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Mangroves and Urbanization: Systems in Transition

A Study of Social-Ecological Systems
of Mangroves in Dar es Salaam,
Tanzania

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MSc International Environmental Studies

Mangroves and Urbanization: Systems in Transition

**- A Study of Social-Ecological Systems of Mangroves in
Dar es Salaam, Tanzania**



MSc Thesis

By Linn Maria Himberg, May 2016

Norwegian University of Life Sciences

Department of International Environment and Development Studies

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Declaration

I, Linn Maria Himberg, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

Abstract

Mangrove ecosystems are highly productive ecosystems along the coast of tropical countries. The system provides a range of ecosystem services that are valuable for human societies. While most African countries are lacking legislations to prevent mangroves, Tanzania's mangroves have been protected by legal measures since 1928. However, degradation of the ecosystem has continued, largely due to land change and urban development. The greatest loss of mangroves in Tanzania have been in Dar es Salaam, which is also where the highest rate of urbanization is occurring. This study examines how the social-ecological systems of mangroves in Dar es Salaam are affected by urbanization and what the challenges and possibilities for a resilient system are. The resilience and vulnerability of social-ecological systems of two mangroves in Dar es Salaam; the urban mangrove system in Msimbazi valley and the peri-urban mangroves in Kunduchi. Data was collected through qualitative semi-structured interviews with residents, local government, CBO-members, businesses and governmental institutions. Additional data was obtained from observations and interpretation of satellite images. The conceptual framework guiding this study was the complementary concepts of resilience and vulnerability. Key drivers of change deriving from an urbanized environment are identified and the concept of vulnerability is valuable in assessing underlying causes of dynamic pressures. This study found that while there are benefits deriving from urbanization such as lower levels of dependency, new stressors have occurred that diminish these positive effects on SES of urban mangroves in Dar es Salaam. The growing population is putting pressure on the current infrastructure which has created disastrous floods in Msimbazi valley and affected both the mangroves and the society. Kunduchi mangroves are still growing and while the management system is detracting from social and ecological resilience, opportunities exist that can potentially enhance the resilience. The SES ability to cope with stressors from urbanization can be improved by fostering participation of the local community, developing viable livelihood alternatives, enforcing current regulations and improving the communication between sub-units involved in management.

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-Asante sana

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List of acronyms

CBO –	Community Based Organization
CBS –	Community Based Security
KICAMP –	Kinondoni Integrated Coastal Area Management Programme
MACEMP –	Marine and Coastal Environment Management Project
MNRT –	Ministry of Natural Resources and Tourism
MoL –	Ministry of Land
NBS –	National Bureau of Statistics
NEMC –	National Environmental Management Council
PAR –	Pressure and Release
PUMPSEA -	Peri-urban mangrove forests as filters and potential phytoremediators of domestic sewage in East Africa
SES –	Social-Ecological System
SIDA –	Swedish International Development Cooperation agency
TFS –	Tanzania Forestry Service
Tsh –	Tanzanian shilling
UDSM –	University of Dar es Salaam
URT –	United Republic of Tanzania
VEO –	Village Executive Officer

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1. Introduction

1.1 Background

Mangrove ecosystems

The ecological communities that are established in the intertidal coastal zones, or zones where fresh water meets saline marine water, are where mangrove forests form. In the harsh place between land and sea mangroves have managed to cope and adapt to changing salinity, waterlogged soil and changing dynamics along the coastline. Mangrove ecosystems are found primarily in tropical regions and they are highly productive and rich in biodiversity. The variety of goods and services, both economical and ecological, that mangroves can provide make them indispensable to societies. The wood from the trees are used as fuel, and the surrounding ecosystem can provide food and traditional medicinal plants for local communities. The structure of mangrove forests provides nursery grounds for fish that support fisheries, that same structure provides buffering from coastal storms and filtration that assist with water treatment (Spalding et al., 2010).

The total area of mangroves is estimated to be just above 150,000 km², divided by 123 countries world wide (Spalding et al., 2010). Mangroves declined by 35, 600 km² between 1980 and 2005 (FAO (2007) and are continuing to decline. Despite the many important services mangroves provide, they are undervalued and seen as muddy wastelands. This lack of value might be attributed to many of its ecosystem services occurring off- site, such as the support of fish stocks with the nursery grounds, or that the services do not have a direct market value, as the reduction of carbon emission (FAO, 2007; Semesi, 2000).

Tanzania has mangrove forest that cover about 1,080 km² (URT, 2014; FAO, 2010). While most African countries are lacking legislations to protect mangrove ecosystems, Tanzania is an exception with all mangroves in the country under protection. Mangroves were listed as forest reserves in 1928, and have continued to receive legal protection, such as a ban on cutting mangrove trees that were introduced in 1987. However, even though local communities were restricted to cut down mangroves, clear cutting for agricultural and urban development continued. In 1988 a mangrove management project was initiated that focused on protecting the mangrove as well as raising awareness about the benefits of maintaining them. Tanzania was the first

country in East Africa to set up a Mangrove Management Plan in 1991 and emphasized the need of invested cooperation between the different stakeholders. This has decreased the pressure to clear mangroves in Tanzania and the degradation today much lower than in other countries (Semesi, 1991; 1998; 2000; Spalding et al., 2010).

Nevertheless, Tanzania has lost around 440 km² since 1980 (URT 2014; FAO 2010). The demand for mangrove resources are growing, especially near cities in Tanzania where a large part of the population still uses charcoals as a source of energy. Cutting of mangroves to fulfil this demand for wood has degraded the ecosystem, compounded to this is the clear-cutting and conversion of mangroves into agricultural and urban development. This land conversion has been the major cause of mangrove decline in Dar es Salaam where the greatest loss of mangroves has occurred (URT 2006; 2014; Semesi, 2000). On the larger scale, about 50 % of the world's mangrove forests have been converted to provide more immediate benefits to economies and populations, such as urbanization. As the urban zone expands, mangroves around Dar es Salaam are prone to clearing (Young and Steffen, 2009; UNEP-WCMC, 2010). Mangrove forest in Dar es Salaam was estimated to be 21,7 km² in 1991 (Semesi, 1991) and few changes were reported between 1990 and 2000 (Wang et al., 2003).

Urbanization

Urbanization is defined as the “a multidimensional process that manifests itself through rapidly changing human populations and changing land cover” (Seto et al., 2013:4). Cities are growing due to natural population growth, migration from rural areas and by redefining administrative boundaries. Urban growth is generally involving more sealed surfaces and peri-urban and rural areas are increasingly surrounded by urban areas or are becoming a part of them. Urbanization and peri-urbanization are changing land from natural environments into urban areas. The social system becomes absorbed into an urban economy and will experience cultural adjustments and a change in lifestyle (Seto et al., 2013).

There has been a rapid process of urbanization in the 20th century. More than 50 % of the world's population is now living in urban areas, compared to 14 % in the early 1900s, and the number is

expected to rise to 80 % before stabilizes. Most of the urbanization today is happening in developing countries, such as Tanzania (UN, 2014; Brand, 2006).

Urban expansion is occurring faster in areas with rich biodiversity than in any other zones. Historically, urban centres have had a dense population but today the urban areas are growing twice as fast as the urban population (Seto et al., 2013). The coastal zone, including those zones with mangrove habitats, is especially vulnerable to land conversion as it is changing faster than any other area. Around 50 % of all people in the world are living within 100 km from the coast and some of the largest cities are located there, which makes the coastline vulnerable to urban migration. Coastal areas are home to diverse and important ecosystems, which are being affected by this rapid urbanization and land use changes movement (Seto et al., 2013; Young and Steffen, 2009; Grove, 2009). Competition for land, whether it's for industry or for urban development, is the major cause for mangroves disappearing and coastal ecosystems being at risk, not wood extraction as a large part of conservation activities have been focused on (FAO, 2007).

Urbanization of Tanzania and Dar es Salaam

Tanzania is experiencing a rapid population growth. In 1967 the country had a population of approximately 12,3 million and today the number is 51,82 million. Tanzania is expected to continue the rapid increase in their urban population and Dar es Salaam are projected to emerge as a mega city of 10 million people by 2030 (National Bureau of statistics, 2002; 2013; UN, 2014; World Bank, 2016). The city had in 1967 a population of 356,286. In 2012 this number had increased to more than 4,3 million, and Dar es Salaam has a higher rate of urbanization than any other urban centre in Tanzania (National Bureau of statistics 2002; 2013; UNDP, 2015).

This rapid growth in Dar es Salaam is putting pressure on natural ecosystems, but also on the adequate supply of urban infrastructure and social services (UNDP, 2015). Unplanned urban expansion, which comes with the rapid rural-urban migration, can lead to environmental degradation and insufficient housing and infrastructure. Traffic congestion, poor infrastructure and an overload on sewage and water system is affecting a large part of the population in the city. More than 70 % of the population in Dar es Salaam lives in poor and informal settlements and lack access to adequate infrastructure (UNDP, 2015; World Bank, 2002).

Literature review

Detailed studies about the mangroves in, then Tanganyika, was produced as far back as the 1930's (Semesi, 2000). However, before the 80's there were relative few studies about mangrove ecosystems in Tanzania. After The Mangrove Management Plan (Semesi, 1991) was written, an increasing amount of studies about mangroves in Tanzania have been conducted. The Mangrove Management Plan of Mainland Tanzania remains the most extensive baseline study produced for the mangroves in Tanzania. The study assessed aerial photographs and used intensive fieldwork to collect data about distribution, species composition, sediment characteristics and activities and uses of mangroves (Semesi, 1991).

Most studies linking social systems and ecosystems have focused on the developing world (Adger, 2000; Carpenter et al., 2001). Studies about mangroves in Tanzania have either looked at the ecological system and the area covered by mangroves, or they are socio-economic studies about the dependency on mangroves of communities around the mangroves (Semesi, 2000). Nevertheless, the studies about Tanzanian mangroves that have linked ecology with socio-economic factors have created an important insight into the relationship between mangrove ecosystems and societies in the area (Semesi, 1991; 1998; Othman, 2005). Several studies have used the resilience concept when analysing mangroves and also social systems surrounding mangrove forests, but only a few of these have been conducted in Tanzania (Othman, 2005; Katundu, 2006).

Many studies have been conducted about human impact on mangroves, but most of them are about mangroves outside urban centres. Several studies about impact of urbanization on ecosystems exist (eg. Elmqvist et al., 2013), but relatively few specially on mangroves (Benfield et al., 2005; Othman, 2005). The majority of these studies focus on the risk and effect of pollution to mangroves (Crona et al., 2009; Bartolini et al., 2011; Kruitwagen et al., 2008). While there is an argument that mangroves thrive in sewage (Othman, 2005), questions have been raised about the effects of the pollution on other organisms in the system, how it influences ecosystem services and the potential health hazard it may create to communities (Crona et al. 2009; Lyimo and Abbu, 2007; World Bank, 2002). An increasing population will generate more waste (Alongi, 2002), and peri-urban mangroves have been proposed as potential bio-filters (PUMPSEA, 2008; Crona et al., 2000). Othman (2005) compared the Social-ecological system SES of two

contrasting mangroves in Zanzibar, and found that the urban mangrove was flourishing and more resilient than the mangroves outside of the urban area. This was attributed to a low dependency on mangrove resources in Zanzibar town. However, the resilient ecological state was not socially desired with high levels of pollution and security issues.

The integration of the concepts of resilience and vulnerability are increasingly being discussed (Miller et al., 2010; Adger, 2006), but only a few studies have tried to integrate the concept of vulnerability with resilience when analysing SES of mangroves (Ellison, 2012) as I have done in this thesis. Also, there are few studies that studying the SES of urban mangroves, such as the Msimbazi mangroves, which is one of the study sites in this thesis. Msimbazi mangroves have been a subject for studies about pollution (Mrutu et al., 2013) while Kunduchi, which is the other study site, have been a subject for more extensive studies (Semesi, 2000; Katundu, 2006).

1.2 the conceptual framework

Social and ecological systems interact and their functions and conditions are closely connected, thus it is problematic to separate humans from nature. People and social systems shape the environment and people depend on ecosystem services for their well-being. A healthy ecosystem is necessary to support human welfare. Having a deeper understanding of how ecosystems and social dynamics are linked is essential to enhance conservation strategies. Better conservation strategies can then contribute to human well-being through sustainable use of ecosystem services (Millenium Ecosystem Assessment, 2005). The term social-ecological system is used to integrate social systems with natural systems witch inevitably interact with one another (Berkes and Folke 1998; Adger 2006).

This thesis incorporates the concepts of resilience and vulnerability to assess the linkages between social and ecological processes of change as applied to urban mangroves. By incorporating these concepts, the characteristics of the SES of urban mangroves and how they are being affected by urbanization can be realized, and result in more adaptive conservation strategies to benefit these diminishing ecosystems and the growing population.

The resilience perspective

The resilience perspective emerged in the 1960-1970s from ecology and Holling's (1973) influential work. Since then it has developed into an interdisciplinary concept that can be used to understand the dynamics in both natural and social systems and the linkages between them (Folke, 2006). The dominating perception in natural sciences has traditionally been that systems are stable and that they will go back to equilibrium when stressors are removed, thus policies should seek to control change (Berkes et al., 2003; Smit and Wandel, 2006; Folke, 2006). Policies emerging from this perspective tend to have a short-time view that tries to control one variable instead of developing strategies that sees variables as interlinked, something that can result in vulnerability of systems (Gundersen et al., 1995; Holling et al 1998; Holling and Meffe 1996).

Holling (1973), however, shifted the focus from system equilibriums toward a dynamic multiple-equilibrium view, and emphasized that variability was a characteristic of all systems. He explained how systems could have low stability while still having high resilience. Rather than control change in a system, policies should build the capacity to cope with disturbances and adapt and shape change (Holling, 1973; Berkes et al., 2003; Folke, 2006).

Resilience can be defined as *“the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedback”* (Walker et al., 2004). The resilience approach view systems as non-linear with constant changes and thresholds. The future is unpredictable with periods of gradual change interacting with periods of rapid change and a resilient social-ecological system can cope with and learn from these changes (Resilience Alliance, 2010; Folke, 2006).

