

Contemporary Issues in Urban and Regional Planning and Development in Africa

A Festschrift in Honour of
Professor Aina Thompson Adeboyejo



Editors:

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ISBN 978-978-31064 2 7

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Ladoke Akintola University of Technology, Ogbomoso, Nigeria, 2020

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Published in Ibadan, Nigeria

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Soft copy designs and hard copy printing by

Emmant-Budd Communication,

Suite 1, 2 & 7, Sholly Summer Building, opposite Goshen Event Centre,

Sango - Mokola Highway,

Ibadan, Oyo State,

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Chapter 17

Planning Instruments And Climate Change Adaptation Strategies For Non-coastal Mopani District Municipalities Of South Africa

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Introduction

Adapting to the changing climate is becoming an unavoidable global phenomenon, particularly with regards to the central role of urban planning and planning instruments (Pieterse *et al.*, 2020). This significantly requires the synergy between bottom-up and top-bottom approaches to effectively curtail the climate change vulnerability (Sanchez-Rodriguez, 2009). Considering the complexity, uncertainties, and scale of possible global climate change impacts, there is the argument that urban planners and managers can to limit the negative impacts of climate change among vulnerable households (Hagen, 2016). This significant role in adaptation is possible because of their power of skill to determine the form, structure, and how settlements function (Pieterse *et al.*, 2020). However, Stephane (2009) stated that only informed decision-making tools can assist municipal authorities in responding more appropriately to the negative impacts of climate change. According to Nicholls *et al.*, (2007); Adger *et al.*, (2007); Milly *et al.*, (2008) it is, rather the quality of urban planning and management at the local level to effectively combat climate change risks that matters. These attributes regarding the qualities of planners and planning to curb the negative impacts of climate change at the urban level is as important as the level of control and the willingness of the planners and manager to inject and integrate creative approaches into solving climate issues.

Planning exists at varying levels (regional, national, sub-national, and local etc.). However, adaptation to climate change should be the responsibilities of the local municipal planning agencies and should be household-driven (Thomas *et al.*, 2009). In line with this submission Piya *et al.*, (2012) assert that effective spatial planning designed for climate change adaptation programming requires an assessment of local (micro-level) peculiarities. Though not mutually exclusive, micro-level policy formulation should serve as a feeder to Macro-level policy formulation. This was corroborated by Burton *et al.*, (2013), as most policies based on Macro-level experiences often failed because they did not reflect the location-specific situation (Piya *et al.*, 2012) particularly climate change impacts being location-driven.

The alteration experienced in weather patterns, particularly in rising average temperatures and dwindling precipitation are occasioning increase in the frequency and intensity of dry spells and droughts particularly in the non-coastal southern Africa region (Chikoore, 2016; Munyai *et al.*, 2019) including Mopani, Limpopo. This has resulted in major water shortages in both quantity and quality. It has equally improved the circumstances for veld

and forest fires to strike and has compromised lives and livelihoods (USAID 2018). Floods become frequent and intensified (Munyai *et al.*, 2019) imperil several infrastructures and subjecting communities (particularly, urban centres) to undue pressure and hardship (USAID 2018). The impacts are, severely, felt in Mopani towns, combined with the persistent pressure of urban reconfiguration that is targeted towards correcting the apartheid-era of segregation, characterized by backlogs of services across the district. This is no doubt a double-edge pressure, by making future policy decisions amidst the pressure to satisfy the retrospective developmental agenda in the face of ravaging climatic scenario.

South Africa, like other developing nations, is highly vulnerable to climate variability and change impacts (Phokele and Sylvester, 2012). Even though climate change occurs globally, the local municipality is where the consequences of the phenomenon are largely felt (Pieterse *et al.*, 2020). These impacts are both short and long terms ranging from heat waves, floods, sea-level rise, and droughts etc. Localities are equally the site where opportunities abound to tackle the scourge (Carminet *et al.*, 2012; Chu *et al.*, 2016). Thus, reducing the impacts of climate change in cities calls for resolute actions that will be championed by the municipalities, to sustainably save guide human, natural and the built environment. The best time to act is now considering the central role that city plays in the world social, economic, cultural, political and environmental spheres (Sanchez-Rodriguez *et al.*, 2005), as well as in anthropogenic warming emanating from city (IPCC 2007; Satterthwaite 2008).

