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Efforts and prospects towards climate change adaptation through urban land use planning in Dar es Salaam

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ABSTRACT

Context and background

Flooding in Dar es Salaam is greatly contributed by the overall increase in daily rainfall amounts, generally identified as rainfall variability which contributes to the overall climate change. Climate change adaptation is the spearhead initiative towards moderating the potential damages associated with actual or anticipated changes in climate. Through variety of options, urban land use planning has emerged as among the options towards climate change adaptation implementation.

Goal and Objectives:

This study aimed at exploring the existing efforts and prospects for integrating climate change adaptation into urban land use planning in the rapid urbanizing city of Dar es Salaam.

Methodology:

Teta and Sokoni subwards were selected as case studies where review of documents, field observation, geospatial mapping, household surveys and key informant interviews were the data collection methods used. QGIS, SPSS and Global Mapper were the main softwares utilized in analyzing the data obtained.

Results:

Findings demonstrate that the preparation of detail planning schemes, construction of stormwater drainage and implementation of building codes are the most appealing efforts executed towards enhancing climate change adaptation through urban land use planning. The notable prospects towards enhancing climate change adaption through urban land use planning are mainly technological advancement, supportive legal frameworks and robust involvement of actors. It was also identified that, urban land use planning isn't a stand-alone component contributing to overall climate change adaptation hence other components such as; adaptation measures, institutional framework, resources and capacities were vital in the integration process.

Keywords:

Climate change adaptation, land use planning, building codes, climate variability, Dar es Salaam

1. INTRODUCTION

Various approaches ranging from mitigation to adaptation options are applied at different levels so as to ensure that anthropogenic emissions are reduced and the associated impacts are properly dealt with. Among the key approach in enhancing climate change adaptation (CCA) in both rural and urban areas especially at local level is land use planning (LUP) which is also applied at regional and national level (Thoidou, 2021). LUP has been highlighted as one of the low-regret approaches that can help both urban and rural areas in the current climate and a variety of future climate change scenarios by improving prevention and preparedness and/or enabling reaction and recovery (United Nations, 2017).

World leaders launched the agenda 2030 for Sustainable Development in 2015, with goal 11 and 13 directly relating to climate change and land use planning. Goal 11 aims at making cities and human settlements more inclusive, safe, resilient, and sustainable while goal 13 aims at taking actions to combat climate change and its associated impacts (United Nations, 2017). Both these goals recognize the significance of LUP, particularly in urban areas so as to achieve the stated targets which among them aims at contributing to promoting resilience and climate change adaptation.

LUP is emphasized in different countries and implemented at various levels with different purposes whereas CCA is among the recent and emerging purpose of LUP for both rural and urban areas (Thoidou, 2021). This is mainly achieved through development control and monitoring which is among the major targets of ULUP. Among others, this target is mainly achieved through preparation and implementation of land use plans which can either be a general planning scheme or detailed planning scheme but also further monitoring and evaluation of the land uses is inevitable (Huang et al., 2018).

In Europe, the reduction of different impacts from climate extremes such as flooding has been promoted through LUP after the rectification of the Territorial Strategy for Europe in 1999 which later got legal backup in other legislations (Palom et al., 2017).

Before this, countries such as Spain recommended that flood maps should be developed then local and regional land use plans should incorporate actions aiming at reduction of floods (Palom, et al. 2017). However, Palom, et al. (2017) further urged that this was hardly implemented until the catastrophic flashflood in 1996 which necessitated the revision of the Spanish land law and introducing the article which aimed at subjecting all potentially hazardous areas to be declared as non-urban and not suitable for development.

Countries such as Nigeria, Philippines and Australia integrate CCA into LUP with different adaptation options ranging from proper design and location of critical infrastructure, buffer zone implementation, building restrictions and land use zoning (Bajracharya et al., 2011; Cuevas, 2015; Aderiye, 2019). In Tanzania the situation isn't contrary to other countries, since it is urged that local governments in collaboration with different actors, should intervene in human settlements and LUP sectors by improving settlements in climate-change-prone areas (URT, 2021).

Local governments are further obliged to promote building standards to accommodate climate change impacts, relocation of settlements from high-risk areas and promoting and enhancing effective land use planning at all levels (URT, 2021; Magembe-Mushi & Matingas, 2022). However, the main issue aligns in the actual translation of these land use planning adaptation options into actual implementation especially in developing countries like Tanzania where in some cases both the planned and unplanned areas are affected almost equally by different climate change impacts (Huang, et al. 2018).

The effects of flooding in Sokoni are usually more severe unlike in Teta mainly due to the overall low adaptive capacity attributed by its geographical characteristics and low income of households (Gore, 2015; Francis et al., 2022). However, it is also documented that in the past years flooding used to frequently cause death in Sokoni subward which its contrary to Teta where there are no cases of reported deaths from flooding incidences. Severity of the impacts of flooding have greatly been reduced

in both Sokoni and Teta, mainly due to numerous efforts such as; improvement in infrastructure systems, early warning systems and overall disaster risk preparedness (Erman et al., 2019; Francis et al., 2022).

2. METHODOLOGY

A case study design was adopted in this study which employed both qualitative and quantitative methods through household surveys, key informant interviews, review of documents, field observation, usage of satellite imageries and town planning drawings (geospatial mapping). Household surveys were administered through the selected sample size from the household population in Mbweni Teta and Tandale Sokoni subwards whereby 80households were selected from each subward. The key informant interviews were done with officials from different institutions and organization.

As to the satellite imageries, they were obtained freely from Moderate Resolution Imaging Spectroradiometer (MODIS) while the town planning drawings were obtained from the Ministry of Land, Housing and Human Settlement Development (MLHHSD). QGIS 3.28.2 and Global Mapper 24 were used in processing of the geospatial data obtained. Most of the reviewed documents were also freely available online with exemption to some that were obtained at the Kinondoni Municipal Council (KMC).

2.1 Description of the study area

Mbweni Teta and Tandale Sokoni are located in Kinondoni Municipality which is among the five municipalities of Dar es Salaam region in Tanzania. Others municipalities are; Ilala, Kigamboni, Temeke and Ubungo. Kinondoni is boarded by Indian Ocean to the North, Ubungo Municipal to the South, Pwani Region to the West and Ilala Municipal to the South. Mbweni Teta and Tandale Sokoni are subwards found in Mbweni and Tandale wards respectively. Mbweni is located along the shores of Indian Ocean on the Northern outskirts of the municipality while Tandale is located at the Western part of the municipality. Mbweni Teta and Tandale Sokoni are located approximately 36km and 9km respectively from the city center.

