

Assessment method on united nation sustainable development goals, applied for sustainable city with focus on Ggreater Khartoum

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Abstract: The first approach for environmental sustainable development to the global community was introduced in 1992 in the United Nations conference on environment and development, the "Earth Summit", which took place in Rio de Janeiro, Brazil [1] Defining Sustainable development as the one that meets the needs of the present generation without compromising the ability of future generations to meet their own needs [1]

Therefore, the study will focus on the United Nations Sustainable Development Goals (UN SDGs) and the making of Sustainable cities. The aim of the research is to propose a framework to transform Greater Khartoum into a Sustainable city and to find out criteria for an Assessment Method that is applicable for Greater Khartoum. Which including: providing Safe affordable housing and basic services, Sustainable transportation, Sustainable home settlements in the three towns, Protect culture and Natural Heritage, Reduce Waste including water, air and solid waste, Public access, Greenspace, Support positive economic, social and environmental links between urban and rural areas, National and local disaster risk reduction strategies, Interlinkages and implications for policy-making

In addition, the methodology of the research focuses on defining, identifying and measuring the indicators and sub-items. The measurement applied through survey and questionnaire. Distributed to engineers in the three cities (Khartoum-Khartoum North-Omdurman).

Finally, the outcomes of the research, applying the criteria of SDGs to evaluate the present situation in sustainable development criteria in Greater Khartoum; most of the indicator record result are weak result between (20-30) especially in services,(Table 1), waste management and open spaces are average (40-49). Will provide valuable recommendations towards improving the future and urban planning and sustainable development for the Capital city.

Keywords: *Sustainable Development Goals, Greater Khartoum Sustainable City, Assessment Method for Greater Khartoum Sustainable City*

1. INTRODUCTION

Greater Khartoum as a city consists of three towns (Khartoum, Omdurman and Khartoum North); it suffering from many environmental problems like waste disposal, increase of CO₂ emission from cars and industrial areas, water waste. The increase in migration towards Khartoum city in the last 20 years; these caused problems in services like education, affordable houses for those people, hospitals, the basic life needs in goods, homes. [2] and [3]

This research is aiming to find sustainable city indicators according to SDGs11 sustainable development goals No.11 for UN. To be applied in Greater Khartoum. The project consists of two phases; phase one is finding out the indicators for the assessment of the sustainable city in a general framework. Phase

2 is applying the indicators on Khartoum city to find measurement and percentage for each criterion.

2. LITERATURE REVIEW

United Nations set up sustainable Development Goals in 1992 in the United Nations conference on environment and development, the "Earth Summit", which took place in Rio de Janeiro, Brazil [4]

UN SDGs [5] published criteria indicators (1) Safe affordable housing and (2) basic services, (3) Sustainable transportation, (4) Sustainable home settlements in the three towns, (5) Protect culture and Natural Heritage. (6) Reduce Waste including water, air, and solid waste, Reduce water waste, air and solid waste, (7) Public access, *Greenspace*. (8) Support positive economic, social and environmental links between urban, and rural areas, (9) National and local disaster reduction strategies, (10) Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials, (11) Interlinkages and implications for policy-making. [6] Studied measuring cities indicators for Sweden city focuses on the focus in vision, Indicator framework, indicator selection, stockholders participation, communication strategy visual design, the study ended by cases study. [7] Discussed China Sustainable Index, which consists of some indicators like basic needs, Recourses Efficiency, Environment Clean Lines, Built Environment, and Commandment to the environment. In addition, [7] discussed the European tools for sustainable cities. Change Climate mitigation, climate change mitigation, sustainable urban mobility, sustainable land use, nature and biodiversity, air quality, noise, waste, water, energy, green growth and eco-innovation, energy performance, and governance. [8] Presented proposal green building for certificate system for the King Saudi Arabia (KSA). The development site, transport, atmosphere, indoor air quality, using environmental quality, water, energy, material, eco-innovation, culture, and labour. [9] Discussed the parameters of Saudi Arabia smart city the indicators are smart buildings, mobility, and security for citizens, healthcare, energy, digitization. [10] Presented paper about categories for the sustainable neighbourhood the indicators are the sustainable site, neighbourhood design, pattern and construction, material and resources, water, Energy, environmental design process and emission and safety. UN-HABITAT published [11], [12] and [13] a report about Saudi Future Cities and announced the programme (FSCP) the focus indicator is the programme studied several cities in Saudi Arabia including Makkah, Al Madina, Jeddah and Al Riyadh cities respectively, the main indicators are urban government and legislation, infrastructure productivity, quality of life, equity and social. Environmental and sustainability.

