

## Sustainable Neighbourhood Development Principles: A Comparison Between Sudanese Planning and Building Regulations with LEED-ND

Mayada Abdelrazig

Faculty of Architecture and Planning Sudan University for Science and Technology

E-mail: [Mayada.abdelrazig5@gmail.com](mailto:Mayada.abdelrazig5@gmail.com) Mobile 00429123062683

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### ABSTRACT

Neighborhoods have great potential in terms of their contribution towards sustainable development. Planning and building regulations, as compulsory legal and administrative framework, are one of the most influential aspects in achieving neighbourhood sustainability. Challenges of attaining sustainable neighbourhood in Khartoum raised the question of this research “*Can the current planning and building regulations achieve sustainable neighbourhood development?*” To address this question, the research objective was to identify the potential of local planning and building regulations to achieve international sustainable neighbourhood principles. The adopted method was critical literature review to identify key sustainable neighbourhood design principles that might be included in planning and building regulations, also promote sustainability. Leadership in Energy and Environmental Design for Neighbourhood Development (LEED-ND), was chosen as a benchmark. It is a pioneering institution in sustainable neighbourhood design and is applied worldwide. The content of current Sudanese planning and building regulations were examined against LEED-ND criteria. The results indicate that local planning and building regulations did not integrate all LEED-ND prerequisites; however they did meet many credit requirements. So, the paper recommended re-writing of planning and building regulations in Khartoum to promote and introduce sustainability principles in them. In addition, it is important to note that, local planning and building regulations should continue to evolve and improve over time regardless of the expected difficulties via inter-stakeholder collaboration and ongoing modifications.

## Introduction:

Neighbourhood is considered the basic component in the urban fabric. It is identified in terms of physical elements representing the area where people live or in terms of the social elements, community representing residents who live within particular areas, Patricios, (2002). It has been suggested that achieving sustainability at the neighbourhood scale ensures achieving sustainability at the level of the whole of the city, Sharifi & Murayama (2013), Garde, (2009); Berke, (2008), Chogill, (2008). Sustainability is not a single and well-defined concept, the most famous definition by the Brundtland Commission WCED (1987). The Rio Earth Summit 1992 outlined in Agenda 21 guiding principle for urban sustainability such as sustainable transportation and energy, shelter for all, combating poverty, community empowerment, conservation of historical and cultural heritage, and enhancing responsible fiscal policies Holel, et al, (2008). There is no one sustainable model, it is depending on the context. So every neighbourhood has its own process to achieve sustainability. Farreny et al, (2010). Choguill (2008) defined sustainable neighborhood as “a neighborhood which can achieve economic, social, technical and environmental sustainability”

Numbers of environmental, social and economical sustainable principle have been developed to illustrate the features of sustainable neighbourhood, Berardi (2013), Spinks, (2013). On the other hand, numbers of sustainability assessment tools in the neighbourhood scale have been designed in the beginning of the years of the 21<sup>st</sup> century, in number of the developed countries and become worldwide spread, some examples of these tools are; Leadership in Energy and Environmental Design for Neighbourhood Development (LEED-ND), the UK BREEAM Communities, and the Japanese CASBEE-UD, Haapio (2012), Sharifi & Murayama (2013) The aim of designation of such tools is to evaluate the success of neighborhoods in addressing sustainability goals, these, frameworks have strong associations to their original national contexts, Haapio (2012), Garde (2009).

In general, there are two main approaches to deal with sustainability; The Top Bottom approach and The Bottom-Up approach. The Top-Down approach depends on the development of policies, strategies, and standards initially then the community has to respond to them, while the Bottom-Up approach depends on public and professional awareness accomplished with continuous feedback process. The former approach is argued to be evaluating approach while the latter is more informative and gives the advantages of developing a sense of responsibility toward the environment, Salama, (2002). However, both approaches have gaps and need interpretations, this study deal with the top-bottom approaches as laws and regulations are considered essential for achieving sustainable neighbourhoods. They organize and meet the needs of the community and individuals for the public benefit Salama, (2002).

