

# URBAN PLANNING AND PUBLIC SAFETY:

Integrating Disaster Preparedness for Sustainable Physical  
Development of the Island City of Mombasa

By

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A thesis submitted in partial fulfilment of the requirements for the degree of  
Master of Arts in Planning

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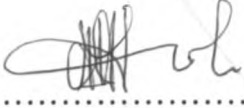
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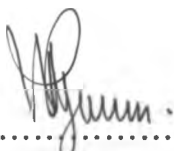
## DECLARATION

This thesis is my original work and has not been presented for a degree in any other University

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**DEDICATION**

*To Asina, Saidi and the One Knocking (Farouq)*

## ACRONYMS AND ABBREVIATIONS

UN	United Nations
ICRC	International Committee of the Red Cross
MOSR	Mineral Oils Safety Regulations
MDDMC	Mombasa District Disaster Management Committee
UNISDR	United Nations International Strategy for Disaster Reduction
USA	United States of America
USAID	United States Assistance for International Development
EAS	East African Standard
UNDP	United Nation Development Programme
LACDE	Local Authorities for Confronting Disasters and Emergencies
UNDRO	United Nations Disaster Relief Office
UNOCHA	United Nations Office for Coordination of Humanitarian Affairs
UNEP	United Nations Environmental Programme
NDP	National Development Plan
GOK	Government of Kenya
MANDISA	Monitoring Mapping and Analysis of Disaster Incidents in South Africa
CMA	Cape Metropolitan Area
CRAG	Chiswell Residents Action Groups
MASURA	Marine Surveillance Radar Station
NADIMA	National Disaster Management Agency
FEMA	Federal Emergency Management Agency

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## ABSTRACT

The first and primary responsibility of government, no matter what form that government takes, is to protect the health, safety and well being of its citizens. Minimizing risk and vulnerability from natural and human induced hazards falls directly into that responsibility. Urban settlements have increasingly become vulnerable from the effects of disasters. The migration of population to urban areas increases human vulnerability as population densities increase, infrastructure becomes overloaded, living areas move closer to potentially dangerous industries, and more settlements are built in fragile areas such as floodplains, beachfronts or areas prone to landslides. Technical advances are supposed to, and do, improve safety against disasters, but they also bring about increased human error and, in their abuse, terrorist activities. As a result, catastrophes affect more people and economic losses increase.

While these concerns have always been there, they have now greatly expanded and a new dimension added after a series of global events such as the Nairobi Bomb Blast of 1998, the New York terrorist attack of 2001, the Indian Ocean Tsunami on 2004 and the Hurricane Katrina deluge on New Orleans in 2005. In all the cases the losses were incalculable. Urban Planners and Designers have never been so much under pressure to make a contribution in making human settlements safer.

International effort has recently shifted from emphasis on response to prevention. This is out of the realization that every urban planning decision has implications for disaster mitigation. Nationally, these global events coupled with local ones such as the incessant flooding at Budalangi in Western Kenya, the El-Nino phenomenon of 1997/1998 and the Paradise Hotel bombing in 2002 in Mombasa, have jolted the Government into instituting several policy measures including the formation of a National Disaster Operation Centre (NDOC) with a view to institutionalising preparedness against future disasters.

This study has localised these global and national efforts by analysing the disaster preparedness of the Island City of Mombasa. It is premised on the fact that only at the local level are there developmental and legal tools required to implement such an effort, particularly the physical planning/development process. The study was carried out by first developing a conceptual framework on disaster preparedness through a review of related literature. A Vulnerability Index, which was the basis of sampling the action areas, was then developed for the whole Municipality of Mombasa at the lowest administrative (sub-location) level by using a combination of three indicators of vulnerability namely; population density,

development density and poverty levels. This indicated that the Island City was more vulnerable than its mainland parts. Next the study analysed the vulnerability of the Island City using three contingent conditions; its physiographic setting, its socio-economic characteristics and its land use patterns. The preparedness services in the Island including medical facilities, police stations, fire fighting installations, green and open spaces, accesses and institutional frameworks were then evaluated to gauge their mitigative role. Public awareness is central in any preparedness initiative, therefore, the perception of the residents on vulnerability and preparedness of the Island Town at household level, key informants and the general public was assessed using questionnaires, focus group discussions, and informal consultations. After synthesizing and analysing the data, the study developed a Planning Matrix for Integrating Disaster Preparedness for the Sustainable Physical Development of the Island City of Mombasa, and potentially other urban centres. From it, policy recommendations were drawn.

The study made the following main findings; firstly, Mombasa was found to be vulnerable from all its contingent conditions. Its preparedness was found to be nominal. Secondly, the study found disasters to be more of social events than physical phenomena in that the factor of people and their vulnerability is the most important ingredient since only its presence transforms hazards into disasters. Since hazards, being the causal factors, are sure to occur as a matter of 'when' not 'if', the contingent conditions which are largely spatial, are what should preoccupy planners wishing to mitigate the effects of disasters by systematically seeking to improve them. Thirdly, the study found that development is the root cause of disasters and, therefore, must not be separated from the disaster management process, since disasters are essentially debts of development; what development forgets to take into consideration, it pays back at a later date.

The study gave policy recommendations for disaster preparedness in Mombasa based on the following four objectives: to decrease the level of potential risk; to mitigate the consequences of disastrous events; to localise and limit the scope of catastrophes, and; to facilitate rescue operations. The recommendations include: improvement of regional conditions both on the mainlands of Mombasa and neighbouring regions so as to better manage and stabilise population densities within the Island; reduction of traffic congestion within the island by planning for transit traffic to bypass the Island, enhancing the existing and introducing alternative (marine and air) means of access to the Island and ameliorating its internal circulation; improvement of land use planning within the Island, and; development of a

vulnerability plan for Mombasa including a comprehensive geological survey of the Island and integrating Vulnerability Assessment within all Environmental Impact Assessments for development projects in Mombasa.

The study identified the following areas for further research; first, the Cost Benefit Analysis of disaster preparedness planning as a tool for trade-offs in decision making; second, the psychological responses during and in the immediate aftermath of a catastrophe which seem to disorient human actions to exacerbate disasters; third, a comparative analysis of the cumulative economic losses of 'normal' small hazards to local economies in comparison to large disasters.

Finally, this study, aimed to stimulate interest towards the following three general goals: first, the creation of awareness of safety issues among planners and their role in facilitating public safety in urban areas; second, the articulation of guidelines for improving existing urban environments and planning new ones with safety in mind, and third, as a contribution to the development of a body of knowledge to ensure urban safety ideas are improved and expanded.



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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the Study

#### (i) Urban Safety

Cities and urban centres have variously been cited as engines of regional development. The important role they play in both national and regional growth is apparent. Surprisingly, most studies on urban centres tend to focus more on their economic, financial and social aspects with less regard to their safety requirement. Despite the important role played by safety towards economic growth, there have been no clear policy guidelines that govern its integration in plan formulation, although, theoretically it is agreed that the highest level of effectiveness would be achieved when all sectors of development planning are completely integrated (UN, 1975:5). Traditionally, scattered regulatory measures under health, sanitation, housing, building codes and zoning provided the principle operating criteria to public safety, and mainly that aspect related to health. Resource constraints, however, often prevented their strict enforcement. The issue has never been approached as deserving special attention.

In addition to providing an enabling environment necessary for economic growth, safety is also regarded as fundamental for instilling confidence to both local and foreign investors leading to increased investment, creation of employment opportunities and increased incomes. Kenya's 7<sup>th</sup> National Development Plan (NDP) affirms that for people to participate fully in the important task of nation building, it is important that the social, political and economic environments in which they live, work and enjoy leisure is secure. Only in such an enabling environment will it be possible to make rational decisions as to the likely future outcomes of investment for national development (NDP, 1994). It is noteworthy that while the Sessional Paper No. 10 of 1965 recognised 'physical' planning together with the other three (social, financial and economic) subsequent plans seem to have dropped it as evidenced by the above. Safety is also one of the recognized underpinning normative factors in land use planning identified with the Public Interest. Although this has traditionally been closely associated with health, in its wider meaning, safety is defined as the quality of being safe and the freedom from danger or risk of injury (Collins, 1993). It also comprises the physical measure designed to safeguard personnel, equipment and facilities and to protect against sabotage and damage (Schultz, 1991).

Now, public safety is a function of many factors. Furthermore, achieving complete safety is neither physically feasible nor economically desirable. This study has, therefore, limited itself to the safety of

urban areas with respect to disasters, both natural and man made. This is because urban settlements have increasingly become vulnerable from the effects of disasters. The 20<sup>th</sup> and 21<sup>st</sup> Centuries have turned out to be of potential dangers and actual disasters as the power of science and technology races wildly ahead of human wisdom and ability in controlling it. As a result, catastrophes affect more people and economic losses increase.

### **(ii) Disaster Preparedness**

The concept of 'disaster preparedness' was developed in the 1970s and 1980s, and it recognised the need to integrate disaster reduction into the comprehensive plans for national physical, economic and social development. It also advocated for increasing the capacity for rescue, relief and rehabilitation during and after a disaster. In 1971, the United Nations Disaster Relief Office (UNDRO), now the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) was established. In addition to mobilizing and coordinating relief activities in times of disasters, it was also to inculcate a culture of disaster prevention through wider application of known scientific and technological mechanisms by a better-informed population. The 1990s was consequently declared the International Decade for Natural Disaster Reduction (IDNDR). The UN also established an International Strategy for Disaster Reduction (ISDR), a global platform aimed at helping all communities to become resilient to the effects of disasters and to proceed from protection against hazards to the management of risk through the integration of its prevention into sustainable development. Previously, the international community considered disasters as exceptional circumstances, when local coping capacities were exhausted and external emergency relief was required. The term 'disaster management' was equivalent to 'disaster response' and tended to be within the exclusive competence of organizations such as the Red Cross and Red Crescent Societies or national civil defence institutions. Now, a new vision is emerging: the development process must reduce risk by lessening populations' and settlements' social, economic and environmental vulnerability (UNEP, 2002).

The concept of 'disaster preparedness' is not aimed at presenting a comprehensive view of various concepts for disaster management, nor bring them under a consolidated approach. Rather, it provides one possible lens for viewing the challenges presented by urban vulnerability. It constructs a specific window, selected not because it offers the broadest or best view but because it is inclusive of both pre and post disaster stages (Nomdo, 2002:3).

### **(iii) Disaster**

A disaster is a serious disruption of the functioning of society, causing widespread human, material or environmental losses, which exceed the ability of the affected society to cope on its own resources, necessitating external assistance (UNEP 2002). Disasters are consequent of two types of phenomena: The first are events induced by natural processes. Most of these can only be mitigated. The second are those events induced by human actions. Many of these can actually be avoided. Human-induced disasters are becoming more frequent and bigger by the day: *“By commission or omission, people are less and less the helpless victims of ‘acts of God’ and more and more the victims of ‘acts of man’”* (UNEP, 2002). These may be intentional or accidental. Despite strong regulations governing the handling of hazardous materials, for example, occasionally serious accidents occur.

The occurrence of extreme natural or man-made phenomena is not in itself a disaster. A disaster occurs when one or more of these phenomena strike a human settlement. These natural or man-made events become disasters where large numbers of people or infrastructure are affected due to high population, especially in urban centres. In essence, disasters thrive at the inter-phase of extreme natural or man made phenomena and the vulnerability of human settlements. The phenomenon, therefore, is only one element of disaster. Without vulnerability and people there would be no disaster. The capacity of the people to deal with a disaster determines the level of vulnerability (UNEP, 2002).

### **(iv) Rationale for Disasters Preparedness**

Impacts of disasters include loss of lives and livelihoods, damage to infrastructure and communications, interruption to economic activities, and increased risk of disease outbreaks. The severity of the impact depends on the nature of the element involved and on the degree of resistance of a man made environment to these elements, otherwise referred to as its vulnerability. In many places, these impacts are worsened by poverty, marginalization, and overcrowding. Vulnerability to disasters is said to be closely linked with population density and economic wellbeing. Inadequate, old and deteriorating infrastructure and lack of economic resources compromise people’s coping capacity and therefore magnify the impacts of disasters. There is growing concern that the frequency and severity of disasters are increasing, that early warning systems are inadequate and that disaster management is weak (UNEP 2002).

The impact of most natural as well as man-made disasters is normally one of immediate and direct destruction. At the present level of knowledge and technical achievement, preventing the occurrence of

natural disasters, given budgetary constraints, is not feasible. In most cases, preventing disastrous consequences is all that is practicable. This is in contrast with those disasters resulting from human activity and habitation, in which case both prevention of the disaster and of its possible consequences is possible by identifying points of intervention in the causal chain between the emergence of a hazard and the destructive consequences.

#### **(v) Global Paradigm Shift**

The sheer scope of socio-economic impacts of disasters, both natural and man-made, has brought about a paradigm shift in the global approach to dealing with the concept of risk in modern societies. Risk mitigation is seen as the only sustainable solution for reducing impacts of disasters. In developed countries, governments, communities and individuals have greater capacities to cope with disasters, the economic losses are to some extent absorbed by a diversified economy, and most assets are insured. Developing countries, with limited economic diversity and poor infrastructure must not only rely mostly on economic relief if a disaster happens but their economies need more time to recover (UNEP 2002). As a result, UNOCHA is mandated firstly, to identify and define the basic problems in the field of disaster prevention and physical planning, building and management of human settlements; secondly, to produce clear statements, general principles and basic guidelines at international level, for eventual localisation, in the field of disaster prevention and mitigation through an integrated planning approach in developing countries (UN, 1976).

The recent international shift of emphasis from response to prevention or mitigation is based on 5 findings: that disasters are a major development problems more so in developing countries; that most disasters can be prevented or mitigated; that most of the basic mitigation and/or prevention measures are less expensive; that damage by disasters always exceeds total external assistance provided; and that there is always a choice between vulnerable sites and less vulnerable ones (UN, 1976).

#### **(vi) Disaster Preparedness in Kenya**

In the recent past, Kenya has been faced with several disastrous situations. These include, the massive tsunamis triggered by a magnitude 9.0 earthquake on 26.12.2004, in Indonesia, which affected several countries throughout the Indian Ocean killing over 300,000 people, displacing and affecting millions more and causing incalculable damage (USAID, 2005). Kenya recorded one death, and neighbouring Somalia several, in addition to experiencing unusually high and strong waves throughout the coastal line, prompting hurried evacuation of the otherwise highly populated beaches and coastal towns during

the Christmas period. Mombasa was caught off-guard causing great anxiety. Others are the August 7, 1998 'Bomb Blast' in Nairobi, the Paradise Hotel Bombing at Kikambala in 2002, incessant floods at Budalangi and fire outbreaks in urban areas, such as the one that almost decimated Lamu Island in the 1980s and the one that recently gutted City Hall in Nairobi, not to mention the ceaseless fires that raze low-income settlements almost every other month. These disasters, both natural and man-made, have posed serious challenges to life, property and the environment. All these result in slowed economic development, destruction of lives, property, infrastructure and impoverishment of people in general.

Kenya's 7<sup>th</sup> NDP recognized that with increasing number of skyscrapers in the major urban centres of Nairobi, Mombasa and Kisumu, there was urgent need for safety precautions against occurrences such as fire outbreaks and industrial accidents (NDP, 1994). Recent acts of terrorism and the most recent flood disasters in Western Kenya have led the government to reaffirm this important element of planning and has committed itself to the institutionalisation of various measures to address the issue within the 2002-2008 planning period (NDP 2002). The recent tsunami disaster in the Indian Ocean strengthened this resolve. As a result, the Government of Kenya has established a National Disaster Operation Centre (NDOC) to plan and coordinate for, and enhance, public safety, especially in the wake of major catastrophes (NDP:2002). Subsequently, the Government has now embarked on the formulation of a National Disaster Management Policy.

## **1.2 Statement of the Problem**

### **Disaster Preparedness in the Island City of Mombasa:**

Mombasa is the oldest city in Eastern Africa. It is the third largest town in the region and the largest seaport. Like other towns in Kenya, it is required to cope with large numbers of people who, unable to find support in the rural areas move to urban centres. Its future as a transport and industrial centre of national importance and its role as a regional service centre and a tourist hub are assured (GoK, 1971).

The concentration of activities within the Island, due to severely limited amount of land available, has resulted in juxtaposition of incompatible land uses such as massive oil storage facilities at Shimanzi in close proximity to residential and industrial areas; mixing of residential units with factories and warehouses in Majengo and King'orani; building of residential dwellings at sea level susceptible to flooding at the Kenya Railway Quarters in Shimanzi and 'Muoroto' informal settlements in Tudor; and perilous congestion of effectively the only accesses to the Island namely the Likoni Ferry, the Nyali Bridge and Makupa Causeway at all times. This is in addition to existing high-density developments in

areas such as the Old Town and Kaloleni mostly inaccessible in times of disasters owing to their narrow streets. The NDOC stated that property worth Kshs 4 Billion was in the year 2003 alone destroyed by fires around Mombasa, which consumed several high profile tourists' hotels. It reiterated the need to '*strengthen preparedness so as to win back investor confidence*' (The Standard, 2004). Recently, leading geologists expressed concern on the structural stability of the Island given the uncontrolled sinking of boreholes and wells for abstraction of water to augment the inadequate supply by the authorities. Currently, the Island has more than 200 boreholes and wells (Coast Express, 2005). All these will, if effective steps are not taken, present a recipe for disasters which are likely to be aggravated by acute population and development densities, severe overcrowding and incompatible land uses (GoK 1971).

While global, national and regional level involvement is necessary to develop effective emergency and disaster mitigation planning, the local authority is the fundamental entity where the program foundation must be built and tailored if they are to be effective. If development of safer cities and societies are to be created, they will have to be created at the local government level. It is essential to keep in mind that almost every planning and development decision made at the local level regarding the built environment has implications for creating more sustainable, less vulnerable and, therefore, safer, more secure communities and societies (Geis, 2002). This study aimed to localise the global and national efforts by investigating the nature and level of disaster preparedness within the Island City of Mombasa and existing measures to deal with public safety threats, including planning interventions. The study subsequently made recommendations towards the Island City of Mombasa's sustainable physical development including the ideal spatial distribution, coverage and capacity among the main disaster preparedness facilities.

### **1.3 Research Question**

The research endeavoured to answer the overall question: To what extent had Public Safety in general and Disaster Preparedness in particular been integrated in the physical development of the Island City of Mombasa?

#### **Specific Questions:**

Many factors are likely to affect the safety of the public within Mombasa Island. However, this study limits itself to answering the following four (4) specific questions, which, in this context, are considered the core in planning for disaster preparedness within the Island City of Mombasa:

- How is the population and other physical developments related to vulnerability to probable disasters within the Island City of Mombasa?
- How adequate are the facilities, services and infrastructure for disaster preparedness in the Island?
- What is the level of public awareness, perception and preparedness to disasters in the Island City of Mombasa?
- How enabling is the policy, legal and institutional framework for disaster preparedness within Mombasa Island?

#### **1.4 Purpose of The Study**

The purpose of the study is to examine the nature and level of disaster preparedness in the Island City of Mombasa.

##### **(i) Study Objectives**

- To examine the vulnerability of population and other physical developments to probable disasters within the Island City of Mombasa.
- To examine the adequacy of disaster preparedness facilities, services, infrastructure and policy in the Island City of Mombasa.
- To assess the level of public awareness, perception and preparedness to disasters in the Island City of Mombasa.
- To propose appropriate policy for integrating disaster preparedness with physical development of the Island City of Mombasa.

##### **(ii) Study Hypotheses**

The study is being conducted under the following Hypotheses:

- That the Island City of Mombasa has the same vulnerability to disasters as its mainland parts.
- That the public in Mombasa perceives the Island City as being as vulnerable to disasters as its mainland parts.

##### **(iii) Study Assumptions**

The study is based on the following assumptions:

- The integration of disaster preparedness is desirable and important to a community. This is the basis for seeking to integrate it in the planning process. Therefore, investment in preparedness is an insurance, not a waste of scarce resources.



- The residents of Mombasa Island are rational in their decision making process.
- The Island City of Mombasa will continue to grow in time and space. This means new developments will continue to be undertaken in the Island as to increase the density of both its population and physical development.
- Despite the differences in verbalising the reasons for their underlying attitudes, if common patterns of perceptions in relation to their vulnerability are observed among the residents of the island, such perceptions will be interpreted as representing the universal.

## **1.5 Justification of the Study**

### **(i) Research Gap**

Globally, Africa suffers the least damage from disasters, in purely financial terms, but the significance of such losses may actually be greater in terms of impact on economic development. Given the enormous economic, social and environmental burden of disasters, adequate attention must be paid in the coming decades to disaster preparedness, assessment and mitigation (UNEP, 2002). It is this area of risk mitigation this research is concentrated on. It is an area, apparently, not given adequate attention. The wide gap in the Literature Review on the subject between the early 1970s and late 1990s attests to it.

### **(ii) Criteria for Preparedness**

Now, while it is a fact that human settlements, like other systems, installations and activities of every kind, require a measure of safety, it is not economically feasible or even theoretically necessary that they all achieve it to the same extent. The degree of safety warranted in any particular system is predicated upon an analysis of two premises: Firstly, it's criticality. The critical portion of any system is one in which partial or complete loss would have an immediate and serious impact on the system's ability to perform its function for a considerable period of time. The relative criticality of such portion may have no direct relationship to its size or whether it produces an end product; this must be determined on the basis of its importance to the system as a whole. Secondly, it's vulnerability. Vulnerability is a function of the hazards that could cause sufficient loss, damage, or destruction to affect the operation of the system under consideration. If one or more hazards exist which could achieve this result, then the relative vulnerability is high. If a system, or a part of it, is both highly critical and highly vulnerable, then an extensive physical safety program is of immediate necessity (Schultz, 1991). The research was geared towards ensuring that disaster preparedness is an important

consideration in the physical planning of the highly critical and highly vulnerable Island City of Mombasa.

### **(iii) The Case for the Island City of Mombasa**

As far as Mombasa Island is concerned, some of the factors that led to its choice for study over other urban centres in Kenya include:

- **Limited Access:** Being an island city, with limited accessibility, it needs as much as possible to be self sufficient in disastrous situations where time would be of essence in containing such situations before external assistance arrives.
- **Regional Importance:** Being the oldest city in Eastern Africa, the third largest town in the region and the largest seaport with its hinterland covering the entire East and Central Africa with such vital installations like the only oil refinery in the region, it occupies a special place among the urban centres. Any disaster in Mombasa will reverberate beyond the borders of Kenya.
- **Tourist Hub:** Tourism is currently the number one foreign exchange earner in Kenya. Mombasa is the centre of the tourism industry in the country. To continue with this tradition, the town needs to have all the necessary facilities to promote the sense of safety to both its occupants, visitors and passers by.
- **Historical Perspective:** The development of Mombasa, from its genesis has closely been associated with safety. Its original name, 'Kisiwa cha Mvita', meaning 'Island of war' implies the many battles that were fought in its defence. Fort Jesus is testimony to its impregnability for centuries. Although the current threats are different from those of yesteryears, they are still, if not more, important and need to be understood so as to be countered systematically and sustainably.
- **Recent Events:** The global community, Kenya included, is still trying to come to terms with the tsunami disaster of 26.12.2004 in the Indian Ocean, the events of 11.09.2001 in New York, the Nairobi Bomb Blast of 07.08.1998, the Paradise Hotel bombing close to the Island in 2002 and Hurricane Katrina's devastation of New Orleans in September 2005. all these have heightened safety concerns on Mombasa.

- **Locational Remoteness:** Mombasa has an isolated position in Kenya, almost 500 km from the next large town, Nairobi. The small nearby towns are completely ineffectual in so far as offering any substantial help in the event of a disaster is concerned (Dyer, 1962:49).
  
- **Future Projections:** The Draft Mombasa Physical Development Plan (GoK, 1971) projected that in the long term future, the whole Island will most likely perform the function of a CBD after much of its residential and industrial activities are pushed to the North, West and South Mainlands. A high rise, high density development is envisioned, making the island prone to great losses of both persons and property in the wake of a sudden destructive event. This study holds these projections still true today.

#### **(iv) Pragmatism**

In practical terms, it is impossible on a global or a national scale to abandon disaster prone regions totally. Selecting the less dangerous site from available choices and developing measures for disaster resistance will therefore be of primary importance. It is unrealistic to suggest that all flood plains and other regions at risk should not be occupied or used for human activity. In many cases, habitation of such regions becomes a firmly established social phenomenon, and for most of the time it is an economically and socially acceptable situation. Moreover, in some regions, it may be impossible to occupy areas other than those at risk. Furthermore, humanity cannot yet prevent the occurrence and actions of the majority of disasters. However, it may be possible to prevent those phenomena from having disastrous effects or to mitigate consequences when their patterns of behaviour and the areas exposed to risk are known (UN, 1976).

#### **(v) Outcomes**

It is evident that while the availability of abundant quality information cannot guarantee successful policies and programs, the absence of such information would most likely ensure failure. This study is aimed at availing such information for use in the future planning of urban areas in Kenya (UN, 1976). Two types of policy responses were envisioned: reducing the threats through prevention and preparedness initiatives, and improving the coping capacity of vulnerable groups to enable them to deal with the threats either by adaptation or early warning (UNEP 2002).

## 1.6 Definition of Key Terms and Concepts

Whatever vocabulary is chosen to describe a situation will highlight certain themes and issues, but obscure others. The definition of any term or concept largely depends on its context of use. The following terms that are key to the current study are no exception. Their meaning here lean towards the context of disaster preparedness since the definitions have mainly been extracted from related books, reports and writings.

