Could/should improving the urban climate in informal areas of fast-growing cities be an integral part of upgrading processes? Cairo case

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ABSTRACT

Many researches have highlighted the importance of environmental justice, where healthy environment is a right to all. Currently, the most vulnerable groups to climate change are low-income urban dwellers, typically residing in urban informalities within cities of the Global South. In Cairo, the awareness about climate change and responsive consumption is minimal and the increase in temperature could have serious effects on residents' health. In 2012, informalities were reported to house two thirds of the population and covered a third of the city's footprint. Thus, this paper highlights the importance of studying environmental performance in informal areas to achieve sustainability and reduce risks. It reviews work related to sustainable urbanization, informal areas, urban heat island and urban climate especially in Cairo. It defines needed parameters and develops an integrated tool to assess comfort in outdoor spaces microclimate. The paper relies on extensive fieldwork, meteorological measurements, socio-environmental surveys, activity mapping and modelling to study both Cairo urban climate and microclimate in one of Cairo's densest informal districts. The paper stresses the possibility of introducing responsive low-tech and low-cost strategies and interventions. This is discussed as an inherent right to marginalized areas and a necessity within a continuous process of urbanization.

1. Introduction

Currently urban debates are dominated by climate change, as it has transferred from mere anticipation into an experienced reality (IPCC WGI AR5, 2013). Cities bear a fair share of both contributing and being victims to the phenomenon. This is mainly manifested in cities of the developing world where the majority of urbanization activities exist, especially in the form of informalization. Many scientists consider urbanization as one of the causes of climate change, with the built environment high CO_2 emissions and concentration of highest consumers living in it, resulting in rising ecological footprints. This will be even accentuated by the expected urban growth to accommodate the demographic growth mainly anticipated in the developing countries (IPCC, 2014a, 2014b). Researchers of the Max Planck Institute for Chemistry and the Cyprus Institute in Nicosia have concluded, based on profound studies and calculations, that the Middle East and North Africa (MENA) region could become so hot, thus compromising human habitability, and the number of climate refugees could increase in future, in unprecedented manners. They claim that the goal of limiting global

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warming to less than two degrees Celsius, as agreed at the recent UN climate summit in Paris 2015, will not suffice to avoid this situation. They stated that the temperatures, in these already very hot areas, during summertime would rise more than double the average global warming rate (Lelieveld et al., 2016). This situation is more critical for city residents within the region when factoring in the urban heat island effect. Globally, there is a movement to address climate change through the recent declared Sustainable Development Goals, where goal 13 calls to take urgent action to combat climate change and its impacts (The United Nations, 2015). Moreover, there is a growing body of knowledge regarding climate change and related health risks for example (Campbell-Lendrum and Corvalan, 2007; Huq et al., 2007; Gosling et al., 2009; Romero Lankao and Tribbia, 2009). Gartland, 2011 elaborates the benefits from Heat Island mitigation, where human health is central to the issue as manifested in heat related, air quality and sunlight-related problems (Gartland, 2011). It is vital to note that only in cities of high-income countries, public health departments have managed to establish a heat-health warning system (Barata et al., 2011; Kalkstein et al., 2008). On the other side, urban dwellers in cities of less income countries are less fortunate. The First assessment report of the UCCRN have flagged the issue and tried to focus on the urban poor (Rosenzweig et al., 2011). Furthermore, the issue of addressing climate change-induced heat stress in poor and informal areas becomes essential as an integrated part of environmental justice and not a luxury that can be overlooked, or only addressed in more affluent contexts (Mega, 1996). This notion was recently promoted by UN-Habitat as an essential part of achieving urban sustainability (UN-Habitat, 2016). Hence, in order to address increased heat stress in fast urbanizing cities, it is essential to study their urban climate especially within the informal parts to develop tailored responsive solutions as an integral component of upgrading and improving liveability.

Thus, this research focuses on the contribution of urban heat island to climate change within the microclimate of cities. Through investigating the past and on-going literature regarding UHI in cities with a special focus on the neighbourhood and the street/space level, the paper reviews the limited research done on the issue in the Egyptian and Cairene context. To adequately address this gap, the paper starts on the *meso* scale with developing an urban climate map for Cairo using satellite images and GIS for the city. Afterwards, the paper uses a case study to analyse the microclimate performance within Cairo's most dense informal district, Imbaba. The paper discusses the results of the fieldwork regarding meteorological measurements, socio-environmental surveys and Envi-met microclimate simulation conducted through summer 2015. Hence, the paper formulates an integrated tool for outdoor spaces environmental performance assessment that could be adaptable to different situations. The work relies extensively on engaging with different stakeholders within the local community in a participatory process to investigate performances and local responses to minimize escalating heat stress.

2. Sustainable urbanization, informal settlements and climate change

In recent decades, more attention has been exerted to address cities as sources of resource depletion and environmental degradation. The past ten years have highlighted different examples of unsustainable city development, suffering from pollution, poor quality built environment and quality of life. This is accentuated by a continuous growth of informal areas and city inability to provide adequate services (UCLG (United Cities and Local Governments), 2014). To realize a sustainable city, there has to be clear concepts about what it should look like and how it should function since it is the physical vehicle where the other aspects of sustainability; economic, social and environmental, would flourish (United Nations Human Settlements Programme (UN-HABITAT), 2012). Urban form is one of these concepts, as it conceptualizes the overall spatial patterns of cities and in turn their physical pattern (Breheny, 1992b). In this regard, significant arguments have been put forward to measure the implications of urban form on a number of sustainability dimensions and this has given rise to the term 'sustainable urban form' in recent literature (Jenks, 2000).

Accordingly, a number of theories and practices have addressed the issue, within the developed world, namely, the urban village (Newman and Kenworthy, 1999; Thompson-Fawcett, 2000), new urbanism, transit-oriented development (Boarnet and Crane, 2001), smart growth (Stoel, 1999) and sustainable urbanism (Farr, 2008). They share many common aspects and principles: compactness advocating walkability and cyclability; completeness with mixed uses and mixed housing; connectedness with improved mobility; preserving open spaces and nature; all through a participatory decision making process (Khalil, 2010). A number of the SDGs especially goals 11[1] and 12[2] related to sustainable cities and their consumption and production patterns support these aspects and characteristics (The United Nations, 2015). The overall common goal is to provide better quality of life with reduced energy consumption. However, these theories' contradicting effect on urban microclimate is another aspect, where according to Erell et al. dense urban form might intensify UHI through higher anthropogenic heat per unit area, reduced vegetation, increased H/W (height/width) ratio and lower wind speeds (Erell et al., 2011).

Looking at how most cities in the developing world currently grow, it is through informal expansion, where informal areas are continuously growing with some estimates that around one in seven of the world's population lives in informal settlements in urban areas. Informalization can be defined as "a process, which is unregulated by the institutions of society in a legal and social environment in which similar activities are regulated" (Oldham et al., 1994). However, unmanaged informal growth could be seen by many as a significant obstacle to sustainable urban development. These settlements by default lack risk-reducing infrastructure and are the most vulnerable type of human settlements to climate change (Lwasa, 2010; IPCC, 2014a, 2014b). Most houses there are either poorly built and/or more liable to collapse when hit by storms or floods. In addition, many areas are built on unsafe sites, for example unstable slopes, as housing is unaffordable in safer locations. Moreover, it is highly unlikely for the inhabitants to have

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[1] "Make cities and human settlements inclusive, safe, resilient and sustainable."
[2] "Ensure sustainable consumption and production patterns."