In addition, the Intensification through consolidation by the construction of apartment buildings on the whole plot area, has increased the affordability of modern housing units (as rented dwellings) resulting in the enhancement of the Quality of Life, which is making the neighborhood a more attractive living place contributing to its quality of life as claimed by Popovic and Kraslawski (2018). This has also contributed to the provision of a mixture of housing types in the neighborhood, which as argued Perrin and Grant (2014) and Everything Connects (2014) would promote urban sustainability and resilience. The introduced variety of mixed housing in all defined urban Zones in the neighborhood has helped attract socially mixed stratum of residents and hence created healthy social interaction and integration in the community. Furthermore, the Intensification process has, in most cases, positively impacted the local identity and the sense of belonging in the neighborhood. Some features of local architectural style (colors, fenestration patterns, etc.) and introduced urban form suitable for the climate conditions (Arcades) have conserved the local

Figure 12 The overcrowded street in Zone A in Bida Bin Ammar neighborhood.

character of the community and considerable enhanced the sense of belonging as a main social sustainability principle. On the negative side, in some cases the Intensification process through the consolidation and horizontal extension via the increase of bulk rights and the attached/detached second dwelling, have adversly affected the sense of safety and security. This is chiefly because it advesly affected natural surveillance on streets and walkways, due to the high fences of the plots and the sealed balconies added to the houses' inner spaces.

Finally, the application of the Intensification tools in the case study area reflected very limited community participation through only allowing the owners to apply consolidation, horizontal expansion and/or adding attached/detached second dwelling, in their housing plots after getting the official permits from the municipality. Furthermore, the only form of tenure in the transformed neighborhood is tenancy, which gives no opportunity of the ownership of properties by the non-Emirati residents. Moreover, public housing development was not considered in any Zone of the neighborhood which made social mix even harder to achieve.

Second, the Infill Development was the dominantly applied measure of urban densification in vacant parcels in Bida Bin Ammar neighborhood since 2010. The Infill Development has significantly contributed to increasing density in the neighborhood due to its application in all five studied urban Zones. The Infill Development was intensively applied through 'demolition and reconstruction' in all Zones reflecting apparent tendency to convert single-family houses occupying a limited area of the plot, to a 100% built-up area of new apartment buildings. This goes in line with Al Ain Plan 2030 that recommended the Infill Development as a primary measure for urban densification, albeit not achieving the benchmark target of the appropriate population density, as discussed earlier. Moreover, Infill through developing vacant parcels and the 'demolition and reconstruction' processes has allowed the provision of various services for residents and hence contributed to enhancing the attainment of the accessibility principle. This, as pointed out by many scholars including Chan and Lee (2008) and Pitarch-Garrido (2018), would certainly cater for social sustainability on the local community level.

The increased density and the introduced mixed-use services and job opportunities through the Infill Development tools have enhanced residents' interaction, hence, as Garrigos-Simon *et al* (2018) highlighted, this would contribute to a more socially sustainable community. Likewise, these introduced amentias have made the study area a more attractive place for people to reside in. Moreover, the Infill Development have enhanced the sense of belonging in the study area, because the development of vacant parcels has considered the reflection of local Emirati culture through using traditional colors and architectural styles. This, as Barton (2000) argued, has a significant impact on social sustainability through respecting the unique characteristics of the neighborhood.

On the other hand, the application of the 'demolition and reconstruction' tool, that resulted in the development of several mixed-use buildings, was only applied in Zone A. This had obviously a negative impact on the neighborhood because concentrating most of the introduced services and job opportunities in one Zone have caused crowdedness in the streets and urban spaces with several associated problems adversely impacting social sustainability such as the lack of the sense of safety and the fear of accidents. The concentrated mixed-use buildings in one Zone have maintained to a large extent the reliance on the car instead of encouraging the people to walk in the other four Zones of the neighborhood. Accordingly, the avoidance of the concentration of mixed-use services and activities should be added to the discourse about urban densification and the claim that mixed-use development makes neighborhoods safer (Pendola, 2017). Besides that, the remarkable dominant reliance on private car use in the neighborhood after applying the urban densification process over10 years might be also attributed to the lack of appropriate pedestrian walkways and cycling routes in all Zones except Zone A. The existing *sikkas* are not practically used because they are not maintained as safe, shaded, and pleasant pedestrians' footpaths.