3. THE METHODOLOGY

- The research is based on UN SDGs for sustainable cities.

Therefore, the Methodology first starts by define, identify measures indicators which are Safe affordable housing and basic services, sustainable transportation, sustainable home settlements in the three towns, protect culture and natural heritage. Reduce waste including water, air and solid waste, public access, green space, support positive economic, social and environmental links between urban and rural areas. National and local disaster risk reduction strategies, Interlinkages and implications for policy-making

- Consequently, after comprehensive literature reviewed in urban indicators applying in Europe, Asia and on the region, the researcher identifies a scale for evaluation as follows.

- Very strong factor (70-80)
- Strong Factor (60-69)
- Moderate (50-59)
- Weak (40-49)
- Very Weak (0-39), Source [11]

- The researcher applies the survey and questionnaire through the Google survey in the social media, focus on engineering groups.
- The results were analysed in tables and figures
- Finally, the results were discussed for the conclusion.

3.1 Define the indicator

[5] define the indicator as “Indicator: a parameter, or a value derived from parameters, which points to, provides information about, and/or describes the state of a phenomenon/environment/area, with a significance extending beyond that directly associated with a parameter value”.

The stages of planning process first identifying the problem, second analysis, then looking for a solution, after that simulation, have a discussion and finally record the performance in tables, figures and radar figure.

3.4 The survey and questionnaire.

The survey distributed by Google forms through many engineering groups in social media A number of response is 100 engineer.

The following Figure 3 the location of Greater Khartoum, While Figure 4 the affordable houses, Figure 3, Figure 4, Figure 5 show the services in education, health, water, energy.



Figure 1 Google Seattlite image, Greater Khartoum including the three towns (Khartoum, Khartoum North, and Omdurman. The circle shows the limit of the study. Source: [14]

4. THE RESULTS

The results are shown in the following

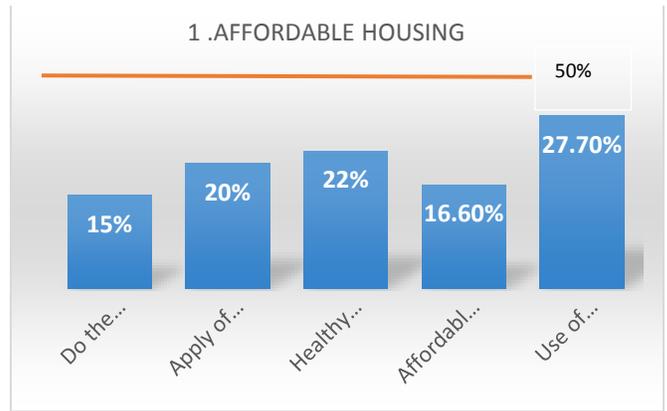


Figure 2: Shows the Affordable housing results.

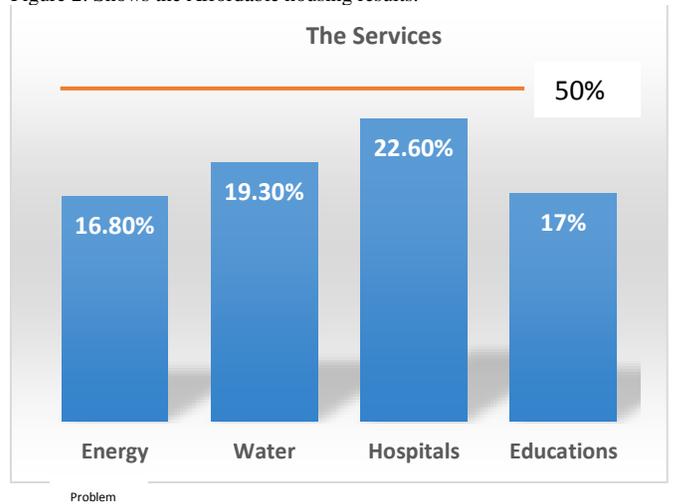


Figure 3: Shows the Services: Water, energy, education and hospitals efficiency results