**Disaster:** A disaster is a serious disruption of the functioning of society, causing widespread human, material or environmental losses, which exceed the ability of the affected society to cope on its own resources, necessitating external assistance (UNEP, 2002). A disaster can also be defined as an unforeseen and often sudden event that causes great damage, destruction and human suffering. Though often caused by nature, disasters can have human origins. Wars and civil disturbances that destroy homelands and displace people are included among the causes of disasters. ([www.disasterrelief.org/Library/Dictionary/](http://www.disasterrelief.org/Library/Dictionary/)). It is any real or anticipated occurrence which endangers the lives, safety, welfare and well-being of some or all of the people and cannot be brought under control by the use of regular Municipal/Local Government services and resources. Major disturbances in the life of a community or population which are sufficiently destructive to leave their record in the 'genetic memory' of the population ([www.cogsci.princeton.edu/cgi-bin/webwn](http://www.cogsci.princeton.edu/cgi-bin/webwn)).

**Preparedness:** Preparedness refers to all measures and policies taken before an event occurs that allow for prevention, mitigation, and readiness. Preparedness includes designing warning systems, planning for evacuation and relocation, storing food and water, building temporary shelter, devising management strategies, and holding disaster drills and exercises. Contingency planning is also included in preparedness as well as planning for post impact response and recovery ([www.ben.edu/semp/htmlpages/glossaryp1.html](http://www.ben.edu/semp/htmlpages/glossaryp1.html)). It is also defined as the attempt to limit the impact of a disaster by structuring the response and affecting a quick and orderly reaction to the disaster. Preparedness is unique among all pre-disaster planning activities in that it addresses actions in both the pre-disaster phase, for example, warning as well as the post-disaster phase such as mitigation evacuation and reconstruction ([www.cdmha.org/definitions.htm](http://www.cdmha.org/definitions.htm)).

**Safety:** Safety refers to the quality of being safe. It also means freedom from danger or risk of injury, or a plan designed to prevent injury (Collins, 1993). Safety can also be defined as the state of being certain that some agent under defined conditions will not cause adverse effects. It is the degree of

immunity from physical danger or the relative protection from adverse consequences. Others say safety is the practical certainty that injury will not result from exposure to a hazard under defined conditions: in other words, the high probability that injury will not result or simply the relative freedom from harm ([onlineethics.org/glossary.html](http://onlineethics.org/glossary.html)).

**Security:** Security, on the other hand, refers to the physical measure designed to safeguard personnel, equipment and facilities and to protect it against sabotage and damage (Schultz, 1991) The security of a system is the extent of protection against some unwanted occurrence such as the invasion of privacy, theft, or physical damage. It is also a condition that results from the establishment and maintenance of protective measures that ensure a state of inviolability from hostile acts or influences. Absolute security is impossible to achieve in practice and the quality of a given security system is relative ([www.cogsci.princeton.edu/cgi-bin/webwn](http://www.cogsci.princeton.edu/cgi-bin/webwn)).

**Vulnerability:** Vulnerability represents the interface between exposure to the physical threats to human well-being and the capacity of people and communities to cope with those threats. It is also defined as the susceptibility of a population to a specific type of event. It is associated with the degree of possible or potential loss from a risk that results from a hazard at a given intensity. The factors that influence vulnerability include demography, the age and resilience of the environment, technology, social differentiation and diversity, as well as regional and global economics and politics (UNEP, 2002). Vulnerability analysis is the assessment of an exposed populations' susceptibility to the adverse effects of a particular hazard. It also refers to assessment of any weakness that could be exploited to violate a settlement or the propensity of a population group to experience substantial damage, disruption and casualties as a result of a hazard. It is also a condition wherein human settlements or buildings are threatened by virtue of their proximity to a hazard, the quality of their construction, or both ([www.cogsci.princeton.edu/cgi-bin/webwn](http://www.cogsci.princeton.edu/cgi-bin/webwn)).

**Risk:** Risk is defined as the possibility of incurring misfortune or loss (Collins, 1993). Risk lies in the probability of exposure to one of the risk factors, which can occur with varying severity at different geographical scales, suddenly and unexpectedly or gradually and predictably, and to the degree of exposure. It is the probability or likelihood of occurrence of an adverse effect or event. It is, actually, the product of: (1) the probability that an adverse effect or event will occur under specific circumstances of exposure and: (2) the probability that those specific circumstances of exposure will be realized. In quantitative terms, risk is expressed in values ranging from zero (representing the

certainty that harm will not occur) to one (representing the certainty that harm will occur) ([www.nbc-med.org/SiteContent/glossary.asp](http://www.nbc-med.org/SiteContent/glossary.asp)). It is the quantitative or qualitative expression of possible loss that considers both the probability that a hazard will cause harm and the consequences of that event. It is usually based on the expected value of the conditional probability of the event occurring times the consequence of the event given that it has occurred ([www.sra.org/gloss3.htm](http://www.sra.org/gloss3.htm)). Whether or not the true probability distribution is known, a probability distribution is selected for analysis purposes based on experience, intuitive feelings, knowledge, and the lack of knowledge ([www.ess.bc.ca/glossary.html](http://www.ess.bc.ca/glossary.html)).

**Emergency:** It refers to an unforeseen or sudden occurrence, especially of danger demanding an immediate action (Collins, 1993) Emergency is defined as (a) Life-Threatening - A situation or occurrence of a serious nature, developing suddenly and unexpectedly and demanding immediate action to prevent loss of life. (b) Operational - An unforeseen combination of circumstances that call for immediate action, but not life-threatening. Also (1) Any occasion or instance--such as a hurricane, tornado, storm, flood, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, fire, explosion, nuclear accident, or any other natural or man-made catastrophe that warrants action to save lives and to protect property, public health, and safety (FEMA, 2004). (2) A sudden occurrence demanding immediate action that may be due to epidemics, technological catastrophes, strife or to natural or man-made causes (WHO).

## **1.7 Scope and Limitations of the Study**

### **(i) Concept**

Since to the best of the author's knowledge, no work has taken this direction before in this school, the challenges and limitations were several. It does not attempt to discuss Disaster Management which, in addition to preparedness, comprises several other stages such as prevention, early warning, mitigation, response, evacuation and reconstruction. It also does not attempt to discuss preparedness against all types of disasters, not even in Mombasa, which by their sheer diversity, can only be tackled by several reports, each dealing with a specific kind of disaster. The present study could not so complicate itself and remain focussed. The study is limited to the concept of Disaster Preparedness only, which is found to be an inclusive concept since it encompasses both pre and post disaster phases.

### **(ii) Level**

To be comprehensive, Disaster Preparedness has to be discussed in at least three (3) levels:

- **Private/Individual Level:** This is the lowest level of preparedness and it occurs at the individual level using one's own resources, eg the person, the household, the business, industry etc.
- **The Municipal Level:** This is the level that the local authority is largely responsible for. Here the preparedness is looked at through what can be termed the Municipal Resources. These are the resources in the hands and control of the local authority.
- **External Level:** This is the level, when resources external of the local authority are required to bring an event under control. This is when municipal resources are unable to cope with the situation.

This study concerned itself with the Municipal Level of Preparedness. Only the Municipal resources were looked at in detail. The other levels, important as they are, were discussed only in as far as they augmented the Municipal Resources, by looking at the institutional framework available or needed to integrate them when the need arises. This is because the Municipal Council, being both a planning and an implementation authority is the one with the mandate to plan and the capacity to implement the resultant recommendations.

### **(iii) Physical extent**

The study, also, only examined the Island City of Mombasa (Mvita) to the extent defined by the physical delineation of the island. The mainland areas of the city were considered in as much as they offered linkages, comparisons and in placing the Island in a regional context.

### **(iv) Scope**

Although a number of factors are likely to affect the safety of the public within Mombasa Island, this study limited itself to the examination of the following four (4) factors that, in this context, were considered the core in planning for disaster preparedness within Mombasa Island City:

- The vulnerability of the population and other physical developments to probable disasters within Mombasa Island City.
- The adequacy of disaster preparedness facilities in Mombasa Island City.
- The nature and level of public awareness, perception and preparedness to disasters in Mombasa Island City
- The planning, policy, legal and institutional framework within Mombasa Island City for disaster preparedness.

## (v) Types of Disasters

Furthermore, the types of disasters considered are those from sudden and violent phenomena necessitating quick action otherwise known as *acute* or *rapid onset* disasters. This study did not concern itself with the *slow onset* or *chronic* type of disasters of a long-term nature. Those most probable in Mombasa Island City, as per the field survey, include: fires, industrial explosions, tidal waves and terrorist attacks. Others are the capsizing of ferries, traffic accidents, oil spills and collapse of buildings.

## 1.8 Methodology

### (i) Research Stages

This study adopted a systematic approach to the problem by way of the following four stages:

**Preparation:** The preparatory stage consisted of analysis of existing secondary data that included literature review on urban safety. Special attention was paid to public policies and programs promoting safety, legislative and regulatory framework. This was from published books, research papers, articles in magazines, journals and newspapers and the world wide web (internet).

**Data Collection:** The basic stage involved gathering the primary data. Stakeholders in the field were contacted in order to improve the analytical framework. Qualitative and quantitative data was collected through, among other methods; field observation, questionnaires, focus group discussions and in-depth interviews with stakeholders.

**Analysis:** The Analysis of the data was carried out using various statistical/analytical tools. Assessment and measurement of vulnerability was done using statistical tools such as Excel. This identified the location of vulnerable populations, the threats to their well-being and the extent of their vulnerability. Vulnerability Index for the entire Municipality was developed from the viewpoint of contingent conditions such as: population density, poverty and developmental density. Preparedness facilities such as: accessibility, open spaces, medical facilities, security installation, fire fighting facilities and other public facilities were considered. Appropriate interventions were then proposed.

**Presentation:** The final part is Presentation stage of the findings and policy options as recommendations for the provision of urban public safety mechanisms for disaster preparedness. This included recommendations on preventive steps that can be taken to improve physical conditions and



reduce the negative impacts of probable disasters. This information was then assembled into a Planning Matrix for Integrating Disaster Preparedness for the Sustainable Physical Development of the Island City of Mombasa (see Chapter Four), a knowledge base that is accessible, scientifically reliable and easy to use, which can help policy-makers and planners seeking to formulate adequate responses.

## **(ii) Research Design**

Any phenomenon can be studied from three perspectives: First it can be studied as a component of a wider concept. In this case Disaster Preparedness can be looked at as a component of Disaster Management. Secondly, it can be studied at its own level of analysis. Thirdly, it can be studied from its constituent parts. In this case Disaster Preparedness can be studied from the elements that would present vulnerabilities against those that would annul or mitigate the effects of these thus facilitating readiness (Prewitt, 1975). This study was conducted, mainly, on the third perspective. In order to appreciate the wider context of disaster preparedness, the research is divided into four (4) parts:

**Geo-Spatial Analysis:** An analysis of the location, physiography, existing population distribution physical development and land uses within the island was done from observations during reconnaissance visits and documented sources. This was discussed in general against established and acceptable standards as analysed by the author through literature review and interviews. From this analysis using predetermined vulnerability criteria, a Vulnerability Index was developed for the Municipality. A Mitigation factors were also considered using preparedness facilities in the island. Comprehensive analysis showed the Island as being more vulnerable than the three mainland parts (see Chapter 4). Closer analysis of the Island itself showed settlements in Old Town, King'orani, Tudor Estate and Kaloleni to be most vulnerable.

**Public Perception:** This dealt with the primary data that mainly sought to establish the awareness and perception of the probable threats and preparedness of the Island City of Mombasa. First, household Questionnaires were administered in the four neighbourhoods mentioned above. Second, general public survey was conducted through questionnaire-guided interviews to members of the public all around the Island. Third, focus group discussions were held with Chiefs, assistant chiefs and headmen together with elders and representatives from all the seven locations in the Island (see Methodology).

**Policy, legal and Institutional analysis:** This sought to analyse the implementation of disaster preparedness initiatives from the different stakeholders including the policy and regulatory

environment. Interviews were held with different stakeholders in Mombasa (see Organisations Consulted).

**Recommendations:** Recommendations were made in view of the analysis of the information, both primary and secondary.

### **(iii) Justification**

The choice of the study area was based on the sensitivity to the Islanders who were perceived to be the most vulnerable to disasters and more so when they lack the necessary infrastructure.

### **(iv) Delineation**

The study area is defined by the administrative delineation of the Island Division of Mombasa District. The island, a largely mixed-use neighbourhood, has developed over time for residential, administrative, industrial, storage and commercial land uses. It presented a formidable context for disaster preparedness arising from the ageing and deteriorating physical fabric in addition to the over-shot population and development densities, together with some very high poverty levels in the face of rapid urban growth and expanding urban population.

### **(v) Subjects**

In the selected study area, the subjects of observation included the entire population of the island. It also included all the physical, environmental, infrastructural, social, cultural, political, economic and institutional aspects of vulnerability to the urban neighbourhoods that have the common observable characteristics of justifying the need for disaster preparedness. The target spatial unit was the entire Island Division of Mombasa District, which if up-scaled is considered to be representative of the entire urban centre whose delineation is the perimeter of the Municipality of Mombasa, whose boundaries coincide with those of the District.

### **(vi) Population**

The target population of this research were all the residents and institutions (both local government and non-government) that have stakes in the island town of Mombasa. In identifying their roles and responsibilities the research drew random samples from the accessible population from the study area. The units of observation included facilities for disaster preparedness such as medical, security and fire management facilities, open areas and accesses. They were studied in relation to their quantities,

location, distribution and capacity. This was in relation to the potential vulnerabilities such as: development and populations densities, industrial and warehousing facilities, flood, fire and accidents prone areas. The role of external support agencies such as professional organisations, research and academic institutions, civil defence institutions and international humanitarian organizations was also considered. The study area, exhibiting all known urban land uses was considered to be representative of any urban neighbourhood unit as a cellular urban planning unit and was thus to allow for generalization of results.

#### **(vii) Sampling procedure.**

Vulnerability Analysis of the urban land use within the entire Municipality of Mombasa indicated that the Island segment of the urban fabric required the most urgent attention towards disaster preparedness. This rationale was, further, under pinned by the fact that previous studies and ground reconnaissance indicated that parts of the study area, such as the Low Density Swahili Residential Neighbourhoods like Majengo, King'orani were earmarked for, and are actually already undergoing, urban renewal and densification (Swazuri, 2002). Due to financial resources, time constraints and the wide geographical area it was found prudent to further sample the accessible population within the Island through further Vulnerability Analysis. The sampled spatial units constituted of the most vulnerable neighbourhoods within the Island. These were observed as the study areas in order to examine the rationale for urban disaster preparedness.

#### **(viii) Units of Observation**

The units of observation within the institutional framework included all households, individuals, Municipal Council of Mombasa's officers within the departments concerned with physical planning, the Fire Fighting Department, the agencies of central government such as Department of Physical Planning, the Disaster Management Unit in the office of the President, the Military, the Kenya Police, the Kenya Ports Authority, the Kenya Ferry Services, the Kenya Oil Refinery, the informal and formal private sector, the local provincial administration, the community elders and leaders, the civil society organizations and external support agencies such as the St John's Ambulance. For residents, a combined stratified random sampling and simple random sampling was used to ensure that each resident is eventually given an equal chance of being included in the sample.

#### **(ix) Data Needs and Sources**

Secondary data has been availed through relevant pertinent literature on disaster preparedness in order to offer retrospective information on the topic in the manner of:

**Conceptual Framework:** This was important in providing information on what has been done and found out about disaster preparedness. A historical evolution of disaster preparedness in the developed and the developing countries was useful in making a comparative assessment. This enabled the identification of its applicability or lack of it in a Kenyan situation. The theoretical perspective is relevant in prying into the causal problems on the various aspects of an urban environment that made it justifiable to undertake preparedness initiatives. The potential benefits and positive implications of undertaking disaster preparedness were highlighted.

**Approaches:** Equally worth reviewing were the various approaches towards disaster preparedness including the processes that have been applied in providing successful solutions to the implementation of disaster preparedness programmes in America, Europe, Asia and Africa. The underlying causes to the failure of some of the approaches were useful in analysing the gradual evolution of contemporary models. This formed a basis for the researcher's personal conceptualisation of the appropriate framework for undertaking disaster preparedness in the Island City of Mombasa.

**Background Information:** Historical documentation on Mombasa and specifically that of the island component was useful in providing background information on its origin. The changes that have taken place on the time scale are important in situating the island within the historical context, the existing situation and its development challenges.

**Primary Data:** Primary data was availed from the study area in order to provide empirical evidence of the existing status and the immediate problems, felt needs and concerns. The aspects to be examined included the existing physical and environmental situation, the housing and community facilities, the infrastructure services, the social, the cultural, the political and the socio-economic situation of the area. An examination of the institutional framework of the internal and external environment of the study area was useful in identifying the roles and responsibilities of all the key stakeholders that have potential stakes in Mombasa Island City.

#### **(x) Methods of Data Collection and Analysis**

The main tools for both quantitative and qualitative data collection for the survey included observation, photographs, drawings and maps which were useful for collecting data on the existing nature of the physical and the environmental aspects. Maps and demographic data for the study area were useful in analysing the land-use intensity and densities. Structured household and institutional questionnaires,

Open-ended questions and interview schedules were also useful in offering an in-depth understanding of within the island including the social and cultural characteristics of the study area. Qualitative data collection was done through interview schedules and focus group discussions with persons and institutions that have stakes in the Island City of Mombasa who included all the Chiefs from the Island and representatives from the different neighbourhoods. Additional qualitative data was gathered from personal contact with previous researchers on both the topic and the study area which was relevant in finding out how to resolve the difficulties of the organization and management of disaster preparedness and to understand the socio-economic conditions of the local community. This gave the research a holistic picture and a complete perception of the government and non-government institutions on the appropriate methodology of preparedness.

#### **(xi) Specific Sources**

Specific sources were visited for specific information as detailed in the attached Interview Schedule (See Appendix 1)

#### **(xii) Data Analysis**

The data collected from the structured household and institutional questionnaires was coded, cleaned and analysed using Excel. In order to examine the emerging characteristics of the neighbourhoods a cross-tabulation of the data was undertaken. The analysis of both the qualitative and the quantitative data collected was presented using simple frequency distributions and analytical tables. The analysis of the qualitative data collected was presented by use of maps, plans, sketches, illustrations and photographs. Conceptual models were equally used to illustrate data, which was discussed in descriptive analysis. The in-depth interviews were then analysed and organized. The overall information and findings were finally interpreted and synthesized to facilitate the writing and composition of this research thesis.

### **1.9 Organisation Of Research Report**

The research, owing to the obvious limitations as mentioned in the scope, was not expected to be so comprehensive or detailed but was to endeavour to be adequately representative. In so doing, the study was to comprise of, the following six (6) chapters:

### **(i) Introduction**

Chapter One initiates the study and offers information on disasters, the types and their impacts on human settlements. The need to integrate disaster preparedness in planning is justified. The challenges to urban planners with respect to disaster preparedness are noted. Methodology of carrying out the study is outlined

### **(ii) Literature Review and Conceptual Framework**

Chapter Two gives information on what has been going on in the field of disaster management at the global scale, nationally as well as locally. The diverse initiatives, both previous and current and their perceived shortcomings and strengths are discussed with a view to enabling the researcher to get a personal conceptualisation of the theoretical framework to guide the rest of the study.

### **(iii) Background to the Study area**

Chapter Three gives an overview of the historical evolution of Mombasa Island City, its origin and transformations that have occurred over time and the current status of the Island City. Analysis of this secondary data together with physical and social surveys of the study area indicates the existing nature and level of disaster preparedness of Mombasa Island City

### **(iv) Vulnerability of the Island City of Mombasa to Disasters**

Chapter Four will seek to analyse the existing geo-spatial situation of the Island City in relation to location, physiography, population and physical developments with a view to developing both vulnerability and mitigation factors for the Island. Further, an in-depth analysis of both the primary and secondary data as regard the Study Area is devoted to assessing the public perception, awareness and understanding of the level of preparedness within the Island. This chapter will seeks to answer research questions one (1) two (2) and three (3).

### **(v) A Framework for Disaster Preparedness in Mombasa**

Chapter Five recognises that disaster preparedness is both multi-sectoral and temporal. It seeks to identify all stakeholders and propose a framework to guide programmes on the appropriate planning, policy, legal and institutional framework for managing the integration of the disaster preparedness process in Mombasa; Best practice principles (planning framework) are established against which the study area is analysed.

**(vi) Conclusion and Recommendations**

Chapter Six, finally, makes a synthesis of the findings, draws conclusions, makes recommendations and outlines areas for further research.

## CHAPTER TWO

### LITERATURE REVIEW, THEORETICAL AND CONCEPTUAL FRAMEWORK

#### 2.0 Introduction

Literature on disasters and their management has recently become very extensive. This has resulted from recent disastrous events of global magnitude such as Hurricane Katrina that submerged New Orleans in September 2005, the Tsunami of South East Asia on 26 December, 2004, that killed over 150,000 people, the bombing of the World Trade Centre in New York on September 11, 2001, the bomb blast in Nairobi that targeted the US embassy on 7 August, 1998 and similar terrorist activities, the volcanic eruptions that nearly buried the Congolese town of Goma a couple of years before, the extensive floods that devastated southern Africa at the turn of the new century, the El-Niño phenomenon that wrecked havoc in eastern Africa about the same time and so on. Consequently this study is able to take it that its theoretical basis is largely now being established. Nevertheless there are gaps and some concepts have been superseded. There are also experiences and descriptions, which can be added to an increasingly rich spectrum of understanding of relationships with hazards. This study may be a small contribution to that process.

The literature review presented here looks globally at issues affecting the safety of urban centres and tries to relate these specifically to the Island City of Mombasa. Further, it looks at the disaster preparedness initiatives in Kenya and narrows these to the Island City of Mombasa itself. The detailed literature review includes library case studies from other regions in the world.

#### (i) Global Overview

Globally, disaster losses have increased dramatically during the 1990s. These losses are reflected in widespread property and environmental destruction, as well as human impacts. The popular view is that extreme natural conditions or 'acts of God' cause disasters. However, more and more people are now beginning to wonder whether the 'Almighty' is really the culprit. Whether human economic activity is to blame is still a matter of uncertainty. What is in no doubt is that bad decisions have amplified human suffering and the economic cost of so-called 'natural' disasters. In fact, there is mounting consensus that disasters occur as an outcome of natural and human induced processes (UNEP, 2002:270). It is in fact, human action or inaction that is primarily responsible for transforming 'natural'



hazard into 'unnatural disasters'. The poor are the most vulnerable to disasters because they have fewer resources and capacity to prevent or cope with the impacts. The following examples from *Earths Report* (OneWorld.net, 2005) suffice to clarify the point:

- **Stripping Away Nature's Defences**

When Hurricane Mitch hit the Caribbean in October 1998 the damage left in the wake of the tropical storm was, for the Central American state of Honduras, a human catastrophe. One year later a 'super' cyclone hit the Indian state of Orissa, leaving 10,000 dead, whole villages washed away and local agriculture destroyed. These poor communities were not just victims of 'natural' events. The human suffering from these climate-related disasters was exacerbated by man's meddling with already fragile environments. When Orissa's mangroves were cleared to make way for shrimp farms, the coast lost its natural shield leaving an unfettered path inland for the cyclones that regularly batter its shoreline. In Honduras, years of extensive logging had left mountain soils unprotected and eroded which the ensuing deluge swept down hillsides, burying whole villages in rivers of mud.

- **Cut Price Construction on Shaky Ground**

On the seventeenth of August 1999, the North Anatolian Fault slipped three metres towards Greece in the west, bringing most of Turkey with it. In the minutes that followed, building after building crumbled into piles of rubble, leaving 17,000 dead. In the wake of the disaster, Turkey's Prime Minister was forced to acknowledge that cut-price construction (and the government's failure to enforce safe building standards) was responsible for the death toll. Now, alarm bells are ringing for urban planners around the world. Forty of the world's fifty fastest growing cities are in earthquake zones - and many have substantial poor populations living in shanty towns or low-cost housing.

- **Civil Engineering's Hall of Shame**

Although ninety-six per cent of disaster deaths occur in developing countries, unnatural disasters are not the sole preserve of the poor. In 1997 the River Oder in Germany burst its banks as floodwater from Poland surged through the river system swamping fertile farmland and 20,000 homes. The cause: upstream, wetlands and marshes - nature's safety valve when rivers flood - had long since disappeared under concrete. Just five years earlier, America's mid-west lay submerged under the floodwaters of the Mississippi - America's most heavily engineered natural feature. With nearly 80% of the riverine wetlands drained and channel leveed, the floodwaters of 1993 had no natural escape. Floodwalls were breached and whole towns swamped. For the same reasons, was New Orleans drowned in September 2005.

## **(ii) Regional Disaster Preparedness**

**Africa:** Globally, Africa suffers the least damage from disasters in purely financial terms but the significance of such losses may actually be greater in terms of impact on economic development. In Mozambique, for example, the costs of floods in 2000 were estimated at US\$ 273 million in physical damage, US\$ 247 million in lost production, US\$ 48 million in lost export and US\$31 million in increased imports.

**Policy responses:** There have been no concerted regional efforts to manage disasters. Disaster responses in Africa have tended to focus on national and sub-regional levels. Efforts have also concentrated on responses rather than mitigation through improved environmental management, agricultural practices and physical planning (UNEP, 2002).

**Asia and the Pacific:** About 75% of the world's major natural catastrophes between 1970 and 1997 occurred in the Asian and the Pacific region, mostly in poverty – ridden developing countries. There has been a general upward trend in the number of natural disasters due to hydro meteorological events (such as cyclones and flooding) in the region, while geophysical disasters such as volcanic eruptions; earthquakes and tsunamis have remained fairly steady. Here, vulnerability to disasters is closely linked with population density and economic resources.

**Policy responses:** Asian countries are at different stages of institutional development with respect to disaster reduction. Some, such as Japan have a long-established system of disaster management. Stimulated by the International Decade for Natural Disaster Reduction (IDNDR), other countries, such as Viet Nam, have either strengthened existing frameworks or are formulating new ones (UNEP, 2002).

