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Urban residents' awareness of climate change and their autonomous adaptive behaviour and mitigation measures in the coastal city of Mombasa, Kenya

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ABSTRACT

Understanding public awareness about climate change is important in directing policy on adaptation and mitigation policies. This paper examines urban residents' awareness and concern about climate change and their autonomous behaviour and mitigation measures in the coastal city of Mombasa through a survey of 290 subjects. The study established that most (96.6%) residents of the city are aware that climate change is taking place and link its causes mainly on deforestation, fuel combustion and nature but less to household activities and poor waste disposal. Although they were able to identify its consequences as an increase in average temperature, occurrence of infectious diseases and flooding, there are certain misconceptions such as ozone layer depletion (67.6%) and earthquake/tremor (12.1%). The study established that a number of residents affirmed some autonomous adaptive behaviour such as staying indoors during extreme temperatures and having an emergency kit at home. The results of the study demonstrate that awareness and concern about climate change had strongest effect on reduced energy consumption at home, and that the strongest barrier to taking mitigation steps is lack of necessary skills. The study concludes by recommending sensitization of urban public on the negative contributions of household activities and poor waste disposal to the concentration of greenhouse gases and the need to focus campaigns on personal mitigation activities.

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Urban residents; climate change awareness; adaptive behaviour; mitigation; Mombasa City

Introduction

Climate change, according to International Panel on Climate Change (IPCC), 'refers to a change in the state of climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer' (IPCC, 2007, p. 30). Although there has been a set of organized attempts to down play the reality of climate change by climate change deniers (Dunlap &McCright, 2010), there is scientific consensus that climate change is occurring (Frumkin, Hess, Luber, Malilay, & McGeehin, 2008; Omoruyi & Kunle, 2012). This is evidenced by increases in global average temperatures, heat waves,

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rising sea levels, glacial retreat,melting ice and snow, and increasing variability in climate (Frumkin et al., 2008; IPCC, 2007; World Health Organization [WHO] Regional Office for Europe, 2003). According to World Health Organization (WHO), 'warming of the global climate is unequivocal' (World Health Organization, 2009, p. 4).

It is undisputed that this phenomenon of climate change is one of the most serious challenges facing the world today and is expected to intensify in years to come (Nzeadibe, Egbule, Chukwuone, & Agu, 2011). Its impacts have direct and indirect effects on human livelihood and well-being and thus pose serious threat to sustainable development. Indeed climate change has been cited as the main impediment to attaining the Millenium Development Goals in developing countries (IPCC, 2007; Nzeadibe et al., 2011; United Nations Development Programme [UNDP], 2004). Although climate change is caused by both natural and anthropogenic (human) factors, it has now become clear that the increased incidence of climate change around the globe is a consequence of aggressive and unsustainable human activities (Ochieng, 2014; Oloke etal., 2013). These activities such as burning of fossil fuels and industrial pollution are associated mainly with urbanization, as such cities are no doubt the main contributors of climate change (Brody, Zahran, Vedlitz, & Grover, 2008; Hanif, 2011; Hunt & Watkiss, 2011; Johnson & Briel, 2012; Oloke et al., 2013). Although it has long been assumed that the high greenhouse gas (GHG) emission in the cities is being driven by industries and motor vehicles, recent research has established that it is also increasingly being fuelled by the energy services required by the large population in their homes for heating, cooling and other electronic use in addition to poor waste disposal (Kamal-Chaoui & Robert, 2009; Oloke et al., 2013). This propels the urban public into the centre stage of climate change mitigation. However, it is not clear whether urban residents are aware that some of their day-to-day activities contribute to the concentration of GHGs in the atmosphere and hence climate change (Oloke et al., 2013). It is also not clear whether they are concerned about climate change and whether this impact on their decision to take mitigation measures. According to Hunt and Watkiss (2011), cities are increasingly recognized as strategic to mitigation action in the framework of tackling the challenge of climate change even in developing countries where the discourse has largely focused on climate change and rural livelihoods. Johnson and Briel (2012) argue that urban areas have not only the potential to concentrate adaptive capacities but also to offer solutions through legislation of policies that encourage greening industrial production, use of alternative sources of energy, encouraging activities that contribute to reduction of energy consumption among others. This calls for studies designed to address the problem of climate change from the urban perspective, especially public awareness and concern about climate change.

