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Flood Risk Management in Urban Residential Areas in Dar es Salaam City: Towards Effective Adaptation Strategies – A Case of Mikocheni 'B' Settlement

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ABSTRACT

This paper presents findings on a study which was conducted at Mikocheni 'B' in Kinondoni Municipality in Dar as Salaam City. The study's focal point was assessment on how policies and planning interventions related to flood risks management are implemented, the capacity of storm water management facilities and coping strategies adopted by the residents against flood risks. The study delved into assessing underlying causes of flood risks and suggests strategies that will help to enhance effective flood risks management in Mikocheni 'B' settlement in particular and Dar es Salaam in general. The study findings revealed failure in deploying existing planning tools and inadequate policy coordination and implementation of flood risks management strategies. Actors involved included government leaders (Regional Administration, Municipal authorities and local '*Mtaa'* leadership), local communities and Community Based Organizations (CBOs). These agencies were tasked with creating awareness to the people and coordination of policies related with flood risk management and enforcement of spatial planning standards as per local government regulations and mandates.. For the local community members in Mikocheni 'B', it was established that by not adhering to the planning and environmental requirements stipulated by different policies and spatial planning standards, most of the drainage networks were poorly designed, constructed and managed and therefore face several blockages. In addition to poor drainage system management and network, it was also found that poor technical design of channels did not consider design factors which help facilitate drainage in the area. Other contributory factors are lack of enforcement of development control resulting in illegal extension of buildings, creation of block wall fences and non-adherence to building lines.

Following the study findings, suggestions are made to include awareness creation to the people on improved flood risks management. It is also proposed to have proper coordination of different potential actors to fully participate in flood risks management process. The study recommends that to get good adaptation strategies 'off the ground', land use needs to be regulated more easily; and city service agencies need to be coordinated more effectively to mitigate flood risks. Effective urban development control by the Municipal authorities and local 'Mtaa' leaders in collaboration with local residents will make it easier to respond to emergencies, maintain drainage and enforce regulations and essential tools for mitigating flood effects.

Key Words: *Flood risk, management, climate change, urban planning, policy initiatives, adaptation*

BACKGROUND AND THE ISSUE

INTRODUCTION

Rapidly urbanizing cities in developing countries are facing serious problems of management of the physical environment (Cristiano et al., 2012). The magnitude of urban population growth presents the degree of spatial concentration of people and human activities; waste generation, floods and other environmental stresses (Moran, 2004). With the world's mega-cities growing even larger, planners

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and policymakers especially those in developing countries-need urban planning that will help these areas withstand the impact of natural disasters (Arndt et al., 2010). The urban population in developing countries is expected to double to 4 billion people by 2030, from 2 billion at the start of the century (UN-Habitat, 2011). The physical space of these cities is likely to triple in size to 600,000 square kilometers over the same period (UN-Habitat, 2011). Thus, implementing the right planning policies and practices will be "the key to resilient and sustainable development" and not least, mitigating flooding risks (IPCC, 2007). Looking at the economic impacts, urban flooding is increasingly becoming more costly especially in low-income neighborhoods. Many examples abound in Dar es Salaam City (Casmiri, 2004). City planners and authorities are trying to save the city from frequent and distractive, flash floods. Yet, one reason is beyond their control: changing weather patterns and extreme weather events have brought short but intense bursts of rains on the densely populated planned and unplanned parts of the city-with the resultant clogged water ways/drains and floods (Mugarula et al., 2011).

Flooding which occurred in Dar es Salaam City in December 2011, when a torrent of rain was recorded in just 24 hours (amounting to about one fourth of the average annual rainfall) caused the City millions of losses, destruction of properties and deaths (UN-Habitat, 2011). The flooding caused widespread destruction of property and infrastructure. This was evident in many streets and thousands of people were left homeless when their houses were swept away. Moreover, different roads were rendered impassable which increased more traffic jam in the City (Mugarula et al., 2011). Flooding causes major losses and disruptions. The losses due to the flooding include loss of life, swapping of little infrastructure provided, which lead to the local government to fail to maintain the infrastructure like roads, culverts and bridges. Replacing or maintaining these infrastructure facilities takes long time, and as a result, lead to the poor communication within the City. It is also observed that some roads remain inaccessible due to lack of requisite maintenance and thereby causing traffic congestion (Mugarula et al., 2011).

What is the Problem?

Flood risks remain to be one among the most frequently occurring natural and man-made disasters in many parts of Dar es salaam City, especially those which lie on low land areas like Mikocheni 'B'. Many of these areas inlcuding Bonde la Mpunga, Jangwani, Msimbazi Valley, parts of Keko and Vingunguti accommodate many of the informal settlements (Appendix 1). They are mostly characterized by being poorly built and are not supplied with adequate services like sanitation and storm water drainage systems, which are very critical aspects in flood risks management (Casmiri, 2004). Ironically, unlike other flood prone areas, Mikocheni 'B' accommodates large proportion of formal (planned settlements) in which it could be thought hypothetically that the areas should have been free from flood risks because of it being planned. A well planned area is expected to have all infrastructure including drainage systems which are well designed to reduce floods risks. However, Mikocheni 'B' is still facing the problem of recurring flooding at least every year as in other flood prone areas constituting urban informal settlements. There is an absence of data and there is limited research that has been done in adaptation impacts of floods in urban residential areas in Dar Es Salaam City. Therefore, this study was conducted in a search for information about the underlying courses subjecting 'Mikocheni B' and other settlements to flood risks (Appendix 3). Arising from the above, what adaptation practices, policy initiatives and interventions are in place towards flood risks management in urban settlements, their effectiveness and inherent challenges constitute the tale of this paper.

Objectives

The main objective is to assess the extent of recurring floods and their impacts in Mikocheni 'B' settlement, planning interventions towards flood risks management, coping strategies adopted by the residents against flood risks and suggest measures for enhancing effective flood risks management in the settlement. It specifically assesses and examines:

i. Underlying causes of recurring floods in Mikocheni 'B' settlement;
ii. Types and levels of planning intervention and policies related to flood risk management that are implemented;
iii. Capacity of storm water management facilities; and
iv. Coping strategies adopted by the residents against flood risks.

Methods

The study adopted non-experimental research design specifically case study approach; and conducted purposive sampling design to collect information from both household representatives and key informants. Field reconnaissance mapping was also used in collecting some spatial information in the field. Data analysis was done using Computer software such as Statistical Package for Social Sciences (SPSS), Arc GIS 10 and Microsoft Excel version 2010.

Selection of the study Area

The study identified five (5) areas found in flood prone zones to be the most vulnerable areas in Dar es Salaam. These areas include (Map): Msasani Bonde la Mpunga, Jangwani, Mikocheni 'B', Msimbazi Valley; and the City Centre. The selection of Mikocheni 'B' as the study area for this study was done based on the assessment of many areas in Dar es Salaam that are lying in a flood prone zone. The selection criteria was based on the literature and other studies that researcher has gone through for all areas under flood risks conditions. Information availability relevant to the study and legality/status of a settlement pattern (formal/informal settlement) were used after the scaling process, and Mikocheni 'B' area was selected to be the study are (see section 2.2).

Data Collection Methods and Sources

Data Types and Sources

Primary data was collected from sampled households in Mikocheni 'B' area while secondary information was collected from Mtaa Executive Officer (MEO) in the study area, officials from the Tanzania Meteorological Authority (TMA), Town Planner from the City Council Town Planning Department, Mapping Unit in the Ministry of Lands and Human Settlements Development, Disaster Management Unit under the Prime Minister's Office, and Town Planning Unit in Kinondoni Municipality.