**Europe:** Disaster resulting from natural and human-caused hazards occur throughout Europe. The overall consequences depend on both the magnitude of the event and on factors such as population density, disaster prevention, preparedness and response measures and emergency planning. Europe generally suffers less from disasters than many developing countries, due to a higher level of 'coping capacity' in terms of government ability to prepare and respond to disasters. Human-caused disasters cause more human fatalities and economic losses than natural disasters in Europe. Despite overall higher technological and safety levels, the number of industrial accidents in the European Union continues to rise.

**Policy responses:** For many technological disasters, holistic approaches are becoming more prevalent, with increasing attention to reducing the risk of long-term environmental impacts

as well as reducing acute health and property damage from accidents. Since population does not stop at political boundaries, one of the most important multilateral agreements in this respect is the 1992 Helsinki Convention on the Protection and Use of Trans Boundary Watercourses and international lakes, which entered into force in 1996. This convention includes requirements to conduct Environmental Impact Analyses (EIAs), to notify downstream states of accidents and it enforces the 'polluter pays' principal. The 1991 convention on environmental impact assessment in the Trans boundary context, which entered into force in 1997, requires parties to notify and consult each other on all major potentially dangerous ongoing projects. Most European countries are parties to these multilateral treaties, and international cooperation under their provisions help governments improve national policies in respect of human – caused disaster prevention and mitigation (UNEP, 2002).

**Latin America and the Caribbean:** In Latin America and the Caribbean, the main natural hazards are, hurricanes, cyclones, tropical storms, floods, tidal waves, avalanches, landslides and mudslides, earthquakes and volcanoes. Mining and oil spill accidents represent the main human-caused disasters in the region. The number of deaths due to disasters declined markedly between 1972 and 1999, coinciding with the global trend. This trend can be explained by fewer severe earthquakes in densely populated or highly vulnerable areas and by the establishment of early warning systems and disaster-preparedness measures in some countries over the past 30 years. Economic losses caused by disasters increased by almost 230 % between the 1960s and the 1990s again reflecting the global trend.

**Policy responses:** Many countries, especially those located on islands, are vulnerable to natural disasters. The major concerns with regard to policy include the following:

- Deficiencies in disaster prevention, including the lack of zoning of vulnerable areas during the development planning process;
- Weak mitigation mechanisms;
- Deficiencies and limited use of anti-seismic building measures, as well as inadequate administrative arrangements and human resources for enforcement;
- Lack of insurance policies for low-income households; and
- Inadequate support systems for affected communities.

Several countries in the region have created and strengthened national institutional frameworks in the areas of disaster management. These include the Centre for Coordination of the Prevention of Natural Disasters in Central America, established in 1988, and the

Caribbean Disaster Emergency Response Agency, established in 1991. Under the auspices of the Organization of American States, the Inter-American Convention to Facilitate Disaster Assistance was adopted in 1991 and entered into force in 1996. The fundamental element is to strengthen and standardize data production methods at a regional level, not only to prevent inconsistencies during emergencies but also to assess losses. Also important are efforts to identify the vulnerability of the territories and populations when faced with natural and human-made hazards. The prevailing disaster response is directed towards risk management. It has a growing component of local and community participation, and makes non-centralized use of non-governmental organizations and citizen groups. Within this framework, a new vision is emerging: the development process must reduce risk by lessening populations' and territories social, economic and environmental vulnerability (UNEP, 2002).

**North America:** Natural hazards such as earthquakes, volcanic eruptions, tornadoes, hurricanes, ice storms, dust storms and other extreme events threaten different parts of North America. Floods and forest fires are also priority concerns. North American governments have put in place many response mechanisms to prevent and alleviate the harm caused by such factors. Despite strong regulations governing the handling of hazardous material, occasionally serious accidents occur.

**Forest fires:** Forest fires are a natural part of North America's landscape and play an important role in maintaining and regenerating some types of forests. As a result of stricter controls, species and dead trees normally eliminated by fire became dominant. Dead trees accumulate during periods of drought, creating excessive fuel loads. Fire suppression prevented natural low-intensity fires from burning this accumulated fuel. The result is increasingly large and disastrous fires. The importance of periodic natural fires began to be recognized in the 1970s. Prescribed burning and 'let burn' policies to reduce built-up fuels and protect settlements and business were introduced (UNEP, 2002).

**West Asia:** West Asia is arid and vulnerable to drought, with rainfall scanty and variable. Nearly 80% of the region is classified as semi-desert or desert. Drought is the most important natural disaster in the region. Human induced disasters are mostly associated with the oil industry. Intensive oil extraction in the region results in frequent oil discharges into the gulf. However, the biggest oil spill took place in January and February 1991, during the 1990-91 Gulf War, when 9,500 million litres of oil were deliberately released in the desert. An estimated 1,500 million litres of oil were released into gulf waters and more than 600 Kuwaiti

oil wells were set on fire. This human made disaster had enormous impacts on the environment and human health. The long-term environmental effects of the Gulf War may persist for decades.

**Armed conflict:** Along with natural disasters, the region has been plagued with wars. Since the beginning of the 20<sup>th</sup> century, the region has witnessed the 1948 Arab Israel War, the 1967 Six Day War, the 1973 October War and the Israel invasion of southern Lebanon in 1982, in the 1980s and 1990s, all inducing disasters (UNEP, 2002).

## 2.1 Disaster Phases

As it can be seen, disaster related vulnerability (susceptibility to disasters) is shaped as much by social and economic factors as it is by climatic or other threats. Communities that are economically and socially resilient are better equipped to withstand the impact of a threat. At-risk communities and households in congested peri-urban settlements and isolated rural areas are often least able to protect themselves against the recurrent threats of drought, heavy rains, flooding, epidemic risk and house fires. They face increased risk of death, injury, illness, and income and property loss. A disaster occurrence worsens existing vulnerabilities, and can seriously undermine development gains and investment. Past approaches to managing disaster risk have focused on five main areas for intervention:

- Disaster *prevention* which refers to measures taken that ensure permanent protection from harm.
- Disaster *mitigation* that refers to policies and activities that reduce an area's vulnerability to damage from future disasters.
- Disaster *preparedness* involves building a response and management capability before disaster occurs to facilitate an effective response when needed.
- Disaster *relief/response* refers to actions taken immediately before, during and after the onset of major disasters to minimise loss of life and harm to people and their property and enhance the effectiveness of recovery.
- *Reconstruction/recovery* refers to programme that provide longer-term assistance for the people who have suffered injuries and incurred losses due to a major disaster. (Nomdo, 2002:134).

There is need for a comprehensive approach to managing disasters in all areas of human settlements, more so in urban centres around the world. A comprehensive approach means considering all issues related to disasters as outlined above. To understand the disaster

preparedness process and what is involved, we need to understand the nature and characteristics of disasters and to be able to analyse the various factors that cause and shape their development throughout the world. Such factors are both constant and variable. On the one hand settlements develop within the limit of constant physical factors such as location, topography, climate, and available local materials. On the other hand, variable social, economic and political needs and priorities as well as technological and security developments continue to transform the shape of cities over time (Mugwima, 2004).

In the course of history, cities change. From defensive bastions, some become commercial centres. Generally, the process that reshapes cities is affected by three main influences:

- Incremental and sporadic development through limited repair and rehabilitation projects, carried out according to individual needs.
- Sudden major events, whether natural disasters such as earthquakes and floods or man-made ones such as wars or civil disturbances and accidents. Such contingencies require intensive redevelopment and reconstruction during a short period of time.
- Carefully planned initiatives by local and central authorities for a comprehensive program covering all sectors related to development of the city including disaster preparedness (Mugwima, 2004). This is the proposed practice.

## 2.2 Definitions of Disaster

To understand disaster preparedness, we first need to understand what constitutes a disaster. Disasters are not wholly natural or 'acts of God'. An 'act of God' is defined as *a sudden and inevitable occurrence caused by natural forces, such as flood or earthquake* (Collins, 1993). It is also elsewhere defined as *the operation of largely uncontrollable natural forces* (Baird, 1975). But this, as earlier discussed, is not the most important element of any disaster. If this definition alone does not, therefore, adequately encompass the nature of disasters, then it is necessary to look more closely at the scope of definitions of 'disaster'.

Disaster is one of the most amorphous concepts in the English language, according to Baird (1975), but four different groups of meaning have been distinguished, namely:

- i. Disaster often refers to the disaster *agent*, e.g. a hurricane, an earthquake, etc.
- ii. Disaster often refers to the *physical impact* which the agent has, e.g. damage to property, loss of life etc.

- iii. Disaster can mean the *evaluation* of the physical event: in other words, evidence of physical damage is evaluated as being disastrous.
- iv. Finally, disaster can also mean the *socio-economic disruption* created by the physical event.

In a practical context, the definition of disaster adopted will reflect the orientation of those involved in a disaster situation. The Disaster Research Unit, University of Bradford, leans towards identifying the socio-economic disruption created by the physical event and towards a philosophy of planning to minimize the effects of extreme natural or man made hazards. This is the definition that has been adopted by the UN. Their definition of disaster contains both recognition of the nature of extreme physical events and the state of human society including the preparations and adjustments that society makes to the possibility of disaster occurrence. They strongly argue that disasters occur at the interface of extreme natural phenomena and vulnerable settlement patterns. The 'act of God', the operation of largely uncontrollable forces, is, according to them, clearly seen as only one element of disaster events. The factor of paramount importance is the state of the population for without people there can be no disaster. According to them, if a hurricane were to strike an uninhabited Caribbean island one would not define the event as disastrous even if several valuable plant and animal species were destroyed (Baird, 1975). Lewis (1999: viii) sums it when he says that 'a disaster is not a physical happening, it is a social event'. Elsewhere, a disaster incident is defined as an event triggered by a natural or human induced hazard that combines with underlying factor of vulnerability exceeding the ability of a household, community or country to cope without utilizing external assistance (Nomdo, 2002:134).

Previously, most research however has had a different emphasis; less than 10% of the research has been people oriented. The concentration of research efforts and monies has been on technology rather than people. The emphasis has been on the extra-ordinary conditions that prevail during and after a disaster, extraordinary conditions which only advance technology could deal with, it was felt. This position is in consonant with that by the ASAIID who tended to look more at the event itself as an extreme physical phenomenon in scientific terms. It did not concern itself much with the losses and where it did it emphasised them only in terms of death, injury and dollar damage. The environmental, psychological and long-term socio economic effects were not considered. In fact the Natural Hazard Research Group in the US limited the definition of disaster to satisfying the following three conditions; at least

1,000,000 dollars damage with at least 100 dead and 100 injured. It went ahead to consider a serious disaster as that covering  $10^{\circ} \times 10^{\circ}$  of longitude and latitude (Baird, 1975).

The two positions above bring about the following important points: that there is no common definition of disaster; that there is no universal scale of disasters and there are no agreed measure of losses to qualify an event into a disaster.

This research subscribes to the view that a more valid approach to disaster research would be to see disaster as the extreme situation which is implicit in the everyday condition of the population. Drought for instance, is too little water and flood is too much water. Drought and flood are therefore the extremes of this everyday condition, water. It is as important, therefore, to define the specific disaster situation as merely an extension of the everyday situation. Only with such an ecological definition, a definition that focuses on man, within his environment, will it be possible to produce effective pre-disaster planning (Baird, 1975:1). It is clear then that disasters are about people and, if disaster research is to have any meaning, it should be focused on people.

### **2.3 Some Concepts about Disasters**

**Mutuality of Disasters:** The first important fact that must be understood are the type of hazard events that would encourage disasters. Generally, disasters are the consequences of two different kinds of phenomena:

- Events induced by natural physical processes.
- Events induced by human activities and habitation.

This is not to imply that the two kinds of disaster sources are mutually exclusive. In fact almost all disasters will always have an elemental contribution from both sources. This means the two types of disasters must, of necessity, be looked at together.

**Chaining of Disaster Events:** It is seldom that only one kind of disaster hits a settlement and its population. In the majority of cases, a chain of events develops and the final disastrous outcome is a cumulative effect of sequential phenomena and forces. Further, when a catastrophe is a combination of various actions of forces and elements, often an action in progress may not only 'open the door' to what follows, but may make what follows more



destructive than when it occurs by itself. Examples of the most common chains of disastrous events are as follows:

- Rainstorm: flood, contamination of portable water, and as a final result, a plague.
- Earthquake: landslide, flood
- Earthquake: fire, conflagration.
- Earthquake: tsunami, floods in distant locations, contamination of water.
- Cyclone: flood, contamination, plague.

Nearly every catastrophe, by destroying existing structures, installations and storage areas may cause dangerous contamination of water and air. Original damage caused by natural forces affects human beings not only physically but mentally. Some people's actions tend to be careless, spontaneous or uncoordinated, which leads to further man-made catastrophes. The chain reaction in many catastrophes is a common and dramatic one. The two kinds of interaction develop between various kinds of disasters and elemental forces causing secondary disasters of human origin (UN, 1976:7).

**Contextuality of Disasters:** This study is based on the viewpoint that there are disasters, but they are part of their contexts; they may be major, but they are not discrete. Not only are they part of their contexts, they are in part caused by their contexts. Contexts are not only physical but social, institutional and political as well. Just like madness, until the 17<sup>th</sup> century, madmen lived alongside their sane fellows; like disasters, madness was an ever-present force, which was not excluded from everyday life. 'Madness' was only later invented, isolated and then treated by the 'dominant viewpoint' (Lewis, 1999: xi).

**Reporting of Disasters:** Disasters make news. Suddenness and disasters affecting national and regional capitals are likely to command headline attention and may occupy prominent positions in national newspapers for several days. Other disasters, of similar impacts but in less topical or 'newsworthy' countries or regions may receive only brief accounts, not commensurate with their magnitude. Disasters are news, but not all disasters have the same news value. Many major disasters are not given significant news coverage, but many minor ones are. Just reporting the magnitude of a disaster does not convey its impact, for fair understanding of the relative impacts of disasters, the following must be adopted in its reporting:

- The reporting must be led by the media local to the incidence which is likely to give

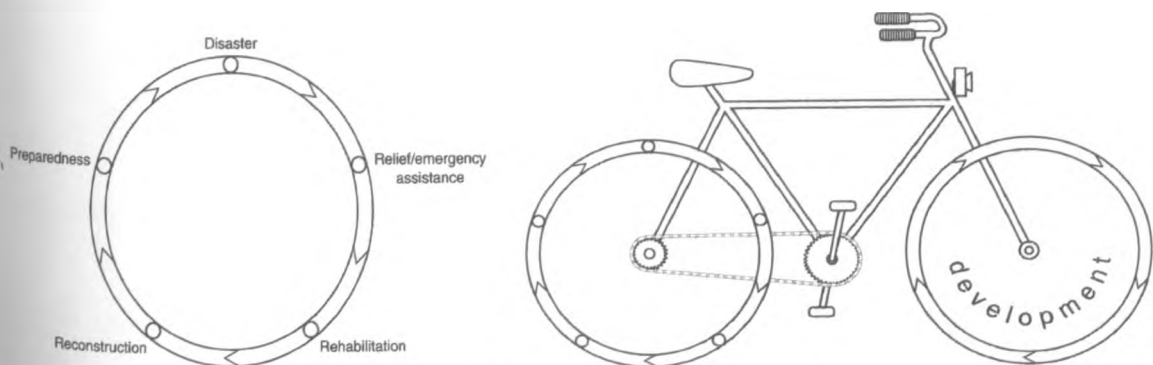
the actual impact rather than the case where the outside media leads the reporting, in the event focusing only on the sensational and plain magnitude.

- Ratios of impact can also be made, either locally, regionally, or nationally according to availability of base data such as population or housing. The national, regional or local impact of a disaster can then begin to be demonstrated.
- Comparisons of country size are another crude indicator of national disaster impact. The impact of disaster, of similar or comparable geographical extent, on a small country will be far greater than the impact on a larger country (Lewis, 1999:45-46).

**Bicyclicality of Disasters:** For a single disaster event, disaster, reconstruction and development are in fact cyclical. For several disaster events the cycles overlap. Rarely does a disaster commence a process that leads to development; instead development has invariably preceded disaster and had a bearing on the extent and implications of the disasters that ensued. It has been the practice to refer to ‘the disaster cycle’, in which disaster, seen usually as the trigger for everything else, occurred in a cyclical sequence of action back to disaster again, acknowledging that disasters could recur. But in actual sense, the triggering event should be development through disaster back to development.

As Lewis (1999) says, what the self-centric ‘disaster cycle’ did not acknowledge was that there were other sectors of activity continuing outside of the cycle. Development, or simply ‘change’ was also taking place – of its own inevitable volition or in a planned and programmed way. ‘Development’ did not appear in the ‘disaster cycle’. In fact there is not one ‘cycle’ but two; it is not a ‘disaster cycle’ but a ‘development-disaster bicycle’.

Figure 1: The Bicyclicality of Disasters



(Source: Lewis, 1999)

But according to Lewis, most bicycles have one rider who also does the steering. Whereas, the disaster cycle and the development cycle are not, driven by the same authorities. Of overriding concern is that the activities of this cycle of events are implemented by various sectors and are rarely coordinated or objectively interrelated. Activities within the development spectrum are organized and managed separately by their sector. Therefore, disaster management has become separated from the development of everyday affairs that create vulnerability. As a result, the activities of one sector may not necessarily subscribe to disaster or vulnerability reduction, which has been made the responsibility of another sector; and by ignorance of processes that subscribe to vulnerability, may actually be making things worse. Vulnerability has frequently been made, or made worse, by 'development'. For example, even at global level, there continue to be relief agencies and development agencies. There is the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), and there is the United Nations Development Programme (UNDP). Even the current proposed reorganization of the United Nations still maintains a distinction between the two groups of aid agencies, one for humanitarian affairs and the other for development.

This study, therefore, seeks to integrate disaster preparedness with development. It seeks to look at the kind of development that would make things better. More precisely the kind of development required in the first place so as to achieve disaster reduction.

#### **2.4 Rationale for Disaster Preparedness**

Many disasters, considered as distinct from the natural phenomena which cause them, can be avoided. Virtually all natural phenomena liable to cause disasters share one common feature: although it may not be possible at the present stage of scientific knowledge to forecast when they are going to happen, (except for a few hours beforehand in some cases), it is often possible to predict with a reasonably high degree of accuracy where they are most likely to occur, for example, in flood plains, seismic areas or avalanche corridors. Even in the case of such 'erratic' phenomena as tropical storms (hurricanes, cyclones and typhoons), it is known that some 90% of the human losses and damage are attributable to the action of the resultant water and not to the effects of the prevalent wind.

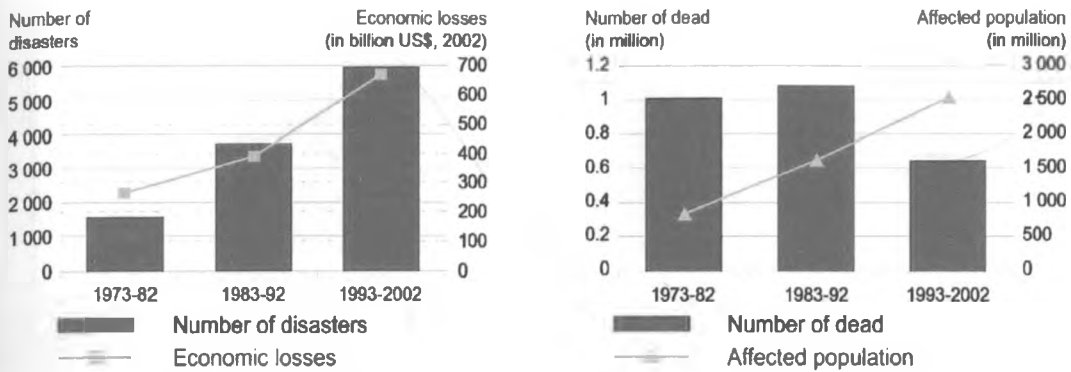
This conclusion has obvious implications for the location of human activities of any kind. There is nearly always a choice that can be made between a dangerous site and a less dangerous one. Such a choice can be encouraged or even imposed by measures whose cost is

negligible if taken in time. Examples would be the adoption and application of town and country planning laws and zoning regulations based on vulnerability studies. The key to ensuring that the best choice is made is to include in the appropriate development projects a vulnerability analysis of the region affected. Whereas expenditure on such a study is negligible in comparison with the total cost of a major development project, the 'multiplier effect' of such a preventive measure is enormous, both in terms of human lives saved and damage avoided, and from the point of view of the savings in aid, which might otherwise have gone into relief and reconstruction. This is a particularly justifiable strategy at a time when the most disaster-prone developing countries are undergoing rapid demographic expansion and urbanization. Errors committed now will be all the more costly to correct later. The massive investments needed to develop the infrastructure of human settlements can be safeguarded by planning and prevention based on vulnerability analyses (UN, 1976:3).

#### **(i) The Development Paradox**

The relationship between disasters and development is a complex issue. On the one hand, development is regarded as deterministic and a major cause of vulnerability and the disasters it exacerbates; on the other hand, it is regarded as the necessary, inevitable and appropriate vehicle for vulnerability and disaster reduction (Lewis, 1999:xi). In terms of a community's vulnerability to catastrophe, the growth of population and advancement of economic and social welfare produces paradoxical consequences. On the one hand, advances in techniques and technology provide better means by which building construction and urban development can be made more secure against disasters. Safer sites for development are more clearly recognised, and advances in knowledge and communication systems makes emergency measures of disaster prevention more efficient. On the other hand, increase in population involves mass movement towards urbanization and agglomeration of buildings and activities. This provides bigger targets for disaster phenomena and an increase in the probability of man-made disaster. The likelihood of property destruction and loss of life is increased. Therefore, the intensity of risk to disaster on a global scale increases even though the capacity to protect communities improves (UN, 1976:9). It, for example, striking that the number of catastrophic events over the past decade has increased threefold in comparison with the 1960s, while the rate of economic losses has increased by a factor of almost nine over the same period even as the number of the dead is reduced due to improved early warning systems in many countries of the developed world (UNEP, 2002).

Figure 2: Economic impacts of disasters, 1973-2002



Source: CRED International Disaster Database, 2003

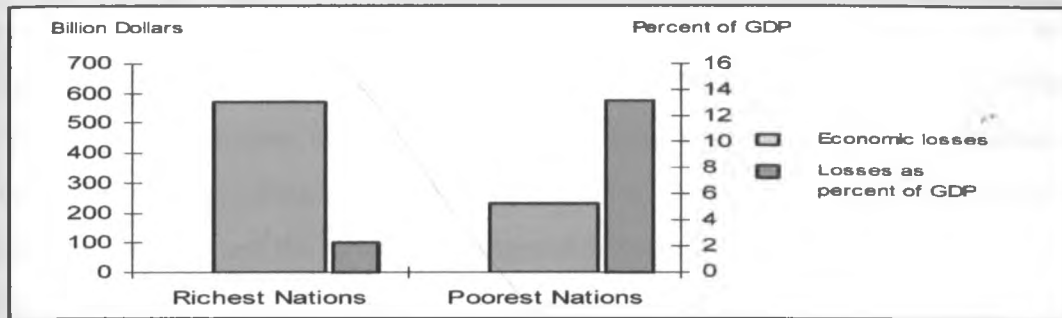
\*Note: Includes drought, earthquake, epidemic, extreme temperature, famine, flood, industrial accident, insect infestation, miscellaneous accident, slide, transport accident, volcano, wave/surge, wild fire and wind storm.

(Source: CRED International Disaster Data Base, 2003; referred in UNSDR, 2001)

### (ii) Disasters as a Problem of Economic Development

Although detailed statistical data on disaster damage are still very scarce, it is known that the damage caused by disasters greatly exceeds the total amount of assistance – both bilateral and multilateral – which disaster-prone developing countries receive from abroad. In terms of percentage of their gross national product, the losses caused by disasters in many of these countries more than cancel out any real economic growth. To cite one example, the Office of the United Nations Economic Commission for Latin America (UNECLA), estimated that in the five countries of the Central American Common Market, disaster damage averaged 2.3% of the gross domestic product in the fifteen-year period 1960-1974. Since the countries concerned also have a population growth rate of about 3% a year, to avoid an actual decline in the rate of economic growth or remain at a static level of development, they must achieve an economic growth rate of at least 5.3%. Very few of these countries actually achieve this rate and, partly because of disasters, many are actually losing ground in relative terms. This fact clearly indicates that disasters cannot be considered exclusively as problems of a humanitarian and social character. Instead they should be viewed as a problem of economic development of potentially great magnitude and that they should be resolved in a systematic manner by concerted action beginning at the level of national planning. It is this simple observation that prompted UNDR0 to propose an “international strategy for disaster prevention” (UN, 1976:2).

Figure 3: Disaster losses, total and as share of GDP



Note: "Richest countries" are defined as having a per capita annual gross domestic product greater than USD 9'361, while "poorest" are defined as those with less than USD 760.

Source: Munich Re and J. Abramovitz, 2001

(Source: Munich Re and Abramovitz, 2001; referred in UNSDR, 2001)

### 2.5 Towards An Explanation of Disaster Proneness

To understand the tendency towards an increase of disasters, particularly in underdeveloped communities, we must examine the process of development. True development is an ecological process in which a 'society' increases its capacity for dealing with the environment including extreme environmental conditions that produce disaster. This capacity for dealing with the environment depends on:

- The extent to which society understands the laws of nature (science).
- The extent to which 'society' puts that understanding into practice (technology).
- The manner in which 'society' is organized (governance) (Baird, 1975:28).

This definition would suggest that if a society were dependent on external science or technology, if the elite are organized towards a dominant foreign focus, then it is not developing.