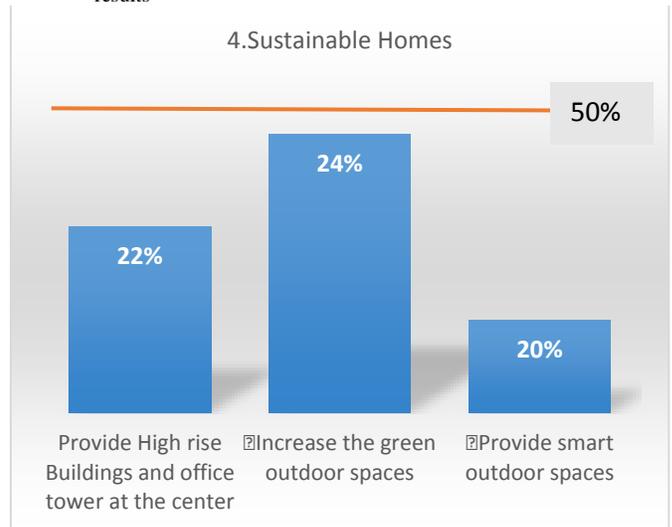


Figure 4: Shows Sustainable homes results.

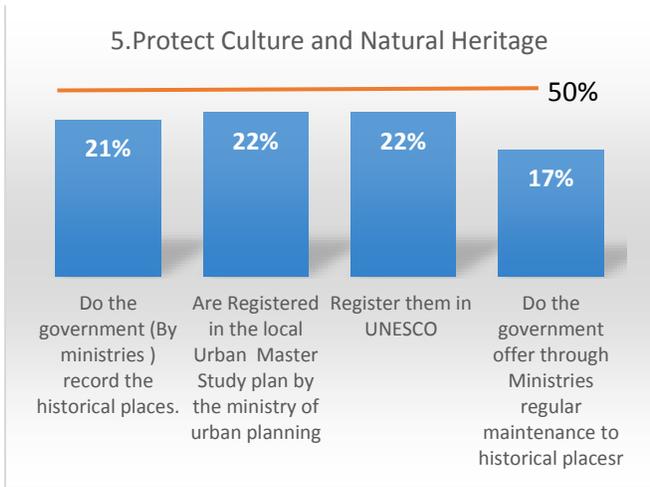


Figure 5: Shows protect culture and natural heritage results

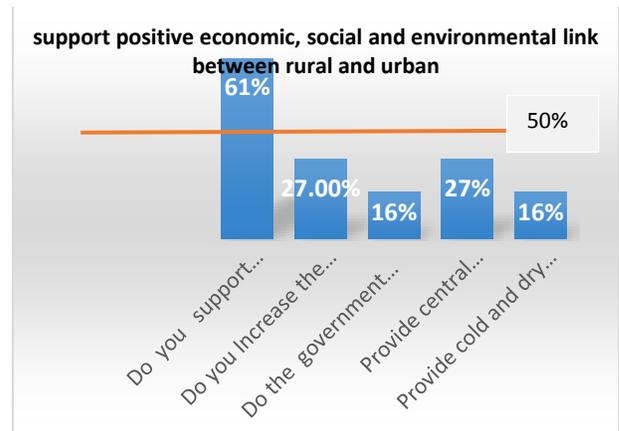


Figure 8: Shows support positive economic, social and environmental links between urban and rural areas.