Data collection methods which were used by this study are observation, interviews, mapping and photographic techniques. Non probability sampling procedure especially purposive sampling procedure was used. Therefore a sample was drawn from households especially those that lay in nearby natural drainage or channels. In this study, the selected sample size involved 89 respondents. This number was derived from the population of 828 households which are in Mikocheni 'B' where the study was conducted. Observation method was selected because it is an appropriate method of collecting spatial data with the associated tools for this method. The checklist helped to have systematic and consistent way of collecting relevant data required in different variables. Different types of interviews methods which include structured, semi structured and unstructured interviews were used. Both open ended and closed questions were included in the questionnaire. Open ended questions provided a free environment for the respondents to express themselves and share their local experiences for example the coping and adaptation strategies to flood risks while the closed questions helped researchers to capture some information in a consistent way so that appropriate analysis and judgment can be done.

LITERATURE REVIEW

Climate Change and Floods: Global situation

The climate change over the past decades has been a hot debatable agendum in political, academic and diplomatic platforms at national, regional and the global scale (Fussel, 2010). Scientific studies have shown that climate change is a result of rise in the global average temperature ―Global Warming‖ which is also caused by the increase in the concentration of Green House Gases (GHGs) in the atmosphere (UN-Habitat, 2011). In the decades to come, climate change may make hundreds of millions of urban residents – and in particular the poorest and most marginalized – increasingly vulnerable to floods, landslides, extreme weather events and other natural disasters (UN-Habitat, 2011). Rainfall variability increases the quantity of the runoff (storm water) differently in urban areas depending on the level of infrastructural development (Andoh et al., 2005). The construction of building, roads and other physical elements in both urban and rural areas has direct impact on the environment by removing vegetation and soil, and grading the land surface (U.S. Geological Survey, 2004).

In developing countries especially in Tanzania, the increase of population happens beyond the governments', capacity to respond by providing basic infrastructures in these countries (Kyessi, 2007). For example, most areas in Dar es Salaam City's storm water drainage system is poor, thus exposing the urban areas in a high risk of the flooding (Kyessi, 2002). In Nigeria, the floods disaster caused displacement of thousands of people. According to Ndege (2012), the heaviest rain in decades pounded Nigeria causing more than a dozen deaths and forcing hundreds of thousands of people from their homes. Many of the displaced were sheltering in camps set up by rescue organizations when the floods continue to sweep across the country (Ndege, 2012). According to National Emergency Management Agency (NEMA) of Nigeria, 623,900 people were displaced and 152,575 hectares of farmland destroyed with estimated number of at least 140 people who were killed; hundreds of thousands uprooted and tens of thousands of hectares of farmland was submerged since the start of July. It has been called a National disaster by the Nigerian President Goodluck Jonathan (Kouadio, 2012).

Global Effect of Climate Change

Increase in surface temperature

Between 1906 and 2005, the global average surface temp increased by approximately 0.74^{o}C. The warming trend increased in 1979 to 2005, to a rate of 0.17^{o}C/decade (Solomon et al., 2007). Global temperature is rising as fast as in the past decade as in the prior two decades, despite year to year fluctuations associated the El Nino-La Nina cycle of tropical ocean temperature (Fussel, 2010). Record high global 12-month running mean temperature for the period with instrumental data was reached in 2010 (Hanson, et al., 2010). The current estimate of continued temperature increase is 0.2^{o}C/decade (Solomon et al., 2007). It has been reported that the atmospheric aerosols that have been estimated to reduce the warming by 1.1^{o}C have been decreasing since the 1990s slowly increasing the amount of sunlight reaching the earth's surface (Solomon et al., 2007).

Floods

Floods, the subject of this study, are among the most costly and damaging disasters posing a critical problem to residents and city planners as they increase in frequency and severity. The frequency and severity of flooding has generally increased during the last decade (compared to 1950–1980 flood data), along with the frequency of floods that exceed levels that only typically occur once every 100 years (IPCC, 2007). Climate change has direct effects on the physical infrastructure of a city – its network of buildings, roads, drainage and energy systems – which, in turn, affects the welfare and livelihoods of its residents (Andoh et al., 2005). Climate change is also expected to increase the severity, duration and frequency of weather related extreme events such as

drought and floods, threatening water availability and food security for millions of poor people and future of humanity in Tanzania (Casmiri, 2004).

Flood Situations in Dar es Salaam

Extent of floods in City settlements

Dar es Salaam is highly vulnerable to climatic variability, which is expected to increase as climate continues to change (START Secretariat *et al*, 2011). While the climate variability increases, Dar es Salaam City has poor drainage, illegal construction in the catchment areas resulting to the failure of the current drainage system failing to cope with the increase of the runoff from the heavy rainfall or due to the narrowing of the channel conduits. Moreover, the City has a relatively flat topography which leads to the slow motion hence low hydraulic velocity or low speed thus resulting to stagnation of water in different areas which lead to flooding in these areas (UN-Habitat, 2011).

The swamped buildings and the infrastructures consumes more resources to get it repaired which increase even more poverty to Dar es salaam residents the same as the local government which works under limited budget of providing basic infrastructures (START Secretariat, 2011*)*. This situation increases more vulnerability to the city's population living in informal settlements with poor sanitation provisions and practices to additional threat diseases commonly occurring in these settlements during floods periods. Among the diseases which erupt during the flooding periods in Dar es salaam as the result of poor sanitation are malaria, cholera, dysentery and diarrhea. The following areas remain vulnerable for flooding risks in Dar es salaam; Jangwani, Msasani Bonde la Mpunga, Mikocheni B, the City center, Kunduchi and Bahari Beach, Ocean Road Beach Area, Vingunguti, Mtambani and Mnyamani, Temeke River, Kizinga areas, and Msimbazi Valley (*ibid).* According to the flood modeling exercise undertaken by the Pan-African START Secretariat *et al*, (2011), the flood modeling used a digital elevation model and a hydrodynamic model and estimated many areas inundation corresponding to floods of differing return periods of 5, 10, and 50 years using varying rainfall magnitudes taking sea level rise into account (*ibid).*

Basing on the extent of the flooding in Dar es Salaam, the severity of the flooding is increasing and needs an urgent solution in managing the flooding risks by having adequate infrastructures which can cope with the runoff from different areas. On the current infrastructure available in the City, it has a total of about 1100 kilometers of open lined ditches and 600 kilometers of piped storm water drainage. However, lack of regular maintenance, illegal construction of additional structures, and residents' practice of dumping refuse into the drains has led to deterioration of drain function (Kyessi, 2007). The infrastructure coverage is still not sufficient to cope with the increase of the rainfall intensity due to the climate change (START Secretariat, 2011).