3. RESULTS AND DISCUSSIONS

This section specifically highlights on the intended urban land use planning (ULUP) efforts executed in Mbweni Teta and Tandale Sokoni which directly contribute to CCA. Furthermore, this section also provides the potential prospects towards achieving CCA through ULUP using Mbweni Teta and Tandale Sokoni as case studies.

3.1 Urban land use planning initiatives that contribute to climate change adaptation

3.1.1 Preparation and implementation of detail planning schemes for Mbweni Teta and Tandale Sokoni

The detailed planning schemes executed in Sokoni and Teta are different due to the nature of urban development that existed in the two settlements at the time of executing the detail plans. Preparation of detail planning schemes greatly involved the zoning of land uses through assigning a particular parcel of land to a specified land use, which is one of the most crucial parts of ULUP. Land use zoning was carried out with careful consideration of the appropriateness assessment, which among other things, includes a detailed evaluation of the physiographic and social characteristics, including terrain, population, soil, climate and vegetation.

Teta Detail Planning Scheme

According to official interview with one of the MLHHSD and KMC town planning officers, a detailed planning scheme for new areas in Teta was prepared mainly because Mbweni was largely undeveloped

and it was generally characterized with bushes, farms and occasional buildings. This was executed through the 20,000 plots project that was initiated and implemented by the MLHHSD in 2002 as a project of enhancing land servicing in different parts of Dar es Salaam. The 20,000 plots project was primarily intended to address the lack of surveyed and serviced urban plots as well as the rapidly expanding informal settlements.

After detail plan preparation and survey was completed, the plots were then made available to the citizens who are willing to purchase these plots with accordance to the dictated land value. The urban land use plan was allocated with different land uses ranging from residential, commercial, institutions, open spaces and play fields (Map 1). The planning standards applied in Teta and Sokoni are different in a way that the standards applied in Teta were clear and straightforward in stating the requirements which paved way to the existence of relatively satisfactory sized plots and roads (Map 1).

Teta's overall land use allocation was the first critical stage in physical land use planning that directly contributes to the integration of CCA into ULUP. The zoned land uses are; residential, commercial residential, commercial, institutions, parking, recreational areas, social and physical infrastructures such as roads. The allocation of these land uses greatly considered different aspects which are mainly physiographic and social characteristics, such as terrain, population, soil, climate and vegetation.

The allocated land uses also influences the overall CCA in a number of ways, firstly through zoning of the land uses and clearly identifying which land use will suite which parcel of land and at a large extent clearly demarcating the hazardous areas such as ponds and river valleys as per section 57 (2) of the Environmental Management Act (EMA 2004). This section provides for the prohibition of human activities that are likely to compromise and affect the conservation and protection of certain areas such as wetlands. Section 57 (2) of the EMA (2004) further provides for the setting of a buffer zone of 60 meters from the edge and/or highest watermark whereby no human activity of a permanent should be conducted.

Section 55 (1) further provides for the authorities responsible in environmental management whereby the local authorities is spelled as the immediate actor then National Environmental Management Council (NEMC). Hence, this study reveals that these sections of the EMA 2004 have been successfully implemented especially in Teta subward. The buffer zone of the river valley located in the northern part of the subward is clearly demarcated and currently not encroached with any human activities (Map 1).

Sokoni Detail Planning Scheme

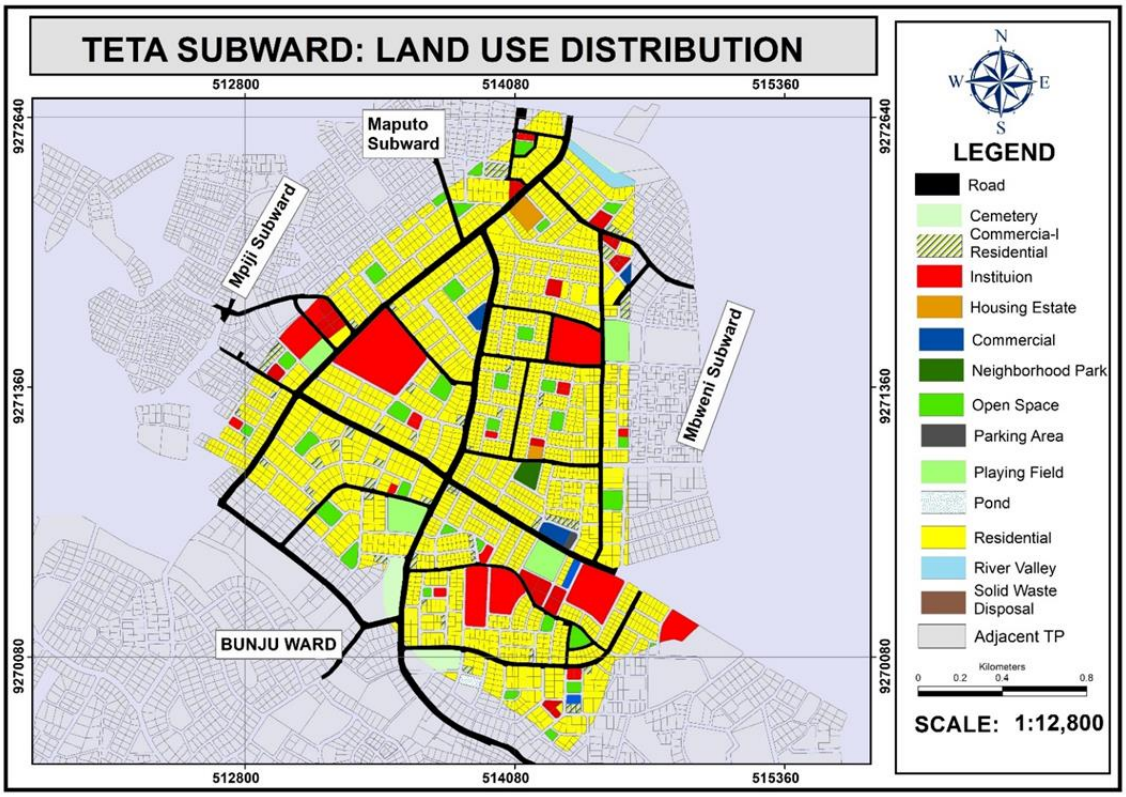
According to official interview with one of the MLHHSD and KMC town planning officer, a detailed planning scheme for informal areas which is also known as settlement upgrading was prepared for the case of Sokoni subward and Tandale ward at large mainly because the area was already largely developed informally. This scheme in Sokoni subward was implemented in late 1980's through the site and service project (SSP) that was mainly funded by the International Development Association (IDA) which is among the WB departments and the Government of Tanzania.