Throughout history, disasters have produced the following typologies of societal response to natural hazards, summarised as:

- *Folk or pre-industrial* adjustment which involve a wide range of adjustment requiring more modification in behaviour in harmony with nature than control of nature. They are flexible and easily abandoned, are low in capital requirements, require action only by individual or small groups and can vary drastically over short distance.
- *Modern technological or industrial* adjustment which involve a more limited range of technological action and emphasizing control of nature, are inflexible and difficult to change. They are high in capital requirement, require interlocking and interdependent social organization and tend to be uniform.

□ *Comprehensive or post-industrial* adjustments which combine feature of both earlier stages so as to involve a larger range of adjustment, greater flexibility and variety of capital and organization requirement. This is the ecological viewpoint that is preferred by this study. This system of post-modern adjustment tends to produce a situation where 'events become less frequent; death rates diminish; and average damage losses per events decrease by up to half the maximum potential damage' (Baird, 1975:34).

## 2.6 Significance of Disaster Preparedness

### (i) Relief and Increased Proneness

After a disaster occurrence, relief aid is brought into the afflicted, the relief aid is correlated with the amount of the international aid and this reflects its trade relationship in developed countries. In such cases, relief merely reinforces the status quo, produces further marginalisation and greater disaster proneness; relief actually hinders community adjustment to future natural hazard and encourages an increased vulnerability when it is seen within the context of aid and underdevelopment. Another way to look at it is that aid is invested in underdeveloped areas where developed countries already have significant commercial interests; aid is used to encourage the underdeveloped country to enter into further commercial and governments agreements with a specific developed country; this mechanism exacerbates the current relationship between the developed and underdeveloped world in which, developed countries export only 22.9% of their primary commodities and 75.4% of their manufactures, while the underdeveloped countries export 75.9% and 23.4% respectively (World Bank, 1973). Many critics of western aid say it suffers a number of defects, principally, that much of it goes to pay expensive western consultants or that it is conditional on African governments doing business with a donor country's companies (Reuters, 2005). Disaster relief can merely reinforce the status quo because it is used as insurance for the preservation of the interests of the developed world.

### (ii) The Cost of Disaster

At this point, however, it is worth examining the cost of disasters to see the level of expenditure in post disaster situations. The difficulties of costing disaster in any general fashion are obvious; the data is unreliable, average figures are meaningless and firm conclusions negligible. The most recent disasters, the deluge by Hurricane Katrina on New Orleans in September 2005, the tsunami of Southeast Asia, cannot yet be costed since the effects are not all yet grasped. Costs are available, however, for the 3 major world disasters,

which took place in the early 1970s. The greatest loss of life occurred in the Bangladesh Cyclone—300,000 people died, 100,000 more than during the Bangladesh Civil Strife, but dollar damage was low, 86.4 million, because of the underdeveloped agrarian nature of the economy. The Philippines Flood, however, ‘only’ killed 653 people, but did US220 million worth of damage, while the Peru earthquake resulted in 66,794 deaths and destruction costing \$530 million. Even if exact costs are not available, the enormity of a disaster strike can be appreciated.

### **(iii) Conceptual shortcomings**

This research hopes that at some point in the future it will be possible to produce atlases of vulnerability but at the moment it is sufficient to state that disaster phenomena are distributed throughout the world. If one takes such a global viewpoint of disasters it is possible to reach general conclusions:

- There is a tendency to underestimate the importance of disasters in the traditional systems of the so called Third World and a related lack of awareness of the role which the strategies chosen by these Third World settlements patterns have played in setting patterns of adjustment to disasters in underdeveloped, Third World countries.
- There is a tendency to underestimate the depth of the traditional man’s understanding of the physical, economic and sociological consequences of disasters and the efficacy of the traditional adjustment of his systems to such threats.

These two tendencies of underestimation of hazards and underestimation of the traditional adjustment system, observable in developing countries, are common features of the appraisal of all hazards. Although disasters occur on a worldwide basis, occurrences in the underdeveloped countries seem to predominate. This is partly due to their location, for example, along fault zones but, more importantly, it is because the underdeveloped countries are unable to withstand the burden of loss from extreme hazards by virtue of their very underdevelopment (Baird, 1975:2). In most cases, the developed countries come with solutions rather than options for the underdeveloped communities. Options would better give the communities alternatives to evaluate and adapt to their environment.



## 2.7 Vulnerability as a Concept

Vulnerability is a variable concept that corresponds with the fluctuations of well-being in the face of a changing environment: 'Environmental changes that threaten well-being can be ecological, economic, social or political, and they can take the form of sudden shocks, long term trends or seasonal cycles' (Nomdo, 2002:123). It is unrealistic to assume a separation between 'normal existence and those-often frequently recurring-periods that are disasters'. Vulnerability, as is to be shown, is an ongoing state. It needs to be addressed as such (Lewis, 1999: viii). That vulnerability is the root cause of disasters is no longer a new issue nor is it a contentious one. It is evident that disasters are contextual matters and that prevailing institutional, social and economic, as well as physical conditions, will largely determine their severity for populations and communities (Lewis, 1999: xi). A focus on vulnerability, therefore, allows for the development of a framework that goes beyond the particular causal factors that are the hazards (Nomdo, 2002:5).

### (i) Why 'Vulnerability' and not 'Risk'

The assessment of risk tends to focus upon 'elements at risk' in aiming at a quantifiable product of that risk; for example, numbers and kinds of buildings destroyed, the amounts of agricultural crops lost, etc. It also focuses on the sources or origin of the hazard, so as to determine the effects of that hazard upon elements at risk. Above all, risk is concerned with the *product* of hazard. Vulnerability on the other hand, looks at the processes at work between the two factors of hazard and risk. It reverses the conventional approach and focuses upon the location and condition of infrastructure, construction, community, dwelling, population or person. Focus upon source or origin of hazard maintains a difference between them; whereas focus upon vulnerability maintains a similarity of probable effects as a result of any hazard. By attending to vulnerability, the effects of all potential hazards can be accommodated to some degree—from the point of view of the victim's potential to survive and recover. Measures to decrease vulnerability are partially integrative with normal collective conditions, small-scale, and individually are less costly and more achievable.

Risk is the product of hazard and vulnerability. Hazard is the potentially damaging (natural or man-made) phenomenon; vulnerability is the degree of susceptibility to a hazard. Risk is thus a statistical probability of damage to a particular element which is said to be 'at risk' from a particular source or origin of hazard. Damage or loss is expressed as of a certain magnitude and as occurring in a particular location or area during a particular period of time. Being faced with

the concept of a large risk makes it more difficult to conceive realistically of risk probabilities that may be smaller, more normal, and more frequent (Lewis, 1999:8).

There may be more than one source of risk, numerous elements at risk, numerous changes which take place within them, different rates of change and thus variable conditions of susceptibility. The overall condition that results is vulnerability. Risk is static and hypothetical, (though re-assessable from time to time) but vulnerability is accretive, morphological and has a reality applicable to any hazard. It is not dependent upon, or applicable, only to specified sources of hazard. Therefore, although it is important to consider risk, it is more important to assess vulnerability. *Vulnerability is actual; risk is actuarial.*

Risk is an assumed totality of an event brought about by forces over which we have no control (or over which we have lost control). Countermeasures against risk are therefore conceived as separate from normal activities, powerful and massive, and therefore usually of high cost. Vulnerability on the other hand, and has to do with susceptibilities resulting from ageing, weakening, limits to options, economic and social level, degree of integration and access to resources and services, and with the reasons why these either are or are not positive. Analysis and assessment of vulnerability on the other hand, relate to that variety of susceptible elements which contribute to the total vulnerable conditions; as such, they are more comfortably, more realistically and more constructively considered and implemented (Lewis, 1999:9).

A number of issues emerge from these concepts:

- The condition of risk is a construct for which certain static values are necessary. Fluid or changing situations do not lend themselves to simple mathematical 'certainties'.
- Risk has been conceived as the product of hazard and vulnerability, in the convenient formula:  $Hazard \times Vulnerability = Risk$ . For these purposes, the hazard has to be identified and specific, and be of a given magnitude; and vulnerability has to be a static and given a degree of susceptibility. As a component in the equation, vulnerability is made to be secondary to the consequence of the equation, which is risk.
- Risk is a prevailing state of affairs; it is not the real source of damage or loss. Being faced with the concept of a large risk makes it more difficult to conceive realistically of risk probabilities which may be smaller, more normal, and more frequent, and of what to do about them.

The consequences of this interpretation focused on magnitude and certainty are far reaching. Where resources are scarce, it is the smaller, normal, and more frequent risks that we are able to take measures against but, clouded by our focus on the risks of greater and more fearful magnitude, we might give up in the face of these, and do nothing. We shall thus sustain loss from more frequent risks when we could have protected ourselves, and subsequent vulnerability to the next disaster that would otherwise have been of limited extent will be increased and be more widespread. Risk is a prevailing state of affairs conceived largely for policy formulation and managerial decision-making. As such it is a construct by 'outsiders' of potential events in other places. Though re-assessable from time to time, it is essentially a static concept. Vulnerability on the other hand is a prevailing condition or interrelated set of conditions. Though assessable by outsiders, it is inevitably an 'insider' experience. To communities and others undertaking localised activities, vulnerability is the more relevant condition, measures of which they may perceive for themselves. Therefore, a more realistic step is the commencement of an expression of vulnerability (Lewis, 1999:10).

Disaster experience and assessment can be considered in two stages:

- The initial impact when vulnerability may be conditioned by location, density and distribution of population, age of people and structures, and technical and social capacity for resistance and protection.
- The aftermath and the capacity of survivors to continue to survive in the longer term. Sustained survival requires an effective culture or infrastructure of indigenous assistance, resources and social services. The greater the area and magnitude of disaster impact, the less available, effective or accessible will be external assistance, and therefore the more essential are indigenous resources and facilities (Lewis, 1999:11).

It is the first aspect of initial impact to disaster predicated by contingent conditions that this study is concerned with.

## **(ii) Why Focus on Urban Areas**

International development agencies have drawn attention to the growing pace of urban migration in developing countries. In the course of the last decade, urban areas in developing countries have collectively had to accommodate 150,000 new urban dwellers everyday. Between 2000-2010, the figure is set to rise to 180,000 per day, or more than 1 million new urban dwellers per week. It is generally accepted that many poor people in the South migrate to

urban areas to access opportunities to secure and improve their livelihoods. But urbanisation does not necessarily reduce poverty and current statistics suggest that poverty in urban areas is rising, and that the number of poor urban areas in some countries is now increasing at a faster rate than in rural areas.

The United Nations Global Habitat II conference, held in Istanbul in 1996, highlighted the continuing deterioration of conditions of shelter and human settlements in urban areas. The Habitat Agenda recognises that vulnerability has distinctive features, which need to be identified correctly so that appropriate interventions are developed. Urban areas present and highlight a particular paradox. In theory, they should provide significant opportunities to reduce vulnerability and improve well-being. In practice, though, there are particular issues in urban areas, which affect the conditions within which people live and work, and how they experience and cope with vulnerability. These particular issues include among others:

- The high premium on land and housing, and the concomitant growth of high density informal settlements, often on the outskirts of urban areas with low access to basic utilities;
- The reliance on service delivery to remove accumulated waste, and provision of access to basic resources such as water;
- A monetised economy in which people need cash, savings and investment to improve well-being;
- Vulnerability to endemic water and airborne diseases, fires and other hazards, intra-and inter-household violence and crime without legal forms of redress;
- Urban populations are heterogeneous, making it much more difficult to strengthen community-level organisation or to identify needs and priorities.
- Exposure to complex problems and hardships in the absence of strong social support systems or equitable political recourse; and
- The inability of urban governments to deal with the scale of these challenges in a cost effective way and /or their unwillingness to acknowledge responsibility towards all members of their continuously growing populations (Nomdo, 2002:57).

Thus, the processes and factors that contribute to vulnerability in urban and rural areas are not the same. Urban environments present particular types and combinations of adversity, and offer a different range of potential strategies for coping with adversity or improving well-being (Nomdo, 2002:7).

## 2.8 The Context for Disaster Preparedness

The tendency towards an increase in disaster occurrence and scale and the substantial capital cost for assistance in relief, rehabilitation and reconstruction has encouraged much thought about disaster preparedness planning internationally. Such a situation should tend to lead to extensive pre-disaster planning in underdeveloped countries but this is not the actuality. To understand the reasons behind this, it is necessary to consider the scope of pre-disaster planning.

Baird (1975) describes a procedure for elementary pre-disaster planning as a first step in the practical application of comprehensive preplanning on a national, regional or local scale. For any pre-disaster planning to be successful, it must be practiced within the following guidelines:

1. Planning must be seen as a continuous process.
2. Planning must attempt to reduce the unknowns in a problematic situation.
3. Planning must aim at evoking appropriate actions.
4. Planning should focus on probability.
5. Planning must be based on knowledge.
6. Planning must partly be an educational activity.

With these guidelines as principles, one can look more closely at predisaster preparedness planning. Disaster preparedness must be seen as occurring within a system of activity, which may be listed as:

1. Prevention
  2. Mitigation
  3. Warning
  4. Disaster
  5. Relief
  6. Rehabilitation
  7. Reconstruction
- Pre-disaster Activity
- Post Disaster Activity
- 

## 2.9 Approaches towards Disaster Preparedness

### (i) Case Study 1: Cape Town

**Using GIS in Consolidating Disaster Incident Information for Strategic Development Planning:** The Case Study highlights ways for better information

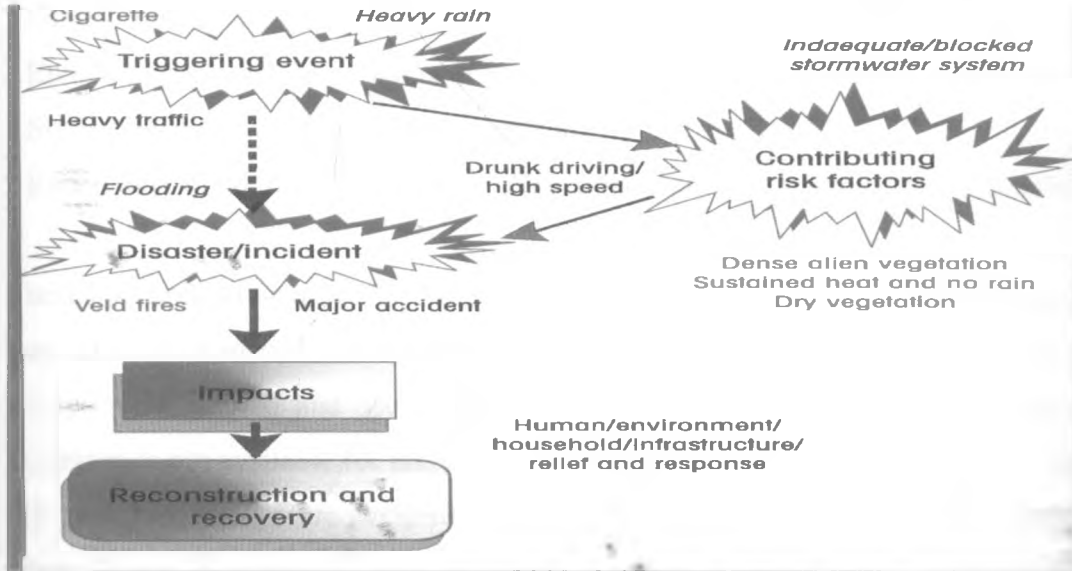
management techniques and enhanced capacities for disaster preparedness to encourage sound planning and effective allocation of disaster management resources.

*Partners Enhancing Resilience for People Exposed to Risk* (Periperi) is a network, in Southern Africa, for those involved in development as well as disaster reduction policy and practice. The network recognises that development is a multi~sectoral undertaking. In the past, the policy and practice of disaster reduction was largely separated from the agendas of sustainable development and social equity. However, recognising the links between disaster vulnerability and development, the Periperi network aims to profile wide-ranging opportunities to build resilience to natural and other threats. In this way it hopes to strengthen and sustain development potential, particularly in the most vulnerable and disaster prone communities. Periperi advocates for disaster risk reduction as one strategy for achieving sustainable development (Nomdo, 2002: vii).

**The MANDISA Project:** In Southern Africa, as is the case elsewhere, there is little consolidated information on localized disasters, despite the frequency of house fires in peri-urban areas and property losses due to repeated flooding of informal settlements. Lewis (1999: viii) vindicates the MANDISA (Monitoring Mapping and Analysis of Disaster Incidents in South Africa) spirit by stating that 'those disasters making the news are not necessarily the most significant. He adds (1999:xi) that 'if we are going to be able to do anything at all about abnormal hazardousness, we should be attending to normal hazardousness, and our vulnerability to it, which is a part of everyday normality'. MANDISA is a strategy to consolidate disaster incident information to facilitate strategic development planning. The strategy is supported by a computerised database that is linked to a Geographic Information System (GIS) for tracking disaster incidents including the loss incurred, especially about 'small', highly localized disasters in the Cape Metropolitan Area (CMA). Lewis (1999: xiii) reasons that if small and localised disasters can be reduced, by the same action so can vulnerability to the large ones as well. The CMA is located within the Western Cape Province of South Africa and covers an area of 2,159 km<sup>2</sup>. Income inequality between the rich and the poor

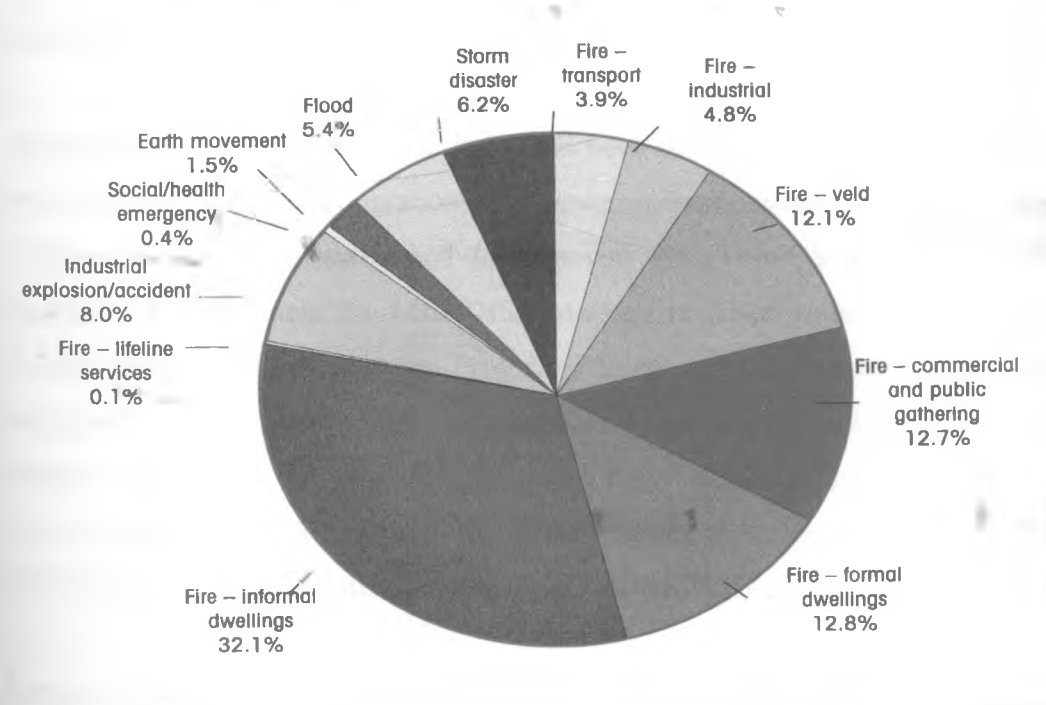
in the CMA is high. Historical inequalities, resulting from apartheid policies, have not been overcome (Nomdo, 2002:136).

Figure 4: The MANDISA conceptual framework



(Source: Nomdo, 2002)

Figure 5: CMA disaster profile (1990-1999)



(Source: Nomdo, 2002)

**Project aims:** The aims of MANDISA project were to:

- Collect/compile information on disaster occurrence in the CMA from 1990-1999;
- Develop methodology and software for disaster data collection and consolidation;
- Consult with MANDISA users for data collection and consolidation;
- Publish finding on disaster loss patterns from 1990-1999;
- Enhance access by a wide range of user groups to disaster related information;
- Strengthen capacities in disaster risk reduction; and thus
- Encourage sound planning/effective allocation of disaster management resources.

There appeared to be a predominance of fire incidents in the informal settlements that often resulted in deaths. Formal dwellings and industrial institutions almost always were insured and used this as a means to recuperate from their losses. Insurance is not available for households living in informal dwellings. It was found that recurrent small scale event have costly but largely unrecorded impact on the poor. There also seemed to be a particular profile of people most vulnerable to death or injury from informal dwelling fire incidents. The elderly (especially men) and children appeared to be the most vulnerable to these incidents. As a result, the team agreed that the MANDISA database should be particularly sensitive to issues around socio-economic and environmental vulnerability (Nomdo, 2002:143).

**A consultative approach:** Close links had been developed between the research team and a wide range of operational and governmental partners with respect to the relationship between disasters and development. As a result, a proposal has been developed to implement the MANDISA strategy province-wide so as to include disaster risk reduction within the Provincial Integrated Development Plan. While many advocacy groups focused on measures to reduce the vulnerability of the natural environment, less attention had previously been given to the vulnerability of poor communities. The MANDISA process made these issues more accessible for both development and disaster-related organisations (Nomdo, 2002:146).

**Lessons Learnt:** The following points come out clearly from the MANDISA project case study that need to be kept in mind while planning for disaster preparedness:



- Small but frequent disasters that do not necessarily attract news are cumulatively more costly to the economy than the infrequent major disasters. By taking care of the smaller everyday disasters, the capacity to deal with the major ones is enhanced.
- Spatial documentation of the disasters is vital to build a data base of the most frequent types, the most affected areas and their distribution in an urban area. This builds the capacity for rapid reaction in the event of occurrences.
- That poverty, age and socio-economic factors are important in planning for disaster preparedness, over and above the prevailing physical conditions.
- That a multi sectoral approach is inevitable in building up the capacity for disaster preparedness.

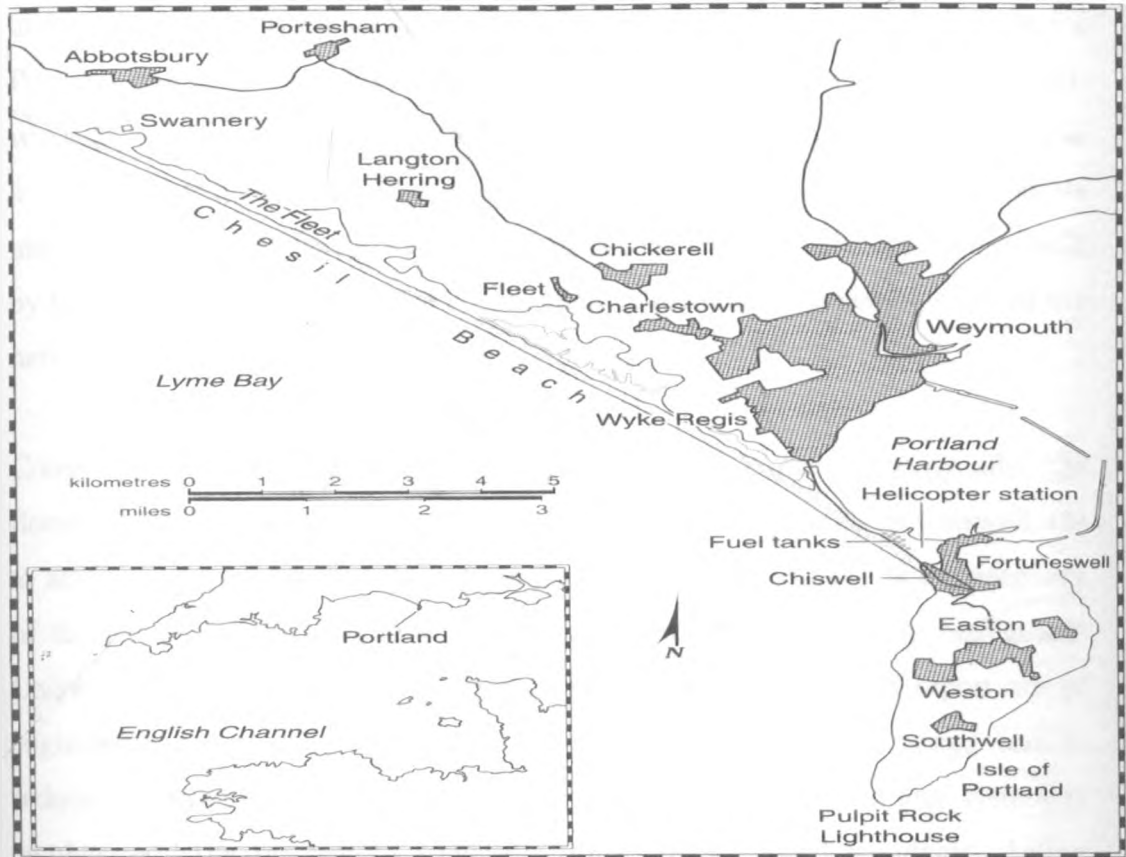
#### **(ii) Case Study II: Chiswell, Isle of Portland**

**Change and Vulnerability to Natural Hazards:** This case study highlights the fact that issues of disaster preparedness are short and long-term and are at once multi-disciplinary processes calling for a fusion of physical and earth sciences, social sciences, and political and administrative processes on a careful balance so that none outweighs the other. It brings forth the dangers of depending too much on technology to guard against natural processes rather than working with nature. At times, it shows, technology makes things worse. The extent to which technology can be effectively mobilized and implemented to ensure prolonged community permanence may be assessed only by detailed analysis of environmental phenomena on the one hand, and by comparison with social adjustments on the other.