Policy, Guidelines and Legal Frameworks for Urban Drainage Systems

There are a number of policies, guidelines and Acts that directly or indirectly address the issues of climate change and drainage systems both in rural and urban areas. These include; Human Settlements Development Policy (2000), National Environmental Policy (1997), Land Policy (1997), Water Policy (2002) and Urban Planning Act (2008), and the Guidelines for the preparation of general planning schemes and detailed schemes for new areas, urban renewal and regularization schemes (URT, 2007)**.** Thus a preview of these policies and how they have been put into practice with regard to floods prevention in Tanzania may be in order.

i) Environmental Policy

The National Environmental Policy of Tanzania (1997), recognize and address issues of urban infrastructures especially those which are prone to the effects of climatic changes. One of the environmental policy objectives which are stated in Chapter 55 states that ―to control indiscriminate

urban development, particularly in vulnerable sites such as coastal beaches, flood prone and hilly areas‖. Therefore the major concern of this policy objective is to prevent the possibility of occurrence of floods and lose of people‘s lives and properties by restricting people from establishing settlements in those areas. The real implementation of this policy objective has not been effective since many people are currently living in such areas like.

ii) Urban Planning Act (2008)

Sections 5, 6 and 7 of the Urban Planning Act (2008) gives mandate to all City Councils, Municipal Councils, Town Councils, District Councils and Township Councils to be Planning Authorities in their respective areas of jurisdiction. Section 10(3) also gives provision for the planning authorities to coordinate different sectors in the areas of their territorial dominion to respond to any planning issue which might arise due to urbanization or natural phenomenon which may call for improvement of the existing infrastructural plan so that it suits the demand of the people. By implication, the planning cadre has been given enough powers by this Act to make effective plans which could help a lot in solving many planning problem like flood risks in Dar es Salaam which is typically a planning issue.

iii) Water Policy

Section 4.8.1 of the national water policy (2002) explains some measures that will be taken in case floods occur. It highlights that:

i. Management of disasters will include establishment of flood monitoring stations and early warning systems so that occurrences of flood events can be detected early and information disseminated to public in advance, strengthening existing hydrological stations and development of mechanisms for emergency preparedness, in collaboration with other sector departments and agencies.

ii. Flood prone areas and areas susceptible to landslides and mudflows will be identified and mapped.

iii. Public will be encouraged to avoid development in areas susceptible to floods and landslides.

iv) Hazardous flood prone areas delineated and development controlled by water legislation.

The statements made in this section of the policy have a direct intention of reducing the occurrence and risks associated with floods.

Land Policy

Land policy recognizes the problem of existence of unplanned settlements most of which have been built in public open spaces and thereby creating pressure and malfunction on infrastructures including blocked drainage systems. With regard to this recognition, Section 6.4.1 indicates that, the government will put more efforts towards protection of public open spaces and arresting the growth of unplanned settlements by timely planning all the potential areas for urban development in the periphery of all towns. However, lack of special areas for low income housing and failure in protecting public open spaces in Dar es Salaam can explain the reasons for subjecting the City to flood risks because many of the natural drainage systems have been invaded and hence, blockages of the conduits of the storm water.

Guidelines for the preparation of general planning schemes and detailed schemes and urban regularization schemes

The urban planning and regularization guidelines of 2007 show that whenever urban plans or regularization schemes are prepared, public utilities like water supply, water sources, their capacities, water consumption, water demand, solid waste management, sanitation, electricity and storm water drainage must be included and mapped accordingly. It should also show improvement plan proposals for: acquired lands for public uses such as road network, water reticulation network, sewerage and sanitation, solid waste management, parking, street lights, storm water drainage system,

electricity supply (electricity, network and location of substations), and telecommunication. The real implementation of this guidelines is uncertain because despite the fact that mapping flood prone areas is among the simplest and least costing assignment, still these maps are not available or if available, they are not displayed to other partners who have a stake in managing drainage systems like local community members.

THE CASE OF MIKOCHENI 'B' SETTLEMENT

Background for Mikocheni (Appendix 1)

Mikocheni Ward as a whole is located within Kinondoni District, West of Msasani. It has a total area of 7.6 square kilometers and is subdivided into three neighbourhoods (Mikocheni 'A', Mikocheni 'B' and Regent Estate). These areas correspond to the different periods of construction, with poorer local residents living alongside their more wealthy compatriots and foreigners. The northern parts of Mikocheni 'A 'and 'B' as well as the whole of Regent Estate are low and medium density residential areas, with residents of relatively high socio-economic status. Mikocheni 'B' hosts industrial and commercial areas in its southern part. The area has buildings used as headquarters for non-governmental organizations or offices for local businesses, a tidy industrial area including the local Coca-Cola factory. Mikocheni is among flood-prone sites in Dar es Salaam City which the AURAN Project report (2009) argued that in case no remedial measures are taken they are subjected to exacerbated vulnerability due climate change. Ponding water is common along the main roads and in courtyards due to lack of space for construction of storm water drainage systems. The natural storm water drainage system has been blocked by haphazard construction; including of heavy cement block houses and multi-storeyed buildings. These have blocked underground channels that used to direct the water flow to Msasani and into the Indian Ocean. The water flow now tends to back up and flood houses and feeder roads for months**.**

Factors contributing to flooding in Mikocheni 'B'

Inadequate Capacity of storm water management facilities

The assessment on the capacity of storm water capacity revealed that the land cover for Mikocheni 'B' is highly exposed to change of land surface from soft to hard cover which increases the peak discharge. Currently with the rainfall intensity of 5.3mm/hour, it has produced the peak discharge of 1.13647m^3/s (TMA, 2013). The construction of buildings and roads removed the soft surfaces which could reduce the runoff. While the peak discharge is increasing, the construction of drainage channels in Mikocheni 'B' is done without following the storm water design criteria and standards. This makes the drainage channels to accommodate more runoff than their capacity and, consequently, causing water upstream to cause flooding.

The insufficiency of drainage channels for storm water management and poor management of the existing channels gives rise to floods. This phenomenon was identified is the blockage by an investor of a natural drainage channels that conveyed storm water to the sea where Mikocheni 'B' borders Mikocheni 'A' along Mwai Kibaki Road. When it rains, storm water is forced to go upward which complicates the flow and water spreads out all along old the Road as shown from the map (Fig 21). In fact, the storm water flows by gravity from the upper areas to lower areas. Basing on this fact, when the storm water speed decreases suddenly by blockage, it causes water back and then upstream ponding follows.

Plate 1 :Conduit of drainage channel culverts with smaller diameter than that of the channel, Mikocheni 'B'

Source: Fieldwork, 2013

From the plate above, one observes construction practices which narrow down the size of drainage channels and the implication will be the decrease of speed due to the change of size of the conduit that will push water back and then upstream and hence flooding. The same applies when the direction of the channel is changed (consider Fig. 18 below).

Plate 2: Typical poor drainage channel design, Mikocheni 'B'

Source: Fieldwork, 2012/2013

The problem of flooding is exacerbated by some blockages that happen in the existing drainage channels due to disposal of solid wastes (which is carried from upstream areas by storm water); and the disposal of solid materials done by some community members in the area. This drainage channels was constructed with the width of around one meter which somehow enough size to convey storm water. But despite the size of the drainage channels if it is full of solid waste, this will be equal as small drainage due to the fact that storm water will not be flowing freely to the reluctance caused by the solid waste in them. Likewise, the change of size adds problem in causing of floods. For instance in the photo above in Fig. 17, the size is narrowed down from 1.2 m to 0.5m which is a serious issue as long water flows in occupying the whole width of the drainage channels with the same speed. Facing this obstacle when the peak discharge is bid, storm water will create the backwater which will finally go out of the drainage channels which result to flooding in these places**.**

Plate 3: Disposal of solid waste in drainage channels, Mikocheni 'B'

Source: Fieldwork, 2013

Another issue is blockage of drainage channel by housing development without recognizing the importance of existing Drainage channel.