SSP were implemented after the failure of the slum clearance project in most parts of Tanzania. SSP primarily sought to increase the quality and quantity of housing options available to low-income urban populations in the regions of Dar es Salaam, Mwanza, and Mbeya. Even settlements in vulnerable areas were identified and demarcated through the SSP project because it involved upgrading in terms of identifying and demarcating the infrastructures, services, and information regarding land tenure throughout the settlements (Map 2). The planning standards applied in Sokoni were unclear which also paved way to the existence of small sized plots and roads (Map 2).

The overall allocation of the land uses in Teta was the first key step of physical land use planning that directly contributes to the integration of CCA into ULUP. The allocation of these land uses took into account a variety of factors, the majority of which are physiographic and sociological in nature, such as topography, population, soil, climate, and vegetation. The allotted land uses have a significant impact on the overall CCA in a variety of ways, including zoning the land uses and explicitly stating which land use will suit which piece of land, as well as clearly demarcating hazardous areas, particularly river valleys. Second, the majority of the SWD are built along roadways that are first delineated in town planning plans.

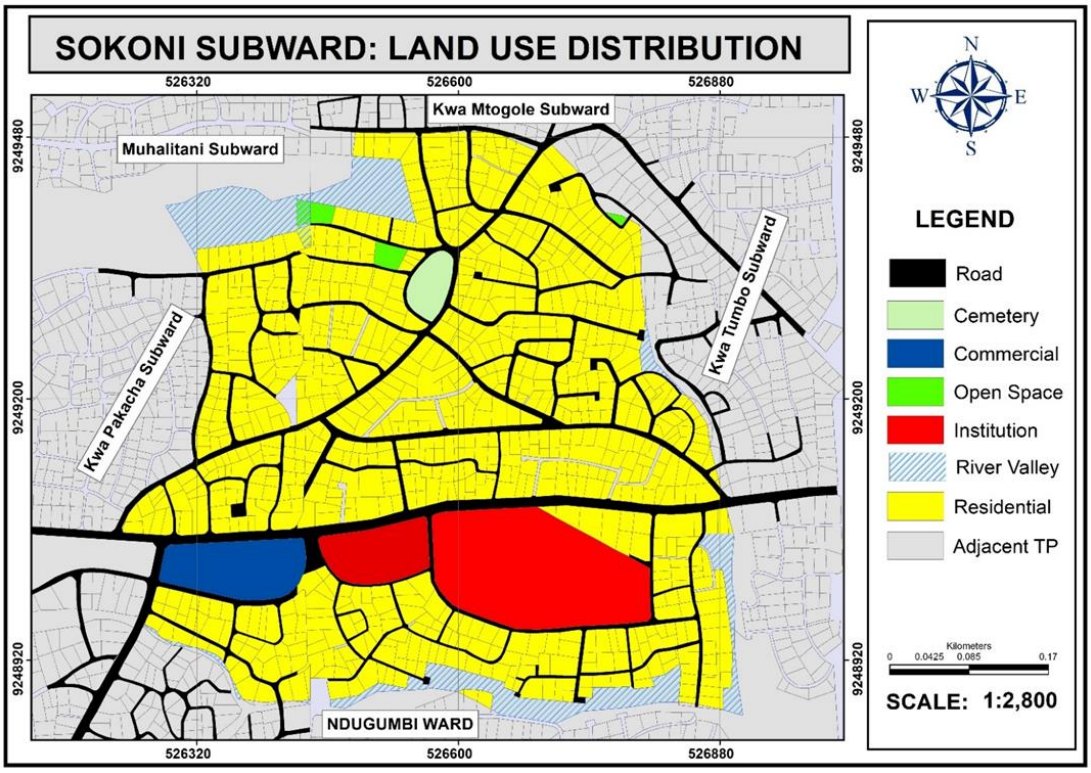
For the case of Sokoni, the zoned land uses are; residential, institutions, commercial, recreational areas, social and physical infrastructures such as roads (Map 4.4). All the major land uses that can be used on such occasions of flood incidents have been allocated on relatively highlands that aren't vulnerable to flooding, hence there is typically a proper allocation of the possible assembly and emergency points during flooding incidences. Additionally, the scenario for protection of hazardous areas as per EMA (2004) and other town planning regulations is somehow contrary to Sokoni since that in the town planning drawing the 60 meters buffer zone isn't designated consistently (Map 2).

Map 1: Teta subward detail planning scheme



Source: MLHHSD and digitized by author, March 2023

Map 2: Sokoni subward detail planning scheme



Source: MLHHSD and digitized by author, March 2023

3.1.2 Building Codes Implementation

Building codes through building standards, designs, and restrictions are among the fundamental urban planning tools that are largely used to conduct development control and further contribute to CCA, climate change mitigation and environmental conservation (Jagarnath et al., 2019). These building codes are also applicable in both Teta and Sokoni subwards.

Building Codes Implementation in Teta

For the case of Teta, the building permit in Teta is issued through submission of a formal building permit application in KMC whereby a rate of 5-9 requests is usually received on a monthly basis. The building permit request requires to have all relevant drawings which are prepared and stamped by a registered professional architect and the application will pass through different sections. Only 70% of the respondents in Teta requested for building permit during their initial building construction while the remaining 30% didn't request for building permit (Table 1).

Findings also reveals that, despite the tendencies of unauthorized building extensions in many urban areas, only 11% of the respondents in Teta have extended their structures and/or constructed new structures within their plots apart from the initial structures that were constructed. From such cases, only 63% of respondents who have extended and/or constructed new structures in their plots in Teta subward made new request for building permit (Table 1).