**Introduction:** Chiswell is a community of 134 people. It is situated at the foot of the north-western slope of the so-called Isle of Portland, off Weymouth, in Dorset, England; Like Mombasa, Portland is an island but for the shingle bar, or tombolo, and causeway which link it to the mainland. It is where the shingle bar joins the Isle of Portland and forms a brief trough between the north-west slope of the Isle and the crest of the shingle that the Chiswell community is located. Flooding by seawater seepage through the shingle and by sea waves overtopping the shingle bank is frequent in Chiswell. In December 1978 and in February 1979, for example, waves overtopped the bank with such force that several buildings were

damaged, and in February the causeway road serving the whole of Portland was breached.

*Map 1: Location of Chiswell, Portland*



(Source: Lewis, 1999)

**Vulnerability:** Most of Fortuneswell, on the Isle of Portland, is between 100 and 150 feet above sea level; but Chiswell is 10 and 15 feet above mean sea level. When waves overtop at Chiswell they wash immediately upon and into habitation. Chiswell's unique location in respect of its direct vulnerability to the sea is matched by advantageous proximity for fishermen. Chiswell was probably established as the principal source of fish for the island at a time when the sea was appreciably further away than it is now.

There are other factors to consider before assessing the role of natural hazard in this vulnerability. Close proximity of Chiswell to major naval, and minor civil, south coast ports created considerable vulnerability to damage by enemy air action between 1939 and 1945.

**Technological change:** In its three-and-a-half square miles, and in addition to Chiswell, the Isle of Portland contains four principal communities, two ancient castles, quarries and stone works for Portland stone, coastguard stations and Pulpit Rock light-house, a prison and a Borstal, a hospital, a naval helicopter station, an under-water weapons establishment, and dockyard installations and fuel depot for Portland Harbour. Most of these communities and establishments are elevated and, while exposed to wind, are protected from the sea. Chiswell, almost at sea level, is a very small community incidental to the island's other activities and uses, but its main street is the one-way main road off the island. The helicopter station was built by the Admiralty in 1962-3. The construction of the helicopter station blocked the natural escape of excess water, causing flooding.

Consultant engineers were appointed by the Wessex Water Authority after the floods of 1979 to (1) assess all available data relevant to flooding at Chiswell, (2) to advise on probable return periods of the storms and floods, (3) on the necessity of further studies, and (4) to suggest options with budget costs, to 'safeguard' Chiswell from flooding. All the four measures considered in that report are of engineering construction to prevent flooding by seepage, over-topping, and to reduce the energy of sea waves. The important need for a warning system is emphasized. The residents of Chiswell formed the Chiswell Residents' Action Group (CRAG), which was partly an expression of frustration and concern due to the absence of a stated policy on social measures. The role of CRAG could only be that of a grassroots pressure group, whereas that of the authorities is long-term. Had there been a policy by the authorities to include social measures at the outset, the formation of the Action Group may not have been necessary.

**Policy options:** Preventive measures against hazard must take comprehensive account of the relationship of man and his environment, and must be ecological adjustments in the activities of vulnerable people and their elected administrations, rather than only separate technological resistance to the forces of hazard. Ecology in this case is the relationship of society, via its adopted administrative processes, with its social and political environment as its means of effective and comprehensive relationship with its physical environment. That some of the society's options with regard to the physical environment are administered and

controlled by its administrators must be understood by those administrators. Vulnerability is compounded of physical and social conditions, and preventive measures must be compounded of physical and social measures.

The preparation of warnings and their dissemination are of prime importance in measures for preparedness. Advice on hazards is to be expected, on what to do, on how to secure property against flood, on what evacuation procedures will be available, how and where to make contact with the authorities, and what measures various authorities will be undertaking in the event, are all examples of preparedness planning. It is obvious that preparedness planning is multi-disciplinary and multi-sectoral, and calls for the closest integration of measures to be taken by authorities and the public at domestic level.

One overriding additional factor has implications for policy formulation in respect of natural hazard at Chiswell. Twelve-and-a-half-thousand people live on Portland, some commute to the mainland and probably several thousand more commute from the mainland to the institutional, scientific, military and commercial establishments on the island. They are all served by the causeway road and by the one-way road approach and exit system to the island which includes the main street of Chiswell. The causeway road and the electricity, gas, water and telephone utilities and services under it, are all afforded protection from the sea by Chesil Beach; as are the naval fuel tanks, and the naval helicopter station. Vulnerability to the sea is increasing for these institutions, as it is for Chiswell. As central government is involved in the improvement of housing stock and sea defences, one hand pays for the protection of what the other hand creates.

**Lessons Learnt:** The following lessons are apparent from the experience of Chiswell, in Portland, an island approximately the size of Mombasa, with similar mixture of activities and only one causeway connecting it to the mainland that is, itself, becoming increasingly threatened by the vagaries of the sea:

- That a fusion of physical and earth sciences, social sciences, and political and administrative processes are needed for the mitigation of disasters. They need to be on a careful balance so that none outweighs the other.

- That over reliance on modern technology to counter natural forces can exacerbate the problems rather than solve them.
- That a careful appraisal must be done so that the actions of one sector do not counter what the other sector is trying to solve. This was evident when the construction of the helicopter station blocked the natural escape of excess water.
- A highly critical island like Portland with vital installations and a historical settlement of world conservation status such as Chiswell need to be planned for disaster mitigation as a priority.

**(iii) Case Study 3: Kobe**

**Developing a Resilient City:** The City of Kobe is 3.5 hours away from Tokyo by bullet train, and forms the focal point for the western-Japanese economy together with Osaka and Kyoto (see Map 1). Divided by the Rokko Mountain Range, the south (coast) side of the city is highly urbanized and industrialized, while the other parts are under hybrid (residential and commercial) development or remained rural. The south part, with 30% of the municipal land (approx. 165 km<sup>2</sup>), is home to 70% of the population (approx. 1 million). Kobe has been actively attracting business by committing physical (land) development since the late 1960s. This urban development method brought significant economic growth to Kobe.

*Map 2: The Location of Kobe*



(Source: <http://www.city.kobe.jp/cityoffice/06/033/outline.htm>)

Figure 6: Description of the Disaster (City of Kobe)

Time and Date of Occurrence:	5:46 am, January 17, 1995
Force:	7.3 on the Richter scale
Depth:	approx. 16km
<b>Human Damage</b>	
Death:	4,571
% of death over 60:	58%
% of crushed or suffocation:	73%
Injured:	14,678
<b>Structural Damage to Buildings</b>	
Fully collapsed: (damaged)	67,421 structures (approx. 82,000)
<b>Fire Damage</b>	
Completely burned:	6,965 structures
<b>Damage to Public Utilities</b>	
Power	Citywide Failure
Telephone	25% Failure
Water	Almost Citywide Failure
Gas	80% Failure
Sewage	2 Reduced Capacity and 1 Inoperative of 7
Refuse	All Inoperative

(Source: <http://city.kobe.jp/cityofice/06/033/earthquake.htm>)

**The Great Hanshin-Awaji Earthquake:** Kobe experienced the immense disaster after the earthquake on January 17, 1995, which is called the Great Hanshin-Awaji Earthquake. A large number of houses, business facilities and transportation infrastructures were collapsed and/or burnt, and most lifelines became inoperative. Expressways collapsed after the quake. The majority of the victims were the elderly and people who lived in poorly built structures. About 20% of the disaster victims in the inner city lived in houses built before 1960, which means the district had been out of urban redevelopment activities. Since water and expressways failed, and streets of the district were too narrow for fire trucks to operate, large-scale life-saving activities were not available where they were needed most. Institutional procedure inefficiency made the secondary disaster more serious. Lack of effective information and order flow among national, prefecture and municipal governments slowed down life-saving activities immediately after the quake. Poor medical, food and housing supply for considerable period of time after the quake seriously inconvenienced evacuees. Financial support from the government to restore personal housing was not immediately available after the quake. Thus, emergency survival and restoration ability of private property were dependent on personal financial capability.

**The Need for Disaster-Resistant City:** The Great Hanshin-Awaji Earthquake crystallized that Kobe was not disaster-resistant physically, socially, economically and institutionally. Kobe needed to have new development scheme. In June 1995, the

city established the ten-year Kobe Revival Plan (the KRP). The KRP is to revive Kobe by fostering community, economy and culture within a multi stakeholder decision-making process. In the short term, quick restoration of urban infrastructure was the focus, while a “disaster-proof” society was the long-term aim. The short-term outcome was to restore Kobe physically, socially and economically. Meanwhile, since communities with strong human ties showed great life-saving operation, the process was to highlight improvements to the physical and social durability of communities. As a result, the KRP was a mixture of customary scheme for public infrastructure development and more collaborative and self-determine community management strategies.

**Restoring and Reviving Kobe:** To revive the city, the following were taken as the necessary milestones to be achieved:

- Safety, activity, attractiveness, collaborative, civic life, rehabilitation, durable community, economic restoration, attractive town, joint town development.
- Providing houses, promoting employment and securing sufficient medical services.
- Rezoning and redevelopment in areas seriously damaged.
- Lobbying national government to establish a law for individual financial support.
- Improving durability of lifelines and infrastructures, and providing information of related issues.
- Adopting the Safe Community Ordinance to promote collaboration among citizen, business and municipal government.
- Supporting existing small middle class business financially, and arousing new business.
- Restoring and improving the Kobe Port to revive logistics such as through implementing information networks.
- Developing information network facilities.
- Developing urban amenities for disaster evacuation, networking riverbeds, parks and roads
- Promoting communicative community for welfare and disaster resistance recognizing importance of mutual support against disaster.

### **Achievements and Challenges:**

**Civic Life Rehabilitation:** Civic life rehabilitation was the main focus of the first part of the KRP, including such things as providing sufficient medical service, restoring housing facilities and promoting employment. Urban physical restoration was concentrated primarily in three years after the quake. A National Act to provide funds to sufferers of natural disaster was established after the quake. The Nishi Municipal Hospital that was severely damaged by the quake is now a primary disaster-resistant health care facility.

**Economic Restoration:** Kobe has been supporting the rehabilitation of existing businesses financially and technically within the given institutional framework. Meanwhile, the physical restoration of public facilities such as port, roads and railways were completed in about two years after the quake.

**Attractive Kobe:** As facilities have been restored, cultural activities are reviving, unified by the disaster experience. In terms of disaster management, expansion and networking open spaces and developing information infrastructures have been achieved. The physical restoration of an attractive Kobe is addressing the KRP's long-term goal of creating a durable community.

**Collaboration:** Community-based organizations (CBOs) are recognized as major contributors to implementation of the KRP including life-saving activities immediately after the quake. As victims who had to move have had difficulty blending into new communities, CBOs have been helping them settle. Efforts to develop durable, welfare community are being implemented. The movement is no longer a restoration strategy, but already an alternative scheme of public management adopted by the municipality.

**Durable Community:** Kobe is implementing physical and social durability improvement at the community level. Community-based educational programs about disaster prevention are underway. Meanwhile, administratively, the fire department has revised its organization and tactics applying the state-of-art information systems and fire-fighting equipments.



**Analysis:** The physical restoration of the city has been achieved as planned, or at an even faster pace, and in an efficient manner. Some policies applied were inappropriate as a result. Taking rezoning and redevelopment for example, a top-down approach was adopted for quickness of restoration, but it has caused severe conflicts in several communities over publicizing private lands and land ownership.

**Results:** Kobe has achieved quick physical restoration of urban structures through both top-down and collaborative approaches. Throughout the process, social improvements have also been implemented. Some communities found that human ties are actually a counter force against vulnerability to disaster. Fostering community function where it does not exist was a crucial social objective.

**Key Replication Factors:** Countermeasures that should be prepared within disaster management are roughly divided into three steps by timescales: emergency, short-term care and long-term restoration. The first two steps should be done by top-down attitude for necessarily quick decisions, while the last one is better implemented with a participatory approach for accountability of the outcome. Kobe has established a database of the city officials' experience regarding disaster management and restoration. The database is open for public, and other municipalities can obtain specific details of Kobe for disaster management. Also, upon request, Kobe sends their officials to disaster-damaged city.

**Revival NOT Restoration:** Kobe has defined "restoration" as "building the city as it was before the quake", while "revival" means "making it better (more sustainable) than before." The development method is adopted not only by Kobe, but also by many other Japanese cities, which risk similar disasters.

**Lessons Learnt:** Kobe's experience provides four major lessons:

- An educated and empowered community is practical unit for disaster management. Considering that governmental function would not be very active immediately after the disaster, fostering communities with self helping ability is highly important.
- Physical durability of structures is the basic requirement to be a disaster-proof city. Since structural demolition is clearly predictable, it is necessary for local authorities to devise countermeasures.

- Institutional preparedness such as security of information and order flow (among governments, between municipalities and residents, and among residents) and injury logistics are highly important. In order to keep the institutional procedure active, it is important to operate it on a daily basis, not for disaster prevention, but for such things as community events. Neglecting these factors will delay life-saving activities and make disasters unnecessarily bigger.
- Identification of appropriate policy approaches for restoration is greatly favoured even under frightened circumstances to reduce conflict after launch restoration programs. The City of Kobe would have preferred to hasten the institutional supply of necessities. However rezoning and redevelopment projects could have been implemented more slowly to increase community involvement. Necessities can and should be dealt with quickly while longer-term restoration requires community consultation.

## 2.10 Conceptual Framework

The subsequent issues have emerged from this chapter's discussion and are considered the underpinning concepts that have guided this study. They are summarised as follows:

- Disasters, including the so-called natural, always have a human element either by commission or omission.
- A new global consensus is emerging that the development process must reduce vulnerability by lessening settlements risks from the environment. Disaster preparedness cannot be sectorised away from the development process, which must be seen as the cause and therefore the solution to preparedness initiatives. Actions of one sector must not counter what another sector is trying to rectify.
- Disasters must focus on people rather than the phenomena themselves. They must be seen, ecologically, as extreme extensions of everyday existence.
- Natural and human induced disasters are not mutually exclusive. Most disaster situations will include an element of both. Consequently they must be studied together.
- Disasters happen in chains, earlier ones causing others. Preparedness, therefore, cannot be only against a specific disaster. Disasters are parts of their contexts and in most cases are caused by their contexts. Planners should seek to eliminate vulnerabilities presented by contexts, since these are largely spatial.
- Reporting of disasters should be relative to their contexts and populations for their proportionality to be appreciated. The reporting should be from the local perspective.

- Disasters are problems of economic development. Early warning may reduce human deaths but not economic losses. Poorer countries suffer more since their losses are bigger percentages of their GDP.
- To deal with disasters, society must understand the laws of nature (science), put the knowledge into practice (technology), by well-organised institutions (governance).
- A balanced mixture of traditional (ecological) and modern (technological) adjustments are needed for a post modern (techno-ecological) adjustment. Technology, if used exclusively can worsen disaster situations.
- Relief assistance tends to marginalize the affected community making it more prone to future disasters and obliging it into a subservient trade/regime with its benefactors.
- Vulnerability is not disaster specific and deals with contingent conditions which if lessened take care of all potential disasters. It is a better concept for dealing with disasters than risk, which is disaster specific and actuarial.
- Urban areas have unique problems of high density, monetised economy, heterogeneity and weak social links requiring special focus.
- Disaster preparedness planning must be a continuous process, geared to reduce the unknown by focussing on probability based on knowledge.
- A spatial documentation of disaster is necessary through such tools as GIS for rapid appraisal of trends and readiness.
- To be ready for large disasters, it is necessary to seek to eliminate small frequent disasters so as to remove cumulative vulnerability and costs.
- Certain social classes of people; the poor, old, men, children are more vulnerable to disasters. Social ties (social capital) are very vital in dealing with disasters.
- The first two stages of disaster, emergency and short term, must be top-down to save on time, while the third, long term, must be participatory.
- Community awareness is a very important factor in dealing with disasters.

## **2.11 Conclusion**

Several points of varying importance emerge from this discussion. First, despite the lack of data and a bias contained within existing data, there is a recognizable tendency towards an increase in disaster occurrence. The areas of the world more often affected are the less developed countries; the most frequent disaster types are flood, earthquake and typhoon. Second, the cost of disaster is high, in fact; expressed as a percentage of GNP, the damage is often greater than the real rate of growth in poor countries. The tendency towards increased

disaster proneness can be analysed and is seen as the direct result of the increased vulnerability. Conclusions so far serve to underline the salient necessity for a form of preparedness planning which will coordinate all relevant indigenous resources and which will recognize as a principle resource the value of grass root involvement and self-help procedures. Any programme of preparedness planning must be comprehensive and coordinated and as such will achieve considerable reductions in losses of property, production and life each time a disaster occurs. Any such programme is clearly worth implementing in any disaster prone society and environment. If however, long-term reductions in disaster proneness are to be achieved it will be necessary to achieve a reduction in the smaller, more frequent but more damaging hazards that do not necessarily attract media coverage.

## CHAPTER THREE

### BACKGROUND TO THE STUDY AREA

#### 3.0 Introduction

A Portuguese sailor who visited Mombasa in the medieval times described it during one of his visits thus:

*'There is an island hard by the mainland, on which is a town called Mombasa. It is a very fair place, with lofty stone and mortar houses, well aligned in streets.... This is a place of great traffic, and has a good harbour, in which are always moored crafts of many kinds and also great ships'* (Dyer, 1962:3).

This chapter commences by providing a background description of the municipality of Mombasa where the Island of Mombasa is located. This is in terms of its location, administrative boundaries and settlements patterns, topography and climate. The chapter then goes to briefly describe the history of Mombasa Island and finally the developmental challenges facing the district. *The Municipal Council of Mombasa shares the same boundary with the administrative district* (Kenya, 2002).

Despite its contested and bloody past, Mombasa has increasingly become a regional centre of significance. Tourists, businessmen and workers of all kinds come in ever increasing numbers for both business and pleasure at the Kenya coast and its main centre, Mombasa, Kenya's second urban centre. This is set to increase now that it has been elevated to city status (Moss, 2002:1). Mombasa is the second largest Municipality in the Republic as well as the Headquarters of the Coast Province.

#### 3.1 Location and Setting

Mombasa is situated in the east coast of Africa approximately a third of the distance from the Horn (Cape Gordaui in Somalia) to the Cape (Cape of Good Hope in South Africa). It is identifiable as a coral island set between two channels or creeks. It is 5 km long by 3 km wide and is positioned at latitude 4°3'S and longitude 39°41'E, about 451 km south of the equator and some 487 km south east of Nairobi (Kenya, 1977). Dar es Salaam lies 450 km southwards along the coast. It forms the eastern terminal of the trans-Africa Highway, Lagos to Mombasa, but of more vital importance is its role as gateway to Kenya, Uganda, the Great Lakes region and beyond, following what has come to be called the Northern Corridor (Moss, 02:46).

Map 3: Regional setting of the study area



Kenya in Africa

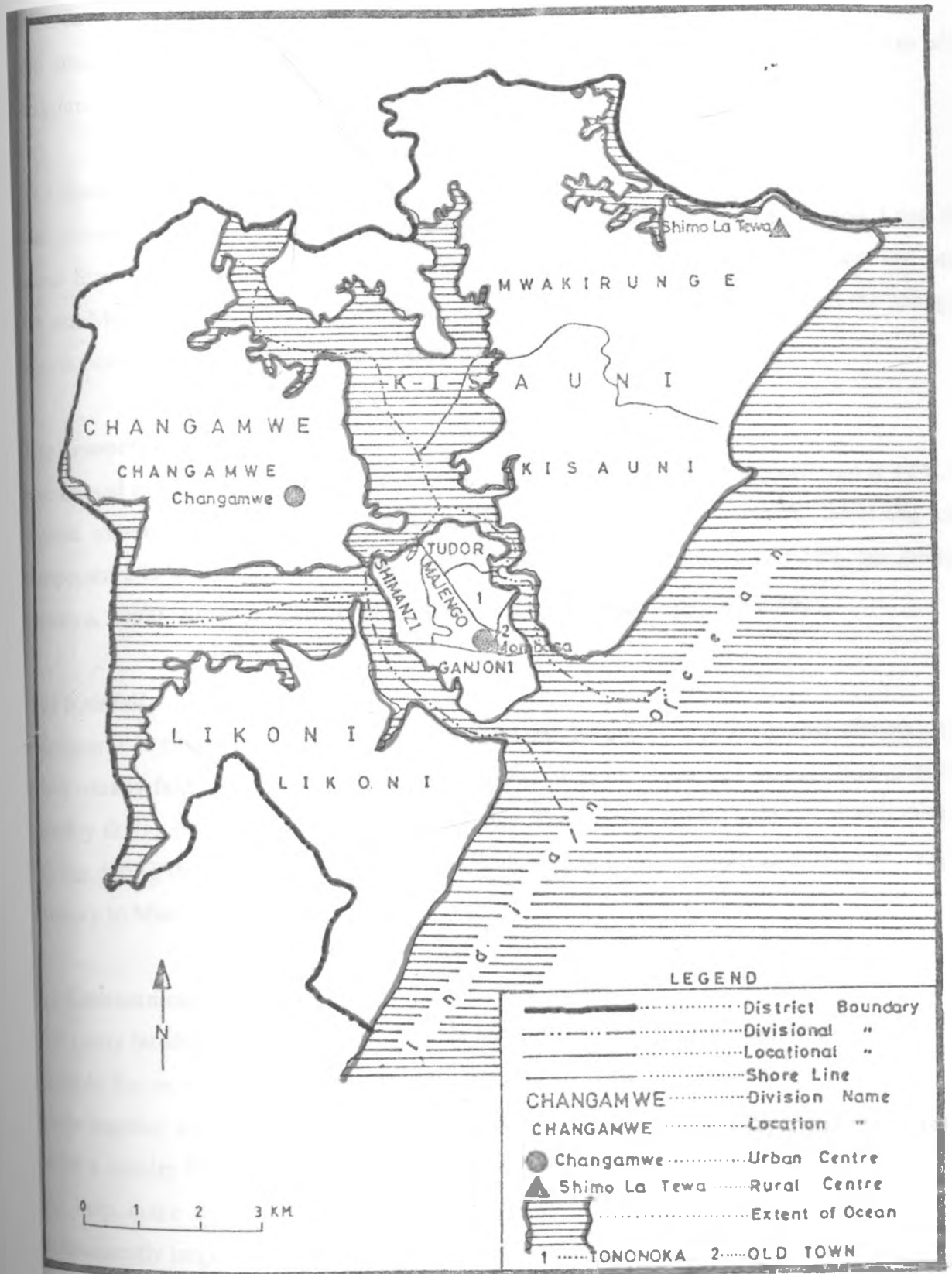


Kenya in East Africa



(Source: [www.mombasa online.com](http://www.mombasa online.com))

Map 4: The Municipal Council of Mombasa



(Source: Mugwima, 2004)

(Note : the Municipality Shares the same boundaries as the District)

### **3.2 Physical Characteristics**

#### **(i) Area**

The area of the Island is about 13sq km but the Municipal boundaries include 867 sq km of the Mainland and Territorial sea (Kenya, 1977).

#### **(ii) Climate**

The climate though warm and humid, is tempered by sea breezes all the year round. Long rains occur from April to May (Kenya, 1963). Situated only 4 degree south of the equator and beside the sea Mombasa enjoys a tropical climate. The sun swings north and south with the change of season but is always vertical enough to ensure a perceptible amount of heat.

#### **(iii) Temperature**

The annual mean temperature is 26.4°C within a minimum of 21°C and a maximum is 32°C. The hottest month and the driest is February with a maximum average of 32°C while the lowest temperature is in July to August when 28°C is the expected maximum and 20°C the minimum (Kenya, 2002). Average humidity at noon is about 65 per cent (Moss, 2002:46).

#### **(iv) Rainfall**

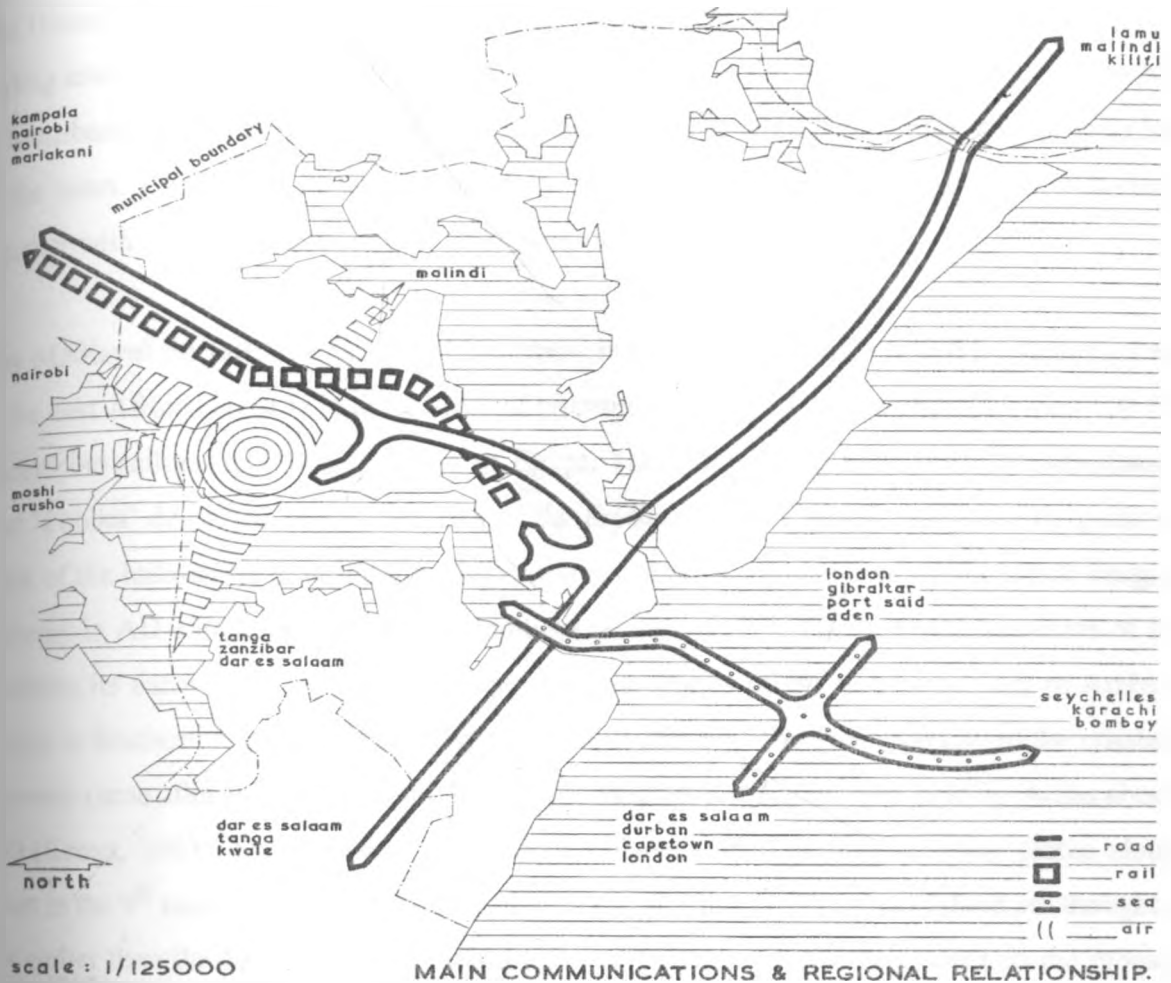
Because it is situated on a windward littoral, Mombasa enjoys a well-watered climate regime. Rain usually falls as drenching showers at any time of day or night, but mostly close to mid-day, quickly drying out in the sunshine, which follows. The average annual total is 1040mm most of it falling during the period April to July. A rainfall minimum is encountered during the months of January to March (Moss, 2002).