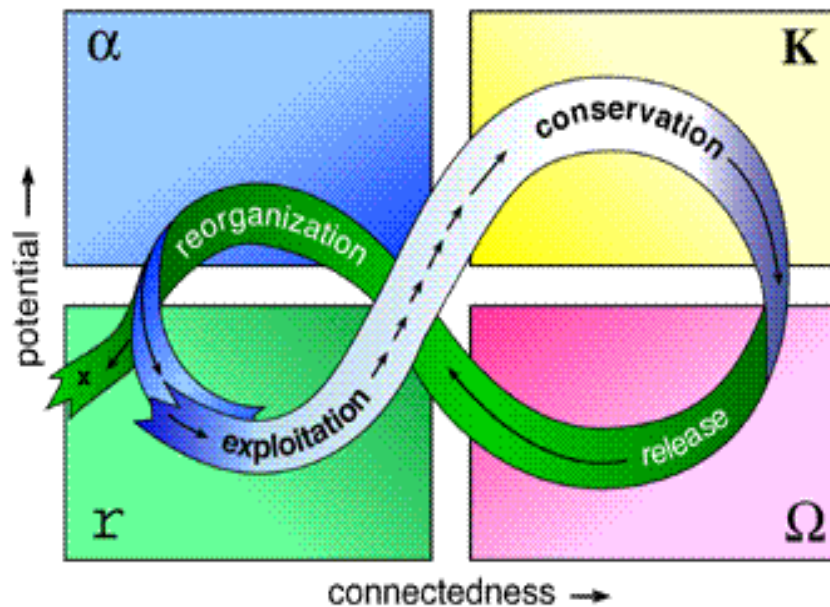
A resilient ecosystem can undergo change without shifting into a qualitatively different state and will therefore still be capable of providing the same essential ecosystem services. Social resilience is the capability of human communities to thrive while changes occur and the ability to recover and reorganize from political, social, economic or natural stressors (Adger, 2000; Magis, 2012). SESs has limits to how much disturbances it can absorb before it changes, thus resilience is about maintaining self-organizing ability and building adaptive capacity of systems (Folke, 2006;

Holling, 1973; Walker et al., 2004). Furthermore, by analysing system dynamics and characteristics the concept of resilience can be used to prevent a possible shift into an undesirable state or to transform the system into a desirable one if the current state is undesirable (Beyer-Farris et al., 2012; Walker et al., 2004; Folke, 2006). Therefore, adaptive capacity and transformability are important aspects of resilience when analysing SESs.

The adaptive cycle

SESs are characterized by slow and fast processes of change that result in a positive or negative feedback loop (Berkes and Folke, 1998; Folke et al., 2010). The adaptive cycle (Figure 1), conceptualised by Holling (1986), is useful when analysing SESs, as it explains cycles of disruption and renewal in complex systems. The model takes fast and slow dynamics into account, as well as cross scale interactions. Resilience in SES involve navigating all stages of the adaptive cycle (Berkes et al., 2003; Fath et al., 2015).

Figure 1. The Adaptive Cycle



The adaptive cycle (Source: Resilience Alliance, 2005. Modified from Holling, 1986; Gunderson and Holling, 2002)

The cycle explains the four phases of development in a system that is driven by processes and disturbances. These phases are: two fast phases, exploitation (r) and conservation (K), and two slow phases, release (Ω) and reorganization (α). The fore loop of the cycle, the r- and K-phase, are

characterised by a slow process of growth, increased connectedness and accumulation in the system. The r-phase of SESs is characterized by expansion of pioneers that are tolerant to variability and a high level of positive feedbacks. Network connections are established, availability of resources is usually high and well-being is increased (Folke, 2006; Pisano, 2012; Berkes et al., 2003; Fath et al., 2015). As the system develops it reaches the K-phase when system functions are stabilized. Resources becomes less available and the system are characterized by more negative than positive feedbacks. Consequently, systems become less flexible and vulnerable to disturbances which can initiate the back loop. The back loop can be described as an unpredictable phase where a disturbance can cause a rapid change in the system (Fath et al., 2015). When the system enter the Ω -phase of disordered collapse, it is important to maintain vital functions for the system not to break down. In a resilient system diversity is high and the system can pull from large stock of resources during the crisis, consequently, the system is more likely to survive. In the α -phase the system either reorganize and restart a new cycle within the same regime with the same structure, functions and feedbacks as before, or it will cross a threshold into a new domain of attraction (Walker et al., 2004, Berkes and Folke, 1998; Fath et al., 2015; Walker and Salt, 2006).

Vulnerability

The concept of vulnerability originated from studies on how social systems are impacted by natural hazards. The focus has been broadened over time to also address how SESs respond to change, thus linking resilience with vulnerability (Chapin et al., 2009). The concept is useful when describing how communities are exposed to and affected by shocks, and the coping capacity of the community (Janssen and Oström, 2006; Miller et al., 2010; Adger, 2006). Vulnerability usually has an actor-oriented view that address power relations, social change, access to resources, conflicts and the knowledge, interests and agency of actors (Miller et al., 2010). Wisner et al. (2003) defined vulnerability as: “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard”. Vulnerability can also be used about systems and the likelihood of harm due to exposure of hazards to a system (Adger, 2006; Turner et al., 2003 in Kofinas and Chapin, 2009).

Vulnerability is sometimes used as an antonym of resilience; when a system has lost resilience it becomes vulnerable (Folke et al., 2002; Folke, 2006). Vulnerability is thus seen as a possible outcome from disturbances or shocks in a social-ecological system that has low resilience and adaptive capacity (Miller et al., 2010). However, in the vulnerability concept resilience is merely one aspect that can influence systems vulnerability, along with exposure and sensitivity (Chapin et al., 2009). Turner et al. (2003) argued that a system could be resilient but at the same time be vulnerable if exposure and sensitivity is high. Exposure refers to the magnitude, frequency, duration and areal extent of disturbances in a system, while sensitivity is to what extent a system is affected when experiencing disturbances. Vulnerability in SESs can be reduced by limiting the exposure of the system to disturbances, reducing sensitivity of the system and increasing resilience and adaptive capacity of the system (Smit and Wandel, 2006; Adger, 2006; Chapin et al., 2009).

In this study resilience and vulnerability are used as interconnected concepts. Both concepts focus on how systems respond to shocks and stressors and the adaptive capacity of systems (Folke, 2006; Miller et al., 2010). To combine these concepts vulnerability refers to how people and systems are affected by disturbances and resilience is about how much change a system can undergo and still recover and maintain the same function.

1.3 Aim of the study

In this study two different mangrove forests in Dar es Salaam and their surrounding social system are examined in terms of their resilience and vulnerability to urbanization. The first study site is the mangroves in Msimbazi valley, located in Dar es Salaam city centre. The other study site is the peri-urban mangrove of Kunduchi and the surrounding community. By comparing one urban and one peri-urban mangrove forest we could strive to gain an understanding of the impact urbanization has on the SES of mangroves. In doing this comparison this study allows for an analyses of the complexity of the social and ecological system of urban and peri-urban mangroves. The intension is to identify how the characteristics and linkages of SESs of urban mangroves have changed and the drivers that is contributing to this change. With the study I wish

to contribute to the understanding of main threats and challenges to SESs of mangroves as well as possible advantages that occur due to urbanization.

Research questions and objectives

Research question: *How are the social-ecological systems of mangroves in Dar es Salaam affected by urbanization and what are the challenges and possibilities for a resilient system?*

To answer the central research questions, four objectives have been examined:

1. To understand how the social and ecological system of an urban and a peri-urban mangrove forests have changed over time, using the mangroves in the Msimbazi valley and the mangroves in Kunduchi as case studies.
2. How does urban development and continuing human activities affect the mangroves in these two forests and the people living around them? Are the systems resilient in the face of urbanization?
3. To understand why the system is changing. Identify what the underlying drivers of change are and assess if the systems are vulnerable in the context of urbanization.
4. Is the current management of mangroves in Dar es Salaam enhancing or detracting from social and ecological resilience? What are the possibilities for resilient mangrove SESs in Dar es Salaam?

2. Research method

2.1 Research approach and design

The approach applied throughout this study was a qualitative methodological approach. A qualitative research approach can provide a holistic understanding of complex processes and give us the opportunity to capture unexpected findings. Not everything can be measured meaningfully as quantitative research is set to do (Mayoux, 2006). In qualitative research the objective is to understand the “the meanings, concepts, definitions, characteristics, metaphors, symbols and description of things” (Berg and Lune, 2012:3). Quality refers to the why and how of things, so through qualitative research we can explore how and why things are happening (Berg and Lune, 2012). As the study was set to identify the characteristics of urban mangroves, and to understand how and why the socio-ecological system of mangroves have changed over time with urbanization, a qualitative research approach was seen as appropriate.

The research design used was a multiple-case study, with two mangroves chosen for their location. Case-studies can be used for in-depth investigations of a contemporary such as a place, an event, a phenomena or a group of people thus giving the opportunity to create a holistic understanding of the studied subject (Yin, 1994; McGregor, 2006; Bryman, 2008). “How” and “why” are central questions in case studies (Yin, 1994), which makes the case study design appropriate for this study since its focus is on how and why the SES of mangroves are changing due to urbanization. Multiple-case studies are more time consuming than single case studies, but are considered to give more robust findings. By multiple cases it is possible to compare and contrast which is valuable for this study (Yin, 1994). Case studies can entail a variety of data collection methods (Berg and Lune, 2012), and that opens up the possibility to use qualitative interviews in combination with observation and visual interpretation of satellite images as is used in this study.

2.2 Study sites in Dar es Salaam

The two study sites used for this research were the mangroves and surrounding community of Kunduchi and Msimbazi valley, both located in Dar es Salaam, Tanzania. Tanzania’s 800 km coastline stretches from Kenya in the north to Mozambique in the south and are the home to rich

biodiversity and marine ecosystems, including mangrove ecosystems (Ngusaru, 2000), and these coastal areas are attracting tourists, industries and urban development. Dar es Salaam, “the harbour of peace” is one of the fastest growing cities in Africa (Sturgis, 2015). The coast of Tanzania is characterized by a hot and humid atmosphere, monsoon winds and tides that are influencing the coastal environment as well as two rainy seasons, the main one from March to May, and the short rains in November and December (Semesi, 1992).

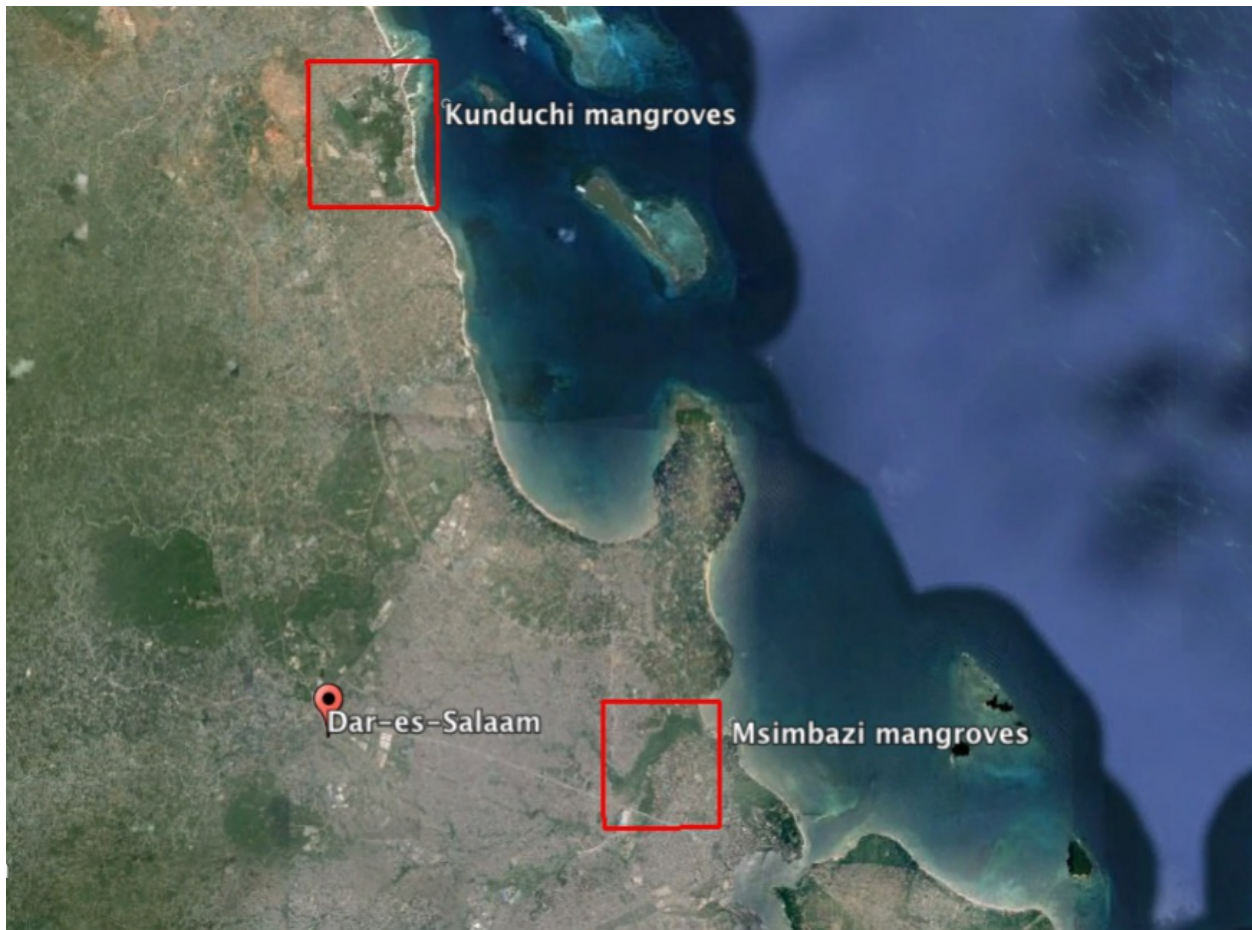
Figure 2. Map of the United Republic of Tanzania



Map source: [clickafrique.com](http://www.clickafrique.com/facts/tanzania/default.aspx) <http://www.clickafrique.com/facts/tanzania/default.aspx>

The selected study sites were chosen for a number of reasons. The most important was the location. The mangroves in Msimbazi valley was chosen since it was located in the city centre of Dar Es Salaam. Other than having some security issues related to it, the forest could easily be accessed. Kunduchi mangroves was chosen as it is located in an peri-urban setting, it was accessible and previous project and studies in the area made it an interesting study site.