Urban planning and design is vital for achieving neighbourhood sustainability, Chogill, (2008), however, various planning approaches have negative consequence on the sustainability of neighborhoods. Some examples of these approaches at the local levels are:

-Urban sprawl, leapfrog and adopting low density planning approach made the metropolis to expand horizontally, increase the cost of services, distances the poor from appropriate habitat, infrastructure, and job opportunities, and increase the financial burdens on the poor as they have to pay more for transport and essential services. (UN, Habitat, 2009)

-the conventional land division approach of the three land classes that depends on the economical ability of the residents Nageeb, M, (2008), and adapting sector policy and segregation, lead to socio-territorial fragmentation and isolation of the poor in vast isolated sectors, highly densely,

and lacking many significant services and chances for jobs opportunities UN, Habitat,(2009). This study tried to identify the content of the planning and building regulations that promote or discourage neighborhoods sustainability in Khartoum. It tries to evaluate planning and building regulation in Sudan in terms of their ability to attend goals of sustainability. It pose the following questions; “*Can the current planning and building regulations achieve sustainable neighbourhood development?*” To address this question, Leadership in Energy and Environmental Design for Neighbourhood Development (LEED-ND) was chosen as a benchmark to evaluate the content of current Sudanese Planning and Building Regulations(SPBR). The value of this study it tries to highlight the main items in the SPBR that promote or discourage neighborhoods’ sustainability. From that information, programs can be designed that will help refining SPBR in a more constructive way. Findings of the study will be valuable to policy makers, planners and researchers.

### **Methodology:**

To provide insights into the current situations; highlighting the strengths, weaknesses, successes, and failures in SPBR, Rules and regulations of neighbourhood in Sudan are elected and measured against the LEED-ND criteria of assessing neighbourhood sustainability. (LEED-ND) was elected as benchmark as it is a pioneering institution in sustainable neighbourhood design and is applied worldwide.

Using a content analysis, the issues of sustainability coverage; principle for site selection, Pattern and design of Neighbourhood and Green Infrastructure and Buildings is governed by a number of laws such as;

- *The Urban Planning and Land Disposal Act of 1994*
- *The Organization of Building Regulations for the State of Khartoum in 2008.*
- *Town and Building Regulation ACT (1956), ( post, 1996)*
- *Environmental protection law (2001)*
- *Health environment law (2009)*

Other standard include;

- *National Guide for Urban Planning(2004 )*
- *Urban Planning Guide (1999)*

SPBR is examined againstprerequisites and credits in LEED-NDrating system. LEED-ND was originally organized into three basic sections each of them has prerequisite and number of credits.

Items in SPBR are measured against prerequisite andcredits in LEED-ND in terms of their inclusion. The rating system in LEED-ND is ignored.The mere inclusion of similar criteria does not assure their achieving sustainability. Differentiate between the inclusion and the destination is needed. This is discussedlater in details.

### **Overview of LEED-ND principles for sustainable neighbourhood design:**

LEED-ND is the latest series of the U.S. Green Building Council's (USGBC) assessment tools which was developed in partnership with Congress for the New Urbanism (CNU) and the Natural Resources Defense Council (NRDC), launched in 2007. USGBC, (2009). The former versions of LEED rating systems focus mainly on green building practice, while the latest version LEED for Neighbourhood Development launched, in 2009, give emphasis on site selections and design USGBC, (2009). LEED-ND adapts Rating System that assess a score value for each element. Theoretically weighting is controversial aspects, scoring and weighting

different criteria argued of being exposed to subjectivity, in addition to ranking and compare different elements is difficult. Again LEED-ND, is argued of not covering the three aspect of sustainability equally, giving emphasis on the environmental aspect in contrast to economic and social aspect that receive little attention in LEED-ND weighting system Sharifi& Murayama, (2012).

