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Climate Change: Implications for Urban Planning in Kenya in the 21st Century

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Climate Change: Implications for Urban Planning in Kenya in the 21st Century

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Abstract

Climate change has been singled out as a major challenge currently facing the world and a major threat to sustainable urban development. Achieving sustainable cities and contributing to climate protection requires planned change to the way in which cities are spatially configured and serviced. Both adaptation and mitigation measures to respond to the effects of climate change require that cities are planned differently. Major towns in Kenya are highly vulnerable to the impacts of climate change as evidenced by many disasters that have afflicted them over the recent past. It is expected that urban planning and land-use management should successfully address and ensure risk reduction. Unfortunately this is lacking. Drawing upon the available literature, this paper synthesizes the factors responsible for the vulnerability of Kenya's major urban centres to climate change, the impacts of climate change vis-a vis failure of current urban planning practices in the country and implications for urban planning in the 21st Century in Kenya.

Keywords: Climate change, urban planning, Kenya

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Introduction

Climate change has been identified as one of the most serious challenges of the 21st century that is set to intensify (Cardwell and Elliot, 2013; Leiserowitz, 2008; Nzeadibe, Chukwone, Egbule, & Agu, 2011). It is caused by emissions of greenhouse gases largely from industries, motor vehicles, agriculture and other ecological processes (Awuor, Orindi and Adwera, 2008). Its impacts that include extreme weather events such as prolonged droughts, increased intensity of storms, flooding and scorching heat (Omuruyi and Kunle, 2012) are likely to have serious impacts on urban areas due to the high concentration of people and infrastructure(Brody, Zahran, Vedlitz, & Grover, 2008; Hanif, 2011; Hunt & Watkiss, 2011). A number of potentially significant climate change impacts such as surface sealing that inhibit rainwater percolation leading to flooding are either unique to urban areas or exacerbated in urban areas (Hunt & Watkiss 2011; Johnson 2012). According to Hanif (2011) the effects of urbanization and climate change are converging in dangerous ways. The results of this convergence threaten to have unprecedented negative impacts on quality of life, and economic and social stability of urban residents.

In Kenya it is projected that more than half the population will live in urban areas by 2033 (World Bank, 2011) most of these will end up in slum areas that are highly vulnerable to climate events like flooding and landslides. Already a number of climate related disasters have been experienced in major cities such as Nairobi and Mombasa (Awuor et al 2008).This means that climate change should take center stage in urban planning in Kenya. According to Satterthwaite (2008), for any city the scale of the risk from extreme weather events is much influenced by the quality of housing and infrastructure in that city, the extent to which urban planning and land-use management should successfully address and ensure risk reduction within urban construction and expansion, and the level of preparedness among the city's population and key emergency services.

The current urban planning in Kenya however, has failed to address these problems and least prepared to confront the new challenges brought about by the impacts of climate change. The master plans that form the basis of the urban plans in Kenya have not helped the situation. The master plans are elitist with little or no provisions for the poor neighbourhood where the majority of urban dwellers reside. Kenya's urban settlements according to Okalebo, Mwasi, Musyoka, Karanja, Gachene and Mwasi (2009), reflect accumulative history of colonialism, segregation and duality based on urban methods that segregate zones of production, commerce and residence exclusively. This has not only contributed to high thermal mass which has in turn developed heat islands but also has accentuated other problems brought about by climate change since the zoning has not appropriately addressed problems of informality.

UN-Habitat (2009) clearly recognises that although 17 per cent of cities in the developing world are experiencing annual growth rates of 4 per cent, the

bulk of these new urbanites will be poor and therefore will not be able to meet their accommodation and service needs through formal mechanisms. Achieving sustainable cities and contributing to climate protection requires planned change to the way in which cities are spatially configured and serviced (UN-Habitat, 2009). Both adaptation and mitigation measures to respond to the effects of climate change require that cities are planned differently. The prosperity of global cities lies in their capacity to adapt and mitigate the impacts of climate change. Drawing upon the available literature, this paper synthesizes the factors responsible for the vulnerability of Kenya's major urban centres to climate change, the impacts of climate change vis-a vis failure of current urban planning practices in the country and implications for urban planning in Kenya.

Methodology

This paper is based on the review of current papers and reports on impacts of climate change in urban areas in Kenya, urban planning and implications of climate change on urban planning.

Vulnerability of Kenya's Urban Settlements to Climate Change

Many factors account for the increased vulnerability of Kenya's urban settlements to the impacts of climate change, these ranges from high population densities and unplanned settlements, location of some cities in low altitude coastal areas and high temperatures.