Figure 3. Dar es Salaam and study sites



The map is showing the location of the mangroves in Msimbazi valley and Kunduchi in Dar es Salaam (Google Earth, 2016)

Msimbazi valley

The mangroves growing in Msimbazi valley covered an area of 25,3 ha in 1991 and the forest were dominated by *Avicenna Marina* trees. The estuary is located in Dar es Salaam city centre and receives freshwater from the Msimbazi river which are heavily polluted from industrial and domestic waste (Semesi, 1991). The study site stretched from Selander bridge at the coast and up to Jangwani bridge which is further up stream of the river. The valley is located between the Illala and Kinondoni municipalities with West Upanga ward on the Illala side and Hanna Nassif in Kinondoni. The population of West Upanga and Hanna Nassif are respectively 13,476 and 37,115 (NBS, 2013). Because of the urban location, the Msimbazi mangrove is surrounded by buildings and infrastructures including roads and bridges. Most people living around the forest, especially in Illala district are from middle classes, while there is a poorer population in informal settlements in Hanna Nassif. There are also non residential buildings around the forest; schools, hotels, office buildings, a hospital and a police station.

Figure 4. Msimbazi valley mangroves



Msimbazi valley 18/02/2016 (Google Earth, 2016)

Kunduchi

The mangroves located along the Manyama creek in the Kunduchi ward was covering an area of 68,7 ha in 1991 (Semesi, 1991). *Avicennia Marina*, *Ceriops Tagal*, and *Sonneratia Alba* along the creek are the most common species (Katundu, 2006; Kimirei et al., 2013). Kunduchi ward is a peri-urban area in Kinondoni municipality and has a population of 75.016 (NBS, 2013). The mangrove area is surrounded by a fishing village, ponds for salt production, hotels and residential buildings. The coastline is attracting tourists and fishing activities.

Figure 5. Kunduchi mangroves



Kunduchi 14/02/2015 (Google Earth, 2016)

2.3 Sampling approach

The approach of non-probability sampling was used during field work to access informants for the qualitative interviews. In non-probability sampling informants are chosen due to availability or specific attributes, thus the sample is not representative for the whole population (Bryman, 2008; Berg and Lune, 2012). Purposive, convenience and snow ball sampling were used alternatively when selecting informants for the study.

Purposive sampling mainly aims at including subjects with certain attributes in the study (Berg and Lune, 2012). Purposive sampling was mainly used in this study to ensure that people that had some relation to the mangrove forest were interviewed. Individuals with a particular knowledge or people that were living or working close to or within the forest were preferred as informants. Convenience sampling were used because of the availability of informants and to gather more general information about the social and ecological system in the study sites. Additionally, snowball sampling was used to ensure that informants with a special interest in or knowledge about the mangroves were included in the study that would otherwise be difficult to locate.

2.4 Data collection

Qualitative interviews were conducted in October and November in 2014 and in June 2015. The interviews were semi-structured with some pre-set questions and special topics that were discussed. Semi-structured interviews give the informants the opportunity to bring up their own topics and thoughts, but at the same time it ensures that important topics is covered in the interview. This type of interviewing can provide more in-depth information about informants' perceptions and gives the interviewer the opportunity to probe beyond the set questions (Willis, 2006; Berge and Lune, 2012). The interview guides used assisted the structure of the interviews. The interview guide developed for people living or working in the area included questions about how long the informant had lived or worked there, what changes they had seen in the population and the mangrove forest, as well as questions about the management, laws and regulations. In the end they were asked about the threats to the mangrove forest in the area, and previous, current and possible threats were discussed.

One purpose of the interviews was to get knowledge about how the mangrove forests and the area they were located had changed over time. Thus, people who had lived longer in the area were preferred as informants. Key informants, such as people that were involved in the management of mangroves, were also interviewed. The Ministry of Land (MoL), Tanzania Forestry Service (TFS), National Environmental Management Council (NEMC), Kinondoni forest officer, Village Executive Officer (VEO) in Kunduchi, members from community bases organizations (CBO) that dealt with protecting the environment in Kunduchi as well as managers of hotels, saltpan workers in Kunduchi, head masters at schools in Jangwani and Kunduchi, owners of land in Kunduchi, the police station near Selander Bridge, a security group in West Upanga and academic staff from University of Dar es Salaam were all included in the research.

Resulting dataset

A total of 78 interviews were conducted with 26 local informants from around Msimbazi valley and 46 local informants from Kunduchi (table 1, table 2). Additionally, 6 more interviews were conducted; 5 with governmental officials from NEMC, MoL, TFS and Kinondoni municipal as well as one interview with academic staff from UDSM.

Table 1. Shows the number of interviews in Kunduchi

	Kunduchi
Households	27
Salt production	5
Fishers	4
Hotels	4
Community based organization	3
Governmental officials	2
Plot owner	1

Table 2. Shows the number of interviews in Msimbazi valley

	Msimbazi valley
Household	20
Club worker	1
Community based security group	1
NGO	1
School	1
Security guard	1
Police station	1

The interviews ranged from 15 minutes to 2 hours depending on the informant's knowledge about the topic. Interview guides with key questions or topics had been developed for the different stakeholders (Appendix 1). Recording devices were not used during the interviews since most interviews were done outside where noise from the environment, either urban noise or ambient wind noise, would affect the sound. Because of the use of interpreter, I was able to write up the answers when the translator was asking the next question. Age and gender range of the informants do not give a nuanced picture. This is because many people often were present and contributed during the interviews. Consequently, many of interviews had the same characteristics as group interviews.

Qualitative interviews were often combined with observations. Other types of data collection techniques used were transect walks and field visits in October and November in 2014 and in June 2015, visual interpretations of satellite images retrieved from Google Earth, personal communications and secondary data. The use of multiple data collection technique is a way of triangulate the findings to strengthen the validity of the study (Berg and Lune, 2012).

Triangulation is the use of more than one methodological technique in the same research to ensure to get a better picture that is closer to reality (Berg and Lune, 2012). Other types of

triangulation done to strengthen the validity of this study was to double-check the data gathered with different stakeholders and by using different theoretical approaches in the analysis.

2.5 Challenges, limitations and ethical considerations

Security issues

While doing field work security issues had to be considered. Especially doing research around Msimbazi valley which is considered as unsafe, thus precautions had to be taken. It was advised for me to arrange that a group of people should help me when conducting research in this area and especially inside the mangrove forest. This proved a bit challenging, but with assistance from the security group in the area we were able to do a transect walk inside the mangrove forest. I was consistently accompanied by the translator who had the knowledge the area and people. In interviews precautions such as no valuable belongings being brought with us were taken. This was done to not attract any unwanted attention. The interviews were always done during the daytime while it was still light.

Interviews

Before each interview, informants were informed about the topic of the research and the reason for the study. The topic is regarded as being of low sensitivity, but informants were assured that their identity and the information given was, and will be, kept confidential. This study will refer to informants by the area they live, their title or the offices they represent.

I was seen as a Mzungu (white person/foreigner) by informants, and this brought with it its own challenges. Informants sometimes did not understand my interest in the topic and some wanted to be compensated for their information. I kept a strong policy on not compensating informants, and my translator helped me clarify that information given was on their own initiative and given voluntarily. The purpose of the study was explained, but informants might have held back information, twisted the information or exaggerated difficulties.

During interviews, sometimes people were stopping by and shared their opinions and individual interviews that turned into group interviews might have affected informants' opinions. Group

interviews can be dominated by powerful and dominant people or individuals can be influenced by collective thoughts (Lloyd-Evans, 2006). However, most of the interviews that turned in to group interviews was small groups of two or three friends were the person initially interviewed were the main informants and the other people only added extra information. In the few cases where there were bigger groups there were sometimes powerful voices that dominated the conversation or there were different views on the topics discussed, which was valuable in its own way.

Some challenges appeared when using a translator. Concept, ideas and valuable information can get lost in translation either by the translator not finding an accurate interpretation or by them filtering out what they see as unimportant. Also, sometimes concepts and words cannot be translated accurately to a different language and this poses a challenge for the interpreter as well as the researcher (Bujra, 2006). In the research I had to change the translator in the early stage of conducting interviews because I noticed how the answers from informants did not match up with the questions. The new translator appeared to not have such discrepancies in information sharing.

Since interviews had to be done during daylight, it was challenging to get hold of informants that had a job outside of the area. Many people were not home before later in the evening. In Kunduchi, most people who had moved into newly built houses usually had jobs outside of the ward and were not home early enough for us to interview them. However, in the end we were able to find informants from this group; either because they were home from work that day, they were students or they were retired. Most of the informants were people who had lived longer in the area. They were often more easily available as they were also working in the area.

3 Findings

3.1 Changes in the mangroves and population in Msimbazi valley

Population

Hanna Nassif and West Upanga, the two wards on each side of Msimbazi valley, are very different. West Upanga is a middle class area and the properties are protected by walls and security guards. Hanna Nassif is an informal settlement where the houses and infrastructure is of poor standards. People in Hanna Nassif started settling after a coconut plantation ended its production in 1963 and previous workers divided the area between them. The high rate of urbanization in the 60's resulted in a rapid development of the informal settlements (Lupala et al., 1997). Table 3 show the population of Hanna Nassif in 1994 and both wards in 2002 and 2012. The population has increased the most in West Upanga and just slightly in Hanna Nassif between 2002 and 2012.

Table 3. Population statistics, West Upanga and Hanna Nassif

	1994	2002	2012	Average annual growth rate
West Upanga		9,252	13476	4,5
Hanna Nassif	19,000	32,023	37,115	1,6

(National bureau of statistics, Tanzania, 2002 and 2013; World Bank, 2002)

According to informants in Hanna Nassif the population has been relative stable the last decade, but population living close to the river have been reduced. Especially after the floods in late 2011, people were moving from the valley, either voluntarily or with pressure from the government. The government started a resettlement project right after the flood in 2011 which were targeting the people living on the flood prone slopes of Msimbazi valley (Campbell, 2014). However, people continued to come in seasonally according to informants in the area. During the dry season people would come back to work. In December 2015, the government destructed around 100 houses built within the restricted area in the valley (Shao, 2015). The satellite images on the next page are portraying one of the areas in Hanna Nassif that are most at risk of flooding. Figure 6 is from 2009, while figure 7 is from 2016. Houses have been destructed and an area that were once built-up are now covered by grass.

Figure 6. Informal settlement in Hanna Nassif



Hanna Nassif, 25/11/2009 (Google Earth, 2016)

Figure 7. Houses demolished in Hanna Nassif



Hanna Nassif, 18/02/2016 (Google Earth, 2016)

Mangrove forest

Informants from Hanna Nassif and West Upanga explained how mangroves had started growing after Selander bridge were constructed in the 1980s, and almost grew all the way up to Jangwani bridge. However, after the heavy flood in 2011, the size of the mangroves started decreasing again. In 1991, the mangrove forest in Msimbazi valley was measured to be 25,3 ha (Semesi, 1991). From satellite images used in this study the mangroves were measured to have increased to 47,5 ha in 2005. However, in 2015 the mangrove area in Msimbazi valley had been reduced to 37.1 ha, with dried trees outside of this area. From the figures below you can see the changes between 2005 (figure 8) and 2015 (figure 9). Some differences in the images can be due to seasonal changes since the first image is from November while the second is from July. Nevertheless, the treeline has receded and been replaced by grasses upstream. Furthermore, trees have dried up in noticeable numbers in the valley (Figure 10; 11) especially in the back, upstream of the river.

Figure 8. Msimbazi valley, 2005



30/11/2005 (Google Earth, 2016)

Figure 9. Msimbazi valley, 2015



16/07/2015 (Google Earth, 2016)

Figure 10. Dried trees in Msimbazi mangroves



19.02.2015 (Google Earth, 2016)

Figure 11. Dried mangrove trees



02/06/2015 (Photo: Linn Himberg)

Figure 12. Dried trees and view from Hanna Nassif



12/11/2014 (photo: Linn Himberg)

A change in the forest was also observed during my field work. In November 2014 trees had started drying close to the informal settlements in Hanna Nassif and when coming back in June, 2015 a drastic increase in dried up trees was observed. While informants close to Selander bridge reported about growth, informants living close to Jangwani reported about a declining forest. According to informants in Hanna Nassif the trees are more scattered now, there are few young trees growing and they often die before getting old. One informant described how she was able to see the buildings on the other side of the valley now, something she could not do some years back when mangrove trees obstructed the view (Figure 12).

3.2 The social-ecological system of Msimbazi valley

Little dependency on mangroves

Informants on both sides of the valley acknowledged that most people do not care about the mangroves. On the south side of the forest, in West Upanga, people are separated from the

mangroves by high concrete walls (personal observations). People are disconnected to the mangroves and have little knowledge about them. In Hanna Nassif people are more aware of how the forest is changing because of their connection to the valley and the mangroves. Some residents in Hanna Nassif live in the slope of the valley, close enough to get affected by flooding, and people living here have no walls separating them from the mangroves.

Around the Msimbazi valley people have other livelihood alternatives than the use of mangroves resources. The city center provides poorer people, who traditionally would be more dependent on natural resources (Lee and Neves, 2009), with the opportunity of alternative livelihoods. Informants from the informal settlement in Hanna Nassif worked in restaurants, in hotels, with petty trade, as craftsman and security guards. Furthermore, houses are made of bricks and many people around the Msimbazi valley get their source of energy from other places. Consequently, people do not see the need to use mangrove forest.

Previously, people living close to the mangroves in Hanna Nassif used to fish in the river and collected crabs from the forest. However, these species have decreased according to informants in Hanna Nassif, and is not part of people's livelihood anymore. Now, informants were instead tempted to start farming activities in the valley close to Jangwani. They believed that this is possible since mangrove trees has been replaced by grassland, which indicates that there is no salt in the soil.

