Towards a Comprehensive Approach for Sustainable Neighborhood -The Sudanese Context

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Abstract

This paper analyzed the main factors of sustainable neighborhoods to evaluate some of the residential neighborhoods in Sudan. The main objective of this study is to highlight the importance of a comprehensive framework for assessing sustainable neighborhood developments in Sudan. Four neighborhoods in Khartoum city were selected as case study areas with socio-spacial diversity. The analysis of the neighborhoods was based on land-use profile and field observations compared with UN-Habitat principles of the sustainable neighborhood which include: the design of street networks, high density, mixed land-use, social mix, and limited land-use specialization. The research examined the current situation in these neighborhoods and their potential to become sustainable in the future. The paper found that these neighborhoods are not fully sustainable and self-contained each selected neighborhood has some sustainable principles. The analysis showed that other influential factors contributing to urban sustainability are ignored by UN-Habitat principles such as the planning pattern of the area and the inhabitants' way of living. The paper presents a comprehensive framework to assess sustainable development in neighborhoods that include in addition to the above-mentioned urban parameters other factors such as location and distance from the town center, isolation from workplaces, and accessibility to a higher level of social services.

Keywords: sustainable neighborhood, street network, mixed land use, social mix, density, services, urban form, social sustainability

1. Introduction

Rabid growth of urban areas is the biggest challenge nowadays in both developed and undeveloped countries. Therefore it is important to guide this growth in cities and towns towards sustainable development, considering the pillars of sustainability: environmental, economic, and social aspects. There cannot be sustainable development without sustainable urban development; it can be achieved using natural resources and tools such as policy, technology, and participation (Herbert Girardet, 2004). Communities have to assess the needs and resources; create clear visions and encourage public participation (Flint 2013). The English government presented a report on supporting sustainable communities and outlined eight important factors: Governance, Transport, Services, Environmental, Equity, Social and Culture, Housing, and Economy (McDonald et al 2009). Moreover, Egan emphasized the importance of the processes and responsibilities of supporting sustainable communities (Egan 2003).

The Neighborhood represents the core unit for urban planning since suggested by Clarence Perry in 1923 (Johnson 2002) and it dominated traditional planning. Afterward, it became the solution to urban sprawl as proposed by The New Urbanism (Duany et al 2000). Sustainable development policies affect people directly at the local level of the neighborhood (Mega 2007).

Three main aspects shape neighborhood are functions, places, and relationships (Barton 2000). Thus, the social sustainability of the neighborhood is the interaction between these three pillars (Shirazi and Keivani 2020). Each pillar can be measured and evaluated using specific indicators. The neighborhood pillar represents the physical qualities of the neighborhood e.g. density, mixed land use, urban pattern and street network, building typology, and quality of the center. The neighboring pillar of social sustainability can be measured by seven indicators: access to facilities, social networking and interaction, safety and security, sense of attachment, participation, neighborhood quality perception, and home quality perception. The third pillar of 'neighbors' studies the 'social

mix' of inhabitants according to socio-economic status. Bramley analyzed the relationship between urban form and aspects of social sustainability of communities, in the context of existing medium-sized British cities. He found that social outcomes relating to attachment, satisfaction, safety, and environment are more positive at lower densities and in less central locations, while outcomes relating to access to services are more positive at higher densities in central areas (Bramley et al 2009). However, sustainable neighborhood principles are high density, adequate diversity, mixed developments, Adequate space for streets, and limited land-use specialization (UN-Habitat 2014), Jabareen (2006) added the built environment design is based on the provision of green open spaces and application of renewable energies.

Metropolitan Melbourne creates the concept of 20-minute neighborhoods based on sustainable community living in a compact, integrated, and connected environment (Figure (1) Victoria Walks, 2018).

Considering the performance of sustainable neighborhoods, some scholars analyzed two eco-city districts (Royal Seaport, Stockholm, and Western Harbor, Malmo, Sweden) and they found key strategies and solutions for achieving urban sustainability comprised of design and technology supported by behavioral change (Bibri et al 2020 and Dehghanmongabadi et al, 2014). The design dimension includes greening, passive solar houses, sustainable transportation, mixed land use, and diversity (using different plot sizes and land tenure leads to a social mix of inhabitants with ranges of family sizes and family types). And the technology dimension includes green technologies (renewable sources- water), energy efficiency technologies (A wind turbine provides most of the electricity while a district-wide system supplied by a geothermal storage network provides almost all of the heating and cooling resources), and waste management systems.



