Quantitative Assessment of Climate Change Adaptive Capacity For East Nile Locality – Khartoum State-Sudan

AHMED ALHUSEEN
Faculty of Natural Sciences
Department of Landscape Ecology
Comenius University in Bratislava
Bratislava 842, 154

ahmedalhuseen@yahoo.com

Abstract: Adaptive capacities of urban societies and economies should be increased so as to be able to cope with expected climate change impacts which are heading. This study aimed to produce generic research findings that will be widely applicable in assessing adaptive capacity for whole Khartoum State - capital of Sudan. However, the specific objectives were to test the applicability of the toolkit of quantitative assessment of climate change adaptive capacity proposed by United Nation Habitat to the case of Khartoum state-Sudan and to quantitatively assess the climate change adaptive capacity for East Nile locality (District) as one of seven localities that compose Khartoum state. This study has used a toolkit developed by UN-Habitat for quantitative assessment of city's adaptive capacity to climate change as main methodology to gain the results. The toolkit composes of group of indicators or dimensions necessary to measure city's adaptive capacity. A quantitative analysis has been done through desk assessment using secondary data driven from localities/city profiles, national and state reports and research results. The result shows that from the highest possible value of 1, East Nile locality's adaptive capacity is found to be below the mid-point as it only registers with a 0.36 rating. It shows also that the toolkit is found to be flexible and practical. The study concluded that; in spite of national and sub-national efforts to adapt with climate change in Sudan, however, these effort so far deemed to be inefficient and inadequate, resulting in lack of capacity and capability to avoid current climate variability at both local and national levels and in supporting vulnerable communities.

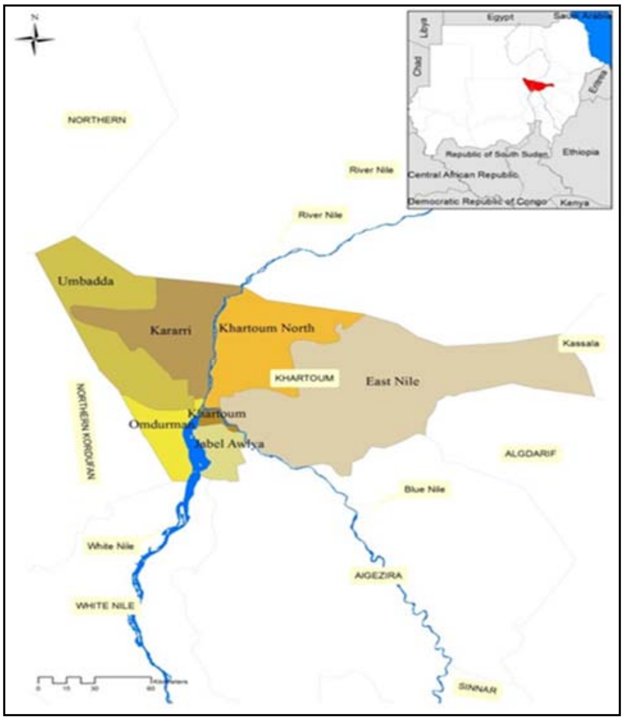
Key-Words: Quantitative analysis, East Nile locality, Adaptive capacity, Khartoum state

Introduction

The human race is fast becoming an urban species: cities occupy less than 3% of the Earth's land surface but now house just over 50% of the world's population, a figure that was only 14% in 1900 and is estimated to increase to 60% by 2030. The rate of growth in developing countries is faster than in industrialized nations [1]. Cities face significant impacts from climate change, both now and into the future. These impacts have potentially serious consequences for human health, livelihoods, and assets, especially for the urban poor, informal settlements, and other vulnerable groups. Climate change impacts range from an increase in extreme weather events and flooding to hotter temperatures and public health concerns [2]. Urgent action is required to reduce greenhouse gas emissions if the worst consequences of climate change are to be avoided. Similarly, early interventions are required to ensure that urban societies and economies are able to cope with inevitable changes in climate that will occur even if emissions are sharply curbed now [3].