Despite the controversy on the efficiency of the tool of assessing goal of sustainability comprehensively, it has remained one of the most widespread assessment tools, and participate in raising the environmental level of awareness among community professionals. At present time LEED-ND has certified over 100 projects, another 135 projects are registered, and 31 local and state governments and federal agencies are using LEED-ND to promote green neighbourhood-scale development, Sharifi& Murayama, (2012).

The LEED-ND 2009 for Neighbourhood Development Rating System initially address three topics, each of them have a number of condition to be met in order to achieve the goals of sustainability; LEED-ND was initially organized into three basic sections in 2009; Smart Location and Linkage (SLL); this set out principle for the development location, its' facilities/infrastructures and preservation of nature USGBC, (2009).

Neighbourhood Pattern and Design (NPD); give guides on what to build, this include utilizing sustainable measures in the layout design of neighbourhood considering matters such as transportation and walkability, mixed use, diversity of houses types, convenient public spaces, compact development and community-based food production USGBC, (2009),it is for social interaction social cohesion social involvement and enabling.

Green Infrastructure and Buildings (GIB); specifies how to manage environmental impacts, though setting out principles for optimal sustainability delivery for water, energy, waste, etc., Conservation of historic land mark, as well as optimal green building technologies Garde, (2009).

Later, two additional sections were introduced in 2014. Innovation and Design Process (IDP); focuses on exemplary efficient performances in the built environment, LEED-ND providing points for items not addressed by the current rating system. Regional Priority Credits (RPC); focuses on promoting communities in the achievement of credits that address geographically specific environmental, social equity, and public health priorities.

#### **Result:**

#### **Comparison between SPBR and LEED-ND**

##### *Smart location and linkage(SLL)*

SPBR were measured against three major theme of LEED-ND; Smart Location and Linkage (SLL), Neighbourhood Pattern and Design (NPD) and Green Infrastructure and Buildings (GIB). The result indicated that of the total ( 53) sub-item in the LEED-ND, only 16 elements were addressed in SPBR. The overall alignment of SR with LEED-ND is not good, it does have some deficiencies. The SR did not respond well to LEED-ND that in (SLL) only Seven out of fourteen items are addressed, in (NPD) eight out of eighteen items are addressed, and in (GIB) only four out of twenty-one item are addressed, this also indicate that the LEED-ND is covered wide spectrum of issues.

**Table 1** illustrated that Smart Location and Linkage (SLL) in the LEED-ND rating system is consisted of 14 sub item, 6 of them described the criteria of developing location efficiency and transportations. SPBR did address only three of the LEED-ND prerequisite and sub items in this section. More over the criteria of design with nature is consisted of 8 sub item, only 2 credits were mentioned in SPBR, noting that the present of some items in the SPBR do not indicate similarity to the LEED-ND sub items.

Table (1) number and percentage of LEED-ND items (SLL) in SPBR (Author)

criteria	NOT ADDRESSED				ADDRESSED			
	Prerequisite	N	Credit	N	prerequisite	N	Credit	N
Smart location and linkage (SLL)	Development location efficiency and transportation	-Smart location	1	-bicycle facilities -housing jobs priority -preferred location -brown field remediation -access to quality transit	5			
	Design with nature	-Umpired species and ecological communities' consideration	1	-long term conservation management of habitat of wet lands and water bodies -restoration of habitat of wet land and water bodies	2	-agricultural land considerations -floodplain avoidance -wetland and water body conservations	3	-steep slopes protection -site design for habitat of wet land and water body conservation
			2		7		3	2

*Neighbourhood Pattern and Design (NPD)*

In table 2 illustrated that there was incompatibility in SPBR with LEED-ND in Development location efficiency and infrastructure, while the SPBR address only two, “walkable street” as prerequisite and one credit of the items of this section. Neighbourhood Pattern and Design (NPD) in the LEED-ND rating system is consisted of 5 criteria and 18 sub item, 7 sub items described the criteria of transportation and walkability, 2 on diversity of houses types, 6 on Mix-use neighbourhood convenient public spaces, 2 on compact development and 1 criteria on Community involvement. The SPBR mentioned only 4 items relating to Mix-use neighbourhood convenient public spaces and 2 two sub items on compact development. NPD section was not covered well by SPBR, except of convenient public spaces and compact development categories, which were fairly covered in SPBR in comparison with LEED-ND items, as it was shown in table (2).