Security issues

Most informants told us about huge issues regarding security around the forested area and in West Upanga a community based security (CBS) group has been established to look after the neighbourhood. Robbers where allegedly hiding in the forest and people saw it as unsafe to go inside. One informant in West Upanga, with property right next to the mangroves, described how she had been robbed. She explained how the robbers had used the mangroves to climb over the fence into her property and after the robbery they had run back to the forest so that no one could catch them. Now the security group had cut down mangroves that were growing close to the walls of the properties. Also, mangroves inside the forest have been cut to make it easier to find bandits. The police as well as the security group was reported to go on patrols around and within

the mangrove forest. Informants, on both side of the forest, said that security used to be a bigger problem, while now the government has taken more actions through the police to prevent incidents.

Floods

Tanzania forestry service (TFS), acknowledged that the mangrove system in Msimbazi were important for protection from floods and storm water, but explained that the river was now blocked up by sand and deposits and that this were disrupting the normal water flow. Many informants expressed concerns about how heavy the floods have been recent years, and how this has become a threat to their lives and their properties. The flood in late 2011 was considered to be a catastrophe, and reported to be the worst flood in many years (50 years according to Aljazeera, 2011). 40 people were reported dead, 200 injured and 1000 people were displaced after the flood in 2011. The people living on the flood prone slopes of Msimbazi valley in Hanna Nassif were affected the most (IFRC, 2012). One informant from the valley said that after the floods many of their things were stuck in the trees so they were able to find them again and she saw the mangroves as a blessing. Without them all her things would have been flushed out to the ocean.

Pollution

From observations and interviews it was clear that waste management was very poor in the area and domestic waste was visible both inside and outside the mangrove area. The mangrove area is used as a dumping site, even if there are laws against it. Signs have been put up to inform people that they are restricted from littering and security guards in the area reported that they try to prevent people from dumping waste. Nevertheless, these efforts have been unsuccessful and especially on the north side of the valley the accumulation of waste is visible (Figure 13.).

Figure 13. Accumulation of waste close to Selander bridge



12/11/2014 (Photo: Linn Himberg)

Large amount of pollution comes from further up-stream and is brought down with the river according to informants in Hanna Nassif. They reported that the river was polluted from industries and construction as well as by domestic waste. Pollution was especially problematic after floods, when waste spread out all over the valley. The informal settlement is lacking functioning drainage, waste or sewage system and this have exaggerated flooding and pollution of the valley. Informants living in Hanna Nassif believed that pollution could be the reason or partially the reason for trees drying up in the forest. Informants reported that it was after the floods and rainy seasons that the trees dried up and died. In Hanna Nassif some informants believed that the chemicals that collected in the soil after the floods contributed to trees dying while others explained that the rubbish that got stuck in the mangroves created a problem as it had changed the flow of the river. Informants had noticed the change of water quality and pollution of the river over the years. In a group interview one of the informants described how the color of the river changed; “Today the water is red, tomorrow black and the next day green”.

Several informants in Hanna Nassif thought the water pollution came from industries, such as the textile industry further upstream which, according to them, was the reason for the change of colour.

Figure 14. Waste stuck in trees after flood in Msimbazi valley



02/06/2015 (photo: Linn Himberg)

Most people explained that they saw the mangroves as polluted and more “dirty” now, compared to before and that was one of the reasons they did not go inside the forested area. Many informants considered the mangrove trees to be resistant to pollution, but it was a problem for their health and safety and for other biodiversity. A resident right next to the river described an incident where one of his pigs fell into the polluted water and later died. Previously, people could fish in the river, but then fish had disappeared and most thought that this was the consequence of pollution. Other organisms that informants reported had disappeared or decreased was crabs (both in size and number), lizards, birds and monkeys.

Property

Most informants from West Upanga reported that there had been little change in the plots close to the mangroves. No construction of new buildings that could encroach the mangroves had occurred. A few reported that some residents in West Upanga with properties next to the mangrove area had expanded their structures to get bigger gardens and that a school in the area had cut mangroves to increase its property. Though, this was not recently and not a big threat according to informants.

In Hanna Nassif, there is an informal settlement with a poorer population. People here bought land after an old coconut plantation ended in its production in 1963 or they obtained permits from the local government (Nguluma, 2003). The houses are of a low standard and the plots in the valley have no walls to protect the property. Houses have been built inside the valley, have no drainage systems, and are vulnerable to the floods that happens yearly (Campbell, 2014). After the flood in late 2011 the government started a resettlement project to reallocate people, from the flood prone Msimbazi valley, to Mabwepande in the outskirts of Dar es Salaam. In 2015, around 100 houses were destructed by the government in the valley (IFRC, 2012; Shao, 2015) (see figure 7).

Utilization

Few people in Msimbazi valley are depending on mangroves as part of their livelihood. In West Upanga people are totally disconnected from the mangroves, thus nothing is utilized. In Hanna Nassif some people still collect mangroves for fire wood. However, most informants explained that because of restriction no one really used fresh mangrove trees anymore; people only collect dry wood when they had no money. However, one informant reported that previously, a few people had cut healthy trees and let them dry out before they collected them to prevent getting caught. Informants reported that they either used the dry trees themselves or sold it on the market, thus are used as an income generating resource. However, people in Hanna Nassif are generally not dependent on the mangrove resources. They build houses of bricks, they have jobs in the city and many can afford to buy other sources of energy.

Infrastructure

Informants on both sides of the valley expressed that improper infrastructure could be the reason for the floods and trees dying in the valley. Improper drainage and sewage systems as well as the two bridges on each side of the valley were thought to be a threat to the mangroves. Informants explained that things were different before when the infrastructure could handle the rainy season, while now even small amount of rain could cause severe damage. The water used to flow out to the ocean, while now because of poor drainage and materials accumulating in the mangroves, the water collects in the valley.

Also, the floods damage the existing infrastructures according to informants; drainages are blocked and water does not flow where it used to anymore. Informants expressed the need to find ways to allow water to pass through the valley out to the ocean to reduce the impact from floods. Channels that could direct the water out to the ocean, and expansion of Selander bridge was seen as possible solutions. Unless something were done with water collecting in the valley, informants thought that trees would continue to dry up.

3.3 Management system in Msimbazi valley

There are little management activities to protect the mangroves in Msimbazi valley. There are no local groups that are working with the mangrove forest directly, but the police and the CBS in West Upanga patrols around the forested area. The security group and the police were considered to have limited interest in protecting the forest and rather cut down trees to be able to find people that were hiding. Other than the police and the CBS informants had not seen anyone else patrolling. However, the government have put up signs around the mangroves that inform people not to cut anything or to pollute in the area and all informants knew about the restrictions.

According to one informant in Hanna Nassif, MNRT and the regional government came to Msimbazi valley in 2001 to decide which areas should be protected and which should be for properties. This was allegedly when the signs came up to show the borders and to inform people. However, after the flood in 2011 the government have focused more on people than the

forest. The informant ended the conversation with saying that people and the government no longer care about the mangroves.

Several informants in Hanna Nassif reported that the government initiated a project that would prevent damage from flooding after the flood in 2011. They had told the community that they were going to build barriers to separate the houses from flooding in the valley. Each household contributed 10 000 tsh (approx. 4.6 \$ 10.05.16) something they were ordered by the government to do. Still, nothing has been done and in 2014 they had been told to contribute 30 000 tsh.

Hanna Nassif Community Based Upgrading Project

Previously, they had a project that aimed at improving the lives of the people in the community. Hanna Nassif Community Based Upgrading Project was initiated in 1993 by the International Labour Organization (ILO), on request from the local community. The project was considered a success as it improved living conditions with less flooding and better waste management (Olofsson and Sandow, 2003; IT transport, 2005). The project ended in 2000 and the area is still experiencing serious floods. Waste and drainage systems are still inadequate (IT transport, 2005), and according to informants a contributing factor to the heavy floods.

Community Based Security Group

The CBS in West Upanga was stated to protect the residents in the area. The people living there pay a small fee for them to be able to protect the area. They are supposed to patrol the area around 4 times a week as well as being available if security problems occur. Though, one informant living in the area stated that it had been three months since the last patrol, and that it probably was because of lack of money. However, the CBS reported that they still were doing patrols frequently and by doing this they also prevented people from cutting mangroves. The informants from the CBS thought they should be acknowledged by MNRT as they feel they are protecting the mangroves. They did not think the local government or the ministries knew anything about the forest. Therefore, MNRT should work hand in hand with them and give them support and gear to be able to walk around in the forest. The CBS do not have any cooperation with MNRT at this moment, but they collaborate with the ministry of internal affairs and the national police force.

Relocation

Many people have moved out from Hanna Nassif after the floods started to cause a threat to peoples lives. The government started a relocation project after the floods in 2011. They have moved some people to Mabwepande and demolished their houses in the valley. During the time of the field work they had stopped moving people but informants in Hanna Nassif said they were waiting for the same thing to happen to them. Informants explained how their house has been marked and the government were trying to find a place to relocate them. Some informants said they wanted to move, because of the threats from floods, but that they have nowhere to go and are waiting for the government to assess their property and move them to a new plot.

Some informants explained that there were problems with the relocation project. Government gave people a plot in Mabwepande if they had title deeds to a house in Msimbazi valley that was damaged during the floods. Some people misused the system and took other peoples allocated plots even though they were just renting. People who went back to the valley to find their house did not get a plot.

One informant expressed frustration over the relocation project in 2012. She explained how some people, including her family, had missed the opportunities because they were not on the list over house owners in the valley. When the bus came to take people to their new plots in Mabwepande some people got on it with force because they felt they deserved a plot, but then they came back empty handed. After the relocation, people from the government came in to the valley with guns and hammers and forced people to step aside while they were demolishing houses. Informants in Hanna Nassif expressed that many have nowhere to go after the government came in and demolished houses in the valley. The government did not give the remaining people anything, so informants were frustrated about how they could move. Also, their kids were studying in the area, so the informant though the government had made the situation worse since they are not able to move and were left with nothing in the valley.

Another informant expressed concern about what was going to happen next. She had heard rumours that the government were going to relocate people far away. She explained that she “feels like they live like animals that cannot plan for the future, because they do not know what

will happen tomorrow (informant 60). Informants do not think moving people to Mabwepande is sustainable. Their livelihood strategies that they depend on is in the city and they are moved to a place where they are not able to generate any money. People that have been moved to Mabwepande is complaining about their situation (Msowoya, 2015), and people keep coming back to Hanna Nassif during the dry season. Informants expressed that a better solution than moving people would be to deal with the floods in the valley. One informant from the flood prone slopes of Hanna Nassif suggested that the government should build apartments further up in the valley which would not get affected by the floods. Construction of a building for a national housing project were already being built in the area, but the informant explained that only rich people would move in while they had to be relocated out of the city.

In the end of 2015 the government started to demolish more houses along the Msimbazi river. 100 houses in Hanna Nassif that were built within the prohibited area, from Dar es Salaam Master plan in 1972, were demolished (Shao, 2015). In the news horrible conditions were described after the demolishing of houses in the valley where around 800 people were affected. Belongings were in some cases still inside houses when they were torn down and people lost everything. Many people expressed concern about that they now had to sleep in the open where they are exposed to mosquitoes. People had been living in the area for several decades, had permits and were connected to electricity (Mwangonde, 2016). However, NEMC said that even those with a permit as they won't recognize any building permits within the restricted area (Shao, 2015).

3.4 Changes in the mangroves and population in Kunduchi

Population

The mangroves in Kunduchi ward in Kinondoni municipality is located in a peri-urban setting and had a population of 75, 016 in 2012 (NBS, 2013). The area around the mangroves includes a fishing village, middle-class residential areas, hotels and salt production ponds. In Kunduchi fishing village livelihoods comes mainly from fishing and small scale businesses. Many people in Kunduchi also get their incomes from working on the salt pans. Kunduchi is going through socio-

economic changes because of urbanization. People with well paid jobs in the city are moving in to the area, while some poorer people are moving out according to informants. Kunduchi is seen as an attractive area for construction of houses and apartments and there have been a lot of constructions lately as Dar es Salaam is expanding.

Most informants explained that population was increasing, but the increase has been slow. In Kunduchi village informants reported that change in population was somewhat seasonal with fishers and salt pan workers moving in and out after the seasons. As table 2 shows, the population has had a slight increase between 2002 and 2012.

Table 4. Population statistics Kunduchi

	2002	2012	Average annual growth rate
Kunduchi	72 927	75 016	0.3 %

(National bureau of statistics, Tanzania, 2002;2013)

Mangrove forest

The mangroves in Kunduchi was measured to be 68,7 ha in 1991 (Semesi, 1991). The mangrove forest is recorded to have been much greater, but during the 1970's and 80's large parts was removed for salt production (Semsi, 1991; Maynora et al., 1986). The forest has increased again, after the area used for salt production declined due to regulations. From satellite images the mangrove area was measured to have been approximately 152 ha in 2005 and around 157 ha in 2016. The forest has expanded in some areas, while it has been reduced in others. Saltpans and properties have encroached the mangroves in some areas, but the forest has generally increased.

Figure 15. Kunduchi mangroves 2005



Kunduchi 08/11/2005 (Google Earth, 2016)

Figure 16. Kunduchi mangroves 2016



Kunduchi 11/03/2016 (Google Earth, 2016)

Figure 17. Salt ponds Kunduchi 2005



Kunduchi, 30/11/2005 (Google Earth, 2016)

Figure 18. New salt pond covering 1,87 ha in Kunduchi 2009



Kunduchi 30/10/2009 (Google Earth, 2016)

The two images below show how mangroves have increased both in size and density in the south of the mangroves in Kunduchi. The increasing number of buildings is also worth noticing.

Figure 19. Mangrove area in the south of Kunduchi 2003



Kunduchi 20/12/2003 (Google Earth, 2016)

Figure 20. Mangrove area 2015



Kunduchi 07/12/2015 (Google Earth, 2016)

When asked about the changes in the mangroves, respondents in Kunduchi had different views. Their answers depended on how long they had lived in the area and where they lived. In the end most informants agreed on that the mangroves at this point is growing in size and number. However, many explained that it was a very slow increase in size and even though the forest grew in some areas it decreased in others. In some areas around the forest people reported about mangroves being cut for properties or for salt production, while in other places people reported about the mangroves growing far beyond where they used to grow and thus expanding. There used to be a lot of big mangrove trees but these have been cut down according to informants. The forest is reported to be relatively young with small trees, but the general size of the trees in the forest is growing according to most informants.