Figure 1. 20-minute neighborhood

Source: (Victoria Walks, 2018)

2. Method

The methodology of the study comprises theoretical methods and field surveys. The study began with a literature review on the concept of sustainable development, and the sustainable neighborhood was defined and the main principles and features of a sustainable neighborhood were explained. Then, four neighborhoods in Khartoum city were selected as case study areas with socio-spacial diversity. A detailed survey of existing development patterns was carried out for the four neighborhoods. The assessment of the neighborhoods was based on the empirical findings of the fieldwork compared with UN-Habitat principles of the sustainable neighborhood. The final part was a proposal for a sustainable Sudanese neighborhood framework.

3. Case-Study Neighborhoods: Selection and General Profile

Four neighborhoods in Khartoum Estate are selected as case study areas: a traditional area -Aburouf, a compact area -Alryad, a socially mixed area -ElWadi Elakhader, and a first-class area- Al-Mujahideen. The socio-spatial diversity of existing neighborhoods offers many potential research areas (see figure (2)). These areas are chosen to reflect the diversity of Sudanese neighborhoods with varying planning patterns, different types of tenure of housing, and the socio-demographic profile of inhabitants.



Figure 2. Location plan of the selected neighborhoods



Figure 3. Layout plan of Aburouf



Figure 4. Layout plan of Alryad

Aburouf Neighborhood: The case study area of Aburouf (size 932,402.00 m²; population 16904) is located in the old part of Omdurman Town. It has an organic planning pattern. The area has a population density of 55.2 m² /person. The study area is laid out over short, narrow, and twisting roads; some of them are dead-end roads which make streets safe for cycling, and pedestrian-friendly (Figure (3)). It is well connected to the city through Cornish Road and Alhigra Road. Public transportation is available on the western boundary and the southern boundary including bus and mini-bus services. The majority of Aburouf inhabitants were low-income families. Mixed developments such as iron manufacturing and pottery are found along main roads especially Cornish Road (Figure (5)). The social interaction between neighbors is enhanced by the urban form. Buildings are close together and most plots accommodate extended and composite families. Social life comprises evening gatherings, children playing, and sometimes eating taking place on streets and alleys. There is no major public green space or public

playground within the neighborhood. The neighborhood suffers from problems related to old areas such as deficiency in basic services (water supply and electricity) and most buildings need replacement(Figure (6)).



Figure 5. Mixed functions (wood trade and pottery) along main roads



Figure 6. A decaying house built of Jaloose

Alryad Neighborhood: The case study area of Alryad (size 2,800,000 m²; population 12,797) is located in Khartoum town. The area has a population density of 218.8 m²/person. The study area has mixed development. Different building typologies are observed, from single detached villas to multi-storied flat complexes. The neighborhood has a grid-iron planning pattern (figure (4)). The main service area is located at the center of the area. The field survey revealed mixed developments (administrative and commercial) found in the neighborhood along the main streets. The study area is laid out over well-interconnected arterial routes and local streets (Figure (7)). Public transport is available on the peripheral streets. The study area is rich in terms of open spaces and playgrounds but most open spaces are not developed. Most inhabitants are high-income families; there is no social mix of different income levels. The neighborhood accommodates a lot of social services (schools, health centers, shops, etc.), even more than the need of the residents. Houses are available in different tenure types. The area suffers from the congestion of streets, shortage of parking, and problems with basic services (Figure (8)).



Figure 7. Selling hot drinks along streets and open air seating



Figure 8. shortage of parking area in front of a mixed use building(restaurants and café)



Figure 9. Layout Plan of ElWadi Elakhader



Figure 10. Layout Plan of Al-Mujahideen

El Wadi Elakhader Neighborhood: The case study area of ElWadi Elakhader (size 683,280 m²; population 4,381) is located North-East of Khartoum North town. The area has a population density of 156 m² /person. The planning pattern of the neighborhood is a systematic gridiron with the main service center in the middle of the area (figure (9)). The community contains mixed housing, 58% of the houses are low-cost houses, 37% are economic houses, and only5% are developed houses (Figure (11)). It has a social mix of different income levels - low-income and middle-income families. The field survey revealed the mixed developments found in the small shopping area (Figure (12)), the block factory, and the sweet factory in the neighborhood. More functions are needed to provide more job opportunities for the local inhabitants. The neighborhood benefits from 4 medium sizes and 32 small size open spaces distributed evenly within the total area. Unfortunately, all of them are undeveloped. The area has a peripheral location and it lacks good transport connectivity with other parts of Khartoum Estate. Also, social services are insufficient.