Why awareness and concern? It is believed that public awareness and concern about their harmful contributions towards climate change is an important step towards climate change mitigation and adaptation strategies (DeBono,Vincenti &Calleja, 2012; Leiserowitz, 2006). According to Babitski (2011), public awareness and concern is one of the most important question to understand in order to precisely make future forecasts about climate change. Leiserowitz (2006) reiterates that personal understanding and concern of risk such as climate change is the strongest motivation of behaviour change and how people respond to hazards. A number of authors have hypothesized that one way of addressing the threat of climate change is to find out the extent to

which the public understands and are concerned about it (Bostrom, Morgan, Fischhoff, & Read, 1994; Brody et al., 2008; DeBono, Vincenti &Calleja, 2012). According to Karrer (2012), Muchanga (2011), Weber (2010) and Steg and Vlek (2008), empirical evidence has shown that analysing lay people's perspective of climate change can provide helpful information for the development and the enactment of useful types of corresponding intervention strategies. Therefore, the purpose of this study was to examine Mombasa City residents' awareness and concern about climate change as well as their autonomous adaptive behaviour and mitigation practices.

The theoretical perspectives that inform this study are derived from the Information-Deficit Model and the Theory of Planned Behaviour. According to Bulkeley (2000), the Information-Deficit Model proposes that lack of knowledge about environmental problems may result in indifference, minimal change in personal behaviour and dependence on government actions. The Theory of Planned Behaviour presupposes that one's actions are determined by how one understands and is concerned about an issue and the outcome of taking action (Ajzen, 1991). In this case concerns about global climate change are presumed to increase the willingness to undertake mitigation measure like conserving or reducing energy consumptions at home.

Methods

Study area

The city of Mombasa is located in the south-eastern part of Kenya and is found between latitudes 3°80′ and 4°10′ S and longitudes 39°60′ and 39°80′ E. Mombasa is the second largest city in Kenya and the largest sea port in Eastern Africa. The population of the city has more than tripled from 350,000 in 1980 to 882,200 in 2007 (United Nations Population Division [UNPD], 2007) and then to 1,051,825 in 2012 (Mombasa County Government, 2013) The rapidly expanding population has led to increased energy consumption and other household activities coupled with increased waste generation and poor disposal that are contributors to the concentration of GHGs into the atmosphere. The city lies on a coastal plain hardly rising above 50 m (above sea level) (Mombasa County Government, 2013) and experiences high temperatures and humidity making it highly vulnerable to the impacts of climate change (Awuor, Orindi, & Adwera, 2008).

Research methods and study population

Our study was conducted through a cross-sectional survey targeting Mombasa City residents. The study covered three residential areas in Mombasa City, that is, low income (Moroto), middle income (Tudor) and high income (Nyali) based on information from Kenya National Bureau of Statistics office in Mombasa and housing division, Mombasa County. Stratified sampling was used to ensure that the three categories of residents are represented in the sample. After stratifying the residential areas, systematic random sampling was used in selecting a total of 300 respondents who were heads of households. The sample size of 300 households was computed using the online SMART Methodology (2012) by considering the prevalence of 10% (given that reports by the

government of Kenya indicate that vast majority of Kenyans are not aware that climate change is taking place (Government of Kenya, 2010; Republic of Kenya, 2013), 95% level of confidence (Cl), 5% relative desired precision and design effect of 1.73. The sample size of 300 is large enough not to invoke sampling errors. Previous studies on perception and awareness of climate change have utilized similar sample size in urban settings (Kehinde, Olaleye, Toyobo, & Oginni, 2014; Moges & Chercos, 2014). Primary data for the study were collected with questionnaires administered on the heads of households. However, out of the 300 sampled households, 10 withdrew from participating in the survey. The questionnaire was prepared in consideration with previous works for reference (Akerlof et al., 2010; Haque, Yamamoto, Malik, & Sauerborn, 2012; Semenza et al., 2008) and in consultation with experts. The questionnaire was supplemented by nine focus group discussions (FGDs) and nine key informant interviews (KIIs). The FDGs consisted of between 8 and 12 participants of mixed gender. The participants in the FGDs were selected purposively from those who had participated in the survey based on the analysis of their responses. Six key informants were drawn from health officials and three officers from meteorological departments located in Mombasa city. There were no inducements for participants to participate in the study. Data collected were analysed both qualitatively and quantitatively. Qualitative analysis considered the inferences that were made from the opinions of the respondents during the KIIs and FGDs (Mugenda & Mugenda, 1999). The qualitative data were transcribed and analysed according to the themes and presented in narrative form and where possible chart and tabular forms. Quantitative analysis consisted of descriptive analysis involving an examination of the frequency distribution, using counts, percentages and totals. The binary logit model was performed to establish association between socio-demographics, awareness of and concern about climate change on taking mitigation measure. The binary logit model was the preferred method of choice because the dependent variable (taking mitigation measure) is binary. The model is useful in exploring the relative influence of categorical independent variables on the dependent variable. It helps in finding the model that is best adapted to the data but is still an acceptable model that describes the association between the dependent variable and a set of independent ones describing it (Milosavljevic, Pesic, & Dasic, 2015).