There is absence of green construction in SPBR. This is a section not well covered by SPBR. GIB is related to resource efficiency, conservation of nature, and conservation of historic land mark as it in table (3). Of the key items identified in LEED-ND, there is absence of green construction in SPBR, It is important to note, that none of item ‘resource efficiency’ were addressed by zero out of eleven items.

Table (2) number and percentage of LEED-ND items (NPD) in SPBR (Author)

criteria	NOT ADDRESSED				ADDRESSED				
	Prerequisite	N	Credit	N	prerequisite	N	Credit	N	
Neighbourhood pattern and design (NPD)	Development location efficiency and transportation	-connected and open community	1	-connected and open community	4	-walkable streets	1	-walkable streets	1
	Diversity of house types			-transit facilities -transportation demand management -reduced parking footprint -Vitality and universal design	2				
	mix-use neighbourhood and conventional public spaces			-housing types and affordability -tree-lined and shaded street spaces -community based food production	2			-mixed-use neighbourhood -access to civic and public spaces -access to recreation facilities neighbourhood school	4
	Compact development					-Compact development		-compact development	1
	Community involvement			-community outreach and involvement	1				
		1		9		2		6	
<i>Green</i>	<i>Infrastructure</i>				<i>and</i>		<i>Building(GIB)</i>		

In the table 3 below demonstrated Green Infrastructure and Buildings (GIB) in the LEED-ND rating system. It consisted of 4 prerequisite and 17 credits. None of the 11 sub items in LEED-ND resource efficiency' prerequisites and credits were addressed in SPBR. Conservation of historic building and building reuse was well identified in SPBR while 3 items of total 8 prerequisites and credits relating to Environmental conservation were mentioned in SPBR.



Table (3) number and percentage of LEED-ND items (GIB) in SPBR (Author)

criteria	NOT ADDRESSED		ADDRESSED					
	Prerequisite	N	Credit	N	prerequisite	N	Credit	N
Resource efficiency	-certified green building	3	-certified green building	8				1
	-minimum building energy performance		-optimum building energy performance					
Environmental conservation	-indoor water use reduction		-indoor water use reduction					
			-outdoor water use reduction					
Conservation of historic building and building reuse			-solar orientation					
			-renewable energy production					
Green infrastructure and building (GIB)			-district heating and cooling					
			-infrastructure					
			-rain water management	5	-construction activity	1	-minimize site disturbance	2
			-heat island reduction		-prolusion prevention		-solid waste management	
			-recycle and reuse infrastructure					
			-light pollution reduction					
			-waste water management					
			-building reuse	1			-historic resource preservation and adaptive reuse	1
		3		1		1		3
				4				

**Discussions:**

*Smart Location and linkages' themes coverage in SPBR and comparability*

From above comparison, the paper find that local planning and building regulations did not integrate all LEED-ND prerequisites of the development location and its' facilities/infrastructures and Preservation of the nature, however they did meet several credit requirements. For the item of site selection for development, guidelines in the National guide for urban planning NGUP (2004) are limited to three points, namely the selection of sites that are easy to develop, avoiding sites exposed to floods or which were a garbage dump, it can be rehabilitate to gardens instead, NGUP, (2004). In according to infrastructures some specifications and measures of the streets are mentioned, UPG, (1999) .These specifications are limited to classification of three types of streets in NGUP, (2004) including: secondary streets connect the neighborhoods, The local streets link the property to secondary streets and corridors reach the property, while the UPG (1999), mentioned that the percentage 15% -20% of planned area is recommend for streets and field, at the same time indicate specifications for the street width with a relative difference in the names and sizes mentioned in NGUP.In accordance to preservations of the nature all that is found in these regulations is related only to secure and protect the urban development from flood risk or prevent developments in areas subjected to flood, Wetland and water body conservation, agricultural land conservations and Steep slope protection.From here it should be noted that the SPBR encourages the selection of sites that are easy to develop without putting restrictions identify city boundaries and to controls urban sprawl and leapfrog. The current applied planning approaches adopting low density encourage urban sprawl and leapfrog, the SPBR do not tackle these aspects appropriately. Increasingly urban sprawl is seem