High Population Densities and Unplanned Settlements

Many urban centres in Kenya are witnessing rapid and largely uncontrolled population growth. For example, Nairobi city has experienced tremendous growth at an average rate of between 4.7 to 4.8% per annum, the population increased from about 0.8 million in 1989 to 2.1 million in 1999 and 3.5 million in 2008 (Omwenga, 2008). Most of this is concentrated in informal settlements and slum areas. Therefore, the very parts of the urban areas that are growing faster are also those that are least equipped to deal with the threat of climate change, as well as other environmental and socio-economic challenges (Un-Habitat, 2011). Poor people living on unstable hillsides of Mathare and other slums in Nairobi and other urban centres in Kenya face continuous threats of being swept away or buried by rain induced mud and rockslides as happened on 4th April, 2012. Many of these slum residents are often blamed by the government for their own poor living conditions, yet the very nature of their poverty status means that they lack alternatives. Even without additional weather-related stresses, such as higher-intensity or more frequent storms, these are dangerous living environments (see Figure 1). Yet, there are no immediate plans to relocate people from these areas. Of course it must be

acknowledged that relocation of thousands of the inhabitants of these informal settlements would require large amount of resources and logistics beyond the means of most urban councils in Kenya. However, little efforts have been made to stop or avoid the emergence of more settlements of this nature. Generally poor planning in Kenya has encouraged the development of slums and informal settlements that are prone to damage from climate-related impacts. There is also poor urban governance, with little involvement of the people. Limitations on governance and planning according to UN-Habitat (2011) increase the vulnerability of cities in developing countries to climate change.

Figure 1. *Scene from a Slum Area in Nairobi*

Location of Some Cities in Low Altitudes

Mombasa, the second largest city in Kenya, the largest seaport in East Africa and a popular tourist destination lies between the sea level and about 45 metres above seal (Kebede, Hanson, Nicholls and Mokrech, 2009). This places it at a high risk of submergence in the event of sea level rise. Given that it is estimated that during the 20th Century, sea level has been rising at a rate of about two millimetres per year (Bondoff et al, 2007), it is estimated that about 17% of Mombasa will be submerged with a sea level rise of only 0.3 meters (Mahongo, 2006). Kisumu town, another city in Kenya is located at the shores of the large expanse of Lake Victoria, exposing it as well to dangers of being swept away in case of unprecedented increase in the lake levels. Such locations put at risks these major towns in Kenya. Despite these obvious dangers that may take place due to climate change, very little have been done especially in terms of planning to prepare for such eventualities.

High Temperatures

Kenya is found within the tropical climatic belt, which is characterized by high temperatures and humidity. The impacts of climate change will make many regions reach intolerable limits. Towns located in hot and humid areas like Mombasa and Kisumu are likely in the very near future to experience heat stress and associated health impact and increased use of energy in cooling (Kebede, et al, 2009). These are more likely to impact upon the vulnerable

populations, particularly the urban poor. However, very little in terms of developing renewable energy for mass consumption in these major towns have been developed. Innovative urban planning is needed to develop infrastructure to support the development of renewable energy sources such as solar and wind energy.

Failure of Current Plans to Anticipate the Impact of Climate Change

The master plans that form the basis of most urban plans in Kenya have not helped the situation. They are often elitist with little or no provisions for the poor neighbourhood where the majority of urban dwellers reside. According to Jenkins, Smith and Wang (2007) and Lwasa and Njenga (2012), some of the major criticisms of the master planning approach, include the focus on the plan as a product rather than on its effects; the stress on spatial factors and land use compared to social; economic and environment issues, the less focus on rapidly changing forces which shape urban development and the failure to recognize realities of urbanizing poverty. The net effect of the inadequacies of these traditional master planning approaches according to Clarke (1995) is that the majority of urban growth has taken place outside the planning 'rules of the game' and the sites that the new settlements sprout are normally in places which are undesirable and highly vulnerable to the impacts of climate change such are riparian reserves and abandoned quarries.

Climate Change Impacts in Urban Centres in Kenya

The impacts of climate change pose serious threats to residents of major urban centers in Kenya. Many of these towns are already affected by extreme climatic events such as flooding and drought. These climate related disasters are projected to increase in frequency and intensity with long-term climate change (Awuor et al, 2008).