Plate 4: Blockage of a channel by wall construction which diverts storm water to neighbours, Mikocheni 'B'

Source: Fieldwork, 2013

Absence of Flood prone areas maps and flood monitoring stations

The study on monitoring stations in Mikocheni 'B' revealed that; no flood prone maps were there in neither MEOs' office nor in the Municipality Town Planning Office (MEO, 2013 and Kinondoni Municipality 2013). With flood monitoring stations, none was found in Mikocheni 'B' (MEO, 2013), an aspect affirmed by the Kinondoni Municipal Town Planner. Lack of flood prone areas maps and flood monitoring stations in Mikocheni'B', does not augur with Section I, (4.8.1) of the Water Policy of 2002 which states that *"flood prone areas shall be identified, mapped and controlled to prevent indiscriminate development"*. In the planning context, lack of flood prone maps implies that, spatial identification of the flood susceptible areas will be difficult which leads into poor flood risks management strategies. Usually, effective strategies to combat flood risks requires comprehensive understanding about geospatial characteristics (eg topography, surface terrain and drainage connectivity pattern/network) of not only the area under flood prone zone. Geospatial information of the neighbouring areas is equally important in predicting and designing best strategies to combat flood risks.

Non-adherence to protecting buffer around drainage channels

When respondents were asked to state whether they knew any signs that shows the buffer around drainage channels, 100% of the responses given showed that none of them was aware of such a buffer. The information was also confirmed by the Mikocheni 'B' Mtaa leader (Mtaa Executive Officer) together with Kinondoni Municipal Town Planner that there are no signs that were put signifying the residents about the buffers along the drainage channels. Failure in informing community members about buffered distance around drainage channels has resulted into indiscriminate development which has been taking place very close to a distance of less than 2 meters from natural drainage channels as the photos below shows.

Non-adherence to building and planning standards

Indiscriminate development along the drainage channels goes against policy suggestions that the government shall control indiscriminate development in flood prone areas and that no any development shall take place within 6 meters from the drainage channel (Environmental Policy 2002 section 55, Water Policy 2002 Section 4.8.1, Land Policy 1997 Section 6.4.1 and Urban Planning Standards).

Plate 5: Houses encroaching natural drainage channel (Mlalakuwa)

The photo above shows the real situation of indiscriminate development process that is taking place in some parts of Mikocheni ‘B’ area. Many houses have been built very close to the natural drainage channel (Mlalakuwa seasonal River) which collects storm water from Mlalakuwa areas downstream to the ocean through Mikocheni 'B'. Some people in such areas not only build very close to the channel, they have been adding some soils and stones along the channel in order to get more land for doing their activities especially keeping animals.

Plate 6: Litter-filled banks of Mlalakuwa River

Plate 7: Blockage of a natural drainage channel as a result of a fence wall that was built on the channel

A clear deviation from the planning regulations has been recorded from a certain person who built his fence wall on top of the natural drainage channel which used to conduct storm water to the Ocean (MEO, 2012). The background photo above shows the fence wall which was built crossing the channel which completely blocked the channel and the owner of the house re-directed the channel to the other part forcing storm water to flow up the hill side; which is an impossible phenomenon under natural gravitational principles. The clip photo has enlarged the drainage chamber that was blocked after the construction of the fence wall.

INITIATIVES TAKEN TO MITIGATE FLOOD RISKS IN MIKOCHENI 'B'

Participation of different actors in drainage system management

Participation of the Local Government

According to the Mtaa leader for Mikocheni 'B' (MEO), the Government particularly the Kinondoni Municipal Council, has been taking charge of the responsibility of

providing funds for the maintenance of drainage channels. This response is supported by the National Human Settlement Development Policy which states that the Government shall finance the rehabilitation of the drainage systems. According to MEO (2013), the Government has been providing some funds though not adequate to cater for the rehabilitation requirements, as shown in the table below.

Table 1: Amount of funds provided by the Government for drainage systems in the past five years

Purpose of disbursement	**Amount of funds disbursed in different years (in T.shs)**				
	2008	**2009**	**2010**	**2011**	**2012**
Construction of drainage channels	0,000	1,800,000	1,600,000	1,900,000	2,500,000
Rehabilitation of the channels					2,500,000

Source: MEO for Mikocheni 'B' (2013)

From the above table, it is clear that there have not been allocated or disbursed funds for the rehabilitation of the drainage channels for four consecutive years. This has created further vulnerability of the settlement to flooding and its effects. About the budgetary requirement per year in these activities, MEO was not sure about his Mtaa, but he only knew the budgets for the whole Mikocheni Ward for the last fiscal year 2011/2012 which was T.shs. 311,575,266 and T.shs. 300,780,300 for channel construction and rehabilitation respectively. This shows that there is no local arrangement by Sub-Ward/Mtaa government for managing drainage systems. This has also been evidenced by local people when they were responding to the question that inquired them to state if there is any local arrangement organized by Mtaa government in managing drainage system. However, efforts have been organized by local people themselves in their ten-cell neighbourhoods. The implication of this is that the Mtaa government will continue to be over-dependent to the Municipal Government and thereby continue to become more weak in carrying out its local functions including management of drainage systems. As long the funds from the government are limited, the local contribution to make a step ahead in managing storm water drainage channels become woefully inadequate.

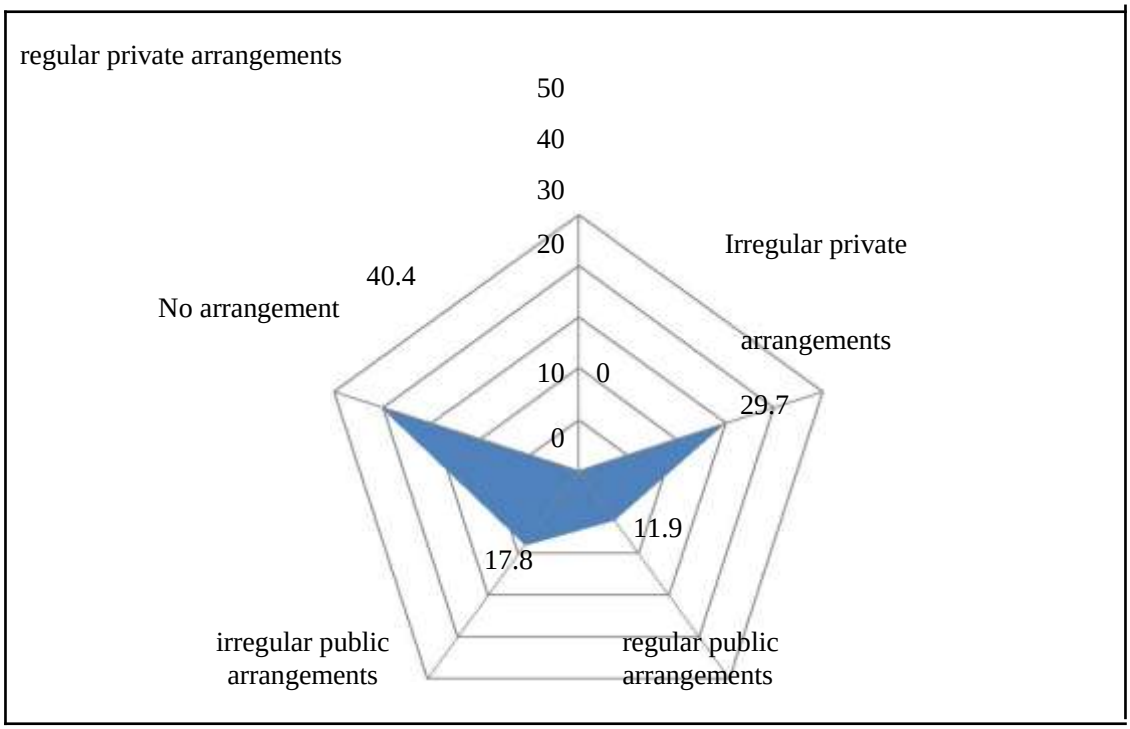
Participation of Mikocheni 'B' community members

The assessment done at Mikocheni B revealed that there is no universal arrangement for managing drainage channels for all households in the area (field data and MEO, 2013). When MEO was asked to explain the general mechanisms applied by residents in the management of drainage channels, he said:

> *"households (in their ten cell neighbourhoods) have organized different public arrangements to clean the channels by removing some garbage in the channels while others have arrangements of prohibiting people from throwing garbage in the channels"* (ibid)".