#### **(v) Communications**

For many hundreds of years the slave trade had flourished along the East African Coast. A road suitable for ox-wagons was cleared from Mombasa to Uganda. As one means of combating this trade together with the realization of the potential productivity of Uganda the British decided to build a railway from Mombasa to Lake Victoria. This was started in 1895 and completed in 1901. To help make this railway pay, European settlement of Kenya highlands was encouraged. Subsequently large development in and around Mombasa occurred including the construction of a new harbour at Kilindini leaving the old harbour to dhows and small craft (Kenya, 1963).



Map 5: Main communications and regional relationships



(Source: Dyer, 1971)

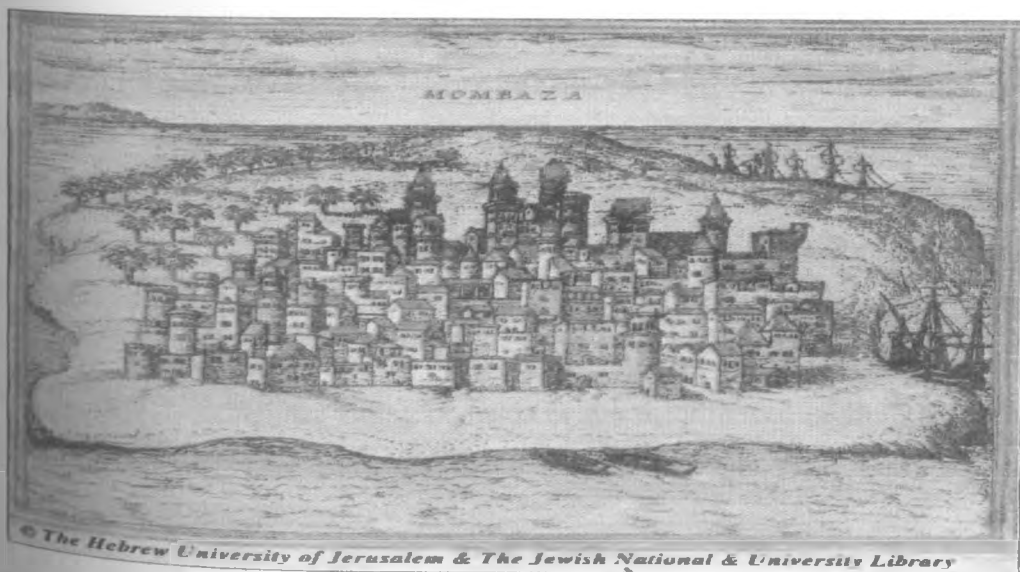
Passage from the mainland was originally by canoe, ferry or by the ford at Makupa. The latter was bridged for the railway in 1895. During the Second World War the bridge was thought to be too vulnerable as a military target and was converted to causeway, which also carried the main road. Access to the north mainland was by Nyali pontoon bridge built in 1931 (Kenya, 1999), while the Likoni motor ferry carries vehicles to the south mainland. The Kipevu Bridge later also converted to causeway, led to the quays of the port extension. Mombasa is the major port for Kenya. Kilindini is a deep and spacious harbour serving Kenya, Uganda and part of Tanzania. There are regular shipping services to Europe, North and South America, India, Asia, ports along the East African coast and islands in the Indian Ocean. The Moi International Airport at Port Reitz can take aircrafts of all sizes and provides direct services to all parts of the world. Mombasa is the terminus of the railway through Kenya to Lake Victoria and Uganda with daily passenger and cargo trains to Nairobi. There are daily road coach services on bitumen roads to Nairobi, Malindi and Lamu, Moshi, Tanga, and Dar-es-Salaam (Kenya, 1977).

### 3.3 Historical development of Mombasa

The History of Mombasa is largely that of the Island. It has for centuries been one of the leading trading towns along the East Africa coast and the gateway to the interior of the region. The history of Mombasa goes back thousands of years. Nothing much, however, remains of this early history of the town. By the end of the 15<sup>th</sup> Century, however, the town history is quite well recorded together with major historical events and developments.

**The Medieval Period:** The history of Mombasa is long and involved. The oldest historical record of the east African coast is in an account of circumnavigation of Africa about the year 500 BC by Phoenician sailors for Pharaoh Necho of Egypt. Their ships must have called at Mombasa. The port 'Tonika' described in the *'Periplus of the Erythraean Sea'* which was a sailing guide to the coast of the Indian Ocean written in Alexandria about 80 AD and quoted by the Greek geographer Ptolemy in AD 150 is identifiable as Mombasa (Kenya, 1977). The National Museums of Kenya confirms its early name as 'Toake'. There are also reports of the Greeks as well as Arabs from Ausan in Southern Arabia visiting these parts about 250 B.C The great opening of the coastal area however came after the rise of Islam. Mombasa, Malindi and Kilwa were held by Arabs about AD 900 (Kenya, 1963). Omani Arabs are reputed to have started settling at many places along the coast in the 9<sup>th</sup> century AD. However, the oldest dated relics on Mombasa Island are thought to be not earlier than the 15<sup>th</sup> century. Sailing the East African coast was dependent on the monsoonal shift of wind from North East ('kaskazi') during January to April round to South Easterly winds ('kuze') later in the year. Thus, ships were enabled to voyage south from India, Arabia and Egypt early in the year and then to return to base later the same year. (Moss, 2002:47).

Fig 7: A drawing of Historical Mombasa



(Source: [http://historic-cities.huji.ac.il/kenya/mombasa/mombasa.html#brief\\_history](http://historic-cities.huji.ac.il/kenya/mombasa/mombasa.html#brief_history))

**The Portuguese period (1498-1697):** Vasco da Gama set out in 1497 to explore the Indian Ocean and dropped anchor in Mombasa in 7<sup>th</sup> April 1498 but sailed on to Malindi soon afterwards due to the unfriendly reception given by the people of Mombasa. This encounter was the start of a not very cordial relationship that was to last 200 years. Following Vasco da Gama's reconnaissance, the Portuguese set about acquiring control of the Eastern Africa Coast. From this point there are written records of what befell Mombasa and very blood-thirsty reading it makes. For example, one Portuguese visitor to Mombasa was so impressed by what he saw that he felt obliged to attack and ransack it! During the 16<sup>th</sup> century the town was subjected to this treatment four times. Evidence of this period abounds in the island. An epitaph on a grave in the grounds of Allidina Visram High School reads: 'Shee Mvita – Ahmad bin Muhammad bin Mshamu - assassinated by the Portuguese in 1563'. Little wonder, therefore that it was referred to as 'Kisiwa cha Mvita' (the Island of War) from where its traditional name Mvita was derived.

Shortly, thereafter, the Portuguese realized that, as Christian invaders, they were anathema to the Muslim inhabitants and that their precarious hold over the coastal region needed strengthening. By building Fort Jesus, the most significant building of this period, between 1593 and 1596, they hoped to achieve their aim. This massive structure, however, and a small garrison stationed there, failed to guarantee permanent control over their Indian Ocean interest. In fact, the Fort changed hands 9 times between 1631 and 1875, most notably following the "Great Siege" which lasted over 24 months (1696 – 1698), in which all the Portuguese defenders died. It eventually fell to the Omani Arabs in 1698, exactly 200 years after Vasco da Gama first passed that way (Moss, 2002). The Portuguese monopoly of sea-power in the Indian Ocean was later ended by other European nations. They finally left Mombasa in 1729. The Fort is now a national museum.

**The Arab Period (1697-1888):** Omani influence had been growing over the years, mostly at the expense of the Portuguese who capitulated for the last time in 1729 and ceased their over lordship of the coast north of Mozambique for good. Yet the Omani did not exercise direct rule or effective protection over the various coastal settlements any more than the Portuguese had. They appointed governors of Mombasa from the powerful Mazrui family for over a century but intrigues and wars continued. A long power struggle between the ruler of Oman and his appointees in Mombasa, with the British sometimes aiding one side or the other, ended in 1837 when Mazrui power was eventually broken (Moss, 2002:48).

In 1832, Seyyid Said, the Sultan of Oman, moved his capital to Zanzibar, which consequently gained in importance and influence eclipsing Mombasa. From the 1850s Mombasa under the

Arabs become increasingly prosperous and began to take the appearance it has today. Between 1850-1897, the population grew from 10,000 to 25,000 inhabitants (Mugwima, 2004). After 1850, Indian traders mainly from Zanzibar and also from India settled in Mombasa. Many of the houses in the Old Town were built by these merchants and are architecturally similar to those in Zanzibar and parts of India. The red flag of Zanzibar continued to be flown over Fort Jesus until Kenyans Independence in 1963. The Zanzibar possessions along the Kenya coast had been included in the British East Africa Protectorate declared in 1895 and were governed de facto as part of that territory, the name of which was changed to Kenya in 1920. The capital of British East Africa was at Mombasa until it moved to Nairobi in 1904.

**The British Period (1888-1963):** The British were all along cruising about the Indian Ocean, purportedly, suppressing the slave trade but also maintaining a presence to balance the imperial ambition of her European rivals. In 1883 the explorer Joseph Thomson set off from Mombasa on his historic trek through Maasailand, the first European to penetrate Maasai territory. He thereby opened up Mombasa's far hinterland.

Although Mombasa was first visited by a British ship in 1591 it was not until 1824 that the port was to become an unofficial protectorate (Kenya, 1963). In 1822-24 the Royal Navy charted the east Africa coast and the survey ships HMS Leven and HMS Barracouta spent some time at Mombasa. At the request of the Mazrui (Arab) Governor, a naval officer (Lt Reitz) was appointed as British Resident in 1824. British influence remained supreme until 1884 when Germany's East African aspirations became increasingly apparent. This was settled in 1890 when the present boundary between Kenya and Tanganyika was drawn (Kenya, 1963). Through Mombasa passed a succession of explorers and traders, many of the latter employed by the Imperial British East Africa Company, which was granted trading and other rights by the Sultan in 1887 (Kenya, 1977). The British East Africa Company, then, received a concession from the Sultan over his dominions from Vanga to Kipini within a 10 mile strip along the Coast. The association one year later was granted Royal Charter to exploit the concession. In 1895 however the concession was transferred to the British Government (Kenya, 1963).

With Mombasa as the seat of British administration the important and practical decision was made to build a railway to Lake Victoria and to thereby facilitate the task of ruling the lands that lay between and beyond. The work began in 1896 for which all personnel and materials needed in this great enterprise were landed at Kilindini Harbour (Moss, 2002:49). At this time only about 1 of the island's 13 sq km was occupied by settlement. Swahili traditions suggest that their earliest

contemporary habitations were north of the present Old Town, which was referred to as Omani Mombasa. The Portuguese had favoured the area just north of the Fort. The only other settlement on the island was the village of Kilindini.

Apart from the old town, the British had the whole island upon which to establish the infrastructure of government. Trade however, remained close to the Old Port and Leven House for a while. Once the decision to develop Kilindini Harbour was made the shipping companies set up shop along the road leading there. During the British colonial rule in East Africa, Mombasa became the major port of entry into the region for settlement and trade. The Old Town of Mombasa was the starting point of the activities of the Europeans as the new dominant settlers in East Africa. From 1900, the British administration transferred its headquarters from Fort Jesus to new and more spacious built quarters around Treasury Square and set up government residence along the town's sea front.

Thus, modern Mombasa began its spread across the sprawling bush-covered acres of the Island. The wilder aspects gave way to the hotels, shops, clubs and residences only gradually as evidenced by 3 lions and one leopard killed on the island in 1945 and 1958 respectively after the lions ate some people (Kenya, 1999). When Kenya gained its independence in December 1963, the 10-mile Coastal Strip under Zanzibar's sovereignty became an anomaly. This was soon tidied up, however, when the revolution of January 1964 sent the sultan into exile and the red flag of Oman ceased to fly from the Fort Jesus flagpole (Moss, 2002).

**Mombasa (1963-to-date):** Mombasa remains the major port of the East Africa coast and the second largest town in Kenya with a total population of over 1.2 million. The main point and commercial activities have shifted away from the Old Town. Largely passed over by modern physical development, the Old Town has retained a physical character of the above history of Mombasa. Mombasa now enjoys city status, albeit not formalised, which, it is hoped, will help it overcome its recent slide towards squalor (Moss, 2002:50).

### **History of Disasters in Mombasa**

No part of the Province has been spared, although Mombasa, because of the concentration of human activities has received a disproportionately higher number of disasters. The following are examples of disaster occurrences in the recent history of Mombasa:

*Table 1: A Summary of disaster occurrences in the recent history of Mombasa:*

<b>Year of Occurrence</b>	<b>Disaster Examples</b>	<b>Area in or around Mombasa</b>
1947, 1961, 1997	El-Niño floods	Entire lowlands of Coast Province
1976, 1993, 1999	Train crashes	Tsavo (Taita Taveta)
1994	Ferry disaster	Mtongwe (Mombasa)
1997	Ethnic clashes	Likoni, Mtwapa, Kisauni (Mombasa, Kilifi, Kwale)
1998	School Fire	Bombolulu Girls (Kwale)
2001	Hotel fires	Travellers, Emerald (Mombasa, Malindi)
2001	Bridge disaster	Sabaki (Malindi)
2002	Discotheque fires	Mamba Village, Tembo (Mombasa)
2002	Terrorist bombing	Paradise Beach hotel (Kilifi)
2003	Market fire	Mwembe Tayari (Mombasa)
2003	Hotel fires	Africa Safari Club, Paradise, Coral, Shanzu, Palm Beach (Mombasa, Lamu)
2003	Bridge disaster	Nyali (Mombasa)
Annually	Floods, Droughts	Tana river, Lamu, Malindi
Annually	Ethnic Clashes	Orma, Pokomo (Tana River)
Annually	Road Accidents	Mombasa Nairobi Highway
Annually	Oil spills	Port, Ocean (Mombasa)
Occasionally	Aircraft accidents	Moi International Airport (Mombasa)

(Source: MDDMC, 2003)

### **3.4 Administration**

Mombasa District is situated in the south-eastern part of Coast Province. It is the smallest of the seven districts in the province, covering an area of 229.6km<sup>2</sup> excluding 65km<sup>2</sup> of water mass (Kenya 2002). It borders Kilifi District to the north, Kwale District to the south and west and Indian Ocean to the east. The district lies between latitude 3° 80' and 4° 10' south of the equator and between longitude 39° 60' and 39° 80' east of Greenwich Meridian. Administratively, Mombasa district shares the same boundaries with the only Local Authority, the Municipal Council of Mombasa. The district is divided into four divisions, which are sub-divided into 18 locations and 30 sub locations as shown in the table below. The district has four (4) constituencies and twenty five (25) electoral wards.

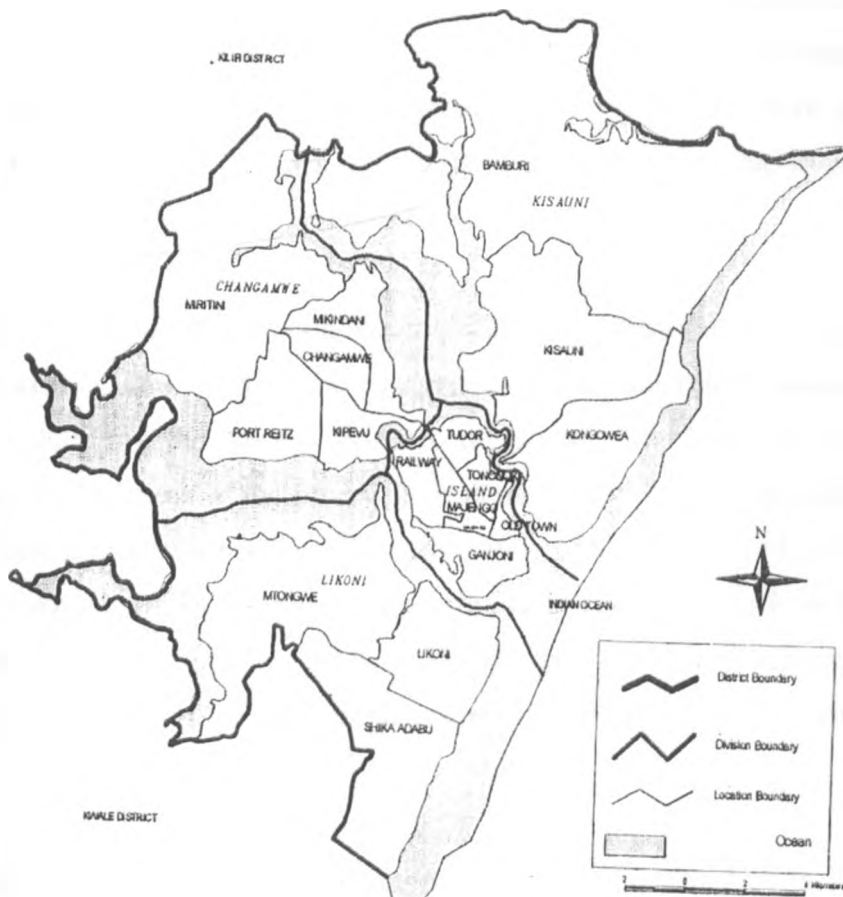
*Table 2: Administrative Units And Municipal Electoral Wards By Division*

Division	Area in (sq. km.)	Location	Sub-location	Municipal Wards
Island	14.1	7	7	12
Changamwe	54.5	5	7	6
Likoni	51.3	3	6	3
Kisauni	109.7	3	10	4
<b>Total</b>	<b>229.6</b>	<b>18</b>	<b>30</b>	<b>25</b>

(Source: Kenya 2002)

Although administrative division and constituencies share similar names (with the exception of Island Division and Mvita Constituency), they do not share same boundaries. The shifting of Tudor, Ganjoni and Old Town locations, to Changamwe, Likoni and Kisauni constituencies respectively has resulted in the three constituencies being larger in area than their respective divisions, but has made Mvita constituency to be smaller in area than Island Division (Kenya, 2002).

*Map 6: Mombasa District administrative boundaries*



(Source: GoK, 2002)

### 3.5 Physiographic Conditions

**Topography:** Mombasa district lies within the coast lowland, which rises gradually from the sea level in the east to slightly over 76.2 m above the sea level in the Mainland West. The highest point is found at Nguu Tatu Hills on the Mainland North that rises to 122m above the sea level (Kenya, 2002).

The district has three distinct physiographic units. First is the coastal plain, which is found close to the sea, covering parts of South Coast, the whole Island, parts of Changamwe and parts of North Coast areas of the District. The plain is between 4-6 kms wide and lies between sea level and about 45m above sea level. It consists of extensive flat terrain dominated by series of raised beach terraces underlain mainly by coral limestone and back reef sand deposits which are well drained, firm ground with good foundation conditions with relatively good ground water yields and a source of constructions materials (Kenya, 2002).

Second is the hilly, severely dissected and eroded terrain that is founded within western part of the district. The area is underlain by shells and rises generally from about 45m to 122m above the sea level (Kenya, 2002). The shell withers into generally poorly drained and easily eroded clay soil, which contains little or no ground water. This together with rugged terrain attracts little settlements and discourages development of infrastructure. However, agriculture is the main land use activity. These unstable shale hillsides are increasingly being settled due to pressure on land and potentially disastrous landslides are imminent.

Third is the Indian Ocean and the shoreline. Geologically, sedimentary rocks of Jurassic to recent age underline the district. During Pleistocene to recent times, numerous fluctuations in the sea level led to the evolution of the present coastal configuration. The lowering of the sea led to severe erosion and down cutting of the river valleys draining into the sea. Subsequent rise in sea level led to the submergence of the valleys and the creation of the island of Mombasa surrounded by deep natural creeks, ports and harbours. These include Tudor Creek, Makupa Creek, Port Tudor, Port Reitz, Mombasa Harbour and Kilindini Harbour. Kilindini harbour has led to the development of Mombasa as one of the most important modern ports on the East African Coast (Kenya 2002).

Other physiographic features includes, the sea, the fringing coral reef and cliffs, the island, ports and harbour, creeks and tidal flats, sandy beaches, the coastal plain and a hilly severely dissected and eroded terrain. These features are as a result of interaction between the existing geologically



condition and natural processes such as; sea changes, erosion and deposition. The features have greatly affected the development of the district in a number of ways, especially by limiting linkages between the different areas of the district.

### 3.6 Population Characteristics

#### (i) People

As with any port, Mombasa's trading activities over the centuries have attracted a large assortment of people, mostly types associated with seaboard commerce. Indonesians, Chinese, Arabs, Persians, Portuguese, Asians, Europeans and Swahilis have entered its harbours, conducted their business and left or stayed according to their inclinations. The indigenous people were of Bantu origin and would have been the *Zenj*, (Black people), encountered by the earliest explorers. One should view the evolution of Mombasa's population as involving the encounter of exotic merchants and sailors mostly from around the Indian Ocean with local inhabitants providing the matrix to form the distinctive Swahili culture. This evolution is reflected in Kiswahili, basically a Bantu language, owing much to Arabic but also incorporating Indian and European vocabulary.

Table 3: Mombasa population trends by ethnicity

Year	Africans	Asians	Arabs	Europeans	TOTAL
1901	18,476	6,524	1,000	300	26, 300
1932	20,000	12,000	6,000	900	38, 300
1958	89,000	26,000	14,000	4,000	133, 000
1989	412,100	24,620	18,830	6,210	461, 760
1999					665, 018

(Source: Moss, 2002:51)

#### (ii) Population size

By today's standards, early Mombasa would be considered little more than a substantial village. By the first head count in 1901, however, it appeared to be growing and has continued to do so ever since. The newly created city is now estimated to contain at least one million people. The size of the population, its structure, growth and distribution in the district are important parameters in the analysis of development effort. This section presents population characteristics of Mombasa District, which also doubles up as the Municipality of Mombasa. Table 4 below shows population distribution and settlement pattern in the district between the two-census periods. The island was the most populated division in 1979 followed by Kisauni and Chagamwe

but as revealed by the table, the pattern changed by 1989 with Kisauni being the most populous, followed by the Island and Changamwe. This was after the construction of the New Nyali Bridge. By 1999 the Island took the third position after Kisauni and Changamwe. More employment opportunities from industries, including the Export Processing Zones, had then been set up in Changamwe. Likoni Division has always been the least populated. However, the population density of the island is still higher than that of other divisions as indicated in the table.

Population distribution and settlements pattern in the district are influenced by infrastructure network such as roads, water, electricity, availability and accessibility of areas of gainful employment, availability of cheap housing, security and land tenure system.

*Table 4: population by division and density*

Division	Population 1989	Population 1999	Pop. Density 1989	Pop. Density 1999
Island	127,720	146,344	6,082	10,379
Kisauni	153,324	249,861	1,217	2,278
Likoni	67,240	94,883	1,051	1,850
Changamwe	113,469	173,930	1,598	3,191

Source: Kenya, 2002

High population densities are found in the Island Division and along the major highway such as Mombasa Lungalunga Road in Likoni division, Mombasa-Nairobi Road in Changamwe division and Mombasa-Malindi road in Kisumu division. These are well served by infrastructure services. Sparsely populated areas are found at the outskirts of the district. The areas include: Mwakirunge, Maunguja, Mwangala and Mkupe jetty area. These areas are least developed in terms of infrastructure such as road network, electricity and water supply (Kenya, 2002).

### (iii) Population growth

According to 1999 population and housing census the population of Mombasa District was 665,018. The population growth rate is now 3.6 per cent. The district population is projected to increase to 796,571 and to 920,313 in the year 2004 and the 2008 respectively. The high increase in population implies that the district will require greater provision for services like water, education and health. The table below shows the population projections for the years 2006 and 2008.

Table 5: Population Projections

	Year						
	1969	1979	1989	1999	2004	2006	2008
Pop.	247,073	341,148	461,753	665,018	766,571	856,209	920,313

Source: Mugwima, 2004

### 3.7 Development Challenges in the Municipality of Mombasa

The major development challenges in the district are outlined below:

#### (i) Provision Of Basic Services

In most cases supply of water and shelter have been inadequate, garbage is not collected, and school standards have been deteriorating. The population as well as the cost of basic needs and service has been on the increase while incomes have stagnated. Provision of services has been poor due to inefficiency and poor local governance (Kenya, 2002). This has seen population concentration on the Island and the three main highways radiating from it. To redistribute the population, services need to be provided to the least populated areas of the district. The challenge therefore is for the Municipal Council of Mombasa and other service providers to improve and provide services delivery at affordable cost by involving the stakeholders.