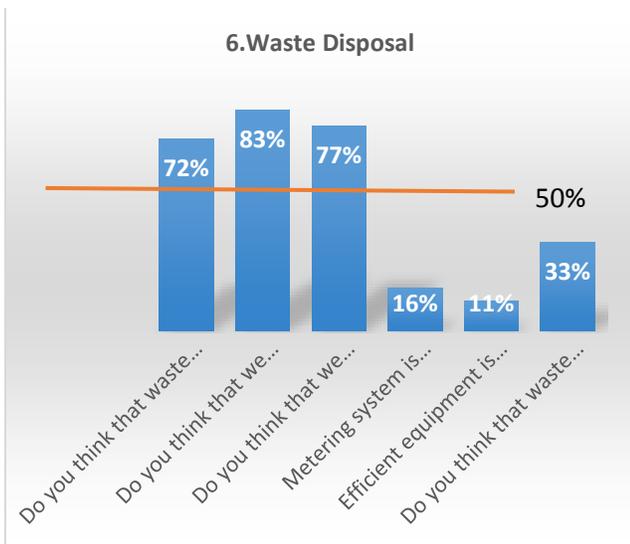


Figure 6: Shows waste disposal results.

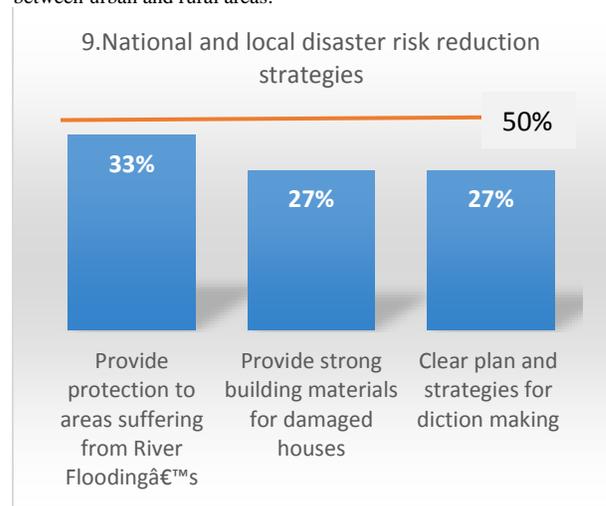


Figure 9: Shows national and local disaster risk Reduction strategies.

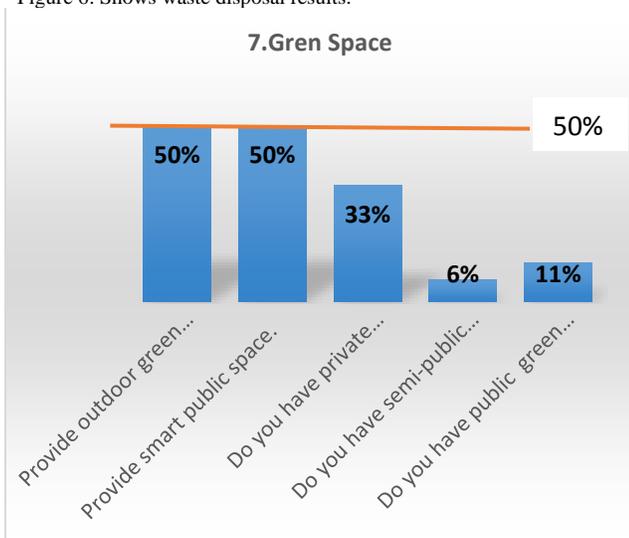


Figure 7 Shows Green space results

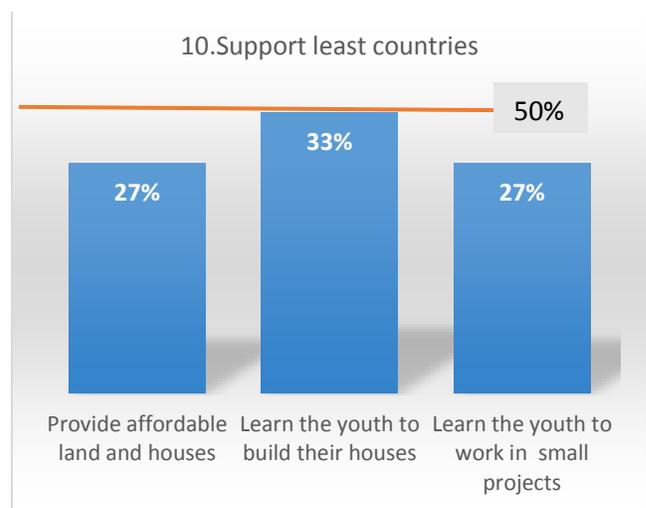


Figure 10: Shows the results of supporting the least countries.