Findings

Climate change awareness

We begin by examining whether the study subjects are aware that climate change was taking place and its causes. Our findings show that 96.6% are aware that climate change is taking place, 3.4% stated that they can't exactly tell whether climate change is taking place, while none indicated that they are not aware that climate change is taking place. Comparison by educational level show that generally those with more education are less likely to state that they don't know or can't exactly tell that climate change is happening (3.2% and 0.0% respectively for middle college and university levels in comparison to 20.0% and 14.8% respectively for no formal education and primary level of education). In regard to the three residential areas, level of awareness about climate change taking place was highest among residents of high-income area (100%) followed by middle-

income area (99.9%) and lastly low-income area (93.8%). On respondents' awareness of the causes of climate change, the results in Table 1 show that most attribute the causes of climate change to deforestation (63.6%), fuel combustion (58.2%) and natural causes (56.4%), but less with household activities (6.1%), poor waste disposal (16.8%) and urbanization (27.9%).

Apart from statement of awareness, the study also captured respondents' knowledge of climate change by use of imagery expressions in which respondents were asked to state how they have visualized the changes in climate over time in their locality. The results show that majority of the city residents rated the intensity of the heat (78.3%) and flooding (73.8%) over the city as ranging from intense to very intense. The length of hot period was rated by 87.6% as ranging from long to very long, while the length of cold period (49.0%) and rainy season (61.40%) as short. The intensity of the rain during rainy season was mainly rated in the range of normal to mild (78.3%), bitterness of the cold during the cold season in the range of normal to bitter (66.5%). And finally, the frequency of drought (56.2%) and flooding were mainly rated as ranging from frequent to very frequent. Interviews with meteorological officers and meteorological data (Figures 1 and 2) indicate most of these observations as correct. Moser, Norton, and Georgieva (2010) commenting on data analysed from Kenya Meteorological Department observe that there was a gradual increase in mean temperatures in Mombasa in all seasons in the past 50 years. These observations of climate becoming extreme also emerged during focus group discussions. More salient from participants in the focus group discussions is that days are becoming warmer, drought and flash floods more frequent.

> These days generally it is very hot during the day which is becoming uncomfortable. It is like the sun is getting closer to the earth. We also encounter droughts almost every year leading to frequent food shortages. (FGD 1 male participant high income area)

Mixed in with this impression of warmer days and frequent droughts and flash floods, there is also the feeling that the seasons are becoming unpredictable.

> These days you can't be sure when the rains will come, it comes and goes; this is unlike in the past when people were sure that the rainy season in this place is from March to May. (FGD 2 male participant low income area)

In addition to awareness, the respondents also rated their concern about climate change on the scale ranging from extremely concerned, very concerned, moderately concerned, slightly concerned and not concerned. The findings in Figure 3 show that 52.4% are either

Table 1. Respondents' awareness of the causes of climate change.

Causes	*n*	%
Deforestation	178	63.6
Fuel combustion	163	58.2
Natural causes	158	56.4
Transportation	130	46.4
Water pollution	129	46.1
Industrialization	127	45.4
Change of land use	99	35.4
Urbanization	78	27.9
Agricultural activities	60	21.4
Gas flaring	58	18.6
Poor waste disposal	47	16.8
Household activities (e.g. cooking, lighting, heating, cooling)	17	6.1