When respondents were asked to explain how they have been engaged in the management of drainage channels, their responses showed that most of them (more than 40%) do not participate in managing drainage channels while others (more than 29.7%) participate by using their own personal arrangements to clean the channels in proximity to heir homesteads. The radar graph below show percentage of responses given by sampled respondents on how they have been engaged in managing drainage channels.

Figure 1: Percentage of people's engagement in management of drainage channels



Source: Field data-Mikocheni 'B' (2013)

When the inquiry was made to the Mtaa Executive Officer (MEO) about the arrangements made by his office in management of drainage channels, he admitted that there is no clear and unique arrangement for managing drainage channel. Lack of the local management mechanisms in managing drainage channels is a problem because the actual and sustainable solutions to drainage systems management is solely dependent on the practices and behaviour of local people in the neighbourhoods while being coordinated by Mtaa leadership since they are the sole player in this exercise and other partners are just facilitators of the process. Community participation is very important for making any infrastructure project to be sustainable; on this basis the fact on not participating fully in cleaning the drainage system limits the effectiveness in managing floods occurrence. Persistent presence of solid waste in the drainage channels is among factors which is contributing to the floods occurrence in different places.

Participation of NGOs and CBOs

According to the Mtaa Executive Officer (MEO), there are neither NGOs nor CBO which are involved with flood risks management in Mikocheni 'B' area. MEO further explained that there are some individual people who are consulted by individual households in collecting garbage and spraying ant-mosquito sprays around their household to reduce incidences of malaria. The practices of consulting garbage collectors has come because of the local arrangements that local people in the Mtaa neighbourhood have designed as a strategy towards proper management of drainage channels in which some people have been using them as dump sites. The Mtaa Executive Officer for Mikocheni 'B' further explained that there has been no any organization apart from Kinondoni Municipal Authority which have been working with his team in managing drainage system. However, there are some organizations like DAWASCO who have been doing their work without communicating with the Mtaa

leadership on doing some works related with drainage systems management - maintenance of the sewerage systems especially repairing sewerage chambers around the streets. MEO explained some cooperation that has been existing between Mikocheni 'B' and Kinondoni Municipality especially when it comes to disbursement of funds for development functions (including contraction and/or maintenance of drainage channels).

According to the Kinondoni Municipal Town Planner there is either weak or no coordination of different actors in management of drainage systems. For example when he was asked to explain how Town Planning office helps in coordinating potential actors he said:

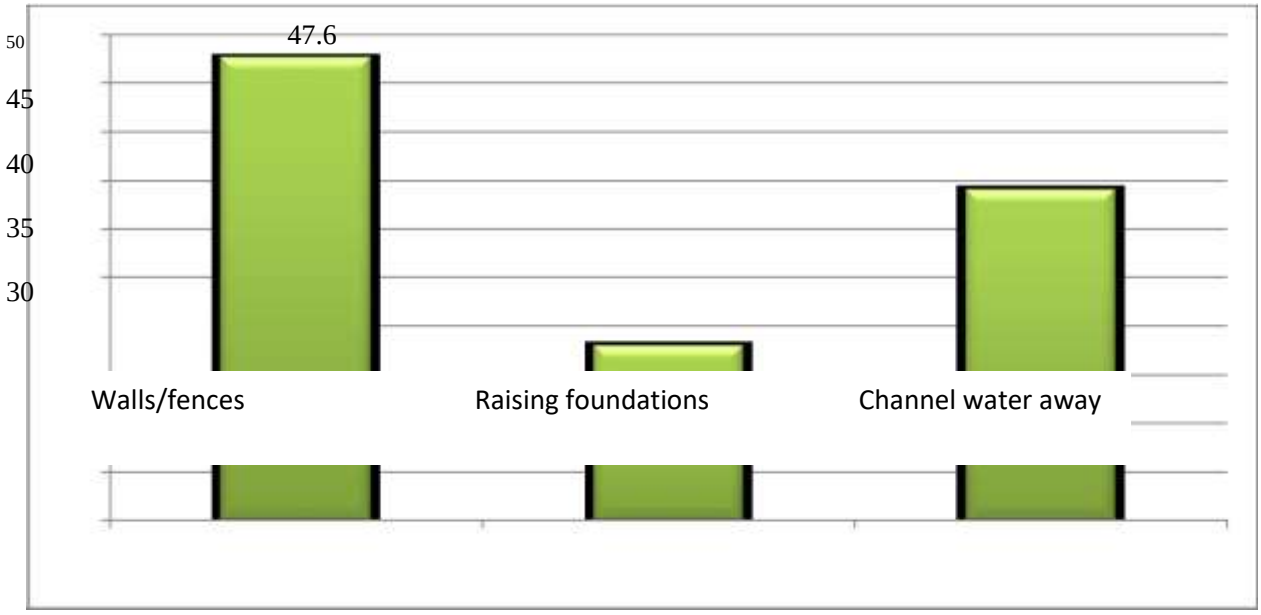
> *"usually different actors are involved especially when flood occur in a meeting with what he named "the district disaster committee".*

This explanation indicates that there is no regular coordination of different actors in management of drainage channels at Mikocheni 'B'. The other response on how the government (Kinondoni Municipal authority) works with community members in letting them aware of the planning restrictions (like that of the drainage channel buffers) and possibility of occurrence of floods; he said they make use of other government officials from lands and environment departments in addressing issues of planning restrictions and mass media channels (radios and televisions) inform the people about the possibility of occurrence of floods.

Flood Risk Adaptation Strategies

The assessment of the a**daptation** strategies against floods revealed that the most common used strategies applied by the Mikocheni 'B' residents include raising the foundations of their buildings, building the fence walls around their houses and building some structures that tend to divert water away from their houses to somewhere else. Among the 89 interviewed respondent about 47.6% commonly mentioned the use of building walls/fences, raising foundations was mentioned by 17.9% and the rest do channel water to the other direction as shown below.

Figure 2: Adaptation Strategies against floods, Mikocheni 'B' Settlement



Channeling storm water away from the homesteads

Channeling storm water away from the homesteads and construction of the fence walls is a very common practice for many residents in Mikocheni 'B'. The fence walls are constructed to serve two purposes; one being ensuring security of the household members from robberies and the second purpose is protecting households against floods. The figure below shows one of the households at Mikocheni 'B' which has adopted construction of the fence walls as a coping strategy against floods. The house has also adopted the strategy of channeling storm water by diverting it elsewhere.