No doubt, South Africa has taken a centre-stage on climate change issue globally with a clear commitment to global treaties, conventions, protocols and several other climate change-related agenda. At the national level, climate change mitigation and adaptation policies have been the strategic focus of government to facilitate policy interventions (Roberts, 2008). However, this is not yet the case at the local level, where several factors, ranging from, but not restricted to limited capacity among municipal staff, the paucity of funding among other limitation have challenged the planning and implementation of climate change adaptation policies and programs (Roberts, 2010). Despite the widespread awareness of the phenomenon and its attendant impacts among citizens (Komet *et al.*, 2020). It equally not in doubt that local planning instruments and policies, particularly in Mopani District recognize the human and settlement impacts of climate change, as well as the central role that spatial planning plays in responding to these impacts (Mopani District Municipality Integrated Development Plan (MDM IDP), 2018/19). However, there is a little pointer to pragmatic and coherent efforts to address these challenges through medium to long-term planning approaches. This scenario signifies challenges associated with climate change adaptation and how limited are the roles currently plays by planning in the Mopani District Municipalities.

Experience has shown that the efforts at local government level in addressing climate change often suffer neglect, to give way for developmental issues like service delivery backlogs that are considered immediate dilemma (Broto, 2014; Pieterse *et al.*, 2016). Many local plans with short-term horizons are often in conflict with such, like climate change (with long-term implications). The story is not different in the context of Mopani, where five-year political agenda enjoyed political attention and patronages than long-term sustainable development such as climate change adaptation.

Consequent upon the households' frustrations occasioned by the failure of the municipalities to adequately protect them from the climate change related-hazards, has ushered in private adaptation strategies, which now becomes increasingly acceptable and an integral element of the urban setting (O'Brien and Sygna, 2013). Having observed that the end to Municipalities' failure is not in sight to assure them effective adaptation interventions to climate change in urban centres. This situation, therefore, raises the question of competence and adequacies of the household's capacity to curtail the resultant adversities of climate change within their limited resources. It is in line with this that this chapter examines the individual household adaptive capacities to climate change extreme events and hazards in the five non-coastal local municipalities of Mopani District in South Africa. This chapter intends to offer the basis for targeting, formulating, evaluating and monitoring urban adaptation policies, programs and projects, through the strengthening of the understanding of the need for its mainstreaming to planning instrument in non-coastal municipalities of South Africa. Thus this chapter aims at justifying the need to integrate the multidimensional and multiscale planning instruments for responsible and responsive adaptation interventions across the region.

Study Area

Mopani District Municipality being the study area is a non-coastal municipality, situated at the northern-most province (Limpopo) in the Republic of South Africa. The district is located within the north-eastern quadrant of the province, bordered with Zimbabwe, Botswana, and Mozambique. On the south and Southwest are Mpumalanga and Gauteng and Northwest Provinces respectively. Mopani District Municipality is a Category C municipality, located on a global view, between the Longitudes: $29^{\circ} 52' E$ to $31^{\circ} 52' E$ and Latitudes: $23^{\circ} 0' S$ to $24^{\circ} 38' S$, with $31^{\circ} E$ as the central meridian. Figure 1 shows the administrative boundaries of the Mopani District indicating the five local municipalities within the context of South Africa.