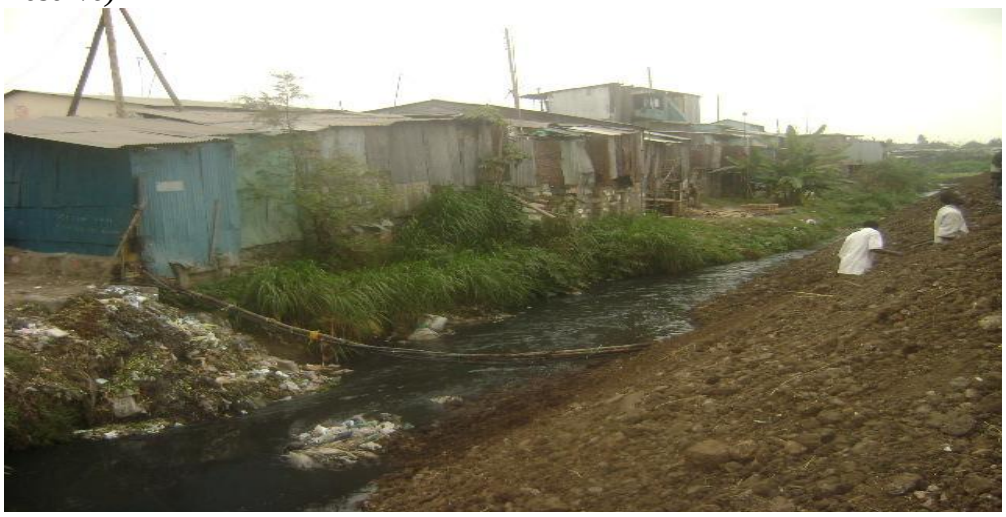
Flooding

Urban areas always present some risk of flooding when rainfall occurs (Kamal-Chaoui, 2009). Buildings, roads, infrastructure and other paved areas prevent rainfall from infiltrating into the soil – and so produce more runoff. Heavy and/or prolonged rainfall produces very large volumes of surface water in any city, which can easily overwhelm drainage systems (Satterthwaite, 2008). Climate change has resulted in occurrences of unexpected heavy rainfall in different parts of the world such as the 1998 el Niño rains in East Africa leading to massive floods in both rural areas and in towns (Suda, 2000).The IPCC Working Group II noted that heavy precipitation events are very likely to increase in frequency and will augment flood risk and the growing evidence of increased runoff (Adger, Pramod and Shardul, 2007). In addition to flood hazards, more extreme rainfall events associated with climate change will also generate increased hazard from landslides in many urban centres.

In well-governed cities, this is rarely a problem because good provision for storm and surface drainage is easily built into the urban fabric, with complementary measures to protect against flooding – for instance the use of parks and other areas of open space to accommodate floodwaters safely from unusually serious storms (UN-Habitat, 2011). But in poorly-governed cities like those in Kenya, this does not happen. Most residential areas have no drainage system installed and rely on natural drainage channels - and it is common for buildings or infrastructures to be constructed that actually obstruct these drainage channels. For instance, in Nairobi City and Mombasa as well as other towns in Kenya such as Kisumu and Eldoret buildings often encroach on or fill in drains and many natural drains have been filled up to construct roads (Awuor, et al 2008). In most of these urban centres a significant proportion of the population is not served services. Thus garbage and plant growth quickly clog drains leading to localized flooding with even light rainfall. Squatters construct their homes very close to the streams using cheap materials exposing them to dangers of flooding (see Figure2).

Formal planning in Kenya have failed to address the problems of such areas that bear the greatest consequences since they fall in areas that are not supposed to be occupied by human settlements, the municipal governments turn a blind eye to such areas or respond through forced eviction which are sporadic and do not offer alternatives. Thus slum dwellers in LungaLunga, Kibera, Mathare among others in Nairobi, Ziwa la Ng'omber and Moroto in Mombasa, Kondele in Kisumu and Langas in Eldoret continue to suffer the consequences of flooding that have been exacerbated by climate change. Unfortunately, the slum dwellers lack the resources and the capacity to respond in a timely manner to the floods or to adapt or to move to less vulnerable areas. Urban governance has also failed to incorporate or engage them in finding lasting solution and often reacts with feigned surprise whenever floods claim properties and life in these settlements (Opiyo, 2009).