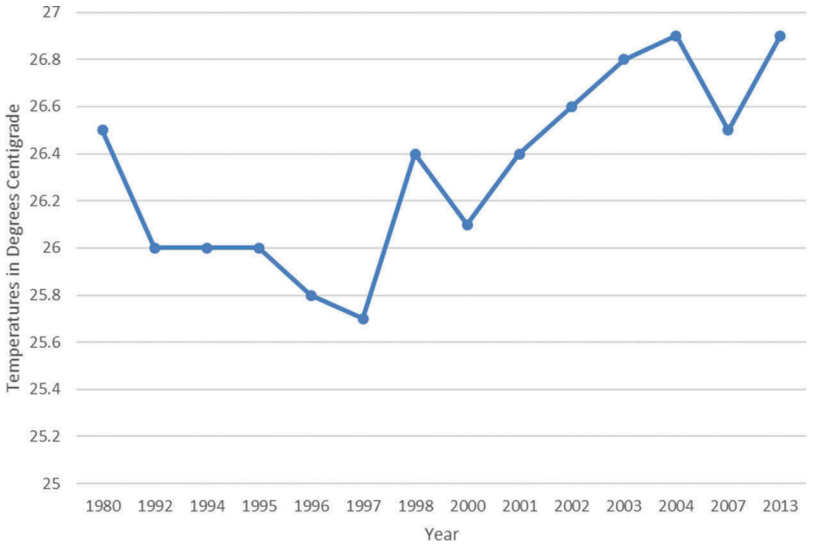

Figure 1. Mean annual temperatures at Mombasa for 1980–2013.

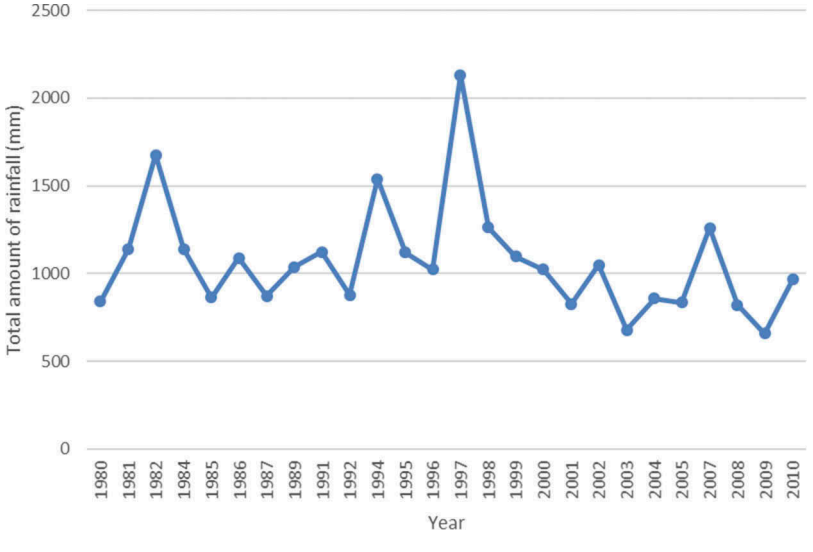

Figure 2. Total rainfall amount at Mombasa for 1980–2013.

very or extremely concerned about climate change, while only 7.2% stated that they are not concerned. The level of concern was found to be highest among residents of the middle income area (58.8%) followed by low income area (49.3%) and lastly high income area (49.0%).

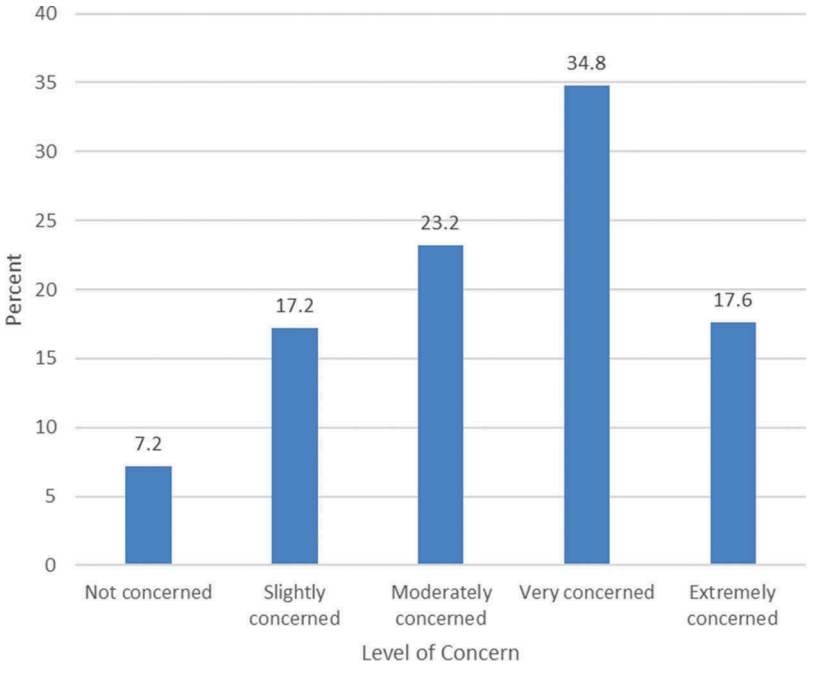

Figure 3. Level of concern about climate change.