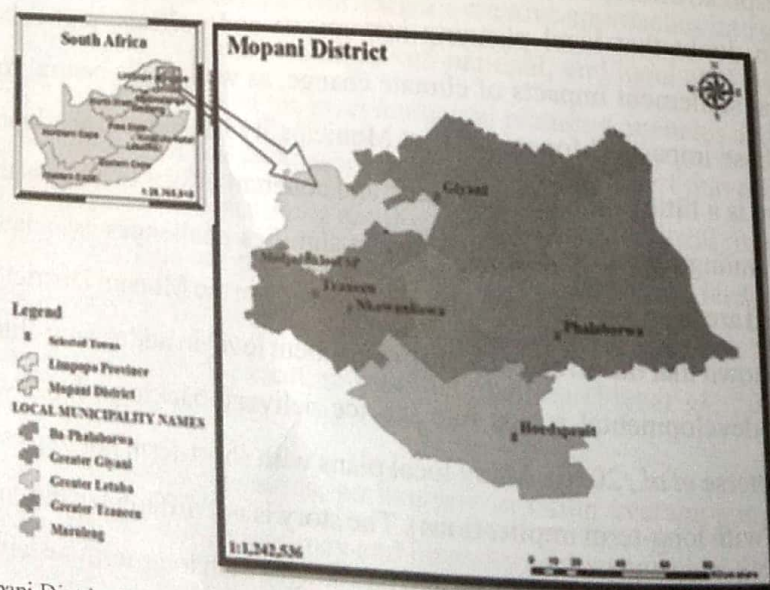


Figure 1: Mopani District Showing the Local Municipalities and the selected towns within the context of Limpopo Province and South Africa
Source: Author's Field Data 2019

The district comprises of five local Municipalities including, Greater Giyani, Maruleng, Greater Letaba, Ba-Phalaborwa, and Greater Tzaneen. Most parts of the district received about 85% of the rain recorded in summer. The rainfall received vary, ranging from 2000 mm/a (in Drakensberg Mountains) to as low as 400mm/a (Kruger National Park) at the dry low veld. The temperature experienced on the other hand range (on the average) from 21°C to 25°C in the dry low veld areas of Kruger National Park (Environmental Management Framework for the Olifants and Letaba river catchment areas,

Method

The study used data from both primary and secondary sources. Primary data used in exploring the indicators and parameters were derived from the field through personal contact with the households, while secondary information was sourced from the Governments documents, journals and other publications. Guided by the objective of the study, the methods of data collection emphasized direct/personal interviews and questionnaire, for a high rate of response. This study adopts the Multistage sampling techniques to sample 500 household (following Lwanga & Lemeshow (1991), for population above 10,000) from the district's total households of 34,790. The selected households were drawn from BA-Phalaborwa, Greater Letaba, Greater Giyani and Greater Tzaneen and Maruleng. Household heads form the primary focus (regardless of sex and age), but where the heads of households were not available, any designated or eldest adult member of the household who is a permanent resident was interviewed using systematic random sampling.

Hypothesised variables that were used in this study as determined by the objective, are referred to as Objectively Verifiable Indicators (OVI). Measuring the households' adaptive capacity from screened lists of the indicators that were hypothesised in the literature to be very essential to determine the household's coping capacity to environmental hazards. Personal Assets Possession/deprivation was measured using 52 assets (items) for households (Personal Possession (PP). The study employed Dummy variable measure ment to derive minimum utility value (MUV) from possessing an asset, where possession is scored: 1, and none possession is scored: 0 and as missing value (adding to 0) where the person did not desire to have that asset. The summation of the possessed assets scores presented the aggregate score of a household. The percentage proportions of household's possessions are thus adopted as Personal Possession Index (PPI)(Nhuanet al., 2016). With an integrated approach, the study adopted the prescribed screened indicators that denote social (Sietchiping 2006), governance (Nhuanet al., 2015), economic (Barr, 2005), human (Wall and Marzal, 2006), ecological and infrastructure (Nhuanet al., 2016) components. In agreement with their capability to minimize risks from climate shocks through risk pooling, risk distribution or as a buffer during extreme climatic, (Nhuanet al., 2015; Sen, 1987 and Borooh, 2011).