Informants from the salt ponds expressed that there used to be a strong relationship between mangroves decreasing and population increasing as more people would use mangrove resource. In the past, new settlement had impact on mangroves, however recently this had not been a problem because of strict regulations. Informants explained how in the 1980's extensive destruction took place and the forest was almost cleared. One informant from Kunduchi fishing village stated that 80 % of the forest was cleared during 1980's, and that in the late 1990's the government started intervening and since then the mangroves have been growing again. The mangrove forest in Kunduchi were described by most informants to have improved since the ban on cutting of mangroves in 1987 and protection and management project started (Semesi 1991).

Nevertheless, informants that had lived long in the area described how it was once a big forest which was cut when people started moving in and even though the forest was now expanding a little, it was far from the size it once was.

3.5 The social-ecological system of Kunduchi mangroves

Decreasing dependency on mangroves

In Kunduchi fishing village informants explained how the social system and the dependency on mangroves had changed over time. Before there were fewer people in the area, but they were more dependent on mangrove resources than they are today. People started to move in to the area

because of its proximity to the city and the area became attractive to richer people that was not so dependent on natural resources. However, the rate of people moving in has now slowed down according to informants. Some argued that because of rich people's power, they are able to encroach the mangroves and thus are a threat to the mangroves, while others believe that there is less impact from rich people since they are less dependent on natural resources. Further, they thought the restrictions kept them from clearing mangrove forest for constructions.

Kunduchi have increasingly become popular for tourism, and hotels have been built, according to informants. More people, both tourists and residents, have resulted in more livelihood options for people living in the area. Many people now are employed in the salt pans, in hotels or as security guards. Also, informants argued that when the ban came in against cutting mangroves it made it harder for people to continue using mangrove resources. New technology and practices as building houses out of bricks and using electricity, gas or charcoal bought from the market further reduced the pressure on mangrove resources and people are not using mangroves in the same extent as they did before.

However, in Kunduchi village there are still many people who are using dry mangroves for firewood as reported by the majority of informants. Fishers explained that mangroves were important for their livelihood and the people working on the saltpan explained that they are dependent on the mangrove forest to produce salt.

Security issues

In Kunduchi there are not as much problems with security as around Msimbazi valley. However, informants reported that there was an increasing security issue in Kunduchi and that some bandits were hiding within the forest. This was seen as a threat to the community and a CBS had been established to protect the residents. These were paid by the richer people and informants on the salt pond explained that the CBO only protected plots of the ones who paid them.

Conflicts over property

When asked about conflicts around the mangroves many informants said that it was some conflicts between people and the government about plots and construction of houses that had been built within the restricted area. One plot owner (in the north of the mangrove area)

explained how he and many other got a title deed and a permit to construct buildings from Dar es Salaam city council. At this time there was little or no mangroves on the plots. Then the mangroves had grown into their plots before they could develop them and now they have been restricted from building anything. NEMC and MNRT is now involved and the informant said that he thought they are more interested in the forest than in the people. Some plot owners, including the informant, have now taken the case to the court in the hope of being allowed to develop their plots. The court case had been going on for 3-4 years according to the informant (interview from November 2014) and signs were put up on the plots to inform about the process.

Figure 21. Sign about ownership dispute



04/11/2014 (photo: Linn Himberg)

Houses have in some cases been demolished by the government if they were built within the restricted area. In 2012, NEMC, MoL and MNRT in cooperation with Kinondoni municipal council demolished a number of houses (Domasa, 2012). Several informants said that plot owners affected had got the wrong permit from the wrong place and thus the houses were demolished. They think there is conflicting interest and a lack of communication between the different ministries and the local government. The plot owner interviewed explained that people can get a permit from MoL, then MNRT comes in and restrict people from doing what the permit gave them the rights to in the first place. A few informants blamed the conflict on corruption and said that the permits had been issued illegally. One informant indicated that politicians gave out permits before an election to gain votes. Informants agreed on that the government had showed that they were serious when they demolished houses that was within the protected area. Although, some informants reported that the mangroves did not grow back in the areas where they had been removed from, and they thought this was because the land had been filled in by sand.

Furthermore, villagers in Kunduchi explained that the construction of groins done by hotels along the coast were having a substantial impact on the mangroves and the local community. The groins were the reason for erosion that had affected the fishing village as well as some mangroves in the creek according to villagers.

Salt production

Salt pans were another source of conflict according to informants. Salt pans had in some places changed into other land uses according to a few informants working with salt production. They further reported that, richer people had bought salt ponds and filled them in with sand; with the plan to build properties. Permits were allegedly given out to powerful people to expand or change the salt pans without anyone from the government coming to have a look at the properties. Some informants thought that this was done illegally through bribes, and reported that this land use change forced salt production to move and further encroach the mangroves. However, most informants explained that this had happened in the past and now salt pans were doing no harm since they had strict regulations.

However, informants in Kunduchi considered salt pans to be a future threat to the mangroves in the area. Informants working on the salt pans had the same view and reported that a lot of people had come to the area lately to find work with salt production. This had led to a decrease in salt production per person and thus the ponds have to expand. The demand for salt is high and many people from Kunduchi fishing village expressed that the industry were needed to create jobs even if it was a threat to the mangroves. The people working on the salt pans thought one of the solutions would be to improve the salt production in the ponds they were currently using with better technology and deeper ponds.

Utilization

People generally have a closer relationship with the mangroves in Kunduchi than in Msimbazi valley. In Kunduchi fishing village the forest is still to some extent being used for construction and as fire wood. Also, the forest has been used for beehives, fishing ponds and extraction of salt. Today, with stricter regulation, new livelihoods and other sources of energy fewer people use the mangroves. Development and urbanization has brought new technologies and building materials. People in the area largely use bricks instead of timber for constructions. Also they have the alternative of using charcoal, electricity or gas that they buy instead of using firewood that they cut themselves.

There are still people that use mangrove trees for fire wood, but the trees are supposed to be dry before people are allowed to cut them. However, some informants explained how people are cutting healthy trees inside the forest during the nights and leave the branches there to dry before they collected them a few weeks later. During walks inside the forest this practice was observed. Some informants told us about this practice and agreed that cutting was still happening, while other informants told that cutting of mangroves had stopped.

Figure 22. Dried branches within mangrove forest



03/11/2014 (photo: Linn Himberg)

An old man that lived very close to the mangrove, said that he saw people coming out from the mangrove forest every day with a bunch of branches and were convinced that cutting were still happening. One fisher from Zanzibar told us how all the big trees had been cut to build houses and boats, and the cutting had been reduced now, but only because there were no big trees left. He believed that the cutting would start again when the trees had grown big.

KICAMP in cooperation with the CBO in the village have tried to introduce new livelihood alternatives to reduce the pressure on mangroves. Beehives were introduced so people would be able to use the mangrove forest in a different way. Villagers would then see the importance of the mangroves at the same time as they would have other income sources. It was the CBO that was in charge of the beehives. The representatives from the CBO explained how the project had been unsuccessful since outsiders stole the honey and the hives. Other villagers explained how they felt that it was only the CBO members that benefitted from the beehives and that it had created a conflict.

Pollution

There are reported to be increasing waste pollution of the mangroves and observation showed that people were dumping waste in some parts of the forest. The mangroves are often used as a latrine for the local population in Kunduchi and consequently seen as dirty by many informants. Through interviews some informants also expressed concerns about pollution of the river from industry further upstream.

3.6 Management system in Kunduchi

KICAMP/MACEMP

Kunduchi Integrated Coastal Area Management Program (KICAMP) was established in 2001 by Kinondoni municipality with support from the Swedish International Development Cooperation Agency (SIDA) with the aim of protecting coastal resources (Wagner, 2002). According to the Kinondoni forest officer, there were three main objectives of the project; to create awareness to local community about the mangrove resources and the importance of them; to involve the local community in the management; and to look for alternative livelihood strategies. The officer explained that before the project the local community did not know about the importance of the mangroves other than for their subsistence and there were a lot more cutting of trees.

A CBO-member in Kunduchi fishing village explained that KICAMP worked with the local community based organization and provided education, seminars, workshops and tried to find alternative livelihood opportunities for villagers that were dependent on mangrove resources. These projects worked well in Kunduchi, according to most informants, because the project had succeeded in raising the community's awareness on the importance of mangroves. Before KICAMP informants reported that there was a lot of cutting, while after KICAMP the forest had been growing.

However, some informants reported that a few people had benefited more than others from the project. And some stated that the program struggled with corruption. They thought that the municipal gained more benefit than the local in Kunduchi fishing village. When training was

given it was more governmental officials than locals that were trained and a lot of money were used for administration rather than the actual conservation. One informant was disappointed about how they were promised that the project was going to be sustainable but then it had ended.

After KICAMP ended a new project MACEMP came in. MACEMP was running from 2005 until 2010 (Yanda, 2013). The Kinondoni forest officer explained that there were not much differences between KACAMP and MACEMP. KICAMP was interested in a platform for discussion between the resource users and the resource managers. They had design activities with the help of the local community and made sure the education reached the whole community. MACEMP, on the other hand, were using a top-down approach and they had focused more on fishers in the area to improve their livelihood. The informant thought that KICAMP had been more effective than MACEMP because they had worked with different stakeholders at that time.

CBO in Kunduchi fishing village

The masingira group, a community based environmental organization, was established in 1992 by the government partly because mangroves were cut for salt production and heavily utilized for building materials and firewood. The CBO, which consist of 15 people, are working with the municipality and are responsible for protecting the mangroves, but do not get any incentives. They mainly work with giving information when community meetings are held and by patrolling the mangrove forest to prevent illegal activities. They also had a replanting project when they started in 1992 and a CBO-member said they have planted more than 40 000 trees.

When KICAMP came in they worked closely with the CBO and started a beekeeping project to give people an alternative to mangroves as an income source. The CBO-members explained that this project had not worked in the long run because the bee hives had been stolen or that honey had been harvested from people from the outside. Other villagers however, thought that it was only the CBO-members that had benefitted from the bee keeping and that this was the reason the project did not succeed. Also villagers were frustrated that some people from the CBO were believed to have been given permits to cut mangroves while they restricted others.

The CBO is not as active anymore after KICAMP ended and CBO members said they work much less now than before. Other villagers reported that they do not feel like they are much involved in the management of the forest. They did not have any responsibilities other than reporting to the local government or the CBO if they saw anything illegal. One informant explained how the government had asked local people to be watch dogs and to report about activities in the protected area.

Workers on salt pans expressed that they feel like they are the ones protecting the forest. They thought that the mangroves would not have been there without them. They are the ones walking around in the area and protecting the forest by trying to prevent people from cutting. One salt production worker continued saying that they (people working on the salt pans) had worked with KICAMP in their time, but that KICAMP were working more for their own benefit.

Ministries and local government

NEMC, MNRT through TFS and MoL are all involved in the management of the mangrove area as well as the local government. The VEO we talked to in Kunduchi said that their main responsibility regarding the mangroves were to give information to NEMC and MNRT. They used to have seminars and mangrove management activities before, but not anymore. This was partially due to limited resources, and he further said that they did not patrol either because of this. Some informants explained that the government through NEMC and TFS were doing patrols in the area while the majority of informants thought patrols were not done by the ministries.

All informants agreed that the government had made strict laws and regulations in the mangrove area more than 10 years ago that prevents cutting of mangroves. The government have put up signs to inform people about the borders and restriction in the area and houses have been demolished because they have been built too close to the forested area. Many believed that cutting of mangrove trees had stopped because people were scared of fines. Villagers further explained that they knew the importance of mangroves, but that people that recently had moved in did not and they were the ones that were cutting now. The same villagers saw the need for more education and information to prevent this from becoming a problem.

Villagers explained how the government only patrolled when they had been told about illegal activities. Many people acknowledged that they do not report to the local government about illegal activity, as they do not think any action will be taken. They thought the local government would only ask for a bribe and release them if someone had been caught cutting mangroves. One informant from the beach unit in Kunduchi village that were involved in the mangrove management explained that one threat to the mangroves were the weak system of the government. He explained how the government had everything in place as laws, regulations and a police force, but that the enforcement were either poor or lacking. The corrupt system has allowed people with money and power are able to play with the rules and encroach the mangroves. However, most people agreed that the government had succeeded somehow in the management because mangroves are not cut in the same extent after the ban and the forest were by many informants thought to be growing.

Villagers in Kunduchi proposed that the local community should be more involved and have more responsibility than they have now. The government can support the community with information, training and money, but locals should be the ones protecting the forest. Also, informants that reported about on-going dependency on mangrove resources suggested that the government should think about new livelihood alternatives and introduce these slowly for people to adapt to the changes.

Informants explained how the different ministries and the local government very often had conflicting interests and that there were confusions regarding permits to use land within the protected area. MoL and MNRT were reported to only come to the area together when there was conflict over land. MoL are responsible for the allocation of land, but have regulations from other ministries. NEMC are for example responsible for Environmental Impact Assessment (EIAs), so MoL have to cooperate with them on bigger projects. The informant from MoL explained that land speculation was a problem. People that gets a permit have to build within three years, but then they are restricted because the permit is not valid. This is why cases about plots in Kunduchi comes up in court. It was believed by informants that lived north of the forest that current restrictions to build would not last for long before construction activities started again since people knew who to ask to get the right permits.

The VEO also believed there were a challenge with the communication between them and the ministries. He explained that when they reported something it took a long time before the ministries responded to the situation, and very often nothing was done. This is damaging the effectiveness of the management. The VEO further explained how the local government had given out permits to plots close to the mangroves because it took too long for NEMC and MNRT to verify. According to the informant from MoL, local governments can issue building permits. The title deeds are handled by the local government, but they inform the ministry about the plot requested.

However, this system has not worked and houses were demolished in Kunduchi in 2012. The permits had been given out by MoL and the local government to build houses, but then MNRT and NEMC found out that the houses had been built within the protected area and they all came together to demolish a number of houses. The informant from TFS proposed that permits could be the responsibility of two people from different ministries so that different interests were protected. He believed that many permits had been given without people in the office even seeing what they approved.

Throughout the research informants were frustrated about the lack of communication between the ministries and the conflicting interests. They also thought the laws were conflicting. The new environmental laws were incompatible with the old laws concerning land rights. This view was also shared by informants from MoL, TFS and the local government in Kunduchi. The people in the ministries agreed that they should be working together and harmonizing the laws to avoid issues.