Perceived consequences of climate change

The study further examined the respondents' perception of the consequences of climate change. The responses were interpreted as a phenomenon occurring when a respondent rated it as very likely, likely or somewhat likely, while no chance of occurring when rated as unlikely or very unlikely. The findings shown in Table 2 generally indicate that increase in average temperature (89.0%), frequent outbreak and spread of infectious

Table 2. Perceived consequences of climate change.

	Very likely		Likely		Somewhat likely		Unlikely		Very unlikely	
Perceived consequences of climate change	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Heat waves	34	11.7	126	43.4	68	23.4	32	11.0	30	10.3
More frequent storms	10	3.4	135	46.6	32	11.0	72	24.8	41	14.1
Earth tremors/quakes	8	2.8	12	4.1	15	5.2	120	41.4	135	46.6
Rise in sea level	36	12.4	119	41.0	58	20.0	69	23.8	8	2.8
Average temperature increase	33	11.4	160	55.2	65	22.4	32	11.0	0	0.0
Depletion of ozone layer	9	3.1	57	19.7	130	44.8	86	29.6	8	2.8
Frequent occurrence of drought	36	12.4	116	40.0	33	11.4	77	26.5	28	9.7
Frequent water shortages	32	11.0	138	47.6	17	5.9	44	15.2	57	20.3
Extreme cold weather	24	8.3	30	10.3	42	14.5	77	26.6	117	40.3
Vitamin depletion in food	24	8.3	30	10.3	35	12.1	125	43.1	76	26.2
Food shortage	33	11.4	52	17.9	57	19.7	112	38.7	36	12.4
Frequent outbreak and spread of infectious diseases	37	12.8	156	53.8	54	18.6	39	13.4	4	1.4
Coastal erosion	21	7.2	54	18.6	132	45.5	80	27.6	3	1.0
Economic decline	14	4.8	79	27.2	54	18.6	107	36.9	36	12.4
Frequent and severe Flooding	50	17.2	134	46.2	24	8.3	42	14.5	40	13.8
Occurrence of land or mudslide	7	2.4	39	12.8	50	17.2	70	24.2	126	43.4

disease (85.2%), occurrence of heat waves (78.5%), rise in sea level (73.4%), frequent and severe flooding (71.7%) and coastal erosion (71.3%) ranked highest. Consequences such as occurrence of land or mudslide (32.4%) and extreme cold weather (33.1%) ranked low. During the focus group discussions, flooding was eminent as one of the major problems resulting from the changing climate:

> Unlike in the past floods in this town is now a frequent problem due erratic downpour, but in our neighbourhood it has become worse, as you can see we don't have proper drainage channels. When you look up there (pointing), the only existing drainage line is full of wastes, so that when it rains the water moves down directly into our houses. (FGD 4 male participant low income area)

The findings also reveal a few misconceptions about some of the perceived consequences of climate change. For example, up to 67.6% of the respondents associate ozone layer depletion with climate change and 12.1% associate it with the occurrence of earthquakes or earth tremors. Comparison on the basis of the residential area shows that the misconception about climate change causing ozone layer depletion was highest among the residents of high income area (85.8%) followed by low-income area (66.0%) and lastly middle-income area (60.8%). Almost the same was found for the misconception that climate change causes occurrence of earthquakes and earth tremors with high-income area leading at 16.4%, but with middle-income area residents coming second at 13.4% and lastly low-income area at 9.8%.

Autonomous adaptive behaviour

Table 3 illustrates a number of autonomous adaptive behaviour that the study subjects affirmed. Most of the adaptive behaviours are reactive rather than anticipation. The most common reactive behaviour was drinking plenty of water (95.9%) and staying indoors or out of the sun (93.1%) during periods of extreme heat and dressing in heavy clothes (94.1%) during extreme cold. Comparison by residential area reveals some variations in some of the adaptive behaviour. For example, cooling or warming the

Table 3. Autonomous adaptive behaviour.

