Tendencies towards Home Gardening as a Coping Mechanism for Climate Change in Khartoum State: A Pilot Case Study

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Abstract. Khartoum, the capital of Sudan, is a densely populated large city with a hot, dry and dusty climate. The summer season is characterised by very high daytime temperatures, low humidity, and large daily temperature fluctuations. Moreover, Khartoum is expected to experience an increase in temperature and a decrease in rainfall due to climate change. Blue-green patios can be a traditional measure of comfort in such a climate, as they maintain the cold air and provide shade in the housing unit.

This paper investigates the current activity and latent tendencies of gardening among simple random sample from Khartoum State. This study uses a qualitative and quantitative methodological approach. A simple random sample of 385 households distributed in 7 localities and 36 administrative units of the study area was surveyed using questionnaires. A literature review of similar studies was also conducted.

The findings revealed that 56.30% of the surveyed households have not planted trees in their housing units, although 67% of them are interested in planting trees. Another finding revealed that concern for offering suitable environment for multiplication of disease vectors especially malaria, size of house and access to water were the major constraints to gardening among the households surveyed.

Keywords: Blue-green patios, climate change, Khartoum State, disease vectors

Introduction

In Sub-Saharan Africa (SSA), droughts are recurrent and the frequency of droughts and lack of rainfall seems to be increasing as a result of climate variability and change. On the other hand, the gardens of houses and neighbourhoods can play a crucial role in regulating the microclimate at the level of individual houses under similar climatic conditions. The state of Khartoum is a densely populated metropolitan area, home to almost a third of Sudan's population, and continues to grow horizontally. Khartoum's climate is characterised by very high daily temperatures, low humidity and large daily temperature fluctuations during the summer, and during the short rainy season Khartoum is prone to dust storms (Zakieldeen, 2009). Furthermore, the climate change scenario predicts that Khartoum State will be affected by an increase in temperature and a decrease in rainfall, indicating that the study area will adapt to drier climatic conditions. In addition, the socio-economic characteristics of Khartoum's population show that there's a high poverty rate and an alarming level of food insecurity and malnutrition among residents.

Blue-green courtyards in housing units can have enormous health, environmental and economic benefits. Green courtyards and yards with trees can improve air and environmental quality in housing units, provide psychological and physical comfort, and combat food insecurity. Therefore, green spaces are one of the adaptation options to climate change.

Despite all these current climatic and socio-economic difficulties and expected climate change hazards faced by the population of Khartoum State, planting trees doesn't seem to be an option for every resident. Furthermore, there's a large knowledge gap regarding the characteristics of home and community gardens, their potential and the challenges they face in Khartoum State. This paper aims to explore the current activity and future latent trend of

gardening among a simple random sample from Khartoum State. It also explores behavioural, social, economic and cultural barriers that may prevent the surveyed sample from adopting tree planting as a coping mechanism for climate change.

Materials and Methods

Study Area

According to Eltayeb (2003), Khartoum State is the capital of Sudan and lies at latitudes 15°, 26' and 15°, 45' N; and longitudes 32°, 25' and 32°, 40' E, and at an altitude of 405.6 m above sea level. Khartoum State is located at the confluence of the Blue and White Niles rivers (Fig. 1). Khartoum State covers an area of approximately 22,000 Km². Khartoum State consists of three cities: Khartoum, Omdurman and Khartoum North; each of the three cities has a specific function. All three cities together form the metropolitan area of Greater Khartoum (Osman, 1996). The climate in Khartoum State is characterised by minimum winter temperatures ranging between 8°C and 10°C, dropping to 5°C at night and in the early morning, while maximum daytime temperatures range between 23°C and 25°C. In summer, however, the temperature can exceed 45°C, especially in May when dust storms occur again. According to Osman (1996), high temperatures and recurrent dust storms pose a major challenge to the planning and design of human habitat in Khartoum.