Figure 11. View of developed houses



Figure 12. Part of the shopping area

Al-Mujahideen Neighborhood: The case study area of Al-Mujahideen (size 900,000 m²; population 5552) is located in Khartoum town. The area has a population density of 162 m² /person. The planning pattern of the neighborhood is a systematic gridiron without service centers (figure (9)). The field survey noticed that social services are located along main streets e.g. Alburaai Street. The area developed as a first-class residential area with villa-type housing. Most houses contain courtyards. The field survey revealed that the mixed developments found along Soba Street – cars galleries and office buildings e.g. Dal headquarters. The neighborhood has 18 identical open spaces some of which are developed by community participation. Public transport is available only on the Northern boundary along Soba Street. The area lacks educational and healthcare facilities. The big challenge facing the neighborhood is incremental development. Some plots are not developed yet, so they cause environmental and health hazards e.g. squatter settlements (Figure (13)) and garbage collection sites (Figure (14)).



Figure 13. A squatting shelter built in a vacant plot adjacent to a first class villa



Figure 14. A vacant plot used as a garbage collection site

Neighborhoods	Aburouf	%	Alryad	%	ElWadi Elakhader	%	Al-Mujahideen	%
Total Area (m ²)	932,402	100	2,800,000	100	683,280	100	900,000	100
Streets	158,508	17	765.380	27.4	210,773	31	200,200	22.2
Services	55,944	6	387,900	13.8	45,012	7	51,600	5.7
Open Spaces	17, 304	1.7	107,000	3.8	42,372	6	28,800	3.2
plots	70,060	75.3	1,540,000	55.0	385,122	56	620,500	68.9



Figure 14. Land-uses profile of the selected neighborhoods

4. Discussion

A comparison between neighborhoods' land-uses profile and findings of field survey with the UN-Habitat five principles of sustainable neighborhood planning is presented in Table (2):

Principle	Formula	Optimum	Aburouf,	Alryad	Elwadi	Al-
		percentage	-		alakhdar	Mujahideen
Adequate space for	Street land-use	(30-45)%	17%	27.4%	31%	22.2%
streets	Street land-use		1770		5170	
High density.	Dopulation donsity	66	55 2	218.8	156	162
m ² per person	I opulation density		55.2		150	
Mixed land-use.	Economic use	(40-60)%	30%	55%	15%	25%
Social mix.	Low-income	(20,50)0/	75%	0%	500/	0%
	housing	(20-30)%			38%	
limited land-use	Residential floor	10%	709/	40%	2 00/	60%
specialization	area		/0%		0070	

Table 2. Neighborhoods profile compared with the UN-Habitat Five principles of sustainable neighborhood planning

Adequate Space for Streets: Principle one deals with the suitable planning and design of street networks for people and cars. The principle recommends that roads and parking accommodate at least 30 percent of the total land of the neighborhood, and open public spaces accommodate at least 15-20 percent. When applying this recommendation to the land-uses profile of the selected neighborhoods (see table (2)). ElWadi Elakhader has sufficient area for interconnected roads -31% of the neighborhood area. Alryad neighborhood has also a sufficient area for roads but reduced little from the optimum percentage -27.4%. Unfortunately, Al-Mujahideen and Aburouf neighborhoods have a lower percentage than the optimum percentage of land allotted for street networks. Regarding open public spaces; all the neighborhoods have lower percentages than the optimum percentage.

High Density: Principle two focuses on population density. The principle recommends achieving high density to prevent urban sprawl and promote sustainable urban extension. It defines a minimum of 150 p/ha- 66 m² per person for a sustainable neighborhood. When applying this recommendation to the land-uses profile of the selected areas (see table (2)). Aburouf is the only neighborhood that has a high density of -55 m² per person which is higher than the optimum percentage. Alryad has a low density of 218.8 m² per person even though building density in Alryad is very high as most buildings' height is more than 3stories. The other two neighborhoods have fewer densities.