Adaptive behaviour	*n*	%
During extreme heat		
Cooling the room using air condition/fan	81	27.9
Staying out of the sun(indoors)	270	93.1
Drinking plenty of water	278	95.9
Dressing lightly	254	87.6
Reduced physical activities	132	45.5
During extreme cold		
Heating the room	97	33.4
Dressing heavily	273	94.1
Doing physical activities, e.g. exercises	47	16.2
Keeping indoors	67	23.1
During flooding		
Making water drains	41	11.1
Pile sand around the house	51	17.6
Clearing blocked drains	39	13.4
Others		
Having emergency kit that include thermometer, flash lights and other essentials	99	34.1

rooms during very extreme temperatures are mainly done by residents of high-income area (79.6% and 63.3% respectively), but less among residents of the low-income area (4.2% and 12.5% respectively).

Mitigation practices

Respondents' mitigation practices were assessed using four items touching on energy consumption, switching to renewable energy, conserving water and walking that were rated on the scale very large extent, large extent, some extent and not at all. Table 4 presents the results of the responses.

The study subjects who indicated 'not at all' in any of the four adaptation measures were asked to state the barriers hindering them from taking the step(s). The barriers identified by the study subjects include; lack of appropriate skills (66.2%), lack of personal motivation (64.1%), lack of resources (63.4%), lack of cooperation from others (62.8%), not knowing what steps to take (59.0%) and belief that it is the government duty to act (54.8%).

Binary logistic regression (Table 5) was performed to see the association between socio-demographics, awareness of and concern about climate change on reducing energy consumption at home (mitigation). Before performing the regression, responses for reducing energy at home were merged into two groups, those who had reduced consumption (ranging from some extent to very large extent) and those who have not. According to the results, concern about climate change (odds ratio [OR] = 3.328, 95% Cl; $p < 0.05$), climate change awareness (OR = 1.291, 95% Cl; $p < 0.05$) and age (OR = 0.514, 95% Cl; $p < 0.05$) are significant predictors of reducing energy consumption at home. This means that those concerned about climate change and those aware that climate change is happening are 3.328 and 1.291 times respectively likely to reduce their energy consumption at home. Age is negatively related to mitigation with the old less likely to reduce energy consumption.

Table 4. Climate change mitigation measure.

	Very large extent		Large extent		Some extent		Not at all	
Adaptation measures	*n*	%	*n*	%	*n*	%	*n*	%
Reduced energy consumption at home	1	0.3	5	1.7	61	21.1	223	76.9
Switched to renewable energy	1	0.3	3	1.0	13	4.4	273	94.1
Conserve water	9	3.1	31	10.7	184	63.5	66	22.8
Walk instead of using vehicle transport over short distances	1	0.3	9	3.1	129	44.5	152	52.1

Table 5. Binary logistic model.

Variable	*B*	Sig	OR
Age	−0.665	0.047*	0.514
Gender	0.147	0.654	1.158
Marital status	−0.223	0.224	0.800
Education level	−2.090	0.244	0.124
Income level	−0.053	0.723	0.949
Awareness that climate change is happening	0.255	0.004*	1.291
Concern about climate change	1.202	0.001*	3.328

Model X^2 (7) = 23.568, $p < 0.05$, Pseudo R^2 values Cox and Snell 0.094 Nagelkerke 0.143. Reduced energy consumption at home, $n = 67$.

Discussion

The findings of the study show that the level of awareness (96.6%) and concern (92.7%) about climate change is high amongst residents of Mombasa City. These findings are significantly different from other studies that have showed that most people in developing countries, particularly sub-Saharan Africa are still unaware of climate change (Chatterjee, 2008; Godfrey, Le Roux-Rutledge, Cooke, & Burton, 2009; Pugliese & Ray, 2009; Rao, 2011). They also contradict the concerns articulated in Government of Kenya (2010) and Republic of Kenya (2013) which state that the vast majority of Kenyans are not aware that climate change is taking place. Other studies in Kenya that agree with our findings include those of Owigar, Angawa, and Githeko (2012) in western Kenya (98.8%) and Ochieng (2014) in Kisumu City (93.7%). In Nigeria, studies by Oloke et al. (2013) in the City of Lagos (95.2%) and Raut (2011) in rural areas of Oyo state, Southwest, Nigeria (87.5%) have also reported high level of awareness among the public. These studies may be an indicator that the lay man in sub-Saharan Africa is increasingly becoming conscious about climate change phenomenon. By use of imagery expressions, our findings further confirmed that most of the respondents are able to clearly and accurately express changes in the parameters that denote changes in climate over time. Our findings compare favourably with those of Haque et al. (2012) in a study of a rural population in Bangladesh which showed that study subjects had a discernible image about the changes in cold, heat and rainfall that had occurred in their locality over the years. Similarly, in a study in Hanoi, Vietnam, Toan, Kien, Giang, Van Minh, and Wright (2014) reported that most of the locals expressed the occurrence of climate change in terms of changes in the trends of temperature, rainfall and strength of the wind particularly during the rainy season.