Sudan has federal governing system, according to it; the country has been divided into 17 states each states divided into localities (Districts), localities divided into administrative units (Counties) and popular committees (Neighborhoods) represent the smallest governance units in this hierarchy. Khartoum State — Sudan; represents the capital of the country and it has been considered as the most populated area of Sudan, its population is estimated as 5,274,321 million inhabitants according to official statistics [4]. Khartoum state extends approximately over an area of 22,000 Km² and it has been divided into 7 localities and each locality divided into a number of administrative units which in total are equal to 36 administrative units (Figure 1) East Nile locality falls at the northeast part of Khartoum state; it has an area of 8188 km2 which represent 30% of the total area of Khartoum state. It has a population of 868147 inhabitants resemble to 16% of the total population of the state and they are distributed over 8 administrative units that compose the locality. Urban dwellers represent 63% and rural is 37% of the total population of the locality [5]. Khartoum city

Fig. 1 Khartoum state and its seven localities



experiences four climatic seasons [6]. The winter season extends from mid-November to March, with clear skies, cool and dry air from the north-east, a minimum temperature ranging between 8°C and 10°C which falls to 5°C during night, and maximum temperatures varying from 23°C to 25°C, and a relative humidity which may sometime be as low as 20 per cent a monsoonal dust storm is common to occur during this season of the year specially in the period from January-March locally called Haboob. The hot, dry summer season starts at the end of March. The maximum temperatures may exceed 45°C by the end of May. Weather instability is indicated by the reoccurrence of dust storms. The rainy season covers the period from July to September, with August being the rainiest month, Generally, annual rainfall ranges between 110 and 200 mm, but a minimum of only 4 mm was recorded in 1984 and an exceptional maximum of 420 mm in 1988. A short, hot (about 40°C) transitional season occurs between mid-September and the beginning of winter. This changeover season from south-westerly to north-easterly winds is accompanied by dust storms [7].

Khartoum Sate suffers from increased emissions of Green House Gases (GHGs); these emissions have been considered as major contributors to the heating up of microclimate of the city as well as being responsible in deteriorating the air quality of the city. Climate scenario analyses for whole Sudan conducted in 2003 by Sudan's First National Communication to the UNFCCC indicated that; there will be rise in average temperature, between 1.5°C - 3.1°C during August i.e. hot season, and between 1.1°C 1°C during January i.e. cold season by 2060 [8]. In addition to that; there will be reduced average rainfall by about 6mm per month during the rainy season. Hazard and vulnerability assessment conducted during carrying out the National Adaptation Program of Action in 2007 has predicted Khartoum state's region will experience extreme weather events and variability as a result of climate change [9]. Flash and river floods, heatwaves and dust storms are most frequently expected climate change impacts to occur in the state. In autumn of 2013 and 2014 successively, Khartoum state has witnessed excessive rainfall, flash and river floods which caused a catastrophic effects on the life and properties of the city inhabitants. East Nile locality was the most badly affected locality among the others with the highest incidences of death toll and houses destruction.

Aim and objectives

The general aim of this study is to produce generic research findings that will be widely applicable in assessing adaptive capacity for whole Khartoum State the capital of Sudan. However, the specific objectives of this study are confined to:

- Test the applicability of the toolkit of quantitative assessment of climate change adaptive capacity proposed by United Nation Habitat to the case of Khartoum state-Sudan.

- Quantitatively assess the climate change adaptive capacity for East Nile locality (District) as one of seven localities that compose Khartoum state.

Material and Methods

This study has used a toolkit developed by UN-Habitat for quantitative assessment of city's adaptive capacity to climate change; it composes of group of indicators or dimensions necessary to measure city's adaptive capacity (Table 1). This toolkit introduces both qualitative and quantitative methodologies that could be used in the climate change assessment [10]. Quantitative analysis has been done through desk assessment using secondary data driven from localities/city profiles, national and state reports and research results. The selected dimensions and indicators to be used in the assessment may vary from one city to another depending on data availability. In this study, socio-economic, technology and infrastructure have been used as major indicators and each indicator have been assigned a weight; the total weight for the three major indictors is equal to 1.

Then each one of the three indicators has been fragmented into sub-indicator and each has assigned score driven from localities/city profiles, national and state reports and research results.

Weighted score has been calculated by multiplying weight per indicator by score driven from reports. Total score has been acquired by multiplying total weight by sum of weighted score per indicator then the summation of the total score gives the score for adaptive capacity of study area.