4 Discussion

Temporary changes in a resilient SES will be absorbed and the system will stay within the same domain of attraction. However, in situations where new disturbances occur before the system have had time to recover or if the SES is faced with a major shock it might not be able to survive without structural changes; the system is then considered vulnerable (Young et al., 2006).

Resilience and vulnerability is the result of a variety of dynamics and in this study key drivers affecting the SESs of urban mangroves in Dar es Salaam will be discussed.

4.1 Adaptive cycle of SES

The resilience of the SESs of Msimbazi mangroves and Kunduchi mangroves are examined by the adaptive cycle (figure 1). The adaptive cycle consists of the four phases of growth or exploitation (r), conservation (K), release or collapse (Ω) and the reorganization phase (α) (Gunderson and Holling, 2002).

SES in Msimbazi valley

The SES in Msimbazi valley started a new cycle after the current Selander bridge were constructed in 1980s (JICA, 2010). The beginning of the r-phase is characterized by growth and colonization of pioneer species, such as *Avicennia Marina*, which is dominant in Msimbazi valley (Duke et al., 2010). Positive feedbacks to drive the growth is high at this stage and informants reported how the mangrove forest grew almost all the way up to Jangwani bridge. Innovation and entrepreneurial leadership that build trust and connections are important for the development of the SES at the r-phase (Fath et al., 2015). In the social system of Hanna Nassif community projects was established; Hanna Nassif community based upgrading project was initiated in 1992, with aim of increasing well-being. It focused mainly on improving drainage in the flood prone community. The system was reported successful in preventing floods with construction and maintenance of infrastructure. However, the project ended in 1996 (Lupala et al., 1997; World Bank, 2002).

The project was less successful in mobilizing the community (Lupala et al., 1997) and after the project ended the community started experiencing heavy floods again and trust towards leaders and the government have been reduced. The SES had entered the conservation phase. In the conservation phase the SES is characterised by negative feedbacks and rigidity and the system becomes less flexible as resources becomes locked up (Walker et al., 2004). The mangrove forest only had a limited area to grow that was free from urban development, and grew almost all the way up to Jangwani bridge before it stabilized.

New methods and innovations are excluded during the K-phase (Walker and Salt, 2006), such as new technologies that would improve the situation with pollution and floods during the rainy season. The inadequate infrastructure in Hanna Nassif is also under pressure from an increasing urban population. The system lost resilience which made it vulnerable to disturbances that could push it past a threshold. Late in the K-phase, the SES might be unable to counteract to disturbances as it has lost flexibility (Fath et al., 2015).

The SES in Msimbazi valley is ultimately pushed over the threshold by positive feedbacks. The strength of floods is enhanced by pollution and insufficient infrastructure. Floods bring down siltation and waste to the valley and blocks the natural flow of the water. With an overload of the drainage system the intensity of floods increase. In 2011 the SES experienced a damaging flood that drove the system into the release phase (Ω). This is when the mangroves started receding and relocation of people from the valley slopes in Hanna Nassif started. The social system reorganized, and many moved back. However, yearly damaging floods and governmental decisions to relocate the residents in the valley have pushed the system back to the Ω -phase.

The question now is if the system will reorganize or transform into a new domain of attraction. Today, the system is not socially or ecologically desirable as pollution and floods are a threat. The government has recognized this and have started the task of moving villagers from Hanna Nassif. However, villagers are complaining about an unfair process where some people are left with nothing, and people who have been moved are struggling in Mabwepande (Msowoya, 2015).

Kunduchi

A new r-phase in the SES of mangroves in Kunduchi emerged after large part of the mangroves had been cut for salt production and regulations and conservation activities was implemented in the late 1980's and 90's. The system was at this point experiencing positive feedbacks that fostered the growth of the mangroves. Villagers from Kunduchi fishing village reported about replanting project and management activities that protected the mangroves. KICAMP was introduced and one of their goals was to introduce alternative livelihoods for local who were dependent on mangrove resources. KICAMP was working with the local CBO and involved other stakeholders as the saltpan workers. According to Katundu (2008), the SES of Kunduchi mangroves was in the r-phase at the time of his research, with high regeneration potential of mangroves, young trees and growth. KICAMP and the CBO was working to involve the local community and raise awareness about the mangroves. Different technology for building houses and other sources of energy that reduced the pressure on mangroves was used.

Now KICAMP, and the succeeding MACEMP, has ended and the CBO work less than before. The villagers trust in the CBO has decreased as well as the trust in the local government and the ministries. The mangrove forest is still young and growing, but the system has entered the K-phase. The growth has slowed down and the system is experiencing negative feedbacks, especially the social system has stabilized and lost flexibility.

Salt production in Kunduchi has stabilized according to informants. Employees on the saltpans expressed that new technology was needed to be able to produce more salt; thus being able to employ more people without encroaching the mangrove forest. The SES has become less innovative and new methods are excluded. Rigidity, little trust, corruption and confusion over title deeds has made the system less resilient to disturbances that can come with population growth and urban development.

However, Kunduchi still have higher biological diversity than the Msimbazi mangroves and the area is also undergoing changes that are increasing the possibility for diverse livelihood options. The community that has been involved in the management of mangroves in some degree or have

obtained knowledge about their environment. This, as well as strong laws that are enforced are increasing the resilience of the SES.

4.2 Drivers enhancing resilience of urban mangroves

Population growth and social-ecological change

Dar es Salaam has experienced rapid population growth. Urbanization have the opportunity to decrease the pressure on natural systems as the direct dependence on natural resources decreases and the environmental impact per person is lower than in rural areas (Brand, 2006; Grove, 2009). In the city, people have various opportunities for income sources compared to rural areas where they are more dependent natural resources for subsistence and income. Around Msimbazi valley, no one is dependent on the mangroves. A few are using dried up trees during times with little income, but most people have other alternatives.

In Kunduchi, this trend is growing as well. Previously, cutting of mangroves for firewood and for building houses and boats was a major threat to the mangroves here (Wagner, 2002), while informants expressed that today this type of cutting was only a minor disturbance. Available alternatives for income, the use of bricks when building houses and different sources of energy that is affordable has decreased the pressure on mangroves. With protection of the mangroves and more people included in the cash economy the mangroves in Kunduchi has started growing again after being heavily cut.

People around the Msimbazi valley expressed that people do not care about the mangroves and many see the mangroves as mere wasteland. The valley is also seen as unfit to develop as it experiences yearly floods. This has provided the mangrove ecosystem with the opportunity to grow as it did. Othman (2005), found similarly that the urban mangrove of Maruhubi in Zanzibar was seen as a wasteland and that an unhealthy environment discouraged utilization of the mangroves. Also, people in the area had alternative income sources and no dependency on mangrove resources. Cities can actually provide for ecosystem recovery (Seto et al., 2013), if people are benefiting from other livelihoods and laws and legislations are enforced.

Management

Conservation projects that focus on conserving the mangroves while providing benefits to the local community can support recovery of mangrove forest. In Kunduchi KICAMP was from 2001 working with different stakeholders to manage coastal resources. The cooperation between ministries, the local government, CBO's and salt producers increased local people's awareness and sense of involvement in the management of the mangroves. They tried to establish alternative livelihoods for people, such as bee keeping. Katundu (2006), found that local people saw benefits from the management during KICAMP and that involvement in the project had raised awareness. Many villagers saw the mangroves as jointly belonging to them and the government. During interviews (November, 2014) most villagers in Kunduchi expressed that KICAMP had been effective and many thought the project should have continued. Even though a few respondents expressed that the people who had benefitted the most were local leaders and CBO members, they agreed that conservation of mangroves had been successful. However, KICAMP, ended and was replaced by MACEMP, which was less effective, and few informants had knowledge about their work.

Othman (2005), argued that the management of Pete mangroves in Zanzibar had been unsuccessful due to high dependency that had been accelerated by poverty and lack of alternative income sources. People saw few benefits from the management and had not been compensated by the government for their effort. People in Kunduchi, was also claiming that compensation was lacking and that only a few gained direct benefits from management activities. However, with increasing urbanization alternative income sources has become more available thus the management activities have achieved growth of mangroves in the area.

4.3 Drivers affecting the resilience of SES in urban mangroves

Population growth and social-economic change

The threats to mangrove system have changed with urbanization. Even with less dependence on mangrove resources in Dar es Salaam the ecosystem can experience pressure from other types of stressors and disturbances. The coastal areas are the most attractive for people to migrate to, thus

mangrove ecosystems can experience clear-cutting for urban development. In Kunduchi large part of the mangroves has been cleared for salt production and urban development.

It seems that the worst destruction of the mangroves happened when Dar es Salaam was rapidly urbanized in the 1960's and 70's. Dar es Salaam had a growth rate of 9.9% between 1967-1978 (Wenban-Smith, 2014). People were still using mangrove resources as a source of income and with more people and development of salt production ponds the rate of destruction of mangroves in Kunduchi was high. The population growth declined in the 80's, a ban on cutting mangroves was passed in 1987 and management activities was introduced to protect the mangrove system. However, the population growth recently accelerated again in Dar es Salaam (Wenban-Smith, 2014), management activities in Kunduchi have been reduced and pressure for land is still high in the area. In some areas the mangroves have recently been clear-cut for salt production and encroached by properties.

Even though the mangrove forest in Kunduchi has increased in the last decades, it is unlikely that the forest will grow back to the size it once was as the area is increasingly being built up. Kunduchi is attractive for hotels and for housing. Affluent people are moving in and are constructing walls around their properties. This as well as salt production is limiting the mangroves as obstacles to migration is affecting the resilience of mangroves (Gilman et al., 2007). The Msimbazi mangroves does also have obstacles to migration as the the valley are surrounded by houses and the two bridges that influence the flow of water. Also, since the size of the mangrove forest in Kunduchi is relative small now compared to before salt production started the ecosystem might have lost adaptive capacity. Generally, larger forests are more resilient than smaller ones (Thompson et al., 2009).

Since people in urban areas do not see any direct benefits from mangroves they might not see the purpose of maintaining the forest. Mangroves near Selander bridge are by locals seen as a wasteland that are creating an unhealthy environment. The mangrove area was also considered dangerous as it was used as a hide out for criminals. Othman (2005) found the same in an urban mangrove in Zanzibar, where people saw the mangroves as something that could have a negative

impact on peoples lives. Some informants around Msimbazi expressed that the mangroves should be removed as there were few benefits from the system, but a lot of negative sides.

Management

Othman (2005) claimed that the low trust in government had evoked overexploitation of mangrove resources. Trust is important for resilience of a SES (Chapin et al., 2009). Both in Kunduchi and Hanna Nassif, the trust in governmental bodies are low. In Kunduchi villagers thought that only a few had seen direct benefits from management activities and especially rich people and powerful corporations had been given access to encroach forested areas, while villagers were prevented from cutting. Hotels had been built in the area, salt pans had been constructed and most informants believed that many permits were issued through corruption. Communication between ministries and local government was poor and people were given permits on the wrong grounds.

However, in 2012 the different ministries came together to demolish houses that was built within the protected areas. Also, MoL restricted people to build houses on plots that previously had been given permits. This has resulted in conflict between the plot owners and the government, but for the villagers in Kunduchi this showed that the government was serious in protecting the mangroves. Most people affected from the dispute over property rights was affluent people, that now had hired people to watch over their plots while the court case was proceeding, and this showed that powerful people were not excepted from the restrictions (Domasa, 2012). This might have increased the trust in the government again.

In Hanna Nassif people live in informal settlements with lacking infrastructural services. After the flood in 2011, people living in the valley was tried relocated by the government. Some families were moved to Mabwepande, but others did not get an alternative and moved back to the hazardous valley. Many came back from Mabwepande and complained about the location. During interviews in November 2014, residents complained about lack of communication and felt like their life were put on hold. They had heard that the government was going to continue the relocation, but they were also confused about why they were asked to pay for upgrading of drainage if they were going to be moved. The trust in the government has been reduced due to the

conflicts from the relocation project. The people most affected from floods in the Msimbazi valley are the most vulnerable and marginalized people. Tenants and house owners without a legally accepted owners have been the ones left outside of the relocation process and many are left with nothing after their houses were torn down by the government in 2016 (Lamtey, 2016).

Pollution

Mangroves are undervalued by many and seen as a wasteland despite of their numerous ecosystem services (FAO, 2007). This is also the case in the mangroves in Dar es Salaam, but more so in Msimbazi than in Kunduchi which indicates that people get distanced from mangroves when areas are becoming urbanized. This might be due to increased pollution in urban mangroves as well as decreased dependency. Urban mangroves are usually more exposed to pollution than mangroves outside of cities. Msimbazi mangroves is much more polluted than Kunduchi mangroves which was perceived as a non-impacted mangrove in 2008 (PUMPSEA, 2008; Crona et al., 2009).

Msimbazi river is polluted from industries and construction as well as by domestic waste. Illegal sewage systems and heavy metal pollution from industries are detrimental for the ecosystem services of the river (IUCN, 2010). Waste disposal in informal settlements in Dar es Salaam is a major problem and this was also a problem in Hanna Nassif. Waste collection trucks cannot fit in narrow alleyways, and the mangroves are used as a dumping site. Due to poor waste management and inadequate drainage system in Dar es Salaam pollution accumulates in the Msimbazi valley (Pan-African START secretariat et al., 2011). With increasing sewage pollution from population growth, urban mangroves become important as bio-filters. PUMPSEA, a project started to prevent coastal sewage pollution by using peri-urban mangroves as bio-filters, was carrying out research in Kunduchi between 2005 and 2008 (PUMPSEA, 2008). However, the more pollution the more mangroves are required to function (Spalding et al., 2010). Large areas of mangroves are necessary for bio-filtration in cities, which the Msimbazi mangroves are not. Thus pollution can affect the coast of Dar es Salaam as well as the mangrove SES.

In Maruhubi mangroves, waste disposal and presence of sewage in the ecosystem was not affecting the mangroves but rather appeared to support a healthy ecosystem (Othman, 2005).