as contrary to sustainability, LEED-ND principles which were based on principles of smart growth, giving emphasis on preventing urban sprawl; Housing jobs proximity, Preferred locations, Brownfield remediation, compactness are some examples for LEED-ND principle to manipulate urban sprawl. None of the items in SPBR deal with this aspect. The planning approaches currently underway in the capital encourage the spread of the city horizontally; urban sprawl, leapfrog and adopting low density planning approach made the metropolis to expand horizontally, increase the cost of services, distances the poor from appropriate habitat, infrastructure, and job opportunities. UN, Habitat, (2009). Historically, in 1908, Mc Leans carried out a “master plan” for the capital Khartoum exercise targeted a population of 100,000 inhabitants in a total urbanized area of 11.5 km<sup>2</sup>, implying a gross density of 87 persons per hectare. that defined an urban boundary, to avoid urban sprawl. Definition of the urban boundary through a surrounding wall was well addressed in that master plan. The subsequent master plans of Khartoum adopted the same schematic pattern but did not take the issue of the urban sprawl into consideration, and dismissed the city boundary, and adopted low density. This successive master plans of Khartoum city included; Dioxidais in 1960, Mefit in 1975 and Doxiadus (M of H and PU) in the 1990s, that proposed densities as follows; 15, 23 and 37 in-habitants per hectare respectively. Dioxidais in 1960 targeted 700,000 inhabitants in 182km<sup>2</sup> applying a density of 15 in-habitants per hectare, Mefit applied the density of 23 in-habitants per hectare. while Doxiadus 2 (M of H and PU), targeted 5.3 million inhabitants in an area of 1,441 km<sup>2</sup>, reaching a density of 37 inhabitants per hectare. The latest master plan 2000-2007 repeated typical previous planning pattern, but introduced new modalities to deal with rapid urbanization such as; the preplanning schemes to settle the growing numbers of migrant in traditional urban village around the boundary of the city, applying major high roads and road networks to link newly neighbourhood to the city center. The master plan of 2000-2007 targeted 7 million inhabitants in an area of 1650km<sup>2</sup> applying a density of 42 in-habitants per hectare.

#### *Neighbourhood pattern and design' themes coverage in SPBR and comparability*

Research finding suggest that a large portion of the Neighbourhood Pattern and Design (NPD) sub-category criteria concern physical planning at the neighbourhood scale are not well identified in SPBR. The items mentioned in the local regulations relating to the design of the neighbourhood residential areas are limited to the following: *Transportation and walkability*: NGUP, (2004) and UPG, (1999) mention some specifications and measures of the streets. Classifying street into; secondary, local streets corridors (for pedestrian), and recommend the Percentage of 15% -20% of the area of the scheme for roads and open spaces. It should be noted that SPBR. Sustainability principles are integrated and each theory is linked to the other. For example, to ensure that streets achieve environmental, social and economic sustainability, a detailed design of the streets must be illustrated, such as containing shaded areas, sitting facilities and means of preventing vehicular access to pedestrian streets. On other hand *SPBR* emphasis on the provision of convenient public spaces), UPG, (1999) and NGUP, (2004) recommend (a Local - Centre) in each neighbourhood including: is: basic schools, secondary schools, neighborhood mosque, local market, squares and clubs, social and cultural centers, health center and clinics, and administrative and security offices. In the NGUP, (2004) the following ratio 60% of the area is for residential plots, and the rest is for services, roads, and open spaces is recommended, and the Minister of physical planning has the power to change the use of public spaces and squares for any purpose if the need arises.