To measure the household adaptive capacity from the 52 identified Personal Possession variables, Personal Possession Index (PPI) was derived. The percentage possession from the hypothesized indicators from its summation was scaled on a 0-1, implying calculated indicator value that is more asymptotic to (closer, but not up to or intersects with) 1, indicates a higher adaptive capacity, but calculated indicator asymptotic to zero (0) indicates a

weak or low adaptive capacity (Nhuanet al., 2015). The result of the calculated indices was further subjected to the Likert Scale of Capability as Very Much Capable (5) for possession of 81-100% of prescribed assets; Very Capable (4) for possession of 61-80% of prescribed assets; Capable (3) for possession of 41-60% of prescribed assets; Not Capable (2) for possession of 21-40% of prescribed assets; and Not Capable at all (1) for possession of less than 21% of those screened assets. ANOVA was used to analyze the variations between municipalities and the estimated indexes.

To spatially delineate the estimated the Household Adaptive Indexes (HACI), the boundaries of the municipalities were geo-referenced through Google map (from www.google.com/maps). The spatial coverages of the municipalities were determined using Google Street Map (for its ability to show delineated boundary). The boundaries were plotted on Google-earth Pro and saved as Keyhole Mark-up Language (KML) polygon format in decimal degrees. Universal Transverse Mercator (UTM) was used to establish coordinates. KML was converted to UTM and to a shape-file to allow working on ArcMap. This file was exported, using Global Mapper to ArcGIS interface to display, edit and map-based query and analysis. Following these procedures, municipalities were populated with results from Household Adaptive Index for mapping. These populated municipality maps were converted from shape files to raster files, using Map Algebra, where HACI were thus analytically transformed to map depicting the rankings (according to levels) of capabilities of municipalities in the colour of varying intensities.

Results and Discussion

Adaptive capacity, being the most defining indicator of vulnerability can influence vulnerability (Nhuanet al., 2015), the lower it is, the higher the propensity to increase vulnerability. This section presents the results of the analysis of households' adaptive capacity at different local municipalities in Mopani District. This is shown in Table 1. Table 1 depicts

Variable	Greater Tzaneen		Greater Letaba		Maruleng		Ba-Phalaborwa		Greater Giyani		Total
	N	%	N	%	N	%	N	%	N	%	%
Very Much Capable	18	7.1	3	30.0	3	16.7	5	6.0	19	14.6	9.7
Very Capable	108	42.5	3	30.0	6	33.3	31	37.0	29	22.3	35.7
Capable	67	35.7	0	0	2	11.1	30	35.7	49	37.7	29.8
Not Capable	60	23.6	3	30.0	5	27.8	18	21.4	27	20.8	22.8
Not Capable at All	1	0.4	1	10.0	2	11.1	0	0	6	4.6	130
Total	254	100	10	100	18	100	84	100	100		100

Households' Adaptive Capacity Index in Mopani District across the five Local Municipalities.

Table 1: Household's Adaptive Capacity Index In Monpani Across Local Municipalities

Table 1 revealed that less than one-tenth (7.1%) of greater Tzaneen's households are very much capable to cope with climate change and its associated adversities. This proportion is comprised of 30%, 16.7%, 6.0% and 14.6% of households in Greater Letaba, Maruleng, Ba-Phalaborwa and Greater Giyani municipalities respectively. The summation of these proportions implied about 9.7% of the total households in Mopani District Municipality (MDM). This indicates that less than one-tenth of MDM population is very much capable to cope with climate change hazards. However, out of 35.7% of the total households that are very capable across the district, 42.5% of them are accounted for by Greater Tzaneen Municipality, 30% by Greater Letaba, 33.3% by Maruleng Municipality, while Ba-Phalaborwa and Greater Giyani respectively accounted for 37.0% and 22.3%. A further investigation revealed that less than four in every ten households can be stratified as being capable to cope with the climate change hazards in the Greater Tzaneen Municipality. Ba-Phalaborwa Municipality accounted for the highest category of capable households to climate change and hazard-related events, while Greater Letaba recorded no household in this category to account for the lowest (Table 1).