Figure 2. *Lunga-Lunga Slums in Nairobi (Some Buildings within Riparian Reserve)*

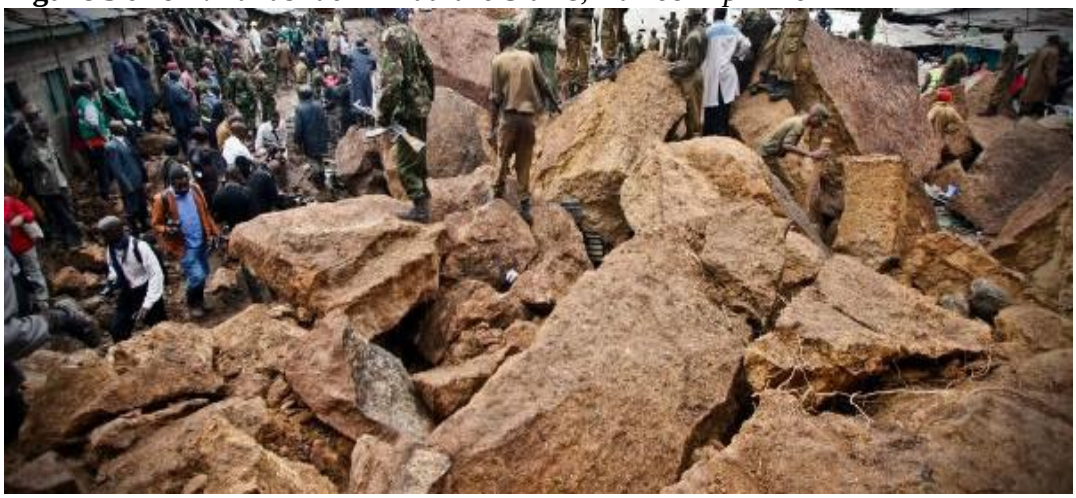


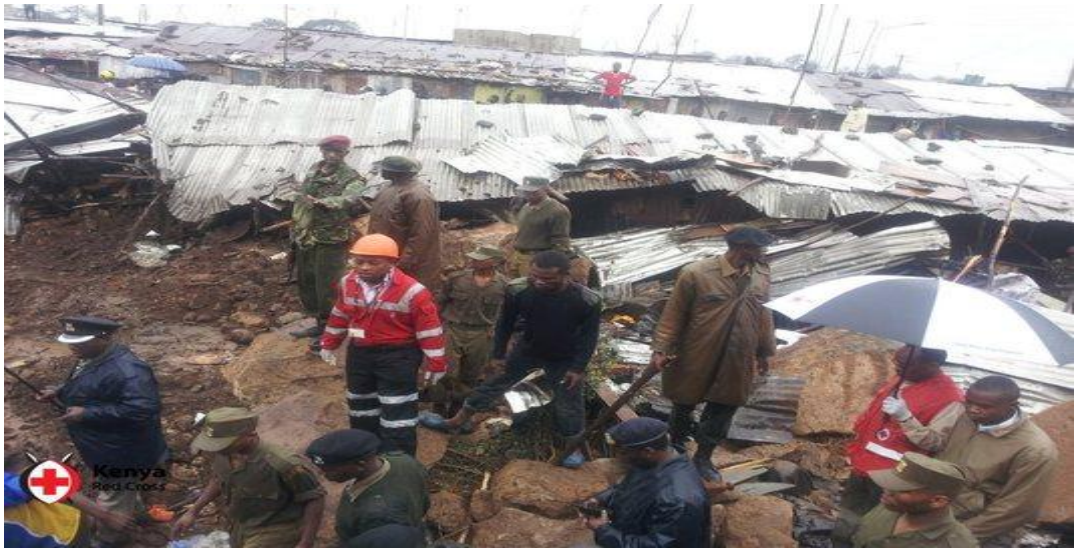
Source: Opiyo, 2009

Landslides

The risk from landslides brought about by heavy and sporadic rainfall due to changes in climate is also likely to increase as urban development continues on marginal and dangerous lands (UN-Habitat, 2011). With rapid urbanization, populations, especially the urban poor, increasingly settle in areas that are prone to hazardous landslides and are unsuited for residential development (Awuor, et al, 2008; Kebede, et al, 2009). In Kenya, this has already been felt with the latest incidence of landslide in Mathare Valley slums in Nairobi in April 4th 2012 where heavy down pour led to a landside that claimed six lives and rendered many homeless (See Figure3 and 4). These people have settled in a valley greatly exposed to the dangers of landslides, but lack an alternative due to poverty. The urban government in their plan failed to anticipate this despite the chronic shortage of housing in Nairobi City. Official records merely show this as a disused land while thousands consider this as their home. According to Smyth and Royle (2000), chronic poverty, urban land speculation, insecure tenure, inadequate urban infrastructure investment, and poor urban planning policies contribute to continued development in vulnerable areas.