There are different reasons that facilitated the respondents of Teta to either request or not request for building permit during their initial construction. Most of the residents who requested building permit were aware of the regulation, others were just informed by the architect who designed their buildings and others received pressure from local leaders and/or municipal (Table 1). Having no awareness on the regulation was the major reason for most of Teta residents not requesting for building permit while

others didn't request mainly because by the time, they were constructing their buildings it wasn't compulsory to have a building permit. However, this is only applicable with the respondents who have constructed their buildings in early 2000's.

Despite Teta being a fully planned subward which had to adhere to different development control conditions, yet 95% of the respondents who didn't request for building permit didn't receive any disturbance from neither the local authority nor local leaders during their construction phase (Table 1). The main disturbances were mainly stop order and fines (Figure 1) which are usually succeeded by the resident filing a formal request of building permit in order to continue with the construction.

Figure 1: Construction stop order issued by the local leaders in Teta subward

Source: Fieldwork, October 2022

Additionally, although a larger proportion of residents in Teta requested for building permit, yet there is a significant proportion of the residents that didn't adhere to the provided building permit and develop their land contrary to the prescribed conditions (Table 1). The larger proportion of the respondents in Teta adhere to the building permit mainly because most of the residents have title deeds, hence they mostly develop according to the needs and requirement of their title deeds. The most common violations of the granted building permit are non-adherence to plot coverage and plot setbacks.

Building Codes Implementation in Sokoni

For the case of Sokoni, the overall implementation is relatively weak although it's among a notable effort conducted in ensuring the integration of CCA into ULUP. In Sokoni, 100% of the respondents didn't request for building permit during their initial building construction in their respective plots. The major reason for the respondents not to request building permit on their initial construction was mainly because the regulation for requiring both planned and unplanned areas to request for building permit wasn't enacted and enforced during the construction of these structures.

Findings also reveals that, 82% of the respondents added new structures in their plots whereby only 21% of these respondents requested for building permit during extension of structures in their plots (Table 4.3). However, the small proportion of respondents who requested for building permit during extension of their structures, 100% of these respondents didn't follow the conditions stipulated in the building permit hence they constructed their structures contrary to the granted permit (Table 4.3).

Additionally, 100% of the respondents who requested building permit during their building extension were influenced by local leaders in Sokoni. The practice is that most of the building permits are being offered by the local leaders while the municipality only receives a maximum of 02 building permit request per months for Sokoni subward. For the case of the permit offered by the local leaders, an individual has to visit the subward office and will be charged a nonspecific amount by the local leaders thereafter the individual will be given a notice to carry on with construction.

DESCRIPTION	Details of the respondents in Teta	Details of the respondents in Sokoni
Building permits during initial construction	Requested – 70% Didn't request – 30%	Requested – 70% Didn't request – 30%
Building structure extension	Extended structure – 11% Didn't extended structure – 89%	Extended structure – 11% Didn't extended structure – 89%
Building permits during extension of buildings	Requested – 63% Didn't request – 37%	Requested – 63% Didn't request – 37%
Adherence to granted building permit	Adhered to permit – 78% Didn't adhere to permit – 22%	Adhered to permit – 78% Didn't adhere to permit – 22%
Reasons for requesting building permit	Awareness of the regulation – 85% Informed by the architect – 6% Local leaders' pressure – 5% Municipal pressure – 2% Informed by a friend – 2%	Awareness of the regulation – 85% Informed by the architect – 6% Local leaders' pressure – 5% Municipal pressure – 2% Informed by a friend – 2%
Reasons for not requesting building permit	Wasn't aware of the regulation – 87% It wasn't compulsory – 13%	Wasn't aware of the regulation – 87% It wasn't compulsory – 13%
Interference during construction due to not requesting permit	Interfered by authority – 5% Wasn't interfered by authority – 95%	Interfered by authority – 5% Wasn't interfered by authority – 95%

Table 1: Summary of building codes implementation in Teta and Sokoni Subwards

Source: Fieldwork, October 2022

As highlighted previously, building codes is among the vital tool in integration of CCA into ULUP through its variety of options. However, basing on the findings of this study building codes is among a notable effort towards integration of CCA into ULUP although it is weakly implemented throughout the case study areas. The number of permits requested reflects the overall applicability of the building codes option whereby Sokoni has a relatively fewer requested building permits compared to Teta mainly because Sokoni is fully developed and most of the construction underway are building renovations and extensions which are mostly handled by the local leaders who lack professional knowledge and don't track such permits.

3.1.3 Construction of stormwater drainages

Through literature it was identified that stormwater drainage (SWD) systems are one of the most important structural adaptation measures for ensuring that stormwater is properly handled and disposed of rather than being logged on the streets. The National Human Settlement Development Policy

(2000) also states that local governments must provide and maintain human settlement infrastructure services in collaboration with different actors such as the private sector, civil society, and non-governmental organizations (NGO's). For the case of this study, physical acquisition of SWD coordinates was done in both case studies.

The SWD system in Sokoni is more than 3km which serves a catchment area of approximately 2km^2. In Sokoni, there are mainly two types of drainage channels which are paved drainage channels and unpaved drainage channels which are mostly constructed by TARURA through the Dar es Salaam Metropolitan Development Project (DMDP) funded by the World Bank. The unpaved drainage channels are composed of the natural drainage channels and the artificial drainage channels that are prepared through different resident and institutional initiatives to aid stormwater movement.

Some of the artificial local drainage channels in Sokoni also acts as plot boundaries. The natural drainage channels mostly act as the subward boundaries and play a vital role in discharging stormwater to relatively larger drainage channels such as River Ng'ombe and Kiboko stream (Figure 2b). The artificial drainage channels also play a vital role in stormwater handling since that they collect a significant amount of stormwater and relieves a great portion of the Sokoni subward area.

Currently, Teta has a SWD network of more than 6km that serves an area of approximately 3km^2. In Teta, majority of the SWD are paved drainage channels which are mostly constructed in recent years by TARURA through the DMDP. These SWD were awaited by the residents for a long time so as to aid in relieving Teta since that it was frequently hit by floods in the recent years.

The SWD channels in Teta are characterized with covered and uncovered drainage channels which are mostly constructed along roads where the stormwater is then directed to the Indian Ocean (Figure 2a). In Teta subward, some of the SWD are still under construction and the subward office aren't given full mandate to manage them yet. However, the subward office is looking forward in engaging the health and environmental committee which is under the Teta subward office in effectively managing these SWD after they are fully completed.