Furthermore, in Table 1 the analysis of household with no capability of coping with climate change was further stratified into two, namely: not capable and not capable at all. The results, based on this stratification, show that Greater Letaba was the municipality that the highest proportion of its households (30%) were not capable and 10% not capable at all of withstanding the hazards resulting from climate change. Similarly, Greater Tzaneen equally accounted for 23.6% of its households were not capable and less than 1% were not capable at all. The levels of HACI is depicted in Figure 2.

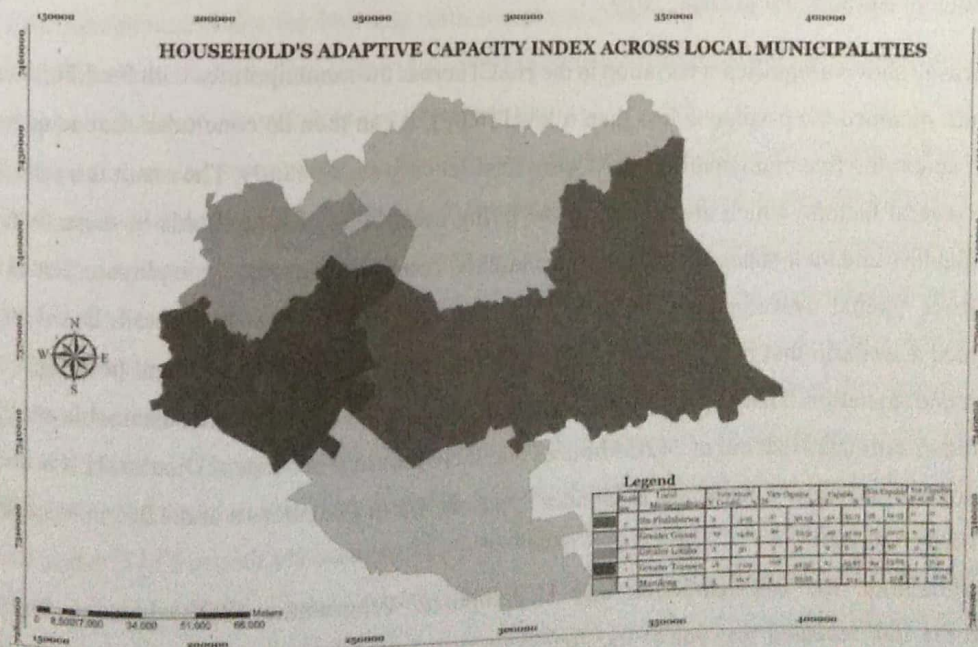


Figure 2: Households' Adaptive Capacity Index across Local Municipalities in Mopani District
Source: Authors' Field Data, 2019

Figure 2 shows the five municipalities within the context of Mopani District depicting the rankings (according to levels) of the adaptive capacities of the respective municipalities in the colour of varying intensities. The map depicts (in deep colour) Greater Tzaneen Municipality having the highest proportion of capable households (ranked first), followed respectively by BA-Phalaborwa, Greater Giyani and Maruleng Municipalities, while Greater Letaba Municipality had the least. Generally, though, the level of adaptive capability was relatively high across the District. However, not less than approximately one-fifth (20%) of every municipality's household heads lack the prerequisite to adapt to climate change hazards in Mopani District. Very few fractions are found across the district not being capable at all to cope with the phenomenon in the study areas (Table 1). Table 2 shows the variation between the adaptive capacity index and its significance level in the neighbourhoods across the Mopani Districts by ANOVA test.

	Sum of Squares	df	Mean Square	F Value	Sig.
Between Groups	353.163	48	7.358	F	0.000
Within Groups	1215.797	447	2.720	2.705	
Total	1568.960	495			

Table 2: ANOVA test results of HACI across the local Municipalities in the Mopani District.