On the causes of climate change, our findings reveal a skewed perception with individual contributions not taking any centre stage. For example, less than 10% of respondents link it to household activities and poor waste disposal yet these have been linked to increased generation of GHGs. Urbanization was also least linked to climate change despite being the main driver behind other causes that were slightly ranked high like fuel combustion and transportation. It can be deduced from our study that although the public are increasingly becoming aware that climate change is taking place, they are yet to clearly understand its causes. Lack of clear understanding of the causes of climate change had also been reported in a study by Owigar et al. (2012) in west Kenyan highlands where they found that most respondents (61%) attributed climate change to the divine work of God as compared to human activities (37.8%) and natural phenomena (17.6%). Imperatively, other studies in eastern Africa have reported the linking of climate change to God, immortality and even witchcraft (Muchanga, 2011). Other studies in Africa have also found that only a small proportion of the population make the link between their household activities and global climate change. For example, Oloke et al. (2013) in a study in Lagos found that most residents attributed the causes of climate change to natural causes (45.7%) and industrialization (38.4%) and less to household activities and poor waste disposal (5.3% respectively). Yet they point out that GHG emission from buildings and household activities in urban areas have become significant drivers because of the requirements of the increasing number of people. According to the United Nations Environment Programme [UNEP]

(2007), the amount of energy consumed by the residential sector alone in sub-Saharan Africa amounts to 56.2% of the total energy consumed while the commercial sector accounts for a paltry 2.2%. Our findings and the observation by UNEP therefore calls for African governments to focus more on sensitizing and educating the public about what causes the changes in climate that they have already noticed, particularly their own contributions.

The findings on the consequences of climate change show that most study subjects perceive climate change to cause increase in average temperatures, frequent outbreak and spread of infectious diseases, occurrence of heat waves, rise in sea level and frequent and severe flooding. These expressions reveal how conscious the respondents view their situation in the context of their location. Predictions show that climate change will not only cause massive flooding in coastal towns but also submergence under water due to sea level rise as well as soaring temperatures and humidity and increase in infectious diseases. Similar finding have been reported in a study in coastal Tanzania by Armah (2015) where the residents perceived the major impacts of climate change as hot weather, rise in average temperature, upsurge in occurrence and spread of infectious diseases, increased incidences and magnitude of flooding and rise in sea level. However, some studies have indicated that the public may not link their vulnerability to future climate change related problem. In a study in Bangladesh, for example, Haque et al. (2012) found that respondents mainly mentioned droughts (97.3%), storms (25.2%), cyclones (30.3%) and salinity issues (34.0%) as the likely impacts of climate change to occur in the future. But they noted that contrary to the expectations, in a flood-prone country, only 14.8% of the study subjects projected that floods might be a future problem.

The current study also revealed some misconception about the perceived impacts of climate change. These include ozone layer depletion and occurrence of earthquake and tremor. Ungar (2000) points out that people mistakenly link the hole in the ozone layer with climate change although both are distinct phenomena which have separate causes, effects and solutions. According to Kempton, Boster, and Hartley (1995), studies have shown that people have the propensity to use 'climate change' as an encompassing phrase, so much so that the depletion of ozone layer and atmospheric air pollution in general often become included within it. Misconceptions about impacts of climate change have also been reported in other studies, for example, Semenza, Ploubidis, and George (2011) in a study in the United States reported misconceptions such as depletion of the ozone layer, earthquakes and even vitamin depletion in food. However, unlike in many studies that laypersons' misperception have often been demonstrated (Bostrom et al., 1994; Leiserowitz, 2006; Lorenzoni& Pidgeon, 2006; Read, Bostrom, Morgan, Fischhoff, & Smuts, 1994), Karrer (2012) in a study of Swiss farmers' perception of climate change found that only a few farmers (1.5%) mistakenly linked climate change to ozone layer depletion.