(a) (b)

Figure 2: Stormwater drainage (a) Covered stormwater drainage in Teta (b) Kiboko stream in Sokoni

Source: Fieldwork, October 2022

Generally, all the stormwater drainage systems in Sokoni and Teta subwards are important structural measures in enhancing CCA. However, due to the different nature of land use planning in these two subwards, it was relatively easier to obtain space for SWD construction in Teta unlike in Sokoni. As noted earlier, ULUP was done prior to settlement development in Teta hence infrastructures wayleaves were clearly demarcated which is contrary to Sokoni where settlement development preceded LUP hence

compensation was necessary in ensuring different infrastructure wayleaves are obtained whereby this tends to increase the implementation costs.

3.2 Climate change adaptation prospects through urban land use planning

3.2.1 Robust engagement of stakeholders

Among the most vivid prospects for integrating CCA into ULUP is how vast actors are involved in the process through different means. The involvement of actors is strongly emphasized in different policies such as the national environmental policy (2021), national human settlement development policy (2000) and national land policy (1997). Satterthwaite & Bartlett, (2017) argues that, it is crucial to include various actors in decision-making processes by fostering open communication and dialogue between stakeholders and government organizations in order to gather suggestions and encourage active involvement in the planning process.

The actors' roles should also be clearly defined and communicated in order to avoid different inconveniences in executing activities related to integration of CCA into ULUP and CCA hence making urban settlements sustainable and resilient. The most prominent and crucial link in all these activities is the local authority which for this case it's KMC. Mainly the national government, local government, international organization, NGO, and CBO were also among the prominent actors identified in this study. According to what they are assigned to and what they are interested in, each of these actors play a specific role as explained hereunder and summarized in Figure 3.

Ministry of State, Vice President's Office - Union and Environment (VPO)

The environmental division of the VPO is responsible with all environmental affairs which also includes addressing climate issues. According to official interview with the one of the officers from the ministry, the VPO works very closely with all the regional and district authorities in ensuring climate variability impacts are dealt with. The environmental division's primary goal is to provide overall policy guidance, coordination, expertise, and services for long-term environmental management and development. Among others, the VPO is also responsible in funding different climate related programs and projects through its own funds or outsourcing different donors.

Ministry of Land, Housing and Human Settlement Development (MLHHSD)

The physical planning division of the MLHHSD is responsible with all urban and rural planning activities. According to official interview with one of the town planning officers from the MLHHSD he stated that, the MLHHSD works very closely with all the regional and district authorities in all the ULUP activities. Some of these ULUP activities conducted through the ministry regional and officials include; preparation of land use plans, monitoring urban planning and development, preparation of urban planning schemes and provisions of tittle deeds. The MLHHSD also ensures the engagement and coordination of different ULUP stakeholders in numerous activities aiming at ensuring sustainable urban planning. Funding of different ULUP related programs and projects is mainly through the MLHHSD own sources or the engagement different donors.

The President's Office Regional Administration and Local Government (PO-RALG / TAMISEMI)

In TAMISEMI, there is one division and one unit that are directly concerned with the integration of CCA into ULUP. The rural and urban development division of TAMISEMI is responsible in monitoring all the urban and rural development activities while the infrastructure unit is mainly responsible to monitor all

the infrastructure development activities which also includes the SWD. In both Teta and Sokoni, there are infrastructure construction projects under the DMDP which are mainly supervised with by TARURA. TARURA is among the agencies that TAMISEMI is directly affiliated with through the infrastructure unit. The Dar es Salaam regional office and Kinondoni municipal council are also directly attached to TAMISEMI.

Through the DMDP which is funded by the World Bank, Kinondoni Municipal has received approximately Tshs. 64 billion to aid in implementing different projects such as construction of roads and SWD. Mbweni being among the beneficiaries of the DMDP funds, approximately Tshs. 9 billion has been used in construction of SWD which will aid in CCA within the subwards. Tandale has also benefited greatly through the DMDP funds through multiple projects which directly and indirectly contribute to the integration of CCA into ULUP.

The Office of Regional Administrative Secretary of Dar es Salaam (RAS-DSM)

According to Regional Administration Act of 1997, it shall be the duty of the Regional Commissioner to facilitate and assist local government authorities in the region to undertake and discharge their responsibilities by providing and securing the enabling environment for successful performance by them of their duties and functions. The RAS office of DSM works closely with KMC by providing information and providing instructions and guidance on CCA and ULUP. The DSM regional office also act as a connector between the responsible ministries and KMC.

Kinondoni Municipal Council

According to official interview with environmental officer of KMC, the full council is made up of units and divisions which work together to ensure the long-term sustainable development of Kinondoni municipality. The division that is directly related to the integration of CCA into ULUP is known as the infrastructure, rural and urban development division which has three main sections namely; work section, roads section and rural and urban development section. Works and roads sections of KMC are responsible with preparation and monitoring of different infrastructure development activities within the municipality. The rural and urban development section of KMC is responsible for preparation of land use plans, monitoring urban planning and development and preparation of urban planning schemes. KMC through its infrastructure, rural and urban development division is also responsible to formulate and enforce different bylaws related to CCA and ULUP.

i. Ward Executive Office (WEO)

For the case of this study, there are two ward executive offices which are Tandale and Mbweni ward executive offices. The ward executive office comprises of a ward development committee which works very closely with KMC and acts as a bridge between the mtaa executive office and KMC. According to local government (district authorities) act of 1982, each ward shall have a WDC that among other responsibilities it shall; supervise and coordinate the implementation of projects and programmes of the district council within the ward as well as formulate, and submit to the village/mtaa councils or to the district council, proposals for the making of by-laws in relation to the affairs of the ward.

ii. Subward/Mtaa Executive Office (MEO)

For the case of this study, there are two mtaa executive offices which are Tandale Sokoni and Mbweni Teta mtaa executive offices. The mtaa executive office comprises of a mtaa development committee which works very closely with WEO and KMC. According to EMA (2004), each mtaa shall have an MDC

that has the responsibilities to ensure proper management of the environment in respect of the area in which it is established and may perform mutatis mutandis any other functions. According to official interview with the KMC town planning officer, the MEO is the immediate development control and monitoring body that has full mandate within their specific jurisdictions.