Plate 8: Channeling water elsewhere as a coping strategy against floods, Mikocheni 'B'

Yet, the coping strategies against floods, which are adopted by the residents of Mikocheni 'B' though they help making and individual house safe from storm water, they also create problems in other places notably on roads, in houses with no fence walls and stagnates on the dished surfaces like in the market. Construction of fence walls and channeling storm water to other areas creates stagnant like that in market areas (right figure below) and nearby NACTE buildings (left figure below).

Plates 9 and 10: Stagnation of storm water after divergence from homesteads, Mikocheni 'B'

Harvesting rain water for flood management

In the current research it has been found that many people are not harvesting rain water nor they do appreciate its usage. Only 27% (mainly low income people) responded that they harvest storm water using buckets and not for the purpose of flood management but for home use in cooking, washing and mopping.

Table 2: Reasons for refraining from harvesting rain water against floods

Attitudes of respondents		Copying strategies to floods adopted			Total
		building walls/fence	raising foundations	channeling water to elsewhere	
Reasons for refraining from harvesting rain water	It is of no use	25	5	10	40
	Too expensive to harvest it	5	10	5	20
	Total	30	15	15	60

By analyzing the table above it is clear that many people (25 over 60), mainly high income, will use fencing rather than harvesting storm water as protection of their home from flooding since for them storm water harvesting is of little use. For others, raising foundation will be a good solution while for them storm water harvest water is somehow expensive which is not really the case. The conclusion to be drawn here is that people tend to individually protect themselves against flood by only directing water elsewhere. Yet, the tendency of channeling water elsewhere may have severe impacts to infrastructures like roads because when water are channeled to roads from households, it stagnate on road surfaces and renders them vulnerable to destruction.

Other Flood Risk Coping Strategies

With coping strategies at Mikocheni ‘B’, this study focused on how people cope with flood risk and the outbreak of diseases which are associated with flooding like malaria and stomach diseases like dysentery, cholera, and typhoid. The study revealed that disease outbreak especially stomach diseases was not a serious problem due to the fact that many households in Mikocheni 'B' do not face the problem of an overflow of the contaminated water into their house premises because most of them (approximately 90%) have fence walls which prevent storm water flowing from other neighbourhoods. The only disease that was seen to be a problem was malaria due to widespread of breeding sites of mosquitoes in the area. The widespread of mosquito breeding sites is mainly caused by the tendency of many residents to diverge storm water away from their homestead to elsewhere which causes water stagnation along the roads or in some swampy areas like nearby Mikocheni 'B' Primary School.

As it has been explained above, malaria is the only flood associated problem at Mikocheni 'B'. The investigation of the study revealed that several strategies are used by Mikocheni B residents in coping with the malaria problem. Those strategies include the use of mosquito nets during nights, slashing grasses around house premises to destroy breeding sites for mosquito, spraying house premises with ant-mosquito repellents to scare mosquito and the use of medication as the curative measure. The primary data which were collected in households revealed that the most coping strategy that is used by many households at Mikocheni 'B' is the use of mosquito nets (79.8% of responses) followed

by spraying anti-mosquito propellants (41.6%).

CONCLUSIONS AND DISCUSSION

Conclusions

The study has revealed that flood risks remain to be one among the environmental problems facing many parts of Dar es Salaam City and Mikocheni 'B' settlement in particular. Flood risks at Mikocheni 'B' are a function of many factors. The most fundamental factors causing flood risks include inadequate implementation of adaptation and spatial planning guidelines, inadequate design and management of drainage channels and inadequate coping strategies adopted by people at Mikocheni 'B' which have exacerbated the problem of flood risks.

With regard to non-adherence to planning and building standards, the study shows serious problems like encroachment of building to a distance of less than 2 meters from the natural drainage channels and others even built on those channels and hence blocking them. These findings suggests that there is no adherence to the regulations among the citizens, and planning standards which prohibits people from constructing their houses in flood prone areas. In addition to that, the study also found that the problem of not adhering to policies and planning standards is not only with the local people, but it is leadership/management problem because government leaders (both at Municipal and Mtaa levels) have not taken adequate initiatives to create awareness to the people about these policy and planning requirements. For example, there is limited understanding about the existence of buffer zones to drainage channels where all (100%) of the respondents knew nothing about such zones.

The findings on the drainage channels network revealed that drainage channels in Mikocheni 'B' are not well designed (with blockages, intermittence, etc.), are not sufficient nor spatially well distributed and are poorly managed. The poor management is due to lack of local community involvement for accountability and responsibility. Blockage by dumping and bridge construction practices over drainage channel which narrow the channels at some points affect the efficiency of the network as whole to convey water. People tend to protect themselves from floods individually by raising foundation and through wall fencing but these measures not sustainable since they transfer floods to other areas.

With coping strategies that are adopted by the people in Mikocheni 'B', the study revealed that some strategies like that in which people create some diversions from their homesteads to elsewhere, creates more problems on roads and to the households which do not have fence walls. This problem was seen in some households but also it was observed in industries which are located upstream. Mikocheni 'B' has also an unutilized opportunity of having different actors/partners who could provide technical and/or material support to supplement efforts done by the local people.

Recommendations

a) Strengthening Coordination mechanisms in drainage system management

Flood risks management is a very broad and integrated phenomenon in the sense that its execution demands involvement of different actors who will be required to play their roles under a given set of policy and legal frameworks as provided by the government (both Central and Local Authorities; NGOs, CBOs and local (neighbourhood) communities). With regard to this study, potential actors include the Dar es Salaam City Council, Kinondoni Municipal Council, Mikocheni 'B' Mtaa leadership, Tanzania Meteorological Authority and the Dar es Salaam Water Supply and Sewerage Company (DAWASSCO). These are important institutions for mitigating flooding risks in the City. The findings also show that there is need for enforcing sustainable drainage system practices which seem to be even less costly than that of high structural engineered drainage channel and fencing but

have so far received little attention due to lack of awareness.

b) Instituting People-centered management of drainage and channels

For proper management of drainage channels local people need to be more active in taking adaptation strategies. The Mtaa leadership should consider or invent different ways of soliciting financial resources from their own local sources so that they can enhance capacity of assuming their due responsibilities in which management of drainage systems is one among them. Potential partners who could provide technical and/or material support to Mikocheni 'B' would be the Lawyers Environmental Action Team (LEAT), Ardhi University, National Environmental Management Council (NEMC) and other CBOs which can be formed by community members themselves. This situation calls for effective flood risks management mechanisms/strategies from various actors like researchers, politicians (the government), local people/citizens, together with public and private organizations (Non-Governmental Organization and community based organizations).

c) Instituting mechanisms for Sustainable storm water management practices

The best of sustainable storm water management practices would be to manage flood risks at source. This includes employing means of harvesting and facilitating infiltration of storm water by strip grasses and green areas, whilst proving to be a significant contributor to local climate protection. The technique of storm water harvesting would reduce surface runoff while providing other home usage like garden watering, washing clothes and cars, mopping and so forth. Using sustainable urban drainage system would assist in managing eventual risks at source and act as an integrative and inclusive strategy for households to be more accountable and responsible to flood management.

d) Planning and Policy Recommendations Urban Planning

It is further recommended that Urban planning system should coordinate the flexibility of the different infrastructure system within the settlement. The coordination is required at three levels: land use, urban structure and life span of the different infrastructure systems. Design of neighbourhoods should take into account land use and space demand of the different infrastructure systems, and synergetic multiple uses of spaces have to be coordinated. Secondly, the spatial structure of the different infrastructure systems has to be coordinated. Flexible and robust elements of the different systems should be assigned in a way, such that they do not restrict each other in their performance. Based on the principles of flexible design a framework consisting of robust storm water ditches and streets could be developed and flexible elements such as retention basins could be included in the framework.