#### (ii) Landlessness

Land issue in Mombasa district like in the whole of coast province are a thorny aspect, which has culminated into landlessness and administrative problems. These have contributed to impoverishment of people in Kisauni, Likoni and Changamwe divisions (Kenya, 2002). It is common to find indigenous families that are squatters in areas they presently occupy. This has been due to factors such as lack of updated land administration and managements tools. The Mombasa Town Planning Scheme (1926), Mombasa Master Plan (1962), Mombasa Draft Physical Development Plans (1971) and others have not been effective in adequately dealing with the ever-increasing complexities and problems of the town (Kenya, 2002). With an increasing population, the challenge will therefore be to settle the squatters and allocate land for industrial development and provision of social service like schools health facilities and shelter.

#### (iii) Drug Trafficking and Abuse

Kenya, (2002) explains that due to the strategic location of Mombasa as a seaport, cases of drug abuse and trafficking have been on the increase. This is a major contributing factor to insecurity in the district. The youth, who are the most active part of the labour force, are also the most affected.

HIV/AIDS has also been associated with drug abuse especially through the use of syringes. The challenge to the government is to stop drug trafficking and abuse in the Municipality.

#### **(iv) Transport**

The road system was designed a long time ago for much less traffic to facilitate the movement of vehicles from the mainland to the island, the central business district and the port being the primary destinations (Kenya, 2002). The roads have been in poor state for quite long because of inadequate maintenance and repairs. This has translated into large financial expenditure, which is beyond the Municipal Council and the Ministry of Public Works. The roads also do not have sufficient car parks. While most roads network have not been extended for quite long, the number of motor vehicles, is continually rising, particularly the public transport vehicle and especially the matatus. This has resulted in heavy congestion and heavy air pollution. Apart from high population growth, land development seems to be unplanned and uncoordinated. Subsequently, roads cannot be expanded due to lack of vacant land and occupation of road reserves by structures (Kenya, 2002). The mobility of urban residents to and from work is thus affected and has a negative bearing on productivity. The challenge therefore is to improve existing transportation system and manage urban growth more effectively.

### **3.8 Environmental Management and Conservation**

Mombasa is faced with a number of challenging environmental issues, which have negative impact on the economic growth and poverty levels. The major environmental issues include: resources consumption, land use, water use, energy use, solid waste, wastewater and air pollution.

#### **(i) Resources consumption**

The district with its large concentration of people and activities consumes more resources than it produces. It is a net importer of food, fuel and water. The town and its dwellers consume large share of natural resources such as building materials, food, fuel wood, mangrove, timber and charcoal (Kenya, 2002). This has resulted in intensive use of resources, which have negatively affected the environment.

#### **(ii) Land use**

Rapid population growth on sensitive ecosystem along the coastline leads to poor land use. Quarrying, construction along the beach, industrial pollution, inappropriate waste management are a few of the environmental problems which have led to the degradation of the coastline and loss of important wildlife habitats e.g. turtle nesting grounds along the beach, leading to soil and

grounds water pollution, a good case in point is Kibarani (Kenya, 2002). This leads to depletion of mangrove forests, nature's own defence against sea-borne extreme phenomena.

**The Island:** All urban land uses are represented in the Island, the main ones being residential, transport in the form of the port and railway, industrial, commercial and civic. There are four hospitals, smaller clinics and dispensaries within the island. There are also a number of schools comprising both primary and secondary with various public gardens and playing fields that are located throughout the residential section of the island.

**West Mainland:** Much of the west mainland is taken up by commercial and public activities, with extensive industrial areas, a large oil refinery, an international airport, housing estates, a hospital and 14 schools. The rest of the land is reserved for agricultural use.

**North Mainland:** The north mainland is given over a variety of uses residential, a cement company, quarries, beach hotels and restaurants, a prison, a berth for ship to load cement for export, and primary and secondary schools.

**South Mainland:** The south mainland is mainly given over to residential purposes. In addition there are schools, a navy installation, a national youth service with the rest of the land given over to agriculture except for a small portion, which has tourist hotels and cottages (Kenya, 2002).

### (iii) Water and sanitation

The demand for water in the district exceeds its supply and is fast growing. This coupled with poor management and pollution of water resources put pressure on both its quality and quantity (Kenya, 2002). Besides, ground water suffers from faster abstraction than natural replenishment resulting into salt-water intrusion and pollution. Lack of adequate sanitation services is one of the greatest threats to the residents of the district, with pit latrines, shallow wells and boreholes being dug in close proximity. Others include direct exposure of human waste near residential places e.g. in Kiembeni.

### (iv) Air pollution

Kenya, 2002 reports that air pollution released from industrial, energy and transportation (vehicular) source is one of the most noticeable environmental problems in the district. The air quality has been worsening overtime. Air pollution has also contributed to chronic and infectious respiratory diseases.

#### **(v) Energy use**

Urbanization, pollution, industrialization and other economic development activities have increased demand for fuel. Use of charcoal and fuel wood has contributed to local deforestation, land degradation and loss of biodiversity.

#### **(vi) Solid waste**

Solid waste has created environmental problems and a challenge in the district. For instance, in terms of solid waste management, the Municipal Council of Mombasa collects only 30% of the total garbage generated (Kenya, 2002). The remaining is either burned or dumped in uncontrolled dumpsites or left in the streets, where it creates health hazards and block drains contributing to urban floods. In addition, household and industrial waste, including toxic ones are often handled together, leading to soil and ground water pollution when waste is dumped improperly e.g. in Kibarani. In order to address the environmental issues, the following corrective measures should be put in place:

- Induction of bacterial lagoon treatment plants to supplement the already existing two sewerage treatment plants,
- Relocation of Kibarani dumpsite to the other three remaining mainland divisions.
- Introduction of integrated solid waste management system, which include waste reduction, recycling and re-use;
- Implement and Enforce Environment Management and Coordination Act.

### **3.9 Land use in Mombasa Island**

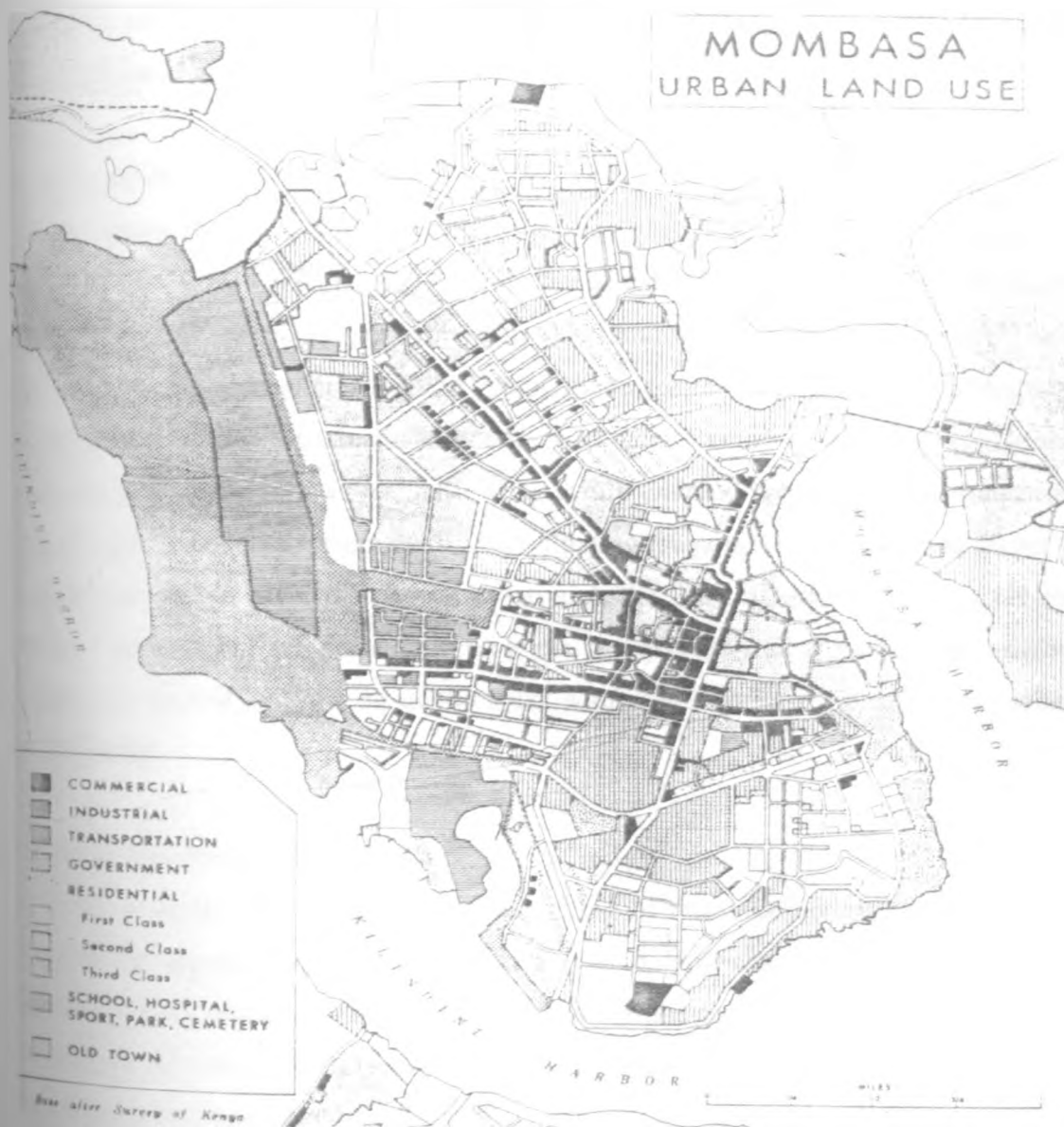
The Island of Mombasa is the centre of the Municipality. The largest portion of land is given over to mainly residential and commercial areas. Included in this category is the central business district. The northwest area of the island and the south of Fort Jesus are strictly more residential. The western area is more heavily commercial in character. The largest land use is given to the port facility at Kilindini, in addition to a fairly large industrial area (Mugwima, 2004).

#### **(i) Transportation**

The island is linked to the west mainland by two causeways, one associated with the port facilities, the other handling vehicular and rail traffic. Two bridges used to connect the island to the northern mainland (one an old pontoon bridge has since been demolished and the other is the modern four-lane one). To the south both vehicular and pedestrian traffic use a ferry. Mombasa is the eastern-most terminus to the Kenya Railways system. It plays a very important role in the

transportation of goods to and from Kilindini Port. The railway links the Municipality to Nairobi, the administrative capital of Kenya via Voi town, with a branch that extends to Taveta town, which is located on the Kenya-Tanzania boarder. An international airport on the western mainland serves Mombasa, handling both local and international air traffic.

Map 7: Mombasa urban land use



(Source: Blij, 1968)

The Port of Mombasa is a major reason behind the continued prosperity of the Municipality, the largest and most important facility is located at Kilindini, currently the largest East African seaport, serving the hinterland and handling millions of tones of cargo. The port is an important source of employment and is managed by the Kenya Ports Authority.

### **(ii) Economic activities**

Much of the industrial activity is based around the harbour facilities on the west mainland. Many are shipping and import/export related companies with some devoted to marine engineering and fishing. Other industries include an oil refinery, a cement company, steel mill and various other light industries located mainly on the west mainland, with the largest industry being tourism with over 40 tour companies, travel agents, hotels and restaurants. In the recent years tourism has lost a leading role as a foreign exchange earner due to tribal clashes at the coast and travel advisories against Kenya; related due to the so-called terrorist threats.

## **3.10 Town Planning in Mombasa**

### **(i) The Town Planning Scheme (1926)**

The first comprehensive planning scheme for Mombasa was in 1926, enacted under the Town Planning Ordinance of 1919, covering only the island (specifically the old town). The scheme set up the Mombasa Municipal Board, responsible for its implementation (Mugwima, 2004). Principal issues dealt with included pooling and redistribution of land into regular shaped plots, establishment of roads reserves, basic zoning rule which divided areas into industrial and non-industrial uses and a maximum density rule limiting the number of dwelling to 20 per acre. Areas outside the district were then controlled through the Public Health Ordinance Of 1928, which allowed certain planning decision to be made on health related grounds. With upgrading of the board to a council in 1961, all of the areas within the district came under the authority of the municipality.

### **(ii) Mombasa Master Plan (1962)**

In 1962, a master plan suggested the upgrading of transportation and roads, improvement of housing and upgrading of several areas of the island. However, this was designed as an advisory plan and had no statutory basis. In addition, some of the proposals underestimated factors such as population increase, therefore limiting its usefulness to planning officers within the council. However, it has many provisions that are useful and still guides the planning of the Municipality albeit unofficially.

### **(iii) Mombasa Structure Plan (1971)**

A draft physical development plan, prepared in 1971, provided a mandate for further studies to be carried out on issues affecting the municipality. Among them, the Mombasa Transport Study and the Mombasa Pollution and Waste Disposal Study were completed in 1976. This was a very detailed study especially as regards transportation links. It recognised the fact that the growth of



Mombasa depended on several factors that cannot be frozen in a Master Plan and decided to offer scenarios depending on such factors as the growth of the main transportation arteries, the expansion of the port and the eventual displacement of both industries and residential land uses from the Island to the mainlands by civic, administrative and commercial activities.

What is important to note is that all the above plans did not mention issues of safety to the population of Mombasa, other than those related to health. Nothing to do with disaster preparedness was even alluded to.

### **3.11 Infrastructure Services**

The following sections will discuss the various infrastructures in the Island. It is important to realize that the services provided to the Island must be viewed in the larger context of services in the whole of Mombasa Town and the entire municipality. Many of the issues and deficiencies discussed, not only affect the Island Area, but also are citywide problems.

#### **(i) Water Supply.**

Before tapped water was introduced, Mombasa Island was serviced by wells. The first piped water was commissioned in 1916 and was supplied by gravity flow from Marere springs in the Shimba Hills located south of Mombasa. In the 1930's a large main was constructed from Marere and is still in use today. A booster station was added in the 1940's and more wells were also added in Shimba Hills to increase output (Mugwima, 2004). In order to cope with the growing demand for water in Mombasa, a pipeline was constructed from Mzima springs in Tsavo West to the Mombasa reservoirs in the 1950's. The water coming from Mzima and Marere is considered clean, and the only treatment carried out is chlorination. In 1979, a new pipeline was constructed from the Sabaki River north of Malindi, in order to again meet the growing demand. However, the water supply remains a problem in Mombasa.

In addition to the piped water supply, several boreholes and wells numbering in excess of 200 continue to be used in the Island mainly by mosques, hotels and other institutions or in the case of the Leven steps well, for washing clothes and bathing. This water is definitely not suitable for drinking as most has been contaminated by wastewater. The boreholes, wells and pit latrines are believed to be weakening the rock structure of the Island and need to be closely monitored (Coast Express, 2005).

## **(ii) Sewerage**

Traditionally, a system of pit latrines, bucket latrines, and septic tanks and soak pits served the needs of Mombasa Island. The properties of coral are such that they do very good job of drainage for these types of systems. Today, in fact, most of the houses on the Island are still using either pit latrines or septic tanks the former mainly in the Swahili neighbourhoods such as Majengo, and the latter in the permanent housing schemes. The municipal council and private firms provide the maintenance services necessary for these systems. Along with the simpler methods of waste disposal, there are several separate sewage systems in the municipality located at Chagamwe, Makupa, Tudor, and the Old Town. The Old Town was fitted with its sewer system in 1962. It serves 105 hectares including all of the Old Town and certain adjacent areas. This scheme was originally designed as phase 1 of a plan that was to cover the whole Island. Up to this time however, no other part has been constructed (Mugwima, 2004).

## **(iii) Storm Water Drainage**

The drainage situation in the whole of the Island is in very serious condition. Rainfall often brings minor flooding and standing water. Wastewater from baths and sinks often sits stagnant in the open drains. Addressing this issue is not easy, however, because there is little to no information available at the Municipal Council about the drainage networks. None of the history of the present system is known nor is a map available to show the present paths of the drainage channels. An outfall channel was constructed next to Fort Jesus in the early 1974, which serve Makadara, Kibokoni as well as areas nearby.

This system, as it exists in its present form, is far from adequate to address the needs of the Island. The lack of knowledge of the drainage scheme has led to lack of maintenance, which has virtually crippled the ability of the drains to function properly. In addition to the health issues, the situation is also bad for buildings as water seeps up into the walls causing deterioration and weakening of their structural integrity. Other problems are the sheer inconvenience that the standing water and flooding causes to residents, and the negative effects it has on tourism. It is recorded that heavy rains submerged a quarter of Mombasa in 1916 (Kenya, 1999).

## **(iv) Garbage collection**

Problems in the system begin with the first stages. The containers in which residents put their trash every morning are inadequate both in size and quantity. Once the trash is on the ground, it is generally not collected. As with the drainage situation, the garbage problem causes many

concerns. The rotting garbage breeds mosquitoes and harmful micro-organisms that cause various diseases. It also provides a fertile breeding ground for such pathogenic pests as rats and flies.

#### **(v) Electricity**

The idea of electric power in Mombasa dates back at least to the first decade of the last century. In 1908, the Mombasa Power and Lighting Company Ltd. was formed by several prominent citizens and started importing equipment through Zanzibar. The First World War, unfortunately, interrupted the company's work of installing lines, and it was forced to fold. In 1916, a new company was formed to take over the work, but it too eventually went bankrupt (Mugwima, 2004). East African Power and Lighting Co. was then started in 1922. Until 1967, electricity was supplied from two generating stations, one located at Kipevu in Changamwe, which was steam powered and one on the Island at Mbaraki which was diesel powered. Mombasa also imported some of its electricity from Tanzania. With the break-up of East African Community, the company was restructured and changed its name to Kenya Power and Lighting Co. which has since also broken up into various legal entities.

With industrial demand, electricity in the Island is also used for domestic consumption, lighting of shops, and for few streetlights that exist. Local demand seems to be increasing at this time, and there is insufficient generation for current needs. The most serious problem with the electrical system in the Island area is the brown and black outs that sometimes occur. The lack of street lighting is also a major concern.

#### **(vi) Telephone Services**

A good number of the households in the Island area have telephone service. Many people also now have the cell phone and communication is much easier. The condition of the fixed telephone services in Mombasa as a whole has not been very good. Services are interrupted fairly frequently due to the age of the system and lack of maintenance on it. It is serious when one considers that at the time of research even the only line dedicated to the Disaster Secretariat in the District was out of order.

#### **(vii) Roads and Alleyways**

All the major roads in the Island are paved, as were most of the smaller alleyways. With few exceptions, however, they are in poor condition. Potholes are abundant, and there is usually standing water on the roads after rains, which, in turn, causes more potholes.

The traffic situation in the Island is another cause of concern. The fact must be faced that most roads of the Island were just not constructed to accommodate the amount or type of traffic that uses them today. They are too narrow and crooked, and they are also filled with pedestrians who form numerous obstacles to drivers. Certain measures have been enacted to try to cope with this situation. First, many roads in the Island, with the exception of the major Roads are one-way. This has reduced the confusion wrought by matatus before, although it is often breached. The Police in Mombasa are of the opinion that Matatus be kept off the Island limits.

Parking is also a problem in the Island. Most of the streets are just enough to accommodate a line of parked cars and still leave room for other vehicles to pass. In some cases, however, this fact does not deter some people from trying to park in the narrower streets. This situation, of course, causes many traffic back-ups and delays. Another parking issue revolves around the fact that there are several of religious communities. On festival days, traffic parking can come to a standstill, especially in the Old Town. Despite the growing number of cars on the roads, the Island remains mostly a pedestrian area. Most people rely on walking as their primary means of transportation. Major problems occur when it rains and puddles and mud form in the narrow paths. Even when dry, however, some of the paths are rocky and filled with debris, making them difficult to use. Calming of traffic in the narrow alleys neighbourhoods, pedestrian friendly initiatives in the Island in addition to restricting long term parking within the Island can go a long way in alleviating the problem. This can be achieved by making it progressively expensive to park for long times, of course after providing adequate parking at the nearby limits of the mainlands and encouraging mass transit within the confines of the Island.

### 3.12 Places of Interest and Cultural Value

Mombasa has several places of interest and cultural value, both within and outside the Island. Many are protected by the National Museums of Kenya. These areas need to be integrated in any disaster preparedness plans due to their cultural value and as places of possible mass concentrations of people.

**Baobab Forest:** These fascinating trees are dotted about Mombasa but a pleasing collection occurs in open ground on the southern tip of the Island east of Likoni Ferry. Mama Ngina Drive passes through the area, which forms a public garden and is much appreciated by those seeking recreation. It is encouraging that the area has recently been gazetted and the Forest remains for the enjoyment of all. It is an open area that, according the Kenya Air Force, also offers itself conveniently for air evacuation whenever needed

**Bamburi Nature Trail and Haller Park:** Thanks to the enlightened attitude of the Bamburi Cement Co., the ugly and barren quarries left behind after their extraction of coral have been transformed into a natural paradise. The change was wrought by agronomist/ environmentalist Rene Haller who has greened a large acreage with recreational facilities from game sanctuary to cycling trails to fish-ponds. This ecological showpiece stretches for some distance along the west side of the Malindi Road (Moss, 2002:52).

**Emmanuel Church:** Frere Town (named after Sir Bartle Frere, champion of the anti-slavery cause) was demarcated in 1874, at Kisauni on the North Mainland, as a refuge for freed slaves. The church was built by former slaves in 1884 and is one of the oldest church buildings in East Africa. Slaves were brought to this compound from slaving ships intercepted by the British squadron, which patrolled the Indian Ocean during the anti-slavery period.

**Fort Jesus:** At the southern end of the Old Town's urban waterfront zone stands Fort Jesus first completed by the Portuguese in 1596 – a monument to Portugal's brief age of imperial splendour. Today it is without doubt the principal historical monument not only of Mombasa, but also of Kenya as a whole. The immediate environs of the fort, however, would benefit from environmental improvement including vegetation control, renovation of the Watergate and the introduction of a carefully designed and located landing stage so that visitors arriving by water could appreciate more easily the remarkable site of the building as seen from the sea, as well as the details of the interior. Tourist visits to the fort by dhow should be initiated, to arrive at the water gate from the Old port. According to the Kenya Navy, it can also provide a convenient landing point for water based transport from both the south mainland (Shelly Beach) and north mainland (Mkomani) to ease road congestion and for alternative evacuation during disasters. It was, after all, the main landing point to the Portuguese town, previously. There is also a flourishing Fort Jesus society, the Friends of Fort Jesus, which promote continuing interest in cultural activities associated with the fort and with the wider context of Mombasa as a port city. Since its first occupation in 1596 it has only briefly been without inhabitants. It is one of East Africa's oldest structures.

*Plate 1: The Watergate to Fort Jesus from the sea offering a landing for water transport*



(Source: Author, 2005)

**Leven House and Steps:** The building presently called Leven House is a reconstruction and revival of the original building, which was owned by the Mazruis, an Arab ruling family. The site is named after HMS Leven, one of the two British naval survey ships, which alighted there in 1824. Leven House is unique in Mombasa in that it has a history that can be documented back over 170 years.

**Mbaraki Pillar:** Rising 14m from its hollow plinth, well preserved but leaning at a 5° angle, is this remarkable 300-year-old hollow column. Its purpose remains conjectural but its phallic outline suggests it may be connected with secret fertility rituals. In fact, women are said to have visited the site until a few years back when the insensitive industrial development, which now hems the Pillar in, must have driven them away. Its national monument status saved it from destruction but, surrounded by sheds and railways, it is bereft of its supporting trees and contemporary ruins.

**Municipal (McKinnon) Market:** Built in 1920 on the site of a former slave market at Konzi, the interesting façade fronts many stalls selling fruit, vegetables and a great variety of other commodities.

**Old Law Courts:** This fine colonial building with its clock tower was opened in 1902 by the British governor of the day. It stands up the road from Fort Jesus and has been gazetted as a

historical monument. It was superseded as a court in 1983. Since then, the National Museums of Kenya have housed some of its activities there.

**Old Town:** The Old Town extends north from Fort Jesus to the Allidina Visram High School and from the shoreline westwards to Digo Road. It is a jumble of houses, shops, mosques, narrow streets and alleys extending inland from the Old Port. Because most of the maritime enterprises have moved across the Island to Kilindini Port, the Old Town has retained the character and atmosphere of past times (Moss, 2002:55).

**The Tusks:** When Britain's Princess Margaret was to visit Mombasa in 1956, the town's leaders were anxious she should carry away an indelible memory of her stay, which is how Kilindini Road (now Moi Avenue) came to be spanned by two giant arches in the shape of elephant's tusks. Originally of wood and now of aluminium, The Tusks have lived up to their planned purpose of symbolizing Mombasa's welcome to visitors (Moss, 2003:56).

**The Government Square:** Strongly associated with European administrators and Asian entrepreneurs in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, the Government Square provides access to Mombasa Old Port, which is now managed by the Kenya Ports Authority. On the south side of the square are several buildings that formed part of the early British colonial government/trading complex in the 1890s.

**The Water Front:** Access to the urban waterfront in Mombasa Island is not clear-cut. Hoyle (2002) explains that unlike Lamu, Zanzibar and Dar-es-Salaam where the urban core zone faces directly onto the water and provides an area of constant and varied interaction between urban and maritime activities, Mombasa is mostly oriented inwards towards itself and towards the central business district of the modern town, and so to large extent turns its back to the sea. This is because much of Mombasa Island is composed of coral reef along the Island waterfront some steep, often vertical cliffs of 7 to 10m high. The waterfront has no causeway, not even a footpath, along most of the maritime perimeter of the Island and public access to the water front is available only at certain points such as Fort Jesus, the Leven Steps and Mama Ngina Drive. Although certain functional access points such as the Old Port obviously provide clear exceptions to this general lack of water-oriented activity, many properties, public and private, appear to turn their backs to the water.