Increased nutrient input can stimulate growth, and as mangroves filters nutrients it is seen as a benefit for human societies (Spalding et al., 2010). However, organic waste might not be to any concern for the mangrove forest, but it does pose a health threat to the social system (Crona et al., 2009). The water from Msimbazi river is contaminated and useless for humans to use and when the valley floods the polluted water reach houses and creates a health risk for the residents in Msimbazi valley. The area becomes a breeding ground for diseases (Pan-African START secretariat, 2011).

Also, high levels of nutrient input and chemicals can affect the mangroves. Mangrove trees are tolerant to pollution, but many other organisms found in the mangrove ecosystem, such as fish, are not (Spalding et al., 2010; Taylor et al., 2003). Biodiversity are higher in Kunduchi in Msimbazi mangroves. Biodiversity in urban areas can improve quality of life and well-being of people living there (Elmqvist et al., 2013). However, many of the services that previous could be provided by the mangroves in Msimbazi valley have been lost or degraded. Msimbazi river is polluted by chemicals from agriculture and industries which can have affected the mangrove SES (Pan-African START secretariat, 2011). Informants reported that biodiversity in the mangroves had been reduced and fish had disappeared from the river. With increasing urbanization in Kunduchi there is a risk that the mangrove system will experience more pollution and loss of mangrove associated species.

Infrastructure

Increased population and impermeable surfaces are affecting the mangrove SES in Dar es Salaam. Construction of built environment can transform the supply of sediments to the mangroves and alter the water flow (Seto, 2013). This has especially been a problem in Msimbazi valley. Lack of proper drainage systems and maintenance, construction of structures (as property walls) and dumping of waste from residents that blocks the drains interfere with the water flow. Clogging of drains and interferences along Msimbazi river are causing floods in the valley. Even in the absence of rainfall some settlements in the valley have experienced flooding (Pan-African START secretariat et al., 2011). Also, with the high rate of urbanization in Dar es Salaam existing infrastructure experience increasing pressure. Impermeable surfaces in the city is further

accelerating the magnitude from floods in Msimbazi valley as it causes increased volumes of runoff from surface water into the valley (Gómez-Baggethun et al., 2013).

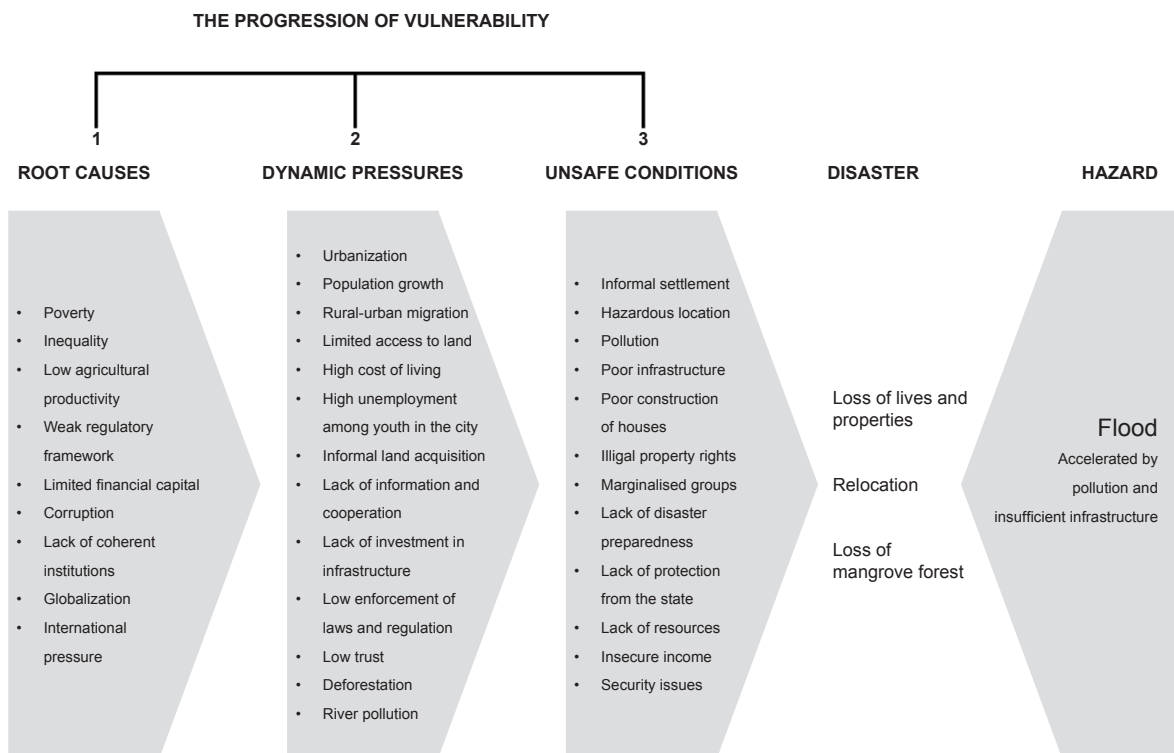
In Msimbazi valley, trees drying up was witnessed. While floods cause an immediate threat to the social system, many informants also believed that this was causing mangrove mortality in Msimbazi valley. Mangroves are adapted to cope with tidal inundation, but can be affected if flooded for a longer period of time (Ellison, 2009). I was after the flood in 2011 that most informants expressed that they had noticed trees drying up. A few informants expressed that they thought sand and the build-up of waste that was brought down with the river was the cause of trees drying up in Msimbazi valley. When rapid build-up of sedimentation occurs mangrove systems can experience mortality (Gilman et al., 2008; Spalding et al., 2010), and if sedimentation accumulates in Msimbazi valley this could be the reason why the mangroves are drying up. Already large parts of the forest had been replaced by grasses and informants thought tree mortality would keep happening if floods and pollution continued.

4.4 Factors affecting vulnerability

Even if numbers of disaster in the world have increased the last decades' natural hazards have not, therefore the social factors that can affect vulnerability have to be taken into account to explain this (Wisner et al., 2003). Any major shock can weaken the resilience of a system (Young et al., 2006), as seen in the case of Msimbazi mangroves after experiencing floods. At the time of the research the SES of Msimbazi mangroves were on the verge of collapse. Trees were drying up, mangroves could not provide ecosystem services in the same way as before and people were experiencing damaging floods which had lead to a breakdown of the social system. The SES of Kunduchi mangroves were doing much better, but with increased urbanization the SES might experiencing the same problems as the Msimbazi mangroves. Thus it is important to analyse the underlying factors that is causing the degradation of resilience in urban mangroves. In this section the vulnerability of the SES in urban mangroves will be analysed, with special attention on Msimbazi valley.

Several slow variables have already been discussed with a resilience perspective, but the concept of vulnerability could give important insight into how SESs are impacted during hazards and how they respond to change. Underlying social, political and economic processes are emphasised by vulnerability and the PAR-model that can explain how disasters occur when vulnerability and hazards meet (Miller et al., 2010; Wisner et al., 2003). The PAR-model is a useful tool when analysing vulnerability of SESs as causes of vulnerability can be traced back from unsafe conditions, through socio-economic pressures to underlying root causes (Wisner et al., 2003).

Figure. 23 The PAR-model of the mangrove SES in Msimbazi valley



(Adapted from Wisner et al., 2004)

Root Causes

Root causes are widespread and general processes that affects a society. The causes are often spatially and temporally distant or invisible in the sense that they are taken for granted. The most significant root causes that can generate vulnerability are economic, demographic and political processes that affects the access and distribution of resources in societies. Existing power relations are something that will be reflected through analysing root causes (Wisner et al., 2003).

A number of root causes are affecting the Msimbazi mangroves and the social system in the valley. Poverty, low agricultural productivity and limited opportunities in rural areas are driving people to seek other opportunities in the cities. 28,2 % of the population in Tanzania lives beyond the poverty line (World Bank, 2015) and are dependent on low-income livelihoods such as small-scale farming and natural resource extraction for subsistence. 75% of the population is employed in the agricultural sector, but the sector only contributes to one third of the national gross domestic product (FAPDA, 2014; OECD, 2013). Tanzania has high underemployment in the agricultural sector and one of the lowest levels of agricultural productivity in sub-Saharan Africa (URT, 2008; OECD, 2013). The sector is dominated by smallholder farmers that cultivates by hand without technical improvements as irrigation that could increase their productivity. Also infrastructure and political decisions have made many farmers marginalized with little access to markets. Tanzania ranks 134th out of 148 countries when it comes to infrastructure, which is largely a reason why crops fail (WEF, 2013; OECD, 2013). Investments in the agricultural sector have been introduced (such as “Kilimo Kwanza”), but without participation from small-scale farmers which will remain poor (Mfugale, 2015). The rural-urban inequality, where urban families have more access to endowments such as education, different livelihood opportunities and available markets have further driven people to migrate to the cities in hope of a better life (World Bank, 2015).

Poor leadership, lack of coherent institutions and weak regulatory framework are also factors that affect the SESs of urban mangroves. Clear laws and policies for the regulation of mangrove areas were lacking as well as coherent policies addressing pollution in the country (UNEP et al., 2009). Informants acknowledged that the different laws and ministries had conflicting interests which affected the effectiveness of regulations and enforcement of laws in the Tanzania. Limited

financial capacity has damaged the development of technology and infrastructure in the country (WEF, 2015).

Also, low transparency and lack of financial resources in the country damaged the enforcement of regulations and opens up for corruption (OECD, 2013; UNEP et al., 2009). Over the last years' corruption has worsened, and Tanzania ranks 106th out of 148 countries (WEF, 2015). Corruption was perceived as a threat to mangroves and the social system by both local informants and governmental representatives. Lack of communication and transparency between different ministries and between MoL and local government is providing industries and people with the opportunity to obtain access and permits within restricted areas. Mangroves have been cut for urban development or industries, houses have been constructed in restricted areas (including hazardous locations) and walls and groins have been built; which have altered the natural flow of water. Corruption, lacking communication and mismanagement by the state have lead to low trust in the societies in Hanna Nassif and Kunduchi.

Other root causes that affects vulnerability in SESs of urban mangroves are globalization and international pressures. Structural adjustment programmes were introduced in the 1980s, which influenced Tanzania's economy with budget cuts in public expenditures. This increased vulnerability in the country by undermining the health and education sector (Wisner et al., 2003). The programme promoted export and private investments. Mangrove areas have been cut as coastal areas have been transformed into tourist hotels or for export industries due to a demand for hard currency (Wisner et al., 2003).

Internationally funded projects that have been involved in the management are very often short-lived (Grosh et al., 2008). Both donor funded projects in Hanna Nassif (Hanna Nassif upgrading project) and Kunduchi (KICAMP) have seen successes, but the benefits have not been sustainable as donors have withdrawn and projects ended.

Dynamic pressures

Dynamic pressures are drivers that channels root causes into unsafe conditions and are often contemporary manifestations of the root causes leading to vulnerability (Wisner et al., 2013).

Rural to urban migration is a dynamic pressure that comes from root causes of social and economic inequality between rural and urban areas. Urbanization is a driver of land-use change that can alter ecosystem services that are important for communities well-being (Elmqvist et al., 2013; Seto et al., 2013). Urbanization is a major factor that can influence vulnerability, especially since pressure for land drive people into informal settlements with unsafe conditions (Wisner et al., 2003). Limited access to land and high cost of living in Dar es Salaam is another driver of informal settlements in Dar es Salaam (Pan-African START secretariat, 2011). People migrate to Dar es Salaam in the hope of more opportunities and a better life. However, there is a high unemployment rate in Dar es Salaam, especially among youth. This unemployment is a pressure that affects the living situation, livelihood choices and it has driven the crime rates up in the city (UN-HABITAT, 2009).

75 % of properties in Dar es Salaam is on unplanned land, owned outside of the legal system (UN-HABITAT, 2005), which was also the case in Hanna Nassif, where permits had been obtained through informal land acquisition. The government and the National Housing Cooperation (NHC) cooperate to provide the urban poor with housing affordable with low income. However, these projects have shown to be too expensive for the poorest in the city (UN-HABITAT, 2009). In Hanna Nassif informants expressed frustration over being moved out of the city, or left with nothing when houses were torn down, while a NHC-project is built right next to the valley.

With a dynamic flow of people moving in (and out) it might be difficult to draw experiences and knowledge from human capital. This was discussed with the senior forest officer at TFS, which explained that information to, and cooperation with the local community around Msimbazi valley was difficult because it was hard to find grass-root leaders, thus making participation in management by the local community difficult. In Kunduchi it was easier to work with local communities according to the spokesperson from TFS, as existing power structures was easier to identify. Urbanization is a dynamic process and local knowledge may be disappearing when people are moving in and out of areas.

Another pressure on vulnerability of SESs of urban mangroves comes with lack of investments in infrastructure. Lack of rehabilitation, maintenance and modernization of the current infrastructure have emerged from limited financial capacity and budget constraints (URT, 2012) and Tanzania is one of the worst countries in the world when it comes to general infrastructure (WEF, 2013). Together with population growth and increased impermeable surfaces it has put pressure on the current sewage and waste system. Especially in Kinondoni, the infrastructure is not able to handle the population growth. Dar es Salaam has grown beyond the institution capacity to govern and implement regulations (Jean Baptiste and Schaechter, 2014). The enforcement of laws and regulations is weak due to root causes such as few resources, transparency and lack of coherent policies (UNEP, 2009), which can create vulnerability in societies and damage natural habitats.

Furthermore, dysfunction of the state and corruption has led to low trust among local communities towards governmental institutions. In Hanna Nassif, people living in the valley had experienced an unfair process of relocation and did not feel as they were prioritized by the government. Low trust was also seen by the local community in Kunduchi towards CBOs. Many informants believed that CBO-members and the local government had benefitted from mangrove management and increased livelihood opportunities, while the rest of the community was left outside. People saw no point in reporting illegal activity since they assumed that the local government and the police would accept bribes. Rumours about politicians that had given about permits before elections was communicated during interviews in Kunduchi.

Deforestation is another dynamic pressure stemming from root causes of poverty, inequality and low productivity in agricultural sector, as well as it is influenced by other dynamic pressures such as urbanization, population growth, high dependency on natural resources and lack of alternative sources of energy and livelihood. Deforestation can lead to unsafe conditions of siltation or erosion of rivers (Wisner et al., 2003). Deforestation further upstream can impact the community in Msimbazi river valley. Additional land-use change outside of an area that are dynamic pressures are water diversion and agricultural and industrial pollution that could have an impact on a system based around a river (Seto et al., 2013). Msimbazi is influenced by siltation and pollution from upstream. Also, in Kunduchi, groins constructed by hotels can lead to erosion and

unsafe conditions. Other dynamic pressures in Kunduchi is saltpans and properties that have encroached the mangrove area.