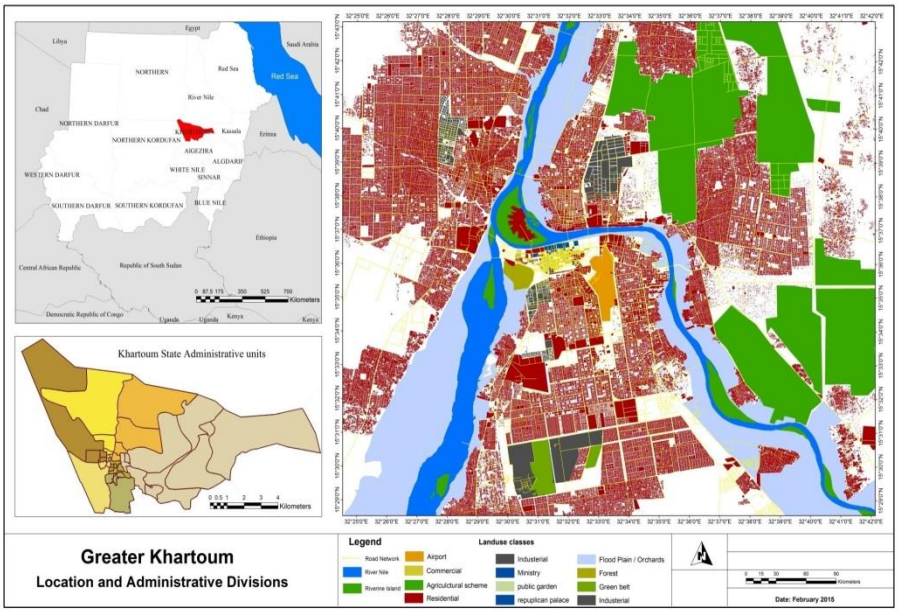

Figure 1. Khartoum State location and administrative division

Khartoum State is home to 5,274,321 people distributed among 894,188 households (Central Bureau of Statistics, Republic of Sudan (2013). The climate change scenario for Sudan projects that Sudan - including Khartoum State - will face a temperature increase of between 1.5°C and 3.1°C in summer and 1.1°C to 2.1°C in the cold season, as well as a 6 mm decrease in rainfall during the rainy season (HCENR, 2003). According to many scholars, these expected changes may negatively affect the development progress made in many sectors and also put undue pressure on the fragile natural system of the study area.

Sudan follows the federal system of government in which there are 18 states, each of which is subdivided into smaller local government units called provinces, which in turn are subdivided into administrative units (districts). Khartoum State is divided into 7 localities and has 36 administrative units. Reports and statistics indicate that sixty percent of houses in

Khartoum State are in poor condition (UN -Habitat, 2012), 26.22% of Khartoum State residents are illiterate and the poverty rate among urban residents is 26%. The percentage of households with access to clean water is 82 % (Water Corporation Performance Report, 2013). Furthermore, in Khartoum State there are 13 doctors for every 1000 patients and one health centre for every 10000 patients. Drainage and sanitation systems are also in poor condition, covering about 8 % of the population. Due to the accelerated urbanisation process and the rapid growth of the Khartoum metropolitan area, the amount of solid waste has increased at the same time. There is a great lack in the statistics and studies on green infrastructure in Khartoum; however, the number of accessible green spaces in the city has decreased significantly. It is true that Khartoum State has 400 kilometres of riverbanks along the watercourses flowing through it, about 200 reserved and unreserved forests, a number of riverine forests and orchards on the banks of the River Nile and its tributaries. However, residents of Khartoum State may have to travel long distances to use these public green spaces to compensate for the lack of neighbourhood and community gardens.

Data and Methods

Holbrook (2009) has listed a wide range of methods for collecting data on private and public green spaces in urban centres. His list of methods includes the following:

1. Survey/questionnaire.
2. Individual interview.
3. Observation and photo documentation.
4. Secondary statistical data.
5. Group or focus group interview.
6. Controlled experiment.
7. Journal/diary.
8. Other experiments.
9. Document analysis

He further stated that the most commonly used research methods are surveys/questionnaires, interviews and observation. Holbrook (2009) mentioned that experiments were rarely used as methodology. In this study, questionnaires and a literature review were used to collect field data. A simple random sample was selected using the following formula:

$$n = \frac{p(1-p)z^2}{e^2},$$

Where p represents the assumed prevalence of the event in the population studied (usually based on previous studies, field data or the literature). In this study, the value 0.50 was used; z is the critical value resulting from a standard normal distribution, using a confidence level of 95 % and the corresponding z-value of 1.96; and e is the maximum absolute error. The value for e was set at 0.50 to represent the maximum absolute error.

Accordingly, a simple random sample consisting of 385 households was determined, with households from all seven localities and 36 administrative units in the study area having an equal chance of being included in the random sample. The sampled households were therefore from all 7 localities and all 36 administrative units of Khartoum State.

Results

The data collected from the questionnaires were analysed using percentages. The four questions asked of the respondents provided information on their current activities and future tendencies in relation to tree planting and home gardening. Fig. 2 shows the percentage of households with/without tree planting in the house, while Tab. 1 illustrates the reasons why respondents who have a home garden might be interested in planting trees. Fig. 3 shows the

tendency of households without indoor or outdoor trees to plant trees in the future. It clearly shows that although a high percentage of the surveyed households do not have trees, they have a relatively high tendency to plant trees in the housing unit. Similarly, Tab. 2 expresses the reasons why households without trees at the housing unit are not interested in planting trees at their house.

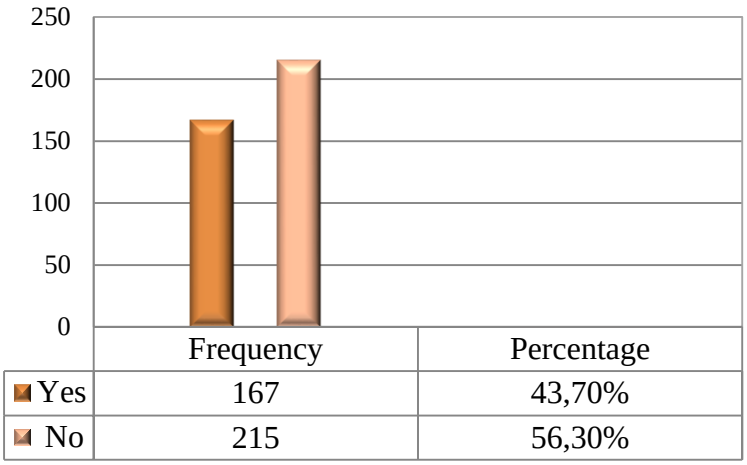

Figure 2. Percentage of households with indoor planted trees

Table 1. Reasons respondents are interested in planting trees

Reasons / Interested	Percentage
For cooling	28 %
As a hobby	6.1 %
Ornamentation purposes	55.6 %
Environment protection	8.9 %
Other reasons	1.40 %