e) Overcoming flood risk challenges through Flexible Planning

Effective flood risk management at Mikocheni 'B' requires both structural and non-structural strategies, which implies a combination of engineering and non-engineering strategies including, but not limited to, water harvesting and efficient design of drainage channels can help in managing the flooding. Nonetheless, the provision of flexible urban drainage systems improves the efficiency of the land use compared to conventional robust solutions. Here are some specific recommendations:

i. The Town Planning Office for Kinondoni Municipality in collaboration with the Councilors for Mikocheni Ward and Mtaa leader (MEO) for Mikocheni 'B' should create awareness among the people about flood management related policies and planning standards which local people need to adhere to in order to reduce their vulnerability to flood risks.

ii. Town Planning Office for Kinondoni

Municipality should find some means of earmarking the buffers zone in which no any development should take place close or on natural drainage channels to safeguard them from encroachment and blockages. Municipal Town Planning Office for Kinondoni should provide directives for construction of culverts and features that preserve drainage channel size.

iii. The use of land rangers which was used to control development on land in some years ago is good and can be adopted to reduce flooding and other planning problems at Mikocheni 'B'. Ten cell leaders can play that role of land rangers/watchdogs for Town Planners so that any development that does not adhere to planning standards can be detected as early as possible and stopped immediately.

iv. Construction of new drainage channels (see proposed drainage channels on Appendix 3) along roads that bound settlements and link Mikocheni 'B' to the whole Dare es Salaam catchment to minimize flood risks.

v. Ten cell leaders should control of dumping of waste and impose sanctions for people who deposit their garbage in drainage channels.

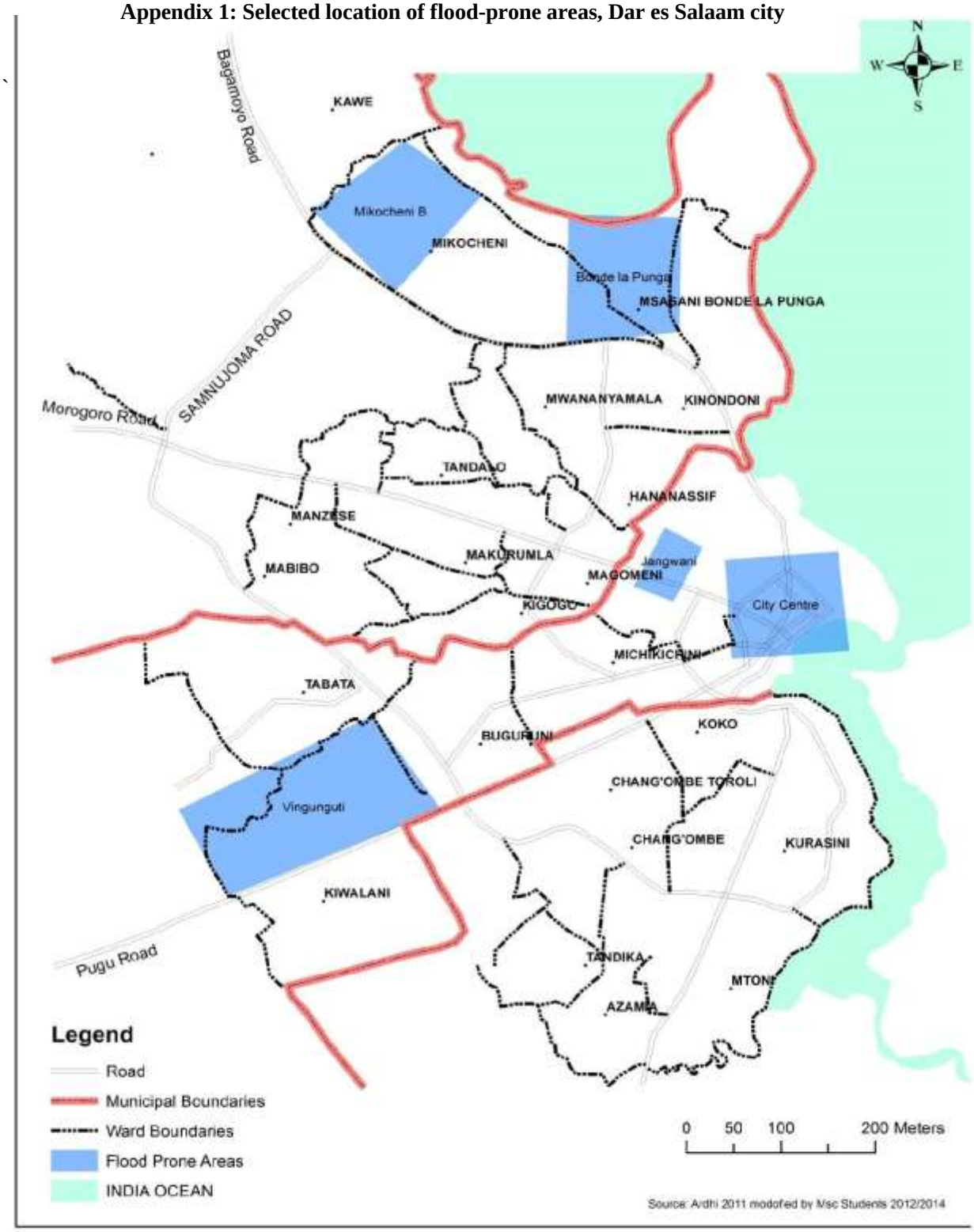
vi. Drainage channels should be constructed as straight as possible in order to avoid change of speed due to the change of the geometry which technically causes the upstream of storm water and, thus, flooding.

