Too hot to handle? Heat resilience in urban South Sudan

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South Sudan is at risk from the impact of climate change. This paper reviews the climate change issues faced by South Sudan, and the strategy as outlined to the United Nations. The author argues that the policy overlooks a key potential cause of future morbidity and mortality: increased ambient temperatures, particularly in urban centres due to the urban heat island effect. The capital is especially susceptible to heat-related mortality as it faces a 'triple threat': rapidly rising temperatures, an at-risk population profile, and inadequate planning for the pressures of urbanisation. Four low-cost, evidence-based recommendations are given to mitigate the impact of heatwaves on human health, and it is concluded that South Sudan has great potential to become a regional leader in heat resilience.

Keywords: climate change, urban heat island, heatwave, heat illness, Juba

INTRODUCTION

South Sudan is one of the five countries deemed to be most vulnerable to the impact of climate change. [1] This paper will discuss the country's climate challenges and review its climate change strategy. The effects of increased urban temperatures on human health will be considered and it will be argued that Juba is especially susceptible to significant heat-related mortality given its climate, vulnerable population, rapid urbanisation, and limited urban planning. Four low-cost, evidence-based, actionable recommendations to improve Juba's heat resilience in anticipation of rising temperatures are proposed.

CLIMATE CHANGE CHALLENGES TO HUMAN HEALTH

South Sudan is particularly vulnerable to climatic variability. Most citizens are dependent on rain-fed subsistence farming for their livelihoods. Summer rains have already decreased by over 20% in the past two decades. [2] The risk from both drought and flooding are projected to increase with climate change, reducing food security and promoting the spread of water-borne diseases such as cholera. [3] Indeed, studies from the East African region suggest that climate change will increase the risk of various infectious diseases, including Rift Valley Fever, Ebola Virus Disease, meningococcal meningitis, and trypanosomiasis. The effect of climate change on malaria is debated. Evidence suggests that global warming will lead to a geographical shift in hyper-endemic regions from West to East Africa, and malaria incidence will increase in mountainous regions which previously were at low-risk. These findings are relevant to South Sudan, which is in the path of the West to East shift and has mountainous regions to the south. [4]

CURRENT MITIGATION AND ADAPTATION MEASURES

South Sudan is a signatory to the Paris Climate Change agreement and in 2017 delivered its National Adaptation Program of Actions (NAPA), [5] which built on the 2015 Intended Nationally Determined Contribution (INDC) to the UN Framework Convention on Climate Change (UNFCCC).

Due to conflict, and lack of technical and economic resources, South Sudan has not produced data concerning greenhouse gas emissions. It is estimated that per capita emissions are low as only 1% of the population has access to electricity. [6] Thus, the focus of NAPA and the INDC was on sustainable development and adapting to climate change. NAPA set out four key policy areas:

1. Protection of South Sudan's forests, promoting agro-forestry, reforestation, and developing protected nature reserves;
2. Implementation of water resource management, with development of infrastructure (reservoirs and irrigation and sanitation systems);
3. Promotion of 'climate-smart' agricultural practices e.g. drought-resilient crops and livestock;
4. Disaster risk reduction through capacity-building for weather prediction and creation of early warning systems.

However, political instability and conflict have hampered progress. [3] As of 2018, South Sudan still has no national forestry policy, hydroelectric development efforts have stagnated, and the risk of famine remains high.

Figure 1. Urban development in Juba (© Rachel Ayrton)

HEAT-RELATED ILLNESS IN URBAN SOUTH SUDAN

Juba is South Sudan's commercial and political capital, with an estimated population of 365,000. [7] In recent years, Juba has seen an influx of migrants seeking employment and educational opportunities and/or driven from rural areas by crop failures and famine. [8] Rapid urbanisation, combined with political instability and under-resourcing, has led to poor urban infrastructure and city planning (see Figure 1).

Juba is at the centre of a 'triple threat' of heat-related illness: it is warming at 0.4^{0}C per decade (more quickly than almost anywhere else on earth) [2]; it is home to a vulnerable population that is ill-equipped to adapt to increased temperatures; it is undergoing rapid unplanned urban expansion. The urban heat island effect causes cities to experience higher temperatures for longer periods relative to rural areas. A significant gap in South Sudan's climate change policy is that it does not outline how the urban built environment should be planned to mitigate the detrimental effect of heat on human health.