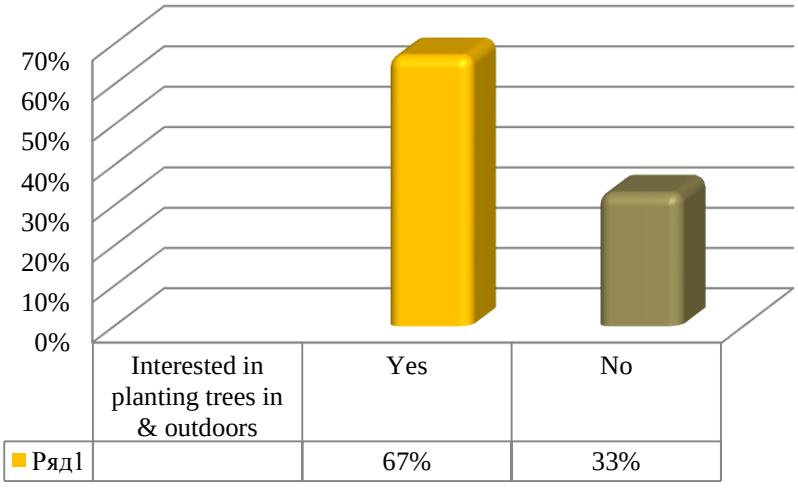

Figure 3. Attitude of HHs with no trees at the house unit towards tree plantation in the future

Table 2. Reasons why HHs without trees not interested in planting trees

Reasons / Not interested	Percentage
No sufficient space and water	29.4 %
Fears from Malaria	37.6 %
Time consuming	22.4 %
House doesn't belong to my family	10.6 %

Discussion

The objective of this study is to investigate the current activities and future trends related to tree planting at the housing unit level in a simple random sample of households in Khartoum State. The results show that 56% of the surveyed households do not have trees in their houses. Many factors that may influence household tree planting behaviour have been analysed in the relevant literature. Heckman's model, for example, analyses the factors that influence tree planting behaviour. According to Heckman, these factors include household plot size, household awareness of tree planting programmes, planting trees for wood energy, and the age of the household head (Heckman, 1979).

Although various studies from different countries show that the social benefits of home gardens include food security and socio-economic and political improvement, the literature also identifies profound limitations to the productivity and sustainability of home gardens. Hoogerbrugge et al. (1993) defined the main constraints to home gardens and tree planting at the household level as: limited access to agricultural inputs, i.e. seeds, planting materials, tools and capital; land size and insecure land tenure; inadequate access to water; insect damage, fear of vector diseases and pests; poor knowledge, lack of information and technical know-how; and poor soil conditions and erosion. Howard (2006) and Marsh (1998) have defined poor environmental conditions as a barrier to successful home garden cultivation, while Marsh (1998), Ninez (1985) and Miura et al. (2003) have identified social and cultural barriers as possible obstacles to home garden cultivation.

One of the main barriers that prevented respondents in the study area from establishing a home garden and planting trees was the fear of creating a suitable environment for mosquitoes and other disease vectors to multiply, especially in a tropical climate such as Sudan. Literature on urban agriculture has demonstrated that urban agriculture, including the planting of home gardens, poses a public health risk by providing breeding sites for malaria vectors such as mosquitoes of the genus Anopheles. Zanis (2009) pointed out that the fear of creating breeding sites for disease vectors is sometimes used as a justification for banning home gardens. Home gardens and urban gardens provide a moist and wet environment where larval stages of mosquitoes can develop in the stagnant water that accumulates in the lowlands. Therefore, there is concern that irrigated urban agriculture provides a breeding ground for vectors. The link between domestic and urban gardening and the creation of a suitable environment for disease vectors, particularly malaria, has been well studied in Africa, where malaria is endemic and poses a serious risk (Klinkenberg et al. 2008). In a study in Dar es Salaam, Tanzania, Dongus et al. (2009) found a statistically significant association (P 0.05) between lowland green spaces, proximity to a river and the presence of relatively impermeable soils and the presence of Anopheles larvae.

Conclusion

The issue of home gardens and tree planting needs to be thoroughly investigated through comprehensive surveys and inventories and in an interdisciplinary approach. Despite the health concerns that may be associated with the establishment of home gardens, home gardening still holds great potential for health, economy and food security. For this reason, governmental and

institutional support and incentives for tree planting need to be developed at the household level and incentives for the introduction of tree planting and home gardens need to be considered.

Acknowledgment

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