Though the convenient public spaces, were fairly covered in SPBR in comparison with LEED-ND items, as it was shown in the above table (2). It should be noted that the designations of



public spaces and squares need to apply comprehensive strategy to provide greenery, shaded areas, and sitting facilities. also “access to civic and public spaces” LEED-ND requirement is the proportion of building distances located within the required 400m (1¼ mile) walking distance of public parks and plaza but this is not exactly what addressed in local regulations. “Connected and open community” is an example of prerequisite not address by SPBR the requirement of this item includes surrounded connectivity, the connectivity requirement must be available for general public use and not gated, connectivity within ¼ mile (400 meters) of the project boundary is at least 35 intersections per square kilometer. Internal connectivity is at least 54 intersections per square kilometer also “mixed-income diverse”, and “transit facilities”, Tree-lined and shaded streets “are example of the not addressed NPD topics. Intensive bodies of knowledge indicate a strong relationship between the detail design of public spaces and squares and the way people inhabit or non inhabit those parks. Whyte, W (1980). So it is recommended that SPBR should integrate such design details and conditions in more details.

SPBR adopt dual land uses approach, in contrast to LEED-ND that put emphasis on mixed land uses, providing diversity of housing types, covenant open spaces. SPBR do not encourage mixed uses in neighbourhood, NGUP defines the single use of residential area with utilities and public services. NGUP, (2004). The Buildings regulation 2008 allows the use of 25 m<sup>2</sup> of any residential plot for commercial purposes. Physical planning guidance UPG (1999) state that it is not allowed to design shops in residential neighborhoods in the area of 500 square meters of markets, except for the commercial streets. By the law Article (16): (1) In case of changing the use of any land which is owned as a free property in accordance with the requirements of the plan directed to a region, the "State Committee for Urban Planning" may determine the value of improvement allowance for land use change. More over Planning and distribution of land in residential neighborhoods is based on the classes system (first, second and third ). According to this classification the first class areas have the bigger plot areas and higher standard for building materials and buildings heights, whereas the third class have the least plot areas and lower standard for building materials and buildings heights. This land classification is based on the economical ability of the stakeholders and their ability to develop the plot. Nageeb, M, (2008). This economical system of land distributions tend to push the poor out of the city fabrics where lands is available at reasonable prices but results social segregations, and fragmentation in the urban fabric, creating tensions among neighborhoods. UN-Habitat,(2009). This has consequence such as social segregations, and fragmentation of the urban fabric, putting burdens on the poor as they have to spend more in transport and essential services. So the aspect of mixed uses and diversity of housing types need to be integrated in SPBR.

*Compact development* is fairly covered in SPBR. In this regard NGUP,(2004) set out some standard for plot sizes in relation to the three land classes mentioned above, this include the following; the first class 400-600m<sup>2</sup>, in the second class plot 350-500 m<sup>2</sup>, and 200-350m<sup>2</sup> .for class three. Planning and building regulations adjusted maximum building heights of building to ground with four floors for grade 1,2 , and ground with three floors for grade 3. The by-law 17(1) states that the percentage of coverage shall not exceed 75% for plot less than 1000m<sup>2</sup>, The by-law 17(3) states that the buildings should be situated in the plot in a way that the setback from the boundaries of the northern or southern adjacent plots in relation to building height (approximately is equal to third of the building height), but not less than 2.5m in any case. Also By law states that set-back should be not less than 1.5m of the boundaries of the eastern or western adjacent plotson other hand.

### *Green building and infrastructure' themes coverage in SPBR and comparability*

Nothing was specified in related to building regulations regarding the sustainability criteria including in relation to building material, room size and climate comfort.