Juba's average temperature ranges between 26–32^{0}C. Temperatures above 31^{0}C are related to increased mortality. [9] There are currently no data regarding heat-related illness in South Sudan, but evidence from sub-Saharan Africa suggests increased mortality with increasing temperature for children under five and adults over 65. [10, 11] The World Health Organization predicts that (without adaptation) heat-related deaths in East Africa from over 65s will exceed 13,000 per year by 2050. [12] Young children have under-developed thermoregulation systems and are at greater risk from high ambient temperatures. Heat and diarrhoeal diseases compound the risk of dehydration. Hence, Juba's under-five year olds are especially vulnerable to the heat threat. The burden of heat-related mortality also falls disproportionately upon women, the uneducated, and the poor [13] which highlights the issue of health inequality.

Evidence from other sub-Saharan capital cities suggests that informal settlements, typically seen in rapid urbanisation, are especially susceptible to heatwaves. [14] Therefore, it is imperative that government agencies act now to implement heat-resilient urban planning policies.

RECOMMENDATIONS

Urban parks

The area surrounding Juba is verdant close to the White Nile. Urban green spaces and trees are known to reduce urban temperatures. [15] Partner organisations have identified suitable areas for grassland and 'green corridors' in Juba and its surroundings. [16] Parks in Addis Ababa have been shown to mitigate the urban heat island effect. Thus, creating designated parks in the plentiful green space around Juba now would significantly increase the heat resilience of the city as it expands. There is evidence that access to green spaces reduces health inequalities. [17]

With the creation of urban parks, there must also be an effort to promote reforestation with urban trees. These are highly effective in improving air quality by reducing air pollution. [18] In the absence of an enforced limit on emissions, reforestation offers a low-cost measure to reduce the exposure of the urban population to air pollutants. In its post-conflict reconstruction, Rwanda has become a global leader in reforestation – South Sudan could demonstrate similar leadership in this area.

Cool surfaces

South Sudan has few paved roads. Surfaced roads are a necessity for efficient transport but asphalt contributes significantly to the urban heat island effect. This provides the opportunity to pave urban areas using new, resilient materials that reflect heat and are more durable than asphalt. As a first step, the simplest measure to reduce the temperature of a city is to paint its surfaces (in particular roads and roofs) white. A further measure is to implement 'green roofs' (roofs of vegetation), which have been shown to reduce nocturnal ambient temperatures by up to 3^{0}C. [19] These are most effective in low-rise buildings (under 2.5m). There is a knowledge gap when implementing green roofs in the developing world. This offers an opportunity for South Sudan to become a leader in these initiatives.

Bluespace

Juba's proximity to the White Nile can be harnessed to divert cooling water, to create canals and 'bluespace' within the city. Urban water can work with parks and trees to enhance further cooling. Indeed, meta-analysis has shown that urban bluespaces may reduce temperatures by up to 2.5^{0}C. [20] South Sudan has already committed to building canals and waterways as part of its water resource management strategy and should be extended as part of its heat resilience strategy.

Cooling centres

Air conditioning is protective from heat-related morbidity and mortality. It is not feasible (and indeed undesirable) for all buildings in Juba to have air conditioning. It has been suggested that 'cooling centres' should be set up so the most at-risk – those with chronic diseases and those at extremes of age – may shelter in times of extreme heat. [21] Air conditioning units generate heat and typically rely on fossil fuels and therefore should not form the centrepiece of a city's heatwave strategy. Nonetheless, designated public air-conditioned spaces in Juba, accessible to the most vulnerable sections of society, would provide an effective and equitably mortality-reducing measure if implemented in addition to other recommendations.

CONCLUSION

Sub-Saharan Africa will disproportionately shoulder the burden of extreme heat events caused by climate change. This review has argued that increases in ambient temperature, driven by global warming, pose a significant and inequitable threat to the health of the South Sudanese living in urban centres. Four evidence-based recommendations have been offered. South Sudan can leverage its existing development links to build local urban planning capacity and ensure that further urbanisation is heat-resilient. The upcoming partnership with Moroccan and South Korean agencies planning the construction of a new capital at Ramciel [22] offers an opportunity for the country to become a regional leader in climate-smart urban strategies.

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