Table 1 Adaptive capacity assessment Toolkit

	A	B	C	D	E	F
	Dimension of Adaptive Capacity And select Indicators	Weight per indicator	Total Weight	Score	Weighted Score Per indicator	Total Score
	Wealth		**.50**			(Sum in G x C)
	(Possible Indicators) -GDP -% HH earning above Poverty Threshold			(rate/score based on city data)	(=score in D x B)	
G					(=Total Score)	
	Technology		**.25**			(Sum in H x C)
	(Possible Indicators) -% HH with access to communication -% HH with access to electricity			(rate/score based on city data)	(=score in D x B)	
H					(=Total Score)	
	Infrastructure		**.25**			(Sum in I x C)
	(Possible Indicators) - Road Density - % paved road - % HH with safe housing unit			(rate/score based on city data	(=score in D x B)	
I					(=Total Score)	
	TOTAL		**1.00**			(= Sum of Above)

Results and Discussion

Table 2 illustrates the quantitative assessment of adaptive capacity by using reference template shown in table 1. The gained results represent the quantitative assessment of the East Nile locality's adaptive capacity. The assessment used selected socio-economic indicators and proxy indicators for technology and infrastructure as measures of adaptive capacity. The result shows that from the highest possible value of 1, the locality's adaptive capacity is found to be below the mid-point as it only registers with a 0.36 rating. This explains the catastrophic consequences which the locality has been subject to during autumn 2013 and 2014 consecutively when the death toll reached thousand and hundreds of families lost their homes.

This result proves that; in spite of national and sub-national efforts to adapt with climate change in Sudan, however, these efforts so far deemed to be inefficient and inadequate, resulting in lack of capacity and capability to avoid current climate variability at both local and national levels and in supporting vulnerable communities. Urban centers in Sudan have been considered as a major affected sector by climate change very recently. For instance, Khartoum state is considered as a major affected sector by climate change in 2013 and adaptive capacity building is carried in three different sectors which are; agriculture and food security, water and health. In November 2013, Khartoum state has designed its climate change adaptation plan as partial part of the National Adaptation Plan (NAP) and it has been submitted to the cabinet of ministers for endorsement as a climate change adaptation policy. The assessment toolkit found to be flexible and practical and it gives realistic image of how far is city prepared to address the adverse impacts of climate change.

Conclusion

study concluded that; in spite of national and sub-national efforts to adapt with climate change in Sudan, however, these effort so far deemed to be inefficient and inadequate, resulting in lack of capacity and capability to avoid current climate variability at both local and national levels and in supporting vulnerable communities.

Table 2 Results of adaptive capacity assessment

Dimensions, indicators and rating used			Locality / District Adaptive Capacity		
Socio-economic		**.50**			**0.13**
- %Poverty Incidence.	0.30		0.037	0.0111	
- %Literacy rate.	0.20		0.046	0.0092	
- %Slum squatter.	0.20		0.32	0.064	
- %Development expenditure from locality's allocations.	0.20		0.81	0.162	
- %Informal sector.	0.10		0.12	0.012	
				0.25	
Technology		**.25**			**0.16**
- %Access to telecommunications.	0.30		0.45	0.135	
- %Access to electricity.	0.30		0.40	0.12	
- %Shortage in disaster risk reduction units coverage.	0.40		0.95	0.38	
				.63	
Infrastructure		**.25**			**0.08**
-%HH with safe water access.	0.20		0.45	0.09	
-%paved roads.	0.20		0.055	0.011	
-%constructed surface rain water drainage system.	0.20		0.15	0.03	
- %Greenery and forestation.	0.10		0.30	0.03	
-% Houses with improper sewage system	0.10		0.78	0.078	
-%Houses with poor condition.	0.20		0.32	0.064	
				.30	
		1.00			**0.36**

The adaptive capacity of the study area is low the thing that necessitate a comprehensive rigorous adaptation plan for the whole city. Inclusion of the city adaptation plan to climate change in development process it may be one possible solution and it may cost less. Provision of high quality city infrastructure and raise awareness of the locality inhabitants represents prerequisites to increase their adaptive capacity to climate change. The toolkit for assessing the adaptive capacity found to be applicable, effective and flexible.

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