World Bank (WB)

The WB is a global organization that collaborates with various nations in all key areas of development, offering them financial and technical support as well as the opportunity to share and implement cutting-edge knowledge and solutions to various problems. In Tanzania, WB has implemented numerous projects and programs in different sectors ranging from land use planning, environmental conservation, climate adaptation and mitigation.

Narrowing down the scale to the selected case studies, the WB together with the government of Tanzania are the primary funders of the DMDP where a total of $300 million was allocated for this project. Teta and Sokoni subwards are one of the primary beneficiaries of the DMDP through mainly the improvement of key infrastructures such as roads and SWD. The WB together with the government of Tanzania also provided funds for the SSP that was implemented from 1970's to 1980's where Sokoni subward is one of the primary beneficiaries in this project. The WB also offers technical assistance during the execution of various projects, allowing technical staff to exchange knowledge and experience.

Open Map Development Tanzania (OMDTZ)

OMDTZ is a Dar es Salaam based registered NGO which also operates nationally. OMDTZ carries out and supports a number of community mapping initiatives, raises map awareness, actively commits to making open datasets available, and keeps expanding its network of ardent mappers in Tanzania. The OpenStreetMap (OSM) platform, which is a map and a database of geographic data owned by contributors on OSM, receives a significant contribution from OMDTZ and anyone can view and use this data for free.

Some of OMDTZ partners are; the UK Department for International Development, the World Bank, Ardhi university, University of Dar es Salaam and COSTECH. Among the key projects conducted by OMDTZ is the Dar Ramani Huria whereby it's a community-based mapping initiative in Dar es Salaam which trains locals and university students to produce extremely accurate maps of the city's most flood-prone areas.

Sokoni subward was firstly mapped by OSM in 2011 but this mapping didn't involve the existing and potential flood prone areas until in 2015 where its map was then updated through the Dar Ramani Huria project as is among the initial wards to be mapped in Dar es Salaam. These maps are now used as the cornerstone tools for development in numerous socio-economic spheres outside of flood resilience. Unfortunately, due to scarce resources as among other reasons, Teta and adjacent areas haven't been mapped yet hence there isn't any information on flood prone areas in OSM database.

Academic and research institutions

Different academic and research institutions play an enormous role in the whole process integrating CCA into ULUP through engaging in different activities which are mainly provision of technical support, conducting research and outreach activities. Academic and research institutions conduct their activities both independently and sometimes jointly.

State University of Zanzibar, Sokoine University of Agriculture, University of Dar es Salaam, and Ardhi University from Tanzania as well as University of Turku from Finland jointly formed the resilience academy. Resilience academy is an initiative of the Tanzania Urban Resilience Program (TURP) aiming at risk identification, risk reduction, disaster preparedness and emergency management by empowering

youth with tools, knowledge and skills. Resilience academy provides high quality services and data, openly accessible and responsive to societal needs. These data can also be used to inform different decision and policy makers prior to their actions.

Media

In the 21st century, media plays a vital role in dissemination of information and various other issues related to ULUP and CCA. This is proven by the rate of the sources of climate change awareness in the Teta and Sokoni subwards whereby more than 60% of the residents become aware of ULUP and CCA mainly through different medias such as; social medias, newspapers, websites, radio and television stations. Thomas Reuters Foundation, BBC, allAfrica, reliefweb and resilience academy are some of the local and international websites that have published issues on Tandale and Mbweni flooding and how participatory mapping and other relevant measures are deployed to ensure urban resilience is attained.

Community

The community members in both Teta and Sokoni are crucial and notable actors in the overall integration of CCA into ULUP due to the intense role they play. In Teta subward, the community members act in a number of ways such as; plot demarcation, tree planting, provision of financial support during flooding events, construction of SWD and environmental cleanness. In Sokoni subward, the community members also act in a number of ways such as; community mapping, environmental cleanness, construction of SWD and land use planning. These activities are executed by the community members in collaboration with the local leaders, local authority and other different actors as elaborated previously.

Private companies and organizations

An interview with one of the town planners from MLHHSD revealed that currently the government involves different private companies, organizations and institutions in preparation of detail schemes for both new areas that are freshly planned and areas that need to be formalized. This action was solely done so as to increase the ability of planning and survey of land parcels that was below the average requirements. The execution of different planning and survey activities by these actors involves the proper adherence of different legislations that are applicable. These companies, organizations and institutions should also be registered with their respective registration boards such as the Town Planners Registration Board (TPRB). However, Teta and Sokoni subwards were fully planned by the government itself and no any private company, organization or institution was involved.