@ $\alpha = 0.05$

Source: Authors' Field Data, 2019

The result shows a significant variation in the HACI across the municipalities with $F = 2.705$ and $p = 0.000$. With the result, obtained the p-value is less than α level (0.05), it can then be concluded that adaptive capacity mean (index) across the five municipalities in Mopani District vary significantly. The result is a reflection of the influence of several factors, which are related to the living conditions of households in these municipalities. Housing availability and their states as well as environmental condition are major role players. For example, the Mopani District Spatial Development Framework 2019, as well as the Integrated Development Plan 2019/20, painted a scenario that many households in Mopani are living without land and housing, no access to potable water and sanitation. That significant percentage of households cannot afford sustainable energy sources. The report further estimated that out of 84,654 houses that were required in Mopani District, 12.4% are needed in Greater Giyani, 9.1% Greater Letaba, 8% in Greater Tzaneen, 4.9 in Phalaborwa and 4.3% in Maruleng (MDM SDF 2019; MDM IDP, 2019).

Furthermore, the Reconstruction and Development Programme (RDP) housing units backlog according to the IDP revealed that out of the 26,735 units required, 11,119 were required at Greater Giyani Municipality, 7879 at Greater Letaba, 5388 at Greater Tzaneen and BA-Phalaborwa and Maruleng shared 1466 and 883 respectively (Mopani Municipality IDP 2019). The degree of the inadequacies in housing (with water and sanitation) in the municipality depicts a close similarity to the order of the respective municipalities' adaptive

capacity. Reinstating this position, results show that Greater Letaba, Maruleng and Greater Giyani with the highest backlog of housing were both reportedly the municipalities that had the households with the lowest capacity to adapt to climate change. Municipalities like Greater Tzaneen, BA-Phalaborwa with Higher coping capability are having lower housing backlogs. Similarly, the following factors equally contributed to compromising household adaptive capacity in the district across the five Local Municipalities.

Investigation revealed that change in water level, reduced rainfall was identified by 100% of the respondents in Mopani. The reduction in (rivers) water level does not only compromise the availability but also reduces the quality of water as a crucial factor of health. Its scarcity in both availability and quality, because of its close connections to food security, sanitation and hygiene, contributes to health burdens (DeNicola *et al.*, 2015). Poor and vulnerable communities (across the five municipalities) suffer the most from the adverse effects of climate change on water and health-related issues (Jongman, 2018). The resultant effects may be devastating on the general wellbeing of the household, reducing the adaptability of households.

Every respondent interviewed across the studied municipalities indicated their non-involvement and participation in planning, concerning the decision-making process on spatial planning, particularly with regards to adaptation planning. Besides the inadequacies in housing stock, several buildings lack durable materials. About one in every (10.4%) household lived in houses constructed with temporary materials, such as card boards, corrugated iron sheets and planks. The study also discovered that 27% of the building stock had their walls in bad condition and 36% roofs in a poor state. These houses are largely characterized by lack of approval, absence of security of tenure with no proper access (tarred) roads and appropriate refuse removal, thus compromising the comfort and security of the inhabitants. Since the building with sound components protect better and lower the impacts of climate-related disasters, the bad states of the identified buildings have high tendencies of decreasing the adaptive capacity of the households to climate change extreme events.

Insurance cover can play a very significant role in curtailing the loss to climate change disaster, as noted in the work of Porrini & Schwarze 2012 that governments (and people) stand to benefit meaningfully using an insurance instrument. Insurance coverage is noted to be capable of covering the damage involved and at the same time provide an incentive for risk reduction-prone behaviours. On this note, the respondents were asked whether or not they have any form of insurance cover. The result of the analysis shows that 48% of Greater Tzaneen households have access to one form of insurance or the other, 40%, 60% and 46.2% Greater Letaba, BA-Phalaborwa and Greater Giyani households respectively had access to an insurance cover. However, every household interviewed in Maruleng Municipality had one form of insurance cover or the other. This result validates the higher HACI in both Maruleng and BA-Phalaborwa as presented in Table 1.