Figure 3 and 4. *Landslide in Mathare Slums, Nairobi April 2012*





Source: Kenya Red Cross 2012

Impact on Water Supplies

Frequent droughts and the attendant reduced water availability in the city's water catchments could lead to more severe water shortages. According to Marshall (2011) Kenya is a generally dry country, as about 80% of the country is arid and semi-arid. This contributes to water crisis in the country. This is attributed to severe drought. Global warming is one critical factor that has prolonged the drought. Drought affects urban areas in numerous ways; it can compromise water quality and increase the operating cost of water systems while reducing their reliability (Bate, Kundzetcz, Wu and Palutikof, 2008). Major urban centres in Kenya with large concentrations of people have continued to experience water crisis and with increasing population and impacts of climate change the situation will get worse. Among the low income groups in the cities, who either depend on communal taps or water kiosks or, in some cases, on wells, drought often translates into increased amounts of time spent fetching water (Awuor , Orindi, and Adwera, 2008). In Kibera slums in Nairobi, almost 90% of residents have no piped water and are forced to buy from commercial street vendors where they pay the highest prices (Mutisya and Yarime, 2011). Frequents drought due to climate change is going to complicate the already acute water shortage. The sources of the major towns' waters are drying up and with continued destruction of water towers like the Mau forests the cities will soon receive no water at all (Marshall, 2011). The boreholes that supply the low informal residents are also faced with contamination making the unsafe for human consumption. Generally, water situation in major towns in Kenya will soon be critical if not already. Sustainable urban planning must be able to place this into serious consideration as populations in the towns continue swell.

Storm and Sea Level Rise

Major coastal towns in Kenya are faced with the threat of sea level rise. For example, according to Awuor, et al, (2008), around 17 per cent of

Mombasa's area could be submerged by a sea-level rise of 0.3 metres, with a larger area rendered uninhabitable or unusable for agriculture because of water logging and salt stress. Among other potential impacts of sea level rise in the coastal towns are rising water levels and storm surges that can cause massive flooding leading to property damage, displacement of residents, disruption of transportation and wetland loss (UN-Habitat, 2010). The increased vulnerability of Mombasa residents particularly the poor to these impacts is the location of their residents in very low lying areas close to ocean (see Figure 5). Thus, urban planners in coastal towns of Kenya such as Mombasa, Malindi and Kilifi have to take this into consideration.

Figure 5. *Settlement Close to the Ocean Shore in Mombasa Old Town*

Source: Kenya Meteorological Department

High Temperatures and Heat Waves

According to Satterthwaite, (2008) most cities in Africa, Asia and Latin America and the Caribbean will experience more heat waves. Even small increases in average temperature can result in large shifts in the frequency of extremes (Kovats and Aktar 2008). Heat waves are likely to increase in severity and duration in the future, contributing to heat mortality in both developed and developing countries (Kamal-Chaoui and Robert, 2009). In Kenya, although heat waves have not been a major occurrence, there has been a steady rise in temperatures particularly in major urban settlements. For example, the high average temperature in Mombasa (26.40C) and humidity (65% at noon) are already approaching intolerable limits and can be uncomfortable at times (Government of Kenya, 2002). As Akbari (2005), points out that, for the average developed city of 1 million people, the effect of heat-island synonymous with cities can cause air temperature that are 10 to 30 higher than the city's surrounding areas. He posits that by increasing temperature urban heat-island effects can aggravate the heat-related negative implications of climate change. Heat waves are more likely to impact upon vulnerable populations including the elderly and the urban poor because of

their low adaptive capacity (UN-Habitat, 2011). In Kenya where over 60% of the urban population are poor these impacts of extreme heat events will be adverse. Increasing temperatures can affect mortality in a number of ways, including heat-induced mortality, famine and exacerbation of non-infectious health problems and spread of infectious disease (Ruth and Gasper, 2008).