Mixed Land-use: Principle three focuses on raising the number of mixed developments within residential areas. The principle recommends residential floor area ranging from 30 to 50 percent and economic floor area ranging from 40 to 60 percent. When applying this recommendation to the findings of the field survey of the selected neighborhoods, Alryad is the only neighborhood that has the optimum percentage - 55% of economic use. Alryad was developed as a commercial and administrative area in addition to its main function as a first-class residential area. Although Abrouf has mixed–use functions (wood trade, the manufacture of iron products and pottery) located along The Cornish Road, the percentage of floor area for economic use is only 30%. ElWadi Elakhader and Al-Mujahideen neighborhoods have lower percentages than the optimum percentage.

Social Mix: Principle four focuses on the social equity of different economic classes in the same area by providing different types of housing. The principle recommends low-cost housing that accommodates 20 to 50 percent of the residential floor area. When applying this recommendation to the findings of the field survey of the selected neighborhoods, Aburouf and ElWadi Elakhader have higher percentages (75% and 58%) of low-cost housing than the optimum percentage. Different building typologies are observed in Aburouf but the majority are single detached houses inhabited by low-income families while the majority in ElWadi Elakhader are semi-detached houses with few single detached houses. Thus the neighborhood has a social mix of different income levels – low-income and middle-income families. Alryad and Al-Mujahideen neighborhoods are inhabited by high and middle-income families. There is no low-income housing in these neighborhoods.

Limited Land-use Specialization: Principle 5 focuses on the land use aspect and prevents the single use of buildings to encourage mixed land-use. The principle recommends that single-function blocks should cover less than 10 percent of any neighborhood. When applying this recommendation to the findings of the field survey of the selected neighborhoods none of these neighborhoods have the optimum percentage of limited land use specialization. All the selected neighborhoods have residential floor areas in each block ranging from 40% to 80%.

5. Conclusion

The paper concluded that each selected neighborhood has some sustainable principles. Aburouf Neighborhood has a high density of -55 m² per person and a social mix of inhabitants -75% low-income housing. Alryad Neighborhood has adequate space for streets -27.4% and mixed land uses -55%. ElWadi Elakhader Neighborhood has adequate space for streets -31% and a social mix of inhabitants -58% low-income housing. Al-Mujahideen Neighborhood has mixed land uses - 25% and to some extent adequate space for streets -22.2%.

Most importantly, the analysis revealed other influential factors that contribute to urban sustainability which is not included in UN-Habitat principles. The planning pattern of the area has a crucial role in achieving better social sustainability and different planning patterns have different effects on social sustainability. The layout of the streets, open spaces, and plots can contribute to the interaction of people with their neighbors e.g. inhabitant interaction is enhanced at the street level – narrow twisting roads and alleys are not attractive for traffic and open spaces facilitate inhabitants' gatherings. Another important factor is the inhabitants' way of living which affects their relationships and feelings e.g. neighbors eat Ramadan meals together in the streets.

However, some sustainable urban factors depend on the layout of the area such as:

- provision of daily needs within accessible distance. Notably, sometimes provision of services and amenities in urban communities can vary based on location, political influence, and legal status.

- provision of good transport, and the availability of green spaces, Therefore, efficient planning patterns would lead to more sustainable neighborhoods.

Other sustainable urban factors depend on the socioeconomic characteristics of inhabitants such as population density, income levels, and family types. Therefore, good community participation and involvement are crucial factors in creating sustainable communities. It is effective to create an inclusive planning process that involves residents, community leaders, civil society organizations, technical experts, and city officials.

So that the paper recommends identifying key challenges facing sustainable development in these neighborhoods and then encouraging community members in all four neighborhoods to invest their own time, money, labor, and political support to solve problems. All these factors reflect in the sustainability of the community regarding attachment to the neighborhood and satisfaction with the home.

The paper recommends an integrated framework for a sustainable neighborhood to measure both physical and nonphysical dimensions of the built environment. The proposed comprehensive approach includes in addition to the above-mentioned UN Habitat principles other urban parameters such as

-Location: Distance from the town center (km), isolation from work, and accessibility to a higher level of social services e.g. secondary schools.

-Political management and community participation: Acquisition of land, urban design, construction materials, financing, and community participation.

-Urban morphology and typology: Population density (m^2 /person), street networks and open spaces, mixed land use, social mixture, and mixed housing.

-Urban mobility: Public transportation, Car ownership, Bicycle paths, Pedestrian ways, Road hierarchy, paved roads.

-Access to social infrastructures: Public schools, public health services, recreation facilities-clubs, religious facilities, shopping areas, and security points.

-Sustainable basic infrastructures: Green technologies, solar energies, rainwater drainage system, sewage system, water supply, and garbage collection.

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