7. CONCLUSIONS

As part of the Plan 2030 of Al Ain city, urban densification implementation through the utilization of the tools of Intensification and Infill Development, has been pioneered in Bida Bin Ammar urban sprawled neighborhood since 2010, while similar urban densification processes have recently started in many other neighborhoods in the city. Determining to what extent have the implemented urban densification measures and tools succeeded in enhancing the realization of social sustainability principles in this neighborhood was the main aim of the research.

For the transformed Bida Bin Ammar neighborhood, it was expected that the resulting denser urban form would enhance the attainment of social sustainability principles. But the research investigations revealed that the urban densification process has achieved variant degrees of success in enhancing social sustainability. While many indicators of social sustainability principles have been enhanced, they have not been fully achieved, such as appropriate population density. Other principles have had paradoxical effects such as mixed-use developed

that was mainly concentrated in one Zone, and so on. These research findings have led to a developed set of guidelines which local authorities might consider when applying the urban densification measures and tools in urban sprawled neighborhoods in Al Ain city and maybe other Emirati cities, which share almost the same characteristics of urban sprawl.

This set of guidelines include *first*, raising further the gross population density in the transformed neighborhoods by introducing more walk-up residential buildings while considering a balanced distribution of the introduced activities in all the neighborhoods' defined urban Zones. *Second*, café shops and restaurants are noticeably attracting many young Emirati consumers who mostly prefer 'drive-through' way of collecting pre-ordered food, and having beverages delivered to their temporarily parked cars. So, these activities should be distributed evenly in the redeveloped neighborhood land-use plan to avoid creating a district-level, or maybe even a city-level activity hub that far exceeds the carrying capacity of the targeted neighborhood especially when locating them by the main streets. Avoiding the concentration of such popular activities in just one or two locations in the neighborhood would encourage walkability and reduce the reliance on the private car in the neighborhood. Also, drive-through lanes should be carefully designed.

Third, *sikkas* and public realm in general should be well-maintained to encourage environment-friendly modes of mobility (walkability and cycling) and to limit the reliance on car use in the neighborhood. *Fourth*, Intensification applications through the consolidation and the horizontal extension via the increase of bulk rights and the attached/detached second dwelling should be controlled to avoid adverse impact on the sense of safety and security due to the associated decrease in natural surveillance on streets and walkways associated with high fences of the housing plots and the sealed balconies. Such control should preserve a proper height of the plots' fences and windows as well as achieving a consistent architectural style for the added masses. It is also recommended to have active street frontages in all Zones to enhance the safety and security in the redeveloped neighborhood.

Fifth, to diversify types of housing tenure in the neighborhoods under urban densification, public housing units should be provided side by side with the market housing dwellings that are now by law exclusively owned or could be owned by Emirati citizens and real estate companies. *Sixth*, community participation should be incorporated with the defined urban densification redevelopment strategies and application processes. Residents of the neighborhood should be given the chance to genuinely participate in the whole urban densification process of their neighbourhoods from design to implementation and urban management. This would help meet their needs and achieve a redevelopment that is more socially sustainable.

Finally, the research-initiated framework and its findings could be perceived as a contribution that might help bridge the gap in the body of literature about urban densification as a vehicle for sustainable urban development in this part of the world, i.e., the Arabian Gulf region, which is distinguished with their urban sprawling neighbourhoods and cities. Most of the literature are dedicated to either highlighting the theoretical background of urban densification (see for example: The Swedish National Board of Housing, Building and Planning, 2017; Kruger, 2017) or analyzing case studies in other parts of the world (see for example: Permana *et al*, 2015; Attia, 2015; Mfusi, 2016; Weinschenk, 2017). In particular, by highlighting the dichotomy of urban densification as a social sustainability enhancement strategy, the research findings are envisaged to contribute to the on-going debate about urban densification as a strategy for enhancing social sustainability in urban sprawled neighborhoods, not only in UAE, but also in other countries in the region, as recommended by Yoo and Lee (2016) who raised the global need to discuss the planning policies in light of the lack of awareness about spatial elements that can affect social sustainability.

For further research, it is important to explore the attitudes and opinions of the different stakeholders, especially residents, about the social impact of the implications of urban densification measures and tools. Interviewing the decision-makers and planners in local municipalities and administering questionnaires directed to the residents of the redeveloped/under redevelopment neighborhoods seem the appropriate methods in this further research. This would rectify the limitation of this study especially in assessing some social sustainability principles such as the sense of belonging. Another field of further research is to explore the effect of the behavior of the residents and retail facilities' owners on social sustainability in the neighborhood and to recommend strategies to encourage positive attitudes and control the negative ones.

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COMPETING INTERESTS

The authors have no competing interests to declare.

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