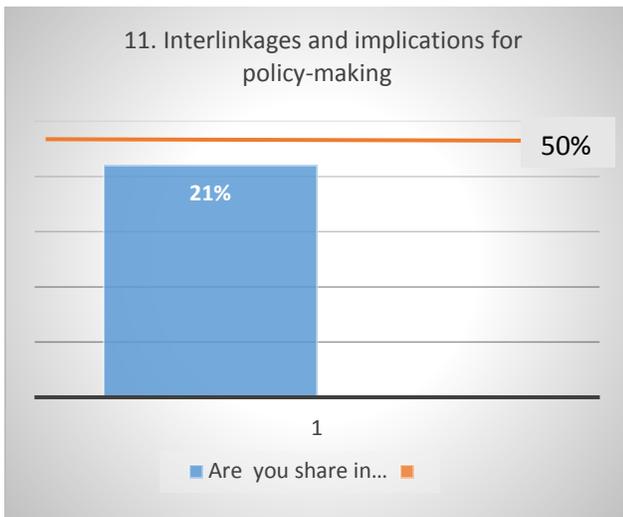


Figure 11: Shows the results of interlinks and implications for policymaking.

5. DISCUSSION

Discussion (All the indicators here related to SDG's), the study focuses on Goal no 11' Make cities inclusive, safe, resilient and sustainable.

5.1 Safe affordable housing and basic services (Fig.2)

The results of the survey as follows; do the government apply for global building standards (15%), and apply of local sustainable building standards (20%), the stockholders builds healthy houses (22%), and the government provide affordable houses (16.6%) and use of local building materials (27.7%). The Challenges is providing sustainable affordable houses, use of the local building materials and the researcher note that all the results for this indicator are below the average (20%), according to the scale of evolution its weak result.

Services: The drainage system infrastructure is drainage net for Khartoum 2 only since the Colonial period. Other places used well and septic tank Gravel and Sand for illegal areas, which contaminate the underground water [15]

5.2 Efficient potable water for drinking is used and available (25%), the water-metering system is applied (21%), do you use greywater recycling (12%). The evaluation of the result according to the scale is weak; all the results are below the average (19.3%).

The result of energy efficiency as follows

Solar energy is available (15.5%), wind energy is available (12.2%), geophysical energy is used (14.4%), metering system is applied in the housing sector (21%), efficient equipment is used in the housing sectors (16%) and efficient are used in the industrial sector (22%).

The evaluation of the results according to the scale is weak is equal to 16.8%.

The results for education efficiency is as follows. Do your school has good physical resources (18%), and the building quality is good (21%), the library is available inside the school (22%), activities and community service are offered by the school (11%), the researches are done in most of the subjects (14%), are the labs are available(13%) and the services like nurse, food-court, sports are available(22%).

The average result is (17%) and according to the scale, it is a weak result.

The result of efficient hospitals as follows

Do the government offer efficient hospitals (19%), number of special hospitals (26%), good and efficient buildings (17%), number of specialized doctors (22%), number of consultant

doctors (23%), equipment are available (17%), labs are available (22%), pharmacy is available (32%), outpatient (24%) and extensive care (24%).

The average result is (22.6%) and the result is weak. The challenges are applying renewable energy like solar energy and wind energy and others in Greater Khartoum [16]

Sustainable transportation

In the three towns (Khartoum, Omdurman, and Khartoum North), there are main transportation bus -stations was built out of the centre to reduce the disadvantages of heavy traffic. There are new bridges like Tuti Island and Almak Nimer new bridges constructed on 2008 and 2009 consequently [17]

The result according to the survey as follows: in figure 9

Do we have proper bus station (12%), and encourage bicycle riding (16.6%), a subway is available (10%), provide central station (15%) and effective bridges (22%).

The average result is 15% and it is very weak. The challenges are constructing new roads especially ring road, subway around the three towns and more new bridges.

5.2 Sustainable homes settlements in the three towns

Reduce the physical expansion over the agriculture lands; urban sprawl is increasing in Greater Khartoum.