Unsafe conditions

Unsafe conditions are the specific expression of vulnerability, that emerge from root causes and dynamic pressures (Wisner et al., 2003).

Poorer people are often more at risk from natural hazards. In urban areas, poorer households tend to be situated in informal settlements in areas that are considered riskier and are often prone to floods, diseases or other types of disturbances (Wisner et al., 2003; Seto et al., 2013), such as the flood prone areas in Msimbazi valley. Hazardous locations and unsatisfying living conditions in informal settlements can be considered to be the best of the worst for vulnerable people (Wisner et al., 2003). People live in the hazardous parts of the valley due to proximity to the city where they have their livelihoods. This location gives them livelihood opportunities, affordable accommodation, low transport costs and also the possibility to grow food for subsistence or for the market (Ngware 2003). However, the valley experiences yearly floods with considerable damage on lives and livelihoods.

Vulnerability can affect different groups of a society differently. This can be seen in the case of the difference between poorer households in Hanna Nassif, north of Msimbazi valley and more affluent households in West Upanga, south of the valley. Both areas experience floods yearly and are lacking sufficient infrastructure (Owens, 2012). But, while people in West Upanga has the resources and capacity to handle the floods, there are considerable damages to lives in Hanna Nassif. This might be because houses are located further down in the valley in Hanna Nassif, but it is also due to poorer construction of buildings and lack of financial capital.

A special group at risk in Hanna Nassif is the people who do not have any permits to land; tenants. Marginalized people, such as the tenants in Hanna Nassif, tend to be marginalised by the government as well and interventions involving them often have low priority (Wisner et al., 2003). The tenants, and the house owners without a legal permit, were the ones being left out of the relocation process, even though they lost everything when government torn down their houses

in the end of 2015 (Mwangonde, 2016). Also, poorer people in informal settlements, generally have less influence than more wealthy people to affect change (Chapin et al., 2009).

Furthermore, unplanned settlements can impact the area severely. For example, waste and sewage discharged into water courses from insufficient sewage systems can decrease the function of ecosystem services (Seto et al., 2011). In Msimbazi valley people are growing food, which could potentially become a health hazard since the river is used to irrigate crops (Leonard et al., 2012). Health hazards occur also when sewage and heavy metals are spread around the valley during floods.

Insecure income is another driver of vulnerability. Access to resources and a stable income which does not come from dangerous livelihoods are important for societies. Poverty and underemployment of youth in Dar es Salaam has increased the crime rate in the city (UN-HABITAT, 2009), and security issues are of special concern around the Msimbazi valley as criminals were said to hide within the mangrove forest.

The experiences from Hanna Nassif shows that the community was lacking disaster preparedness and protection from the states for the most marginalized group, which is also increasing the vulnerability of the people to hazards.

Hazard and disaster

Flood, accelerated by pollution and insufficient infrastructure, has been identified to be the main hazard to the mangrove SES in Msimbazi valley. Flooding, that are seasonal and often short-lived can have devastating impact for a vulnerable society (Adger, 2006), such as the poorer settlement in Hanna Nassif. Human actions can influence disturbances and alteration of magnitude, frequency and duration of hazards can be the outcome from urbanization (Folke et al., 2009). The synergetic effect of combined stressors can increase the magnitude of hazards. Thus, there will be an increased risk to vulnerable people in the face of hazards.

Disasters are the result of both the social system and natural hazards; when hazards and vulnerability meet disasters occur (Wisner et al. 2003). The floods in Msimbazi valley have

created disasters since there has been loss of lives and damages on properties as previously discussed. Houses have been demolished and people have been relocated to Mabwepande, far away from their previous livelihood in the city and many mangrove trees have dried up in the valley.

The mangrove SES in Kunduchi has yet not experienced a disaster. However, it is valuable to draw experiences from Msimbazi valley. Urbanization, in combinations with lack of financial capacity and dysfunctional governing have created a vulnerable system in Hanna Nassif. Urbanization can be characterized as a slow driver of change. Top-down impacts, as cutting of trees, in combination of bottom-up impacts, as soil erosion or redirection of water flows, and altered disturbances regimes, as increased frequency and intensity of rain and floods, can cause vulnerability in social-ecological systems and ultimately shift a system into a less desirable one (Folke, 2006; Gundersen and Pritchard 2002). Increased impermeable surfaces and accumulation of pollution in the Msimbazi river have created a system that is at risk of disasters. Thresholds is often heterogeneous and thus difficult to identify in a social-ecological system. It can be difficult to predict the exact boundary where the system flips into an alternate system, especially if the (Folke et al., 2004; Adger, 2006). In Kunduchi the social system is largely dependent on fishing and salt production; systems which are dependent on functional mangroves. However, with increasing pollution and urban development the ecosystem might be altered, as seen in Msimbazi valley, which ultimately will affect the vulnerability of people in Kunduchi.

4.5 Reduce vulnerability by enhancing resilience

The concept of vulnerability consists of three components; the exposure of stressors that can cause change in a system, the sensitivity of the system to these stressors and the resilience of the system to be able to adapt to change. Vulnerability in a SES can be reduced by focusing on these three components. Mitigation (minimizing exposure) can be done by reducing intensity, frequency, duration and extent of a given stressor (Chapin et al., 2009). For example, preventing toxic pollution or pollution of waste in Msimbazi valley will reduce the health hazard from floods. Other examples can be to move people further up in the valley to reduce damages to

houses and lives, and prevention of siltation building up so that water does not collect in the valley during the rainy season. Sensitivity of the SES to hazards can be reduced by sustaining slow ecological variables, maintaining institutions that are beneficial for human well-being and focusing the attention on segments of the society that are most disadvantaged. This can be done by making sure that the infrastructure is capable of withstanding floods in Msimbazi valley (Chapin et al., 2009).

However, strategies building on exposure and sensitivity assumes that the stressors are known and predictable. To ensure a long term reduction in vulnerability strategies that enhance resilience are needed. Surprising events might alter a system and by increasing the adaptive capacity of a system as well as reducing exposure and sensitivity to known stressors the sustainability of SESs are best maintained (Chapin et al., 2009).

The SES in Msimbazi valley have reached an undesirable state, both for the social system and for the mangrove ecosystem. Thus transformation of the system into a new, more desirable state is preferred. In Kunduchi, where the system is in the conservation-phase, governance should seek to maintain and build resilience.

Kunduchi mangrove SES

Social capital is one important aspect in SES that influence the resilience; knowledge and learning is essential to build and maintain adaptive capacity of SES and to create development (Siemonsen et al., 2012). People need be aware about their system and surrounding environment, how it changes and how to protect it. In Kunduchi there have been several conservation activities that involve the local community, as KICAMP. The local population are aware of the benefits of mangroves and how to protect them. Although, there have been few activities informing local people about mangroves recently. To enhance resilience of the SES in Kunduchi increased local awareness, and especially education of newly settles residents and seasonal workers, should be stimulated.

For a SES to be able to buffer shocks and adjust to change a crucial factor is to build and maintain diversity; which could be ecological, social, institutional or economic diversity (Chapin

et al., 2009; Miller et al., 2010). To obtain social resilience the ecosystem management should be shared by various subunits; CBOs, local governments, municipalities, ministries and international agencies (Siemonsen et al., 2012), as has been the case of Kunduchi mangrove system. However, the communication between the different sub-units are poor. Also, CBO-members explained that they did not were not active at the time of the research. The local government was in effect managing the restricted area; as both explained by the VEO and the town planner at MoL. This is partly the cause of the ownership disputes in Kunduchi. When buildings built inside the restricted area were demolished MoL, NEMC and the local government came together. However, this conflict could have been prevented if the transparency and cooperation between different institutions had been better. The different institutions should come together to improve the situation in Kunduchi fishing village, where erosion due to groins are affecting the resilience of the village (Almstrom and Larsson, 2008).

To enhance resilience in the Mangrove SES in Kunduchi income diversity should be encouraged. Especially livelihoods that involve managing the mangroves could be beneficial in an increasingly urbanized environment. In Msimbazi mangroves, few people see benefits from the mangroves and expressed that grass land for agriculture was better for their livelihood. People would be more positive to protect the mangrove ecosystem if they saw direct benefits from the management. Salt producers and fishers already see benefits, but the introduction of beehives as a livelihood option has been unsuccessful in Kunduchi. However, if managed the right way beehives could be an alternative income source for marginalized people.

Msimbazi mangrove SES

Transformation of the SES is needed in Msimbazi valley to protect the mangroves and the marginalized people. Transformability is how to reorganise social-ecological systems into a desirable state. Transformation of a system will create both winners and losers as different social groups will have different views on desirable states of the system which need to be considered (Beymer-Farris et al., 2012; Walker and Salt., 2006). A desirable state can be when the system provides services, ecological and social, for societal well-being and development, also for previous marginalised people (Chapin et al., 2009) such as the people in the informal settlement of Hanna Nassif. A possible alternate state that would be desirable is were the river and the valley

is clean for pollution and siltation have been prevented; infrastructure have been improves so that the drainage can cope during rains; and where people currently living in hazardous location (or relocated to the outskirts of the city) have a viable alternative for housing that would allow them to continue their life in the city.

5 Conclusion and recommendations

Tanzania's mangrove forest has been relatively well protected with lower levels of mangrove degradation compared to neighbouring countries (Spalding et al., 2010). However, even with well established regulations and conservation efforts, mangroves around Dar es Salaam have seen great losses (Semesi, 1991; Spalding et al., 2010). Urbanization in Dar es Salaam is a rapid process which affects mangrove ecosystems and the societies that surrounds them as examined in this study. While lower dependency on natural resources and easier access for research and conservation activities are outcomes of urbanization that can have a positive impact on the mangrove system, new stressors appear from an increasing population and an urban environment.

The infrastructure in the city is outdated, and together with lacking financial investments and a growing population the situation has worsened. Waste pollution is adding an extra dimension as lack of proper waste management results in clogged drains. Flood disasters have been the outcome of this synergetic effect, which have affected both mangroves and societies in Msimbazi valley. Many new residents are settling in unplanned areas in hazardous locations such as the Msimbazi valley.

In Kunduchi large part of the mangroves were cut for salt production. Now, after efforts to protect the mangroves, the forest is growing. However, the system is changing in the face of urbanization. Land in Kunduchi is high in demand and wealthier people are moving in. There have been land disputes and houses have been demolished within the restricted area – which can be seen as a positive action. It will protect mangrove area from being built up and the government has revealed that they are serious in protecting the mangroves something that can increase the trust in the community towards the government. However, more and more houses are being built in the area, which will be challenging for the existing infrastructure.

Kunduchi has the advantage of a well established local community where people have been involved in coastal management. In the city centre of Dar es Salaam it has shown more difficult to mobilize local communities (Lupala et al., 1997), thus bringing people into the management is a challenging task. The local community in Kunduchi might be changing with urbanization, but

the government should encourage an environment where the community is actively involved in the management of the mangroves. The mangroves in Kunduchi is important for fisheries and it is essential that the levels of pollution in the river is kept to a minimum so that fish can continue to thrive. In Msimbazi valley the situation is becoming a serious problem; fish has disappeared and the pollution has created a health hazard to the most vulnerable people in Hanna Nassif. In the case of Msimbazi mangroves, the SES needs to undergo a transformation to reach a desirable state. The government has tried to relocate people in 2012 and started a new relocation project in the end of 2015. However, if the new alternatives provided by the state are inadequate residents will try to resettle the valley.

The management of mangroves in Dar es Salaam is detracting from social and ecological resilience. In Msimbazi valley there are no direct management activities concerning the mangroves. In Kunduchi management activities which involves the surrounding community has ended and trust towards management leaders has decreased. The system is in the conservation phase with growth and possibilities for a resilient system. Nevertheless, with the high population growth that Dar es Salaam experiences, the mangrove SES are likely to experience some of the same pressures of vulnerability as Msimbazi valley.

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Appendix

Interview guide

Semi-structured interviews with local community in Kunduchi and Msimbazi valley

Interview number: ID: Date/time:

Place:

Age:

How long have you lived/worked in the area?

Source of income?

Have you seen any changes in the mangroves since you arrived?

What, why, when?

Have you seen any changes in the population and the society?

Population growth, demographic changes, economic changes?

Do you know if this has affected the mangroves? How?

Do you see any benefits from the mangroves? How/why not?

Do you know if people are still utilizing the mangroves?

If yes, for what? Is this causing problems for the mangroves?

If no, why not?

When did people use to utilize the mangroves?

For what?

What are the alternatives now?

What are the restrictions? What would happen if you cut mangroves?

Who manage the mangroves? Who are involved? What are the governments role?

How are the mangroves managed?

Is the community involved? Do you have any rights to use, and responsibilities?

Have you received any information about the mangroves?

Management before, after and during KICAMP (Kunduchi)

What do you think about the current management?

What are the benefits?

What would you change?

Have there been any conflicts between different stakeholders regarding the mangrove area?

What are the threats to the mangroves?

Past, current, future threats

Do you experience pollution in the area?

How is this effecting the society?

How is this effecting the mangroves?

Do you have problems with security issues in the area?

Have you seen any changes in the biodiversity in the area?

Can you tell me about the salt pans? (Kunduchi) Are the industry considered a threat?

Can you tell me about the hotels? (Kunduchi?) Are they considered a threat?

Can you tell me about the floods? (Msimbazi mangroves)

Causes?

Effects on society?

Effects on mangroves?

Government officials/local management

Interview number:

ID:

Date/time:

Position:

Change in population

Change in mangroves

Change in the use of mangrove resources?

How are the mangroves managed? What are your involvement? Who else are involved?

What are the laws, regulations? Monitoring?

How is the communication between different stakeholders?

Who are responsible for what? Eg, permits

Threats to mangroves? What are done to manage them?

Pollution

Floods

Saltpans/other industry

Hotels

Property rights

Have there been any conflicts? (Properties in Kunduchi)

Mangroves before, during and after project? (For people involved in specific projects)



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