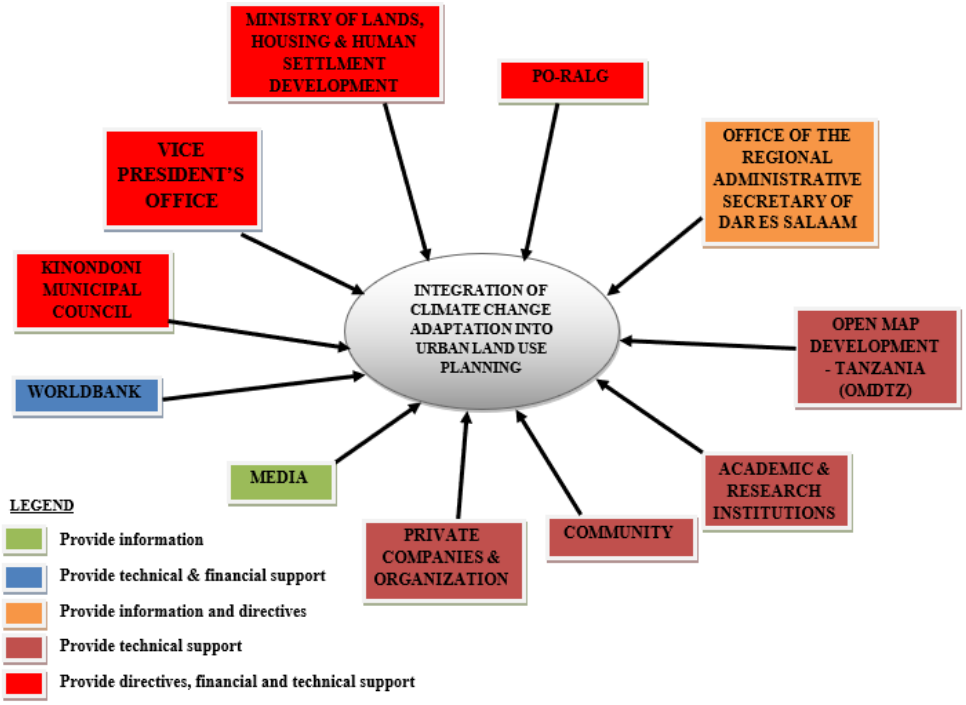


Figure 3: Sketch of actors and their roles

Source: Fieldwork, September 2022

The importance of engagement of different actors and their overall coordination is also elaborated by Macarthy, (2012) and Jagarnath, et al. (2019) whereby the authors clearly identify how engagement of numerous actors and their overall coordination has facilitated to the overall enhancement of CCA through different urban planning initiatives. To further elaborate the importance of actors' engagement and coordination, Rahman & Tosun, (2018) elaborates on how state bureaucracy in Bangladesh has resulted to poor stakeholders' engagement and unclear institutional arrangement that led to overlapping and vague authorities with minimum or no cooperation leading to negatively impacting CCA. The findings of this study shows that the engagement of numerous actors is a vital component towards the process of developing CCA in ULUP context. Each actor has specific roles and a satisfactory coordination exists among the identified actors.

3.2.2 Technological advancement

Technology has greatly simplified the process of developing CCA through ULUP in a number of ways when the technical personnel are equipped with the necessary skills which also includes proper ways to incorporate local knowledge into spatial planning (Kombe & Alananga, 2022). Wan & Nochta, (2020) and Odongo & Ma, (2021) documents that developing CCA through urban planning has been simplified by technology through open data sources, data analysis, GIS based data visualization and integration as well as data sharing schemes. Findings of this study reveals that, these aspects are scantly utilized and some of the technical personnels responsible don't have the skills to access and utilize them.

As elaborated in preceding section, OMDTZ largely contributes to OpenStreetMap platform whereby this platform has various spatial information that anyone can view and utilize them freely. Unlike Sokoni which has been fully mapped and spatial information are largely available online, Mbweni has currently not been mapped. Examples of data that are available online are the flood risk information that clearly shows all the buildings in Tandale, levels of flood risk in different areas as well as possible evacuation areas (Figure 4). This information can greatly be used by the technical personnel from KMC and different

other actors. Such information can assist in informing decision-making during land use zoning, land use monitoring (Wan & Nochta, 2020) and issuing of building permits which can positively contribute to developing CCA.

Furthermore, due to technological advancement the MLHHSD has successfully managed to prepare a land management system known as Integrated Land Management Information System (ILMIS) which is among the key provisions from the NLP 1997. ILMIS aims at improving the overall functions related to land administration and management ranging from land delivery services, town planning, cadastral surveying, workflow management and others. According to the town planning officer from MLHHSD, ILMIS is currently mostly used for land administration related activities whereby all the town planning and survey drawings were digitized and stored in the system for ease access and functioning.

Since that the ILMIS contains various information and integrates them in one system, it will greatly assist in proper development control not only in Teta and Sokoni subwards, but rather Dar es Salaam and Tanzania at large. However, some important aspects of land management such as land use monitoring are still missing in ILMIS but it is continuously being upgraded to ensure that all the required data are made available to the concerned technical experts.

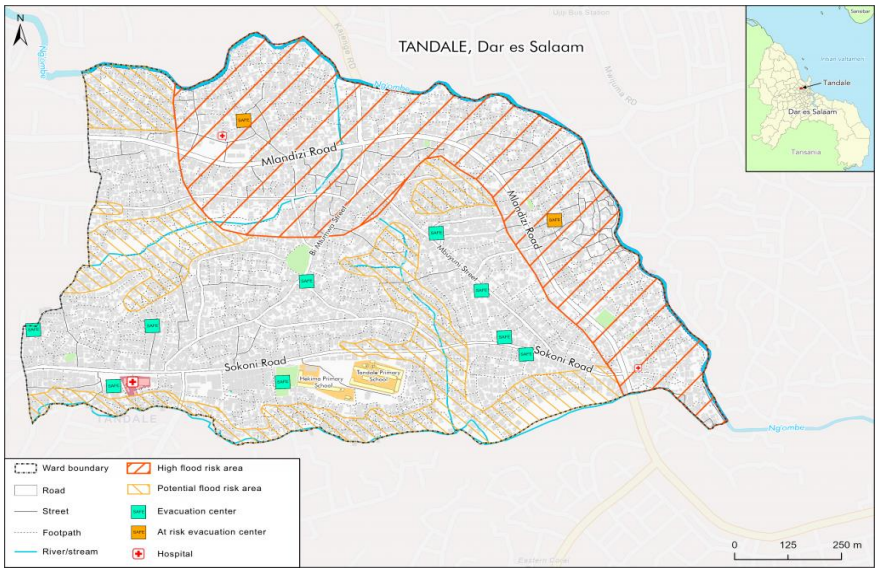


Figure 4: Tandale ward flood risk map

Source: Nygren & Msilanga, (2020)

GIS and remote sensing have evolved from a data visualization and integration system to a system that acts as artificial intelligence, assisting in problem identification, monitoring change, managing and responding to events, forecasting future trends, setting priorities, and understanding prevailing undercurrents (Odongo & Ma, 2021).

As elaborated in preceding sections, currently in both Teta and Sokoni, GIS and remote sensing is minimally applied in different aspects such as land use monitoring mainly due to the inadequate technical skills and equipment's. GIS and remote sensing, on the other hand, enable users to comprehend urban space patterns, relationships, and geographical contexts related to a phenomenon under examination, resulting in increased efficiency, improved communication, more reliable decision making, and better management of urban environments. Hence, if the responsible technical personnel are well equipped with GIS and remote sensing skills which is widely available, integration of CCA into ULUP will be enhanced.

3.2.3 Supportive Legal Framework

Among the notable prospects for the integration of CCA into ULUP is the supportive legal frameworks that comprises of policies, acts, guidelines and bylaws. These legal frameworks have direct and indirect provisions that provide for the necessary conditions and aspects. The highlighted hereunder are the policies that have direct inputs to the overall process of integrating CCA into ULUP.

National Environmental Policy 2021 (NEP 2021)

The NEP 2021 is a major review of the previous NEP 1997 which had some shortfalls due to emerging of different environmental concerns. The NEP 2021 acts as a national framework for environmental planning and management using a coordinated, comprehensive, and adaptive strategy that takes into account both current and emerging environmental challenges as well as problems with both domestic and global development.