The results from the survey are as follows in figure 4

Provide high-rise buildings and office tower at the centre (22%), increase the green outdoor spaces (24%), provide smart outdoor space (20%).

The average result of 22% and it is a weak result. Challenges are increased the high-rise buildings, improve the outdoor environment in a landscape, apply to smart outdoor gardens and parks, and improve the transportation system. Establishing of new sustainable urban community and housing. Using proxy indicators.

5.3 Protect culture and Natural Heritage

The local building regulations for the National Capital of the Republic of Sudan, and the environmental framework [18]

by The Ministry of Housing in Khartoum stated the primary setting taking into account historical places and buildings preservation like Khartoum University buildings, Abdel Ghaume Gate, Al Mahdi old Palace, some of Churches in Khartoum.

The results of the survey are as follows in figure 5:

Do the government record the historical places (by the ministries) (21%), are registered in the local urban master plan (22%), register them in UNESCO (22%) and offers regular maintenance (17%).The average results are 20.5%, and it is weak.

Challenges: Identify the historical places and register them in UNESCO Global Historical places. Many historical places in Greater Khartoum were found since the colonial period and Othman Architecture.

5.4 *Reduce Waste including water, air and solid waste:* Greater Khartoum is suffering from solid waste, gaseous and water waste.

The results of the survey are as follows in Figure 6

Do you think that waste management should support by regulations (72%), do you think that we should apply clear standards in waste disposal (83%). Do you think that we should apply clear management (77%). Meeting system is applied (16%), efficient equipment is used by stockholder's (11%), and do you think that waste disposal handling should be by private sector (33%).

The average result is 48%. Challenges: Government and NGOs should set up regulations and management solutions for private

and industrial sectors in order to minimize the solid, gaseous and water waste. Increase quality according to World Health Organization (WHO) standards. Enhance monitoring for the current situation. Identify its impact on Human Health and encourage people to follow orientations.

5.5 Public access, Green space:

Greater Khartoum improves transportation in the three towns, public space is improved, and the government removes Khartoum Hospital to the suburb area. As well as the International Khartoum airport will be removed to the suburb area in Omdurman and reuse its place of public green space.

The results of the survey as follows: The results show in fig.7

Provide outdoor green space (50%), provide smart public space (50%), do you have a private garden in your home (33%), do you have the semi-public green area at the centre of your neighbourhood (6%) and at the centre of your city (11%).

The average result is (30%) the result is weak. Challenges: Transportation efficiency, as well as the, improve road structure, and its drainage net, provide more of public space improvement, more land allocated and reuse these areas for recreations. Provide safety urban space especially for children and women.

5.6 Support positive economic, social and environmental links between urban and rural areas

To provide a global overview of the state of urban policy at the national level and serves the purpose of monitoring this indicator through four categories: Feasibility, Diagnosis, Formulation, and Monitoring and Evaluation (SDGs). Greater Khartoum has a strong relationship with the suburb areas, especially in the agriculture industry, Cattles and animals industry. Government between Greater Khartoum and the rural areas established fast roads.

The results of the survey are as follows in Figure 8:

Do you support positive economic, social and environmental links between urban and rural areas (61%), do you increase the industry in the rural areas (27%), do the government provide fast and efficient roads (16%), provide central markets (27%), provide cold and dry store (16%). The average result is (29.5%), the result is weak

Challenges: Provide fast and proper transportation system between the Greater Khartoum and the rural areas, Provide central market to welcome these products with cold and dry warehouses, control the prices of these products, regular maintenance of these roads, support the industry in the rural areas.

5.7 National and local disaster reduction strategies

Supporting sustainable and resilient cities and human settlements and the achievement of the SDGs requires that disaster risk reduction integrated into core social, economic and development planning (SDGs). Greater Khartoum suffering from flooding, [19] stated in his M.Sc. research that Sudan suffered the most destructive floods during the last 20 years. Many cities, especially Khartoum (the capital of Sudan). In addition, the minor earthquake happened in 1946, 1988, 1993, 2010 and 2013 between 3 to 5 Richter. Without any serious effect.