Our findings also show that a number of respondents affirmed autonomous adaptive behaviour during adverse weather events. However, it is important to point out that some of the adaptive behaviours reported by the respondents may also be counterproductive, for example, staying indoors away from the scorching heat may lead to social isolation resulting to suicidal tendency that is becoming more common in urban settings. Reduced physical activities like walking and exercises may increase overweight among residents and resultant obesity. At the same time

when extreme heat discourages many people to walk, it leads to increased use of vehicle transport and more generation of GHG and resultant global warming. Generally, most of the autonomous adaptive measures taken by the respondents are reactive in nature than proactive (planned) (Semenza et al., 2011). Normally planned adaptation measures are initiated by governments or organizations through deliberate policies. Opondo (2013) points out that planned and autonomous adaptation interact in many ways and complement one another. Individuals may also undertake planned adaptation measure by adapting their homes to climate change such as installing air condition, eliminate mosquito breeding sites, raising the foundation of their homes among others (Semenza et al., 2011). The current study found that some adaptation measures are influenced by the income category of a residential area, especially those that require monetary investment like installing air conditioner. Residents of high-income area rank high in the percentage of those who had installed air conditioner or fan. Satterthwaite, Huq, Pelling, Reid, and Lankao (2007) observe that there are large variations in the asset base that different income groups can turn to in order to cope with extreme weather conditions. The poor have diminished capacity to cope due to their asset base. This calls for pro-poor programmes that can enhance their ability to initiate planned adaptation measures to climate change.

Finally, the results of our study show that only a few study subjects had taken practical mitigation measures towards climate change. The possible explanation can be derived from the barriers stated by the respondents particularly lack of skills or knowledge of appropriate steps to take. This implies that even where the people could be willing to take action there is a wide knowledge gap that could lead them into taking appropriate actions to mitigate climate change. It is therefore important to educate people on how they can reduce or avoid activities that contribute to GHG emissions. Although according to Ochieng (2014), at national level, the government of Kenya has developed the *National Climate Change Response Strategy* – 2010 and its implementation plan, the *National Climate Change Action Plan 2013–2017*, which outlines actions to be taken to mitigate and build resilience to the impacts of climate change, this needs to be complimented by public education. Binary logistic model indicated that concern and awareness that climate change is taking place are significant predictors of reducing energy consumption at home (mitigation). Our study, thus, agree with the two theoretical perspectives that we adopted, that is, Information-Deficit Model and the Theory of Planned Behaviour, that both posit that behaviour change, particularly, taking mitigation measures to climate change depends on awareness and concern about climate change. This result is consistent with the general truth that knowledge and concern about climate change can influence adoption and support of mitigation measures. Other studies have come to a similar conclusion, for example Bord, O'Connor, and Fisher (2000) in a survey in the United States of America established that accurate knowledge of climate change was strongly associated with willingness to change behaviour and support for mitigation policies. Similarly, in a study among urban residents in Portland and Houston, Semenza et al. (2008) found that respondents with increasing concern about climate change were likely to take mitigation steps.

Conclusions and recommendations

The study examined largely urban residents' awareness and concern about climate change, its causes and consequences, their autonomous adaptation behaviour and mitigation measures. The findings show that despite high level of climate change awareness among the residents of Mombasa City, many do not associate their household activities and disposal of waste with emission of GHG. In order to control household practices and poor waste disposal methods that contribute to climate change, then there is need to educate the urban public about the role of household activities and disposal of waste in GHG emission. The government should also invest in economically and environmentally friendly alternative household energies like solar energy and biogas and make them cheaply available to urban residents. The study has also shown that Mombasa City residents have devised some autonomous behaviour in response to extreme weather events, and that such initiatives should be supported and appropriately directed by government agencies to increase adaptive capacity. It is suggested that disaster preparedness and climate change skills should be provided in educational institutions and other forums like community meetings and church gathering to equip the residents with necessary skills. Finally, the study established that mitigation steps (reducing energy consumption at home) depend on the level of awareness and concern about climate change, it is suggested that apart from increasing awareness, climate change programmes should target issues that raise level of concern such as seriousness of climate change on individual health.

Disclosure statement

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