f) Building resilience to flooding disasters: the need to be more proactive

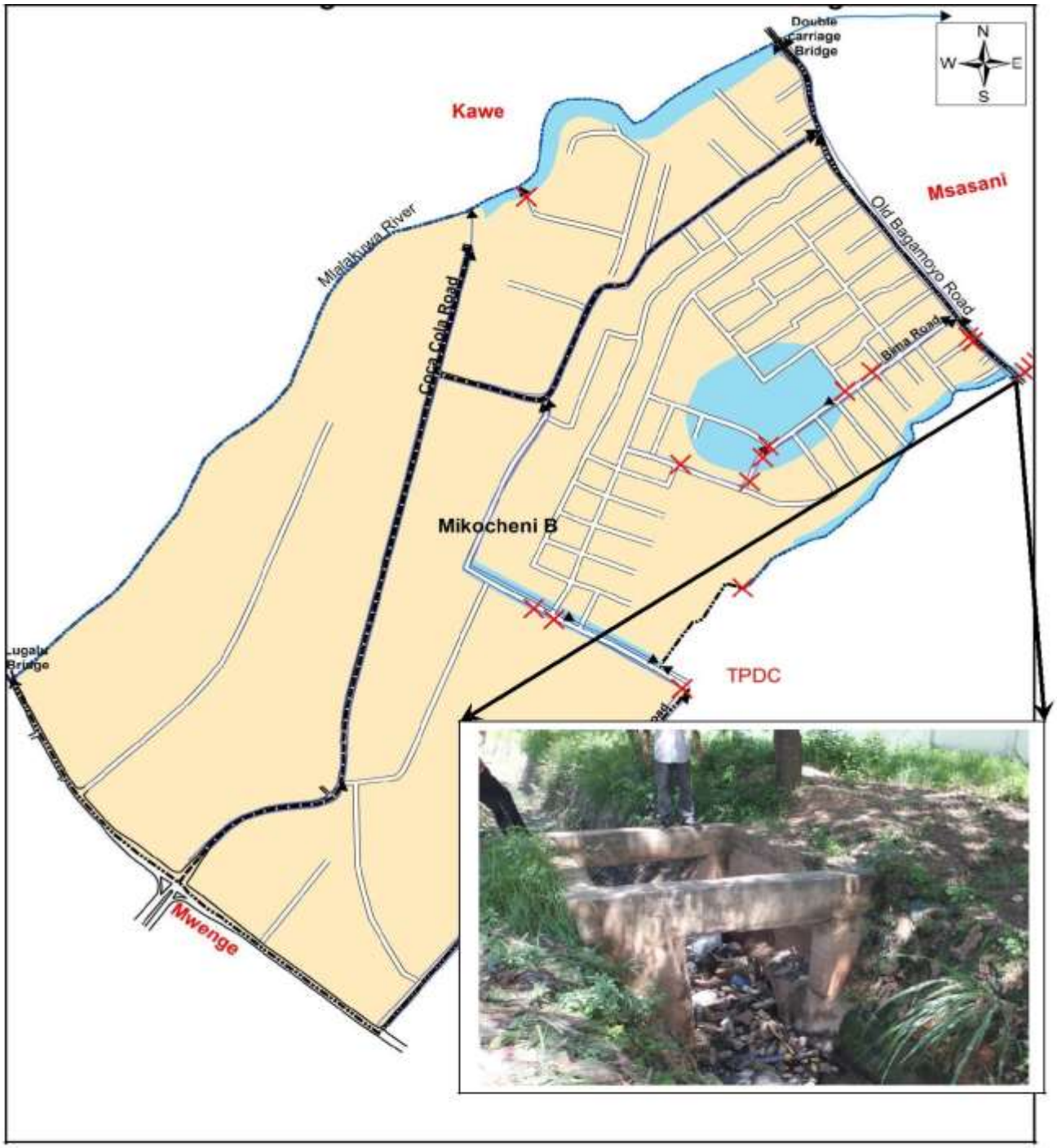
Proper solution for flooding in Mikocheni needs to be done together with other parts of the Dar es Salaam, as long runoffs are generated in Mikocheni 'B' in additional to storm water from other places. Therefore the flooding problem has to be solved in other places as well. In addition, taking the following steps may be in order:

i. An assessment of the risk levels city wide,
ii. A cost-benefit analysis of available interventions,
iii. An inventory of existing capacity and financial resources,
iv. Devise key ways to prevent urban flooding; including developing-and keeping updated-an "urban master plan", flood maps and other tools for mitigating floods,
v. Involving the private sector in flood control management, and
vi. Carry out periodic training, research and documentation on flooding disasters city wide impacts and capacity for interventions.

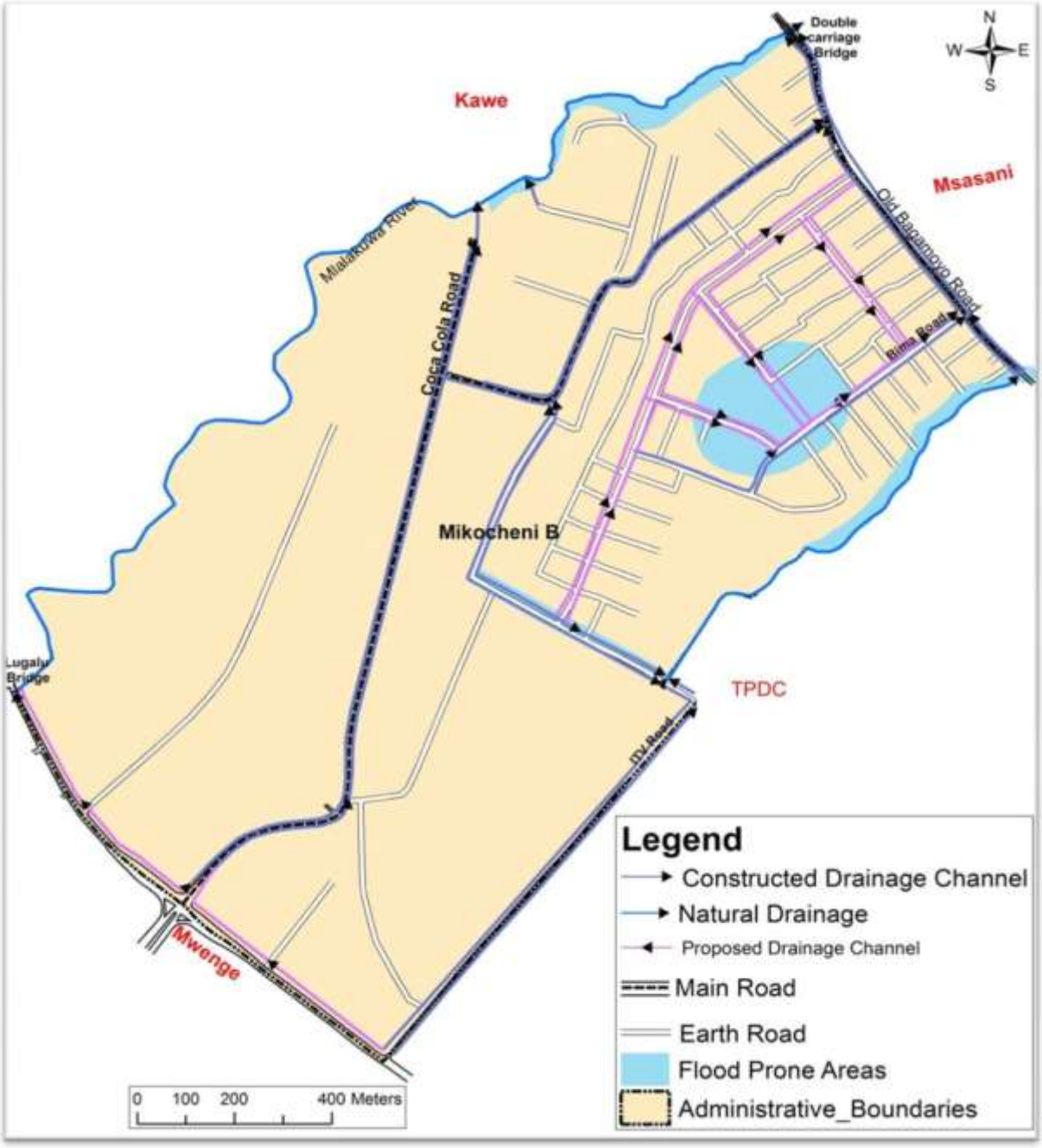
Appendix 1: Selected location of flood-prone areas, Dar es Salaam city



Appendix 2: Location of places blocked by the developers who built the fence wall across the natural drainage channel



Appendix 3: Proposed drainage channels to facilitate the drainage network


Double carriage Bridge
N
W
E
S
Kawe
Msasani
Mikocheni B
TPDC
Coca Cola Road
Old Bagamoyo Road
Bima Road
Lugalu Bridge
Mwenge
0 100 200 400 Meters
Legend
Constructed Drainage Channel
Natural Drainage
Proposed Drainage Channel
Main Road
Earth Road
Flood Prone Areas
Administrative_Boundaries

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