#### *Low levels of Similarities between LEED-ND and SPBR*

The study found that the SPBR are divided into several separate documents issued by different parties. They have not been developed by an advisory team or developed by coordinated advisory bodies. And no specific guiding principles appear in the whole regulations that appear for example in the slight different between two or three documents that determine streets width NGUP, (2004). Also the regulations documents are very difficult to be read not focused and have no oriented visions. Whereas LEED-ND, as it have been mentioned earlier in this paper, was created by three organizations: the US Green Building Council; the Congress for the New Urbanism; and the Natural Resources Defense Council, and developed a rating system for neighbourhood planning and development based on three principles: green infrastructure and building; New Urbanism; and Smart Growth USGBC, (2009).

Moreover, Some Sudanese regulations rely on reference to the State Planning Committee in certain items, for example, in the case of a changing land use, approved after the Committee's decision, which is not found in LEED-ND.

The study has some limitations as the study applied three theme out of five theme in the LEED-ND, this included; Smart Location and Linkage (SLL), Neighbourhood Pattern and Design (NPD) and Green Infrastructure and Buildings (GIB). Two theme that were introduced later in LEED-ND 2014 was excluded these are; Innovation and Design Process that focuses on exemplary efficient performances in the built environment, and Regional Priority Credits that focuses on promoting communities in the achievement of credits that address geographically specific environmental, social equity, and public health priorities, as the study concentrating on SPBR the aspect in the first three themes were quite fair. Other limitation on applying LEED-ND, as bench mark is that LEED-ND is argued of not covering the three aspect of sustainability equally, giving emphasis on the environmental aspect in contrast to economic and social aspect that receive little attention in LEED-ND weighting system Sharifi & Murayama, (2012). Further, there are many constraints, lie extremely economic problem (poverty). The LEED-ND rating system may be incompatible with local sustainability objectives stemming from local conditions. Thus, it is not able to use LEED-ND by one simple way, limitation observed was the inability of the rating system to address local context and conditions. The study doesn't need to take the LEED -ND as it is, because there have significant differentiation between context for example, was inflexible in addressing local context for example "imperiled species and ecological communities" not relevant to Khartoum context, "bicycle facility" a cultural issue in local Khartoum instead of it there is "Ragsha" it use less energy than car and facilitate transportation, there may be regulation to provide and facilitate its work. The "community-based food production" not possible to integrate in regulations as the price of land and sprawl, and "walkability", so we only take it as a guide from it. Also, LEED-ND is not mandating while the SR are mandating so some items in LEED-ND could not be as regulations for example "certified green building", and "renewable energy production". It is clear that the SPBR are old and not consistent with new issues like sustainability.

As illustrated above using LEED-ND as assessment tool has some limitations, so further study to develop new assessment tool responding to local requirements and addressing principle of

sustainable neighbourhood consistency is recommended. Also, the study deal with the top-bottom approaches, so further study that focused on the Bottom-Up approach is recommended.

#### **Conclusion and Recommendations:**

In many ways, this review of the comparison of SPBR with LEED-ND is a study in variation: variation in the format and content of the LEED-ND and SR, variation in how often sustainable neighbourhood principles appear in the LEED-ND and SPBR, variation in the use of LEED-ND as voluntary tool and SPBR as regulation as a tool of sustainability. At the same time, there is evidence of some consistency: May LEED-ND items appear in SPBR regardless of differences in the details.

#### **Recommendations to improve SPBR to achieve neighbourhood sustainability:**

The study recommended re-writing of planning and building regulations in Khartoum to promote and introduce sustainability principles in them, to do that the following steps are required;

- There must be a collaboration and teamwork of many regulatory bodies to put specification and standard for the sustainable neighbourhood design, standard suitable for local context.
- When reviewing regulations, the committees working in the review should benefit from the study of many different international experiences sustainable neighborhoods, and addressing local context seriously.
- Expand the law to limit individual handlings or treatments across the State Planning Committee
- Unified regulation which would avoid the of going through many different documents for the purpose of easy and readability effective all regulations.
- Enforcing special regulations related to government housing projects and real estate development and, that when there is one owner of neighbourhood development it is easier and constable to incorporate sustainability principles.
- The government encourages individuals to apply sustainability concepts.
- It is recommended to better inform and educate individuals about the current LEED-ND rating system.

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