The level of household adaptive capacity largely reflects the socioeconomic attributes of the household heads across the district from lack of jobs to lack of income by a significant proportion of the households. These essentially influenced the level of personal possession of household items that are important for strengthening the households' capability. The high level of HACI recorded in Greater Tzaneen can best be explained by the high

level of educational attainment, quality environment, low poverty level and higher personal assets possession.

However potable water remains the prevailing and a serious challenge to the households in various towns in the district. Furthermore, vegetation loss to built-up, wood energy sourcing, bush burning and various other forms of human activities have collaboratively influenced a reduced coping capacity of the households in the district. It is worthy of note that the dichotomised nature of land management system in the district has significantly facilitated an increasing occupation of unsafe informal site locations that are mostly flood-prone, characterised by lack of tenure, with the dearth of basic services and infrastructure and occupied significantly by illegal immigrants. Most of these inhabitants' desire to be fully serviced without fiscal obligations in terms of tenement and taxes to the government that would translate into services to boost their tendencies for higher adaptive capability.

Nevertheless, our findings show that local municipal plans and policies recognize the impacts of climate change on households and settlements and the central role that spatial planning plays in responding to these impacts (Pieterse *et al.* 2020). However, there is little evidence to indicate the municipal efforts to address these challenges pragmatically and coherently by employing medium to long-term planning approaches. Although various efforts are put in place by governments (at all level) but the frustration of its failure to address household needs brought about the adoption of individual household's coping strategies to adapt to the changing climate across the district.

Conclusion

This study set out to show the coping capacity of urban households across the five Local Municipalities in Mopani District to climate variability and change. The study, however, revealed the varying levels of households coping capacity to climate change phenomenon within the studied municipalities. Moreover, questionnaires and interviews were employed as techniques to explore and collate the relevant data with the household head being the focus. Thus, the study revealed that coping capacity with climate change is largely a reflection of social, economic, ecological, and infrastructure components of both human and the built environments. Variation exists in the adaptive capacities of households across the Local Municipalities. The results from this study further showed that Greater Tzaneen Municipality had the highest proportion of capable households, this is followed by BA-Phalaborwa, Greater Giyani and Maruleng Municipalities respectively, while Greater Letaba Municipality accounted for the least households in that category. The level of households' adaptive capacity, though generally high, across the municipalities. It is instructive to note that not less than 20% of the municipalities' household heads lack the requirement to favourably adapt to climate change hazards in Mopani District.

In line with the findings of this study, the need for impactful adaptation policy and program formulation and mainstreaming through the understanding of the households' adaptive capacity level will be significantly justified in the non-coastal region of Mopani. The results of the HACI was populated to generate a map that pictorially shows the ranking of the HACI of the Local Municipalities within the context of the district. The HACI is indicated to be influenced by factors that range from housing availability and condition, availability and access

to basic services, environmental quality, socioeconomic characteristics (employment and income, education, etc.). Other identified factors include the vegetation loss to built-up area and wood energy sourcing as well as dichotomized land management system. Therefore, households' adaptive capacity to climate change would be largely successful if it is mainstreamed in a well-articulated planning instrument and institution.

Although governmental at various levels have recognized the central role of planning, this had brought about several adaptation-centred strategies. It is however observed that there is little evidence to signify a pragmatic effort to mainstream household adaptation (and capacity building) in both medium and long-term planning processes. The chapter hence underscores the need for mainstreaming of climate change adaptation strategies in planning instruments, with emphasis on households' capacity enhancement in collaboration with the private sector. The chapter equally emphasizes a fostered inter municipalities collaborations, in knowledge sharing, while the incorporation and enhancement of indigenous adaptation knowledge and experiences (through participation) to supplement planning interventions at the local municipal level. These are reasons why there is an urgent need to mainstreaming climate change adaptation to planning instrument in non-coastal municipalities of South Africa through the integration of the multidimensional and multiscale planning instruments for a responsible and responsive adaptation interventions regime across the region.