Some of the objectives of the NEP 2021 that are directly linked to this study are; promoting the integration of environmental concerns into LUP and management across sectors, strengthening capacity in waste management and urban planning, enhancing the involvement and empowerment of communities and different stakeholders in land utilization and management and lastly strengthening the institutional and human resource capacity on CC.

National Human Settlement Development Policy 2000 (NHSDP 2000)

The overall human settlement development in Tanzania can be traced from the colonial era to post-colonial era whereby due to the rapid transformation of human settlement development in Tanzania, the formulation of the NHSDP 2000 was inevitable. The NHSDP 2000 has several objectives and statements that provide for its implementation.

However, protecting the human settlement environment and ecosystem from degradation and destruction, encouraging the development of housing in areas that are functional, healthy, and environmentally friendly, ensuring that planning legislations, building regulations, standards, and other development control measures are consistent, as well as enhancing the participation of numerous actors in planning, development and management of human settlements are some of the main objectives of the NHSDP 2000 that are directly affiliated to this study.

National Land Policy 1997 (NLP 1997)

Since independence, the overall land sector has undergone a number of changes, most of which can be attributed to extensive land use changes brought on by an increase in the population of both people and livestock. As a result, the NLP of 1997 paved the way for the government's commitment in ensuring proper land utilization and management in both urban and rural areas. Among others, promoting a sound land information management and protecting land resources from degradation for sustainable development are among the key objectives of the NLP 1997 that are directly linked to this study. However, the policy has been under review since 2016 and o date it hasn't been approved yet, hence it is expected that the reviewed version will have a clearer guidance in how CC considerations should be integrated into LUP activities from the neighbourhood, community, municipal, region and national level.

Urban Planning Act 2007 (UPA 2007)

The UPA 2007 is among the parent legislation that widely governs all the urban planning related activities. In order to further conserve and improve amenities, the UPA 2007 calls for the orderly and

sustainable development of land in urban areas. It also addresses how to grant permission to develop land and govern how it is used, among other things.

Environmental Management Act 2004 (EMA 2004)

The EMA 2004 is among the most relevant legislation that guides the overall integration of CCA into ULUP through its different provisions. Section 57 (2) provides for the prohibition of human activities that are likely to compromise and affect the conservation and protection of certain areas such as wetlands. Section 57 (2) further provides for the setting of a buffer zone of 60 meters from the edge and/or highest watermark whereby no human activity of a permanent should be conducted. Section 55 (1) further provides for the authorities responsible in environmental management whereby the local authorities is spelled as the immediate actor then NEMC.

Guideline for the Preparation of General Planning Schemes and Detailed Schemes for New Areas, Urban Renewal and Regularization 2007 (GPGPSDS 2007)

The GPGPSDS 2007 was formulated as tool to guide professional urban planners and managers and other related practitioners in the preparation, implementation, monitoring and review of these schemes. It is important to note that these guidelines have been prepared in close observation of relevant legislation and policies governing urban development planning development and management such as the Urban Planning Act (2007), the National Human Settlements Development Policy (2000) and the Land Act (1999).

Health and Hygiene of the Environment Bylaws of KMC 2020 (HHEB 2020)

HHEB 2020 was formulated basing on the provisions from the Local Government (Urban Authorities) Act of 1982. The HHEB 2020 has the government notice number 183 of 6th March 2020. The Local Government (Urban Authorities) Act of 1982 provides the base of several other legislations including the local government (urban authorities) (development control) regulations of 2008 and different other municipal bylaws are formulated through it.

The HHEB 2020 provides for different provisions, however the provisions that are mainly associated with our study are the cleanness of the SWD as well as waste disposal and management which are important aspects contributing to CCA. The HHEB 2020 clearly states that the SWD within the streets should be cleansed by the adjacent households and the community at large.

4. CONCLUSIONS

Urban settlements have continuously faced different climate variability impacts specifically flooding which leads to a range of consequences. In recent years the effects have been tremendous hence paving way to adoption of different CCA options including ULUP. Despite the application of ULUP, planned settlements continue to face different climate variability impacts as much as unplanned settlements. Hence, the goal of this study was to broaden the understanding of different efforts that deployed as well as the potential prospects of enhancing the integration of CCA into ULUP.

So as to properly integrate CCA into ULUP, different efforts such as detail planning schemes preparation, building codes implementation and construction of SWD are being executed in both Teta and Sokoni subwards. These efforts play a vital role in ensuring the integration of CCA into ULUP. The preparation and implementation of detail planning schemes is however the most enduring and dependable effort since that the execution of all other efforts highly depend on the existence of the detail planning scheme.

Different aspects were also identified as the potentials/prospects towards developing a robust CCA through ULUP in the long run. Technological advancement being one of the prominent prospects, if properly utilized will greatly assist in curbing most of the challenges related to climate variability

especially flooding. Technological advancement can positively contribute to the integration of CCA into ULUP through GIS and remote sensing technologies as well as availability of various spatial information through different open sources such as OpenStreetMap (OSM).

Furthermore, due to technological advancement, the MLHHSD has developed an interactive system known as ILMIS which aims at improving the overall functions related to land administration and management ranging from land delivery services, town planning, cadastral surveying, workflow management and others. All these technological platforms and tools have widely spread and further assist in executing different urban planning and developments activities such as development control, climate modelling, early warning systems and detail planning.

The formulation and implementation of supportive legal frameworks such as policies, acts, guidelines and bylaws also provides a room for better implementation of CCA since that they provide for the needs and processes in executing various CCA and ULUP activities. The involvement of supportive actors with well-defined roles is among the most vivid prospect in developing CCA through ULUP whereby numerous actors are engaged in both Teta and Sokoni subwards. These actors have different roles and there is a relatively satisfactory coordination among them.

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7. AUTHOR CONTRIBUTIONS

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10. KEY TERMS AND DEFINITIONS

Building codes: A set of stipulated rules that may include but not limited to building standards, design and restriction that are usually set by respective urban and rural development authorities.

Climate change adaptation: The alteration in processes, practices, or structures with the aim of moderating potential damages or exploiting advantage of opportunities associated with actual or anticipated changes in climate.

Land use planning: A set of procedures and processes in accordance with which land use in a particular planning area or zones are prescribed, managed, monitored and evaluated.