Energy Systems

According to UN-Habitat (2011), cities by their very nature are centres of high demand for energy and related resources. Climate change is likely to affect both energy demand and supply. The combination of urban population growth, changing local weather conditions, urban heat-island has the potentials to substantially increase demand for energy. In Kenya, the most obvious impact of climate change on energy resources that is already being experienced is the disruption in hydro-electric power generation due to frequent occurrence of drought periods. Power rationing is a common phenomenon in major towns, a situation that have contributed to major losses particularly in industries. Unfortunately, despite abundant solar energy all year round and strong winds in some areas these cheaper alternatives have not been fully exploited. The main reason being the high initial costs involved. Thus, in many towns expensive fossil fuel powered generators are engaged during the periods of power rationing.

Climate Change, Implications on Urban Planning in Kenya

From the foregoing it is clear that urban settlements in Kenya are extremely vulnerable to the impacts of climate change. Already, several disasters have been experienced in major towns in the country. These climate related disasters are projected to increase in frequency and intensity (Government of Kenya, 2010). Cities and municipal governments have the main responsibilities for planning, implementing and managing most of the measures that can diminish risks from the direct and indirect impacts of climate change-through provision of infrastructure and services, disaster preparedness and the planning and regulatory framework (Satterthwaite, 2008). Responding to climate change has important implications for urban planning (UN-Habitat, 2009). In Kenya, they include:

Developing innovative plans that respond to challenges of informality, it must be recognized that informal settlements will remain a permanent part of the urban settlements in Kenya. Yet they are also the most vulnerable to the impacts of climate change. Therefore, they must be included in planning by extending services that will help in reducing risks and improving living conditions. According to Opiyo (2009);

> *"planning framework should ensure that problems associated with uncoordinated urban growth are handled amicably and also take into account the desires of the urban poor who form majority of*

> *urban population in Kenya and who will be worst affected by climate change due to nature of their activities and locations and characteristics of where they live, this is in realization that sustainable urban planning and governance is no longer a preserve domain of professionals and bureaucrats, but an inclusive process, accommodating various facets of stakeholders…this will require participatory revision of repugnant laws (pp3).*

Developing urban plans that create the infrastructure needed to support solar and wind power at the scale required to help power a town. For example, Cape Town (South Africa) has an integrated Metropolitan Environmental Policy which has an energy strategy designed to put the city in the need "in meeting energy needs in a sustainable way, where everyone has access to affordable and healthy energy services, where energy is used efficiently, and where transport is efficient, equitable and emphasises public transport and compact planning" (UN-Habitat, 2009)

Coming up with plans that make the city easily walkable, safe and with provision of cycle lanes (Friel, Hancock, Kjellstrom, McGranahan, Monge and Roy (2011), like most cities in the Netherland. This will help reduce generation of carbon dioxide by motor vehicles and also make city residents healthier. Urban planners in Kenya have rarely considered these as important instead concentrating on the expansion of motorable roads.

Enforcing the physical Planning Act and by-laws to ensure that areas earmarked for basic services such as water and sanitation are not interfered with could help reduce flooding in urban centres in Kenya since these have been blamed on blocked drainage. It will also ensure that places that are not designated for settlements and are prone to disaster arising from extreme weather occurrences are not occupied. Encouraging settlement away from the most vulnerable areas remains one of the least expensive and pro-active ways through which future vulnerabilities may be reduced (Okalebo, et al, 2009).However, apart from enforcing the already existing laws to cushion the impacts of climate change, above all, citizens should be incorporated in urban planning. This may curb the invasion of land that is prone to disasters.

Planning and construction of new settlements outside the major cities to avoid further concentration of population and activities in the most vulnerable areas. The new plans should encourage settlements in the periphery-urban space. This has successfully been implemented in cities such as London.

Coming up with plans that have building standards that can accommodate future climatic conditions such as high temperature, humidity and flooding. This could be expensive given that majority of urban dwellers are low income earners, but the use cheap environmentally friendly materials can be promoted to serve this purpose.

The use of renewable energy at both household and industrial level should be promoted. Wind and solar energy are widely available in Kenya and can be used for water heating at the household level, while wind energy can be used in

water pumping for boreholes. Although the initial costs are very high the long term benefits are outstanding.

Coming up with plans that ensure parks, green spaces and roadside trees are part and parcel of the basic urban infrastructure will help regulate town temperature, thus helping to cope with extreme heat as a result of climate change and also act as carbon sinks. The planning and allocation of these "green" adaptation measures must be done in such a way that low-income groups has the same access (Friel et al. 2011)

Conclusion

Climate change is a reality all over the world; it is already having adverse effects on urban areas particularly those of developing countries like Kenya. However, its impacts can be cushioned by developing innovative plans that will assist in predicting, adapting and mitigating the effects of adverse weather events.

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