The results of the survey are as follows in figure 9:

Provide protection to the area suffering from river Nile (33%); provide strong building materials for damaged houses (27%), a clear plan and strategies for diction making (27%).

The average result is (29%) which is weak.

Challenges: Provide solutions for those areas are suffering from flooding near River Nile, especially in constructing burials wall and sandbags. As well, as for providing solutions in buildings construction. People awareness. Allocate those suffering building into safe places.

5.10 Support least developed countries: including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials

The construction industry has a significant impact on material extraction, consumption of natural resources and human comfort (SDGs). Greater Khartoum attracting people from South Sudan, Ethiopia, Eritrea, and from East and West Sudan. The migration reach 20% of the total Khartoum Population Most of them lived in illegal houses. The Ministry of Urban Planning with UN-HABITAT program me to have a good on-going plan to own these lands and provide services for water and energy.

The results of the survey as follows in Figure 10

Provide affordable land and houses (27%), learn the youth to build their houses (33%) and learn the youth to work in small projects (27%). The results show

The average result is 29% and it is weak Challenges: The government should provide safe, low-cost houses, provides services like energy and water, waste disposal to those people. Incur rage people for jobs; construct their houses by bricks and stones.

5.11 Interlinkages and implications for policy-making

Connect the SDGs to urban policies and a clear impact on cities and human settlements [20].

Challenges are updating and link the local building regulations for the National Capital of the Republic of Sudan, and the environmental framework by The Ministry of Housing in Khartoum

The result of the survey is (21%), which is weak shown in fig.11

6 THE RESEARCH OUTCOMES

6.1 The research outcomes is finding general framework assessment Method to Evaluate Greater Khartoum in SDGs, 11 in all categories under Sustainable city. Which are: providing Safe affordable housing and basic services, Sustainable transportation, Sustainable home settlements in the three towns, Protect culture and Natural Heritage, Reduce Waste including water, air and solid waste, Public access, Greenspace, Support positive economic, social and environmental links between urban and rural areas, National and local disaster risk reduction strategies, Interlinkages and implications for policy-making

6.2 Report present situation, challenges and future plan for each item.

6.3 Provide monitoring for the present achievements for each item in SDGs applied in Greater Khartoum.

Table 1

Number of indicators	The Evaluation of the results for each indicator		
	The indicator	The percentage	The evaluation
1	Safe affordable housing	20%	Weak
2	Services		
	Water efficiency	19.3%	Very Weak
	Energy	16.8%	Very Weak
	Efficient education	17%	Very Weak
	Efficient hospitals	20%	Very Weak
3	Sustainable transportation	15%	Very Weak
4	Sustainable homes settlements	15%	Very Weak
5	Protect culture and Natural Heritage	20%	Very Weak
6	Reduce Waste including water, air and solid waste	40.8%	Average
7	Public access, Greenspace	30 %	Weak
8	National and local disaster reduction strategies	29%	Weak
9	Support the least developed countries	29%	Weak
10	Support positive economic, social and environmental links between urban, urban and rural areas	30%	Weak
11	Interlinkages and implications for policy-making	21%	Weak



Figure 17: the evaluation for all indicators and the average result by KPI focus on SDGs.

- 6.4 The research recommends applying Sustainable and efficient roads and transportation system to link Greater Khartoum to suburb areas.
- 6.5 The research recommends built up sustainable homes settlements, and applying assessment methods for sustainable homes.
- 6.6 The research recommends protecting the historical and cultural places; by record them in Khartoum strategic plan, regular maintenance, and record them in UNESCO heritage places.
- 6.7 Reduce solid, water and gaseous waste, set up regulations for people, and companies to manage the waste will be effective.
- 6.8 Public access, to the green space in different levels of the urban, indoor garden, intermediate green space at the middle of the neighbourhoods, and large green space and smart public space at the middle of the city.
- 6.9 Provides solutions for a local disaster, reduce risk, and provides strategies, Set -up strategies in managing, the disaster especially in flooding season will be effective.
- 6.10 Support least developed countries, by providing suitable, healthy homes and services to them, allocate the land, encourage youths to build their homes, and learn them small projects
- 6.11 Link the SDGs to local urban planning policies and to policymaking strategies.

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