### 3.13 Emerging Issues

Background on the study area bring out the following issues that have a bearing on the vulnerability of the Island City of Mombasa:

- History suggests that the location of the Island City of Mombasa makes it vulnerable from sea borne disasters both natural such as flooding, tidal waves and man-made ones including enemy attacks and terrorist activities.
- Restricted communication between the Island and its mainlands, due to its geography has made the Island more vulnerable due to its population density encouraged by superior services and employment opportunities.
- The port, airport, rail terminus and road hub together with its vital installations and administrative importance makes Mombasa a strategic town to be taken care of from all vulnerabilities and is a likely target by any malicious persons intent on inflicting maximum harm on the country and the region.
- Mombasa's cosmopolitan population makes it heterogeneous and difficult to give a sense of community outside the Swahili culture. The Swahili culture being inclusive and dominant should be fostered to enhance this social capital.
- On the western part of the Municipality, the dissected hills of shale can be very dangerous as they are becoming increasingly under pressure for settlement. Disastrous landslides are likely to happen in future if necessary measures are not integrated.
- Poor service delivery by the Municipality can exacerbate potential hazards into disasters when communication, traffic flow, electricity, water etc are not functioning properly causing delays.
- Poor environmental management and land uses along the beaches are stripping them of natural defences, exposing settlements, including the Island, to the vagaries of weather and extreme natural elements.
- Continued drilling of boreholes, wells and pit latrines is apparently weakening the structural integrity of the base rock on the Island. Inadequate water provision and lack of central sewer by the local authority is to blame for this.
- The medieval Watergate at Fort Jesus is a reminder that alternative means of access to the island abound and waiting to be revived and exploited so as to ease the road traffic congestion and offer rapid alternative evacuation ways. So is air rescue from areas such as Mama Ngina Drive and Central Sports Grounds, Railway Gardens and Municipal Stadium.
- Pedestrianization of the Island, banning of matatus and restricting of private vehicles in addition to encouraging mass transit has great potential in lessening traffic congestion and consequently improving rescue and evacuation time. ◊



## CHAPTER FOUR

### VULNERABILITY OF THE ISLAND CITY OF MOMBASA TO DISASTERS

#### 4.0 Introduction

The Mombasa District Disaster Management Committee (DDMC) recognises that Coast Province is prone to disasters, both natural and man-made and of varying magnitudes. The Committee singles out marine, fire and floods as the most common occurring disasters. Their occurrence is attributed to geography, weather, increasing economic and human activities including religious affiliations as the major underlying causes of the occurrence of these catastrophes. Terrorism is also recognised as a new disaster phenomenon with strong external, historical, religious and diplomatic causative factors. Ethnic clashes in Tana River and Likoni are also included as additional causative factors the committee must deal with. According to the Committee, no part of the Province has been spared, although Mombasa, because of the concentration of human activities has received a disproportionately higher number of disasters. The Committee, further, recognises that the disasters have continued to cause infrastructural, economic and human losses not to forget psychological trauma. Other than the human suffering, they have also diverted substantial national resources from crucial and needy areas to remedial reconstruction and relief (MDDMC, 2003)

The greater the exposure there is to a hazard, the higher potential there is that some impact will result. It becomes a matter of *when* not *if* (Nomdo, 2002:35). It is on this basis that this Chapter would like to investigate the question; is Mombasa exposed to hazards? What is the level of exposure, if any? What developmental measures will have the effect of mitigating probable disasters? And should they happen, what measures will mitigate losses, of both life and property? Consequently, the Disaster Preparedness of Mombasa will be discussed from the point of view of its vulnerability with regard to its *contingent conditions* rather than from the *causal mechanisms* or hazards themselves. This is out of the realisation that taking care of the contingent vulnerability, as discussed in Chapter Two, is not disaster specific and will take care of all the hazards to which Mombasa would be prone of.

Hazards as *causal mechanisms* interact with vulnerable conditions, *contingent conditions* to increase the likelihood of disaster. It is often a combination of these factors that interact to produce disaster (Nomdo, 2002:199). As Lewis (1999: xii) states, 'not only are disasters a part of their contexts, they are in part caused by their contexts'. The analysis of place, as the context of the manifestation of hazards, illustrates how contextual vulnerability analysis can be applied for the purpose of disaster reduction. This is because the hazardousness, or vulnerability, of a place relates

not to one phenomenon, but to all hazards to which the place is prone (Lewis, 1999:47). Consequently, this chapter seeks to examine the existing situation in the Island of Mombasa, with a view of investigating the rationale for disaster preparedness. It is based on the detailed analysis and an overall assessment of the physical environment, the demographic, the social, the cultural, and the economic aspects that are useful in highlighting the emerging issues in the vulnerability of the Island City of Mombasa. Use was also made of the primary data, collected through physical and social surveys of the sampled study areas of Old Town, King'orani, Kaloleni, and Tudor Estate residential neighbourhoods. Participant observation, administration of household and general public questionnaires and photographs was also used.

#### **4.1 The Experience of Vulnerability in Mombasa**

Disaster experience and assessment can be considered in two stages:

- The initial impact, when vulnerability may be conditioned by location, density and distribution of population, age of people and structures, and technical and social capacity for resistance and protection.
- The aftermath and the capacity of survivors to continue to survive in the longer term.

Now, physical planning is about space and although as seen, vulnerability is experienced in a range of contexts or at various levels or sectors, it is the spatial intervention that this study will concentrate on, where the disaster vulnerability of Mombasa will be looked at from the following three-fold contingent criteria:

- Vulnerability due to natural conditions
- Vulnerability associated with socio-economic factors, and finally
- Vulnerability related to functionality and types of development.

#### **4.2 Vulnerability Due To Natural Conditions**

Natural conditions have to do with the location, physical and environmental aspects that a settlement is set in. These are the givens that are independent of human influence until the activities of man start interfering with them.

##### **(i) Locational Vulnerability**

Mombasa is located on the Indian Ocean coast of East Africa. This is an area that has not, traditionally, been associated with extreme tectonic, geological or weather related phenomena. This, however, does not completely rule them out as evidenced by the recent Asian tsunami of December 26, 2004 when several people were killed on the coastline, including one Kenyan. The

worst aspect of such a phenomenon like the tsunami is that it has the potential to catch communities at their most unprepared state. This is due to the fact that it can affect communities far from its epicentre, which do not have any experience of the phenomena.

In fact, recently following the Asian tsunami of December 26, 2004, the Government of Zanzibar was at pains to allay fears of locals that the Island was not in an earthquake zone. This was after lawmakers had queried the archipelago's disaster management capabilities in the follow up to Zanzibar, which is in close proximity offshore of Mombasa, being stunned by the Asian tsunami and a tremor on the island itself measuring 5.3 on the Richter Scale on January 15, 2005 (XINHUA, 2005).

The history of Mombasa, as told in Chapter two, bears witness to its susceptibility to attack from the sea. This can take the form of either terrorist activities or enemy action. After the September 11, 2001 New York terrorist attack, the international community believes the next front for terrorists will likely be the sea. It is for this reason that the Golden Spear initiative recently launched involving 11 countries from the Horn of Africa, Kenya included, together with the US scouts the oceans in this region to ward off any such threats (US, 2003). Also, in August 15, 2005 the Golden Spear Symposium and Regional Disaster Management Centre of Excellence was opened in Nairobi. In conjunction with The Centre for Strategic Studies, the centre is intended to develop mechanisms for disaster preparedness and response in this region. Special units, some from the military, will be created to respond to such disasters (Kisia, 2005:6).

The recent gazettelement of Kenya's offshore Exclusive Economic Zone, calls for proper planning of the Maritime Surveillance Radar (MASURA) Stations along the Coastline in addition to strengthening of the Marine Police Unit.

Mombasa has an isolated position in Kenya, almost 500 km from the next large town. The small nearby towns are completely ineffectual in so far as offering any substantial help in the event of a disaster is concerned (Dyer, 1962:49).

#### (ii) Physical Vulnerability

Mombasa is an Island City. Islands have vulnerabilities peculiar to them. Lewis (1999:18) states that islands have, in their relative smallness, an extraordinary vulnerability. Natural phenomena in their destructive power can engulf entire islands and cause devastation on a proportional scale unknown in larger and sub-continental regions. Their smallness has special

implications for administration and management, which provides more constraints for development strategies. In the shifting interplay of contributing factors of vulnerability, what happens in islands will be much the same as what happens at local level anywhere. The difference is that islands are immediately local level and appropriately identified strategies are implementable there, being manageable and small scale.

It is the characteristic of islands that their comparatively small area and extent is physically limited and defined by a natural containment. They are physically and administratively finite. They are, also a containment of interrelationships between activities. The advantage of smallness and containment within islands to contextual analysis is that interrelationships between one event, action or activity and another, are evident and relatively unobscured (Lewis, 1999:47).

Urban planning, for example, in the context of Mombasa is physically more complex and problematic than in any other town in Kenya. Two large intrusions of the ocean: Port Reitz and Port Tudor have been responsible for its birth and continued growth. But they also present significant problems for its future expansion by physically dividing Mombasa into four (4) distinct and relatively isolated areas: The Island; The West Mainland; The South Mainland and The North Mainland. The strict physical confine of the island brought by this physical separation of areas is envisioned in the long-term future to bring about a high rise, high-density city centre on the island. It is expected that future residential and industrial developments will take place in the North, West and South Mainlands and that the Central Business, Commercial and Administrative aspects will become increasingly more important as the main economic functions of the island. In the long term it may be more realistic to assume that the whole island will be the Central Business District (CBD) (GoK, 1971).

The concentration of activities within the island, because of the severely limited amount of land available will, if effective steps are not taken, present a recipe for multiple issues of public safety concerns caused by severe overcrowding, incompatible land uses, loss of amenity, reduction of health standards and slowing down of economic growth. This is because large and prohibitive expenditures are required to install adequate transportation links between the four distinct physical confines of the city if they have to work harmoniously and if people are to be encouraged to occupy the north and south mainland areas and not to continue to crowd on the island. Also, if industrial developments are to be located off the island and west mainland a transportation network designed to encourage and stimulate decentralisation of population, industries and services is a basic

necessity. Any link across Kilindini and Port Reitz, for example, will be very expensive since the structure must not interfere with shipping.

### (iii) Geology

The seaward boundary of the coastal plains (Pleistocene) is composed of the coral reef, which gradually gives way inland to areas of Lagoonal Sands. The drainage, ground water and other properties of the lands with characteristics important for disaster analysis are:

- **Raised Coral Reef:** Drainage is excellent. Ground water potential is good from shallow wells although the possibility of seawater intrusion is always present. The coral, which covers the entire island is structurally stable and provides an excellent base for building.
- **Lagoonal Sands:** Drainage is fairly good, but there is tendency for swampy areas to form in wet weather. Ground water potential is similar to the conditions in coral. These soils are generally sandy with good load bearing properties, freely draining when not at low elevations.
- **Jurassic Shale:** Drainage is very poor. Pockets of overlying soils are liable to become waterlogged in rainy season. Ground water, when present, is mainly saline. These grounds provide diverse conditions for building. On the residual sandy plateau such as Changamwe the soils have clay content which increases with depth. The sub-base therefore is subject to movement as the moisture content of the clay varies and special care is needed in designing the foundation of buildings for this area. The increasing clay content also means that pit latrines are not a suitable means of soil disposal in this condition, as they fill up during the rains and often collapse.

Where the sand overburden has been removed, drainage courses have incised the shale and produced an eroded landscape which varies in the degree of dissection. Some areas are totally unsuited to any form of urban development; other areas might be used with caution for lower density development if the necessary conservation measures can be justified. Although this land is unsuited for building, especially construction according to traditional methods, the authorities will become under increasing pressure to allow development to take place, since the area has the advantage of well developed transportation links passing through it. The risk is, since much of the land is unsuited for industry and will be avoided due to higher cost of development, it will be left vacant and tempting to the builders of traditional houses who could not afford the proper measures to safeguard against erosion. If stringent development controls are not exercised, and large numbers of houses were built at high densities, 'residential landslides' such as the ones that have occurred in Rio de Janeiro and Hong Kong, could result (GoK, 1971:6).

- **Magarini Sands:** Drainage is variable, largely dependent on amount of clay present. Sweet water does occur in the middle of Changamwe and on the South Mainland, west of Mtongwe. For the most part the area is suited to urban development although locally it can be severely broken or poorly drained.

As regards suitability for building, areas other than shale are satisfactory both physically and economically. Shale areas, due to lack of drainage are liable to extensive erosion and when wet, the subsoil is completely unpredictable and unstable. Where overlying sands have high clay content, as at Changamwe, similar conditions occur. In both these latter cases, detailed site and sub-soil surveys are required before development and special consideration must be given to construction, foundation works and drainage (Dyer, 1962:5).

#### (iv) Environmental Vulnerability

The scale of urban vulnerability is linked to the way in which people have negatively changed the natural environment, also known as the *ecological footprints*. Cities leave large ecological footprints and development puts communities at risk. People choose to accept a certain level of risk in a city as it provides opportunities for improvement in quality of life. However, the concentration of people in cities and the need to provide services and infrastructure means that human induced hazards are introduced and need to be well managed to avert risk of disaster (Nomdo, 2002:198). Environments are vulnerable in themselves, and they have implications for the vulnerability of inhabitants and populations. Beach mangroves destroyed for development may deprive beach communities of their sea defences and expose them to the vagaries of the sea (Lewis, 1999: 26).

#### (v) Coastal Tourism

Coastal development for tourism is common in many countries along coastlines. Such developments are automatically at risk of flooding as a result of tropical cyclone or sea surge. In many cases, however, construction activity destroys protective mangroves and trees by clearance, and dunes and reefs by quarrying and excavation for construction materials. Not only is the development at risk by its choice of location, but its own physical vulnerability and that of adjacent communities is increased by removal of natural protective features. Bearing in mind that development of most kinds draws an increase of population for the employment prospects it offers, vulnerability is at once compounded. Nothing has been done to discourage extensive tourist development close to the shore. Use of shoreline sites is on the increase in Mombasa, putting investments, visitors and residents all at peril from rare but quite possible events.

The proposed (1998) US\$4.4 billion development, largely for tourism, of the Nungwi Peninsula of Zanzibar, off Mombasa, is currently not in an area prone to tropical cyclones. Sea surface temperatures do however already reach 26° C at certain times of the year and could do so over increasingly wider areas of the East African coastline as a result of climate change. The development itself, with its visitors and staff, will be at risk, but more particularly so will be the thousands of displaced former occupants of the peninsula (Lewis, 1999: 30).

#### (vi) Climate Change and Sea Level Rise

There is now less uncertainty than there was with regard to the acceptance of the phenomenon of climate change and one of its most significant consequences, that of sea level rise. Internationally accepted assumptions for increased mean climatic temperatures were established in 1988 as 1.5-4.5°C, and sea level rise of 20-140 centimetres before the end of the 21<sup>st</sup> century. Interim accepted assumptions are for a 1.5°C temperature rise and 20 centimetres rise in sea level by the year 2025. Variations are beginning to emerge which have relevance for islands (Lewis, 1999: 28). The low-lying flood prone areas of Mombasa have recently been occupied by settlements. These areas, and others like it, are soon going to be treeless. Un-reinforced by tree roots, these areas will be most prone to erosion and will be much lower than before deforestation. The building of residential dwellings at sea level susceptible to flooding at the slight increase in sea water level at the Kenya Railway Quarters at Makande is a case in point. Another area of flooding potential is the Kaa-Chonjo basin and the Muoroto informal settlements of Tudor.

#### (vii) The *El Nino*

Mombasa was not spared the devastation wrought by the *El Nino* weather phenomenon. Unusually heavy rainfall in the late 1997 and early 1998 left an estimated 2,000 people dead, nationally, caused major damage to roads and railways, including the main road between Mombasa and Nairobi which serves the whole region, cut off rural communities, disrupted trade and agriculture and created ideal conditions for the spread of epidemics (Rift Valley fever, cholera). The poor state of the roads and weight restrictions on vehicles hampered even the movement efforts to assist conflict and disaster victims in the Horn of Africa and Great Lakes regions.

#### (viii) Dependency on External Assistance

At each level, susceptibility, and therefore vulnerability, is increased by dependency. This is, reliance upon external assistance or upon systems of exogenous origin. Dependency is a very real cause of vulnerability, whether it is by choice, chance or inevitability. The removal, disappearance or failure of the dependency 'prop' results in a worsening of a vulnerable condition (Lewis, 1999:

23). Being an island city with limited accessibility, Mombasa needs, as much as possible to be self sufficient in disastrous situations where time would be of essence in containing such situations before external assistance arrives.

#### **4.3 Vulnerability Associated With Socio-Economic Factors**

This set of vulnerabilities have to do with the condition of the populations within settlements. This study has taken the position that disasters are socio-economic, not physical, events. Lewis (1999: viii) sums it when he says that 'a disaster is not a physical happening, it is a social event'. It is then clear that disasters are about people and, if disaster research is to have any meaning, it should be focused on people. The factor of paramount importance is the state of the population for without people there can be no disaster. This study will now look at the population dynamics in Mombasa that have a bearing on its vulnerability to disaster. Other than the population, vulnerability is also increased by poverty and density of development.

##### **(i) Population: its Distribution, Density and Trends in Mombasa**

It is an established principle that areas of highest population density would suffer greatest losses, that is, that high-density areas have the greatest vulnerability (Lewis, 1999:106). The population of Mombasa District as per the 1999 Census was 665,013. The area of Mombasa is 229.5km<sup>2</sup>. This gives a density of 2,898 people per km<sup>2</sup>. The four physical divisions in Mombasa also correspond to the administrative divisions. They are almost physically mutually exclusive, and their populations need to be looked at individually. From the table below, it shows that the most settled area of Mombasa is the north mainland (249,861) followed by the west mainland (173,930). The island comes third (146,344) and the last is the south mainland (94,878). When it comes to density of settlement, the expansive Kisauni comes a distant third (2,280) after the island (10,379), which is three times as densely settled as the second placed west mainland (3,191). Likoni maintains its position as the least populated of the divisions (1,849).

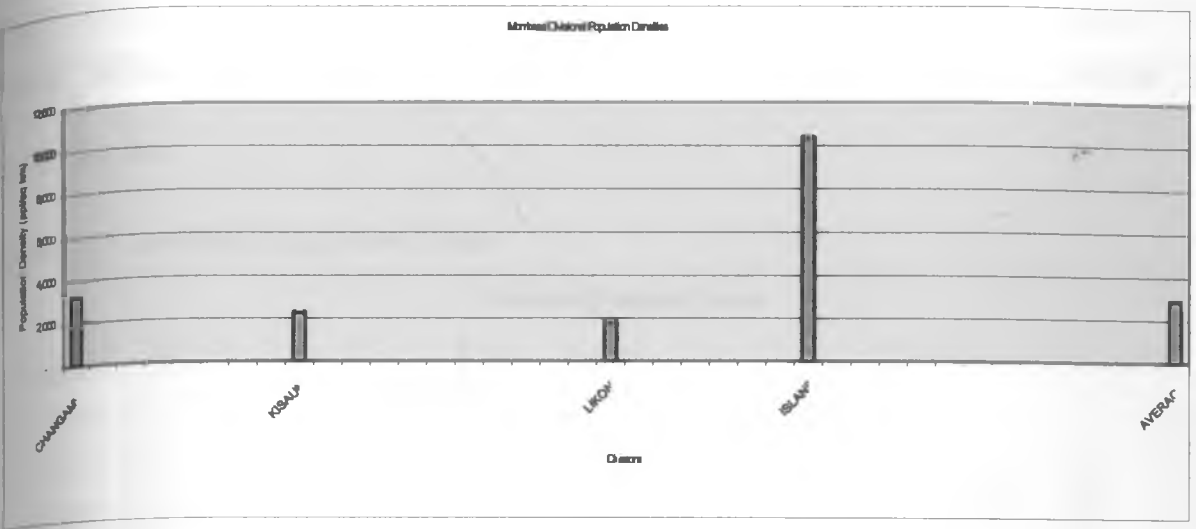


Table 5: Vulnerability Rating Analysis

Division	Popn	Area(Km <sup>2</sup> )	Density/Km <sup>2</sup>	Popn	Area(Km <sup>2</sup> )	Sublocation	Popn	Area (Km <sup>2</sup> )	Density	Pop Index	Pov Index	Dev Index	Ulnerability	V	Sum
Changamwe	173,930	54.5	3,191	44,720	4.4	Chaaani	44,720	4.4	10,164	3	4	2	24	3	
				54,084	9.6	Port Reitz	54,084	9.6	5,634	4	4	2	32	4	
				11,346	3.8	Changamwe	11,346	3.8	2,986	5	5	2	50	5	
				31,295	30.3	Jomvu Kuu	16,123	21.4	753	5	3	3	45	5	
						Miritni	15,172	8.9	1,705	5	3	3	45	5	
				32,485	6.4	Kwashee	20,689	4.0	5,172	4	4	2	32	4	
						Birikani	11,798	2.4	4,915	5	3	3	45	5	31
Kisumu	248,861	109.6	2,280	117,889	23.8	Kisauni	51,250	8.2	6,250	4	4	2	32	4	
						Magogoni	53,075	6.6	8,042	4	4	2	32	4	
						Junda	13,564	9.0	1,507	5	3	3	45	5	
				86,678	14.8	Kongowea	49,156	8.0	6,145	4	4	2	32	4	
						Maweni	37,522	6.8	5,518	4	4	2	32	4	
				45,294	71.0	Bambun	12,026	13.2	911	5	3	3	45	5	
						Mwakirunge	2,856	20.0	143	5	1	3	15	2	
						Maunguja	2,856	20.0	143	5	1	3	15	2	
						Mwembe Legeza	18,324	11.3	1,622	5	3	2	30	3	
						Shanzu	9,230	6.5	1,420	5	5	2	50	5	38
Likoni	94,878	51.3	1,849	21,181	23.6	Mtongwe	21,181	23.6	898	5	4	3	60	6	
				56,367	10.5	Likoni	15,001	1.0	15,001	2	4	2	16	2	
						Bofu	25,554	1.8	14,197	3	4	2	24	3	
						Timbwani	18,812	7.7	2,443	5	4	2	40	4	
				14,330	17.2	Vijiweni	5,154	12.0	430	5	3	2	30	3	
						Vyemani	9,176	5.2	1,785	5	3	2	30	3	21
Inland	148,344	14.1	10,379	29,044	1.8	Bondeni	8,800	0.5	17,600	2	5	2	20	2	
						Tononoka	20,244	1.3	15,572	2	6	2	24	3	
				32,431	1.7	Majengo	18,804	1.1	17,095	2	5	1	10	1	
						Kingo'rani	13,627	0.6	22,712	1	5	1	5	1	
				7,810	0.5	Mwembe Tayari	7,810	0.5	15,620	2	5	1	10	1	
				9,527	2.9	Shimanzi	9,527	2.9	3,285	5	6	2	60	6	
				27,225	2.1	Tudor Estate	14,077	0.7	20,110	1	5	2	10	1	
						Tudor Four	13,148	1.4	9,391	4	5	2	40	4	
				21,516	0.8	Makadara	10,129	0.4	25,323	1	5	1	5	1	
		Mji Wa Kale	11,387	0.4	28,468	1	4	1	4	1					
18,791	4.3	Ganioni	11,626	2.1	5,536	4	6	2	48	5					
		Kizingo	7,165	2.2	3,257	5	6	2	60	6	32				
Average	665,013	229.5	2,896	665,013.00	229.5		665,013	229.5	2,896						

(Source: author, 2005)

Figure 8: Mombasa Divisional Densities



(Source: Author, 2005)

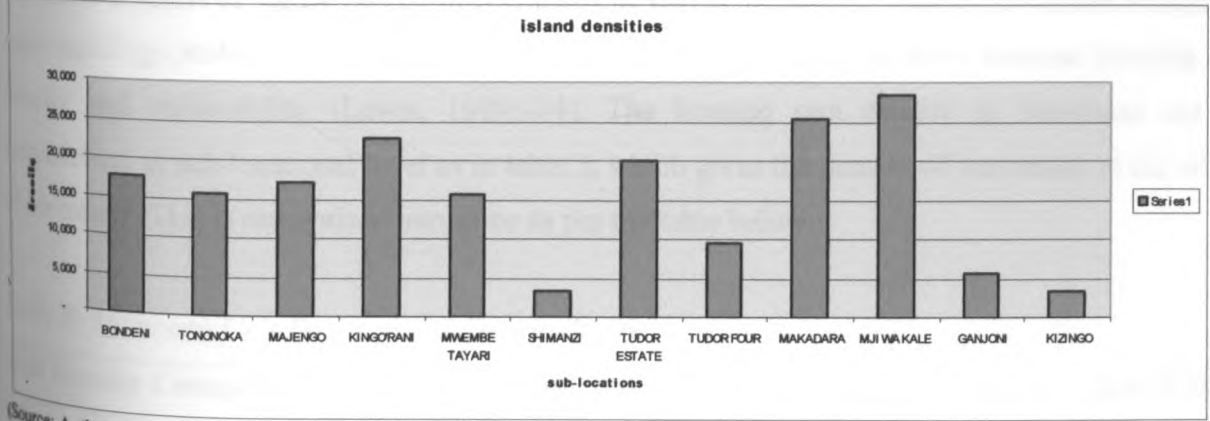
Further the densities were reduced to the smallest administrative unit, the sub-location, which were categorised into five sectors as per the table below:

Table 6: Population Density Index

Density Category	Density (people/km <sup>2</sup> )	Population Density Index (PDI)
Very High	>20,000	1
High	15,000-20,000	2
Medium	10,000-15,000	3
Low	5,000-10,000	4
Very Low	<5,000	5

(Source: Author, 2005)

Figure 9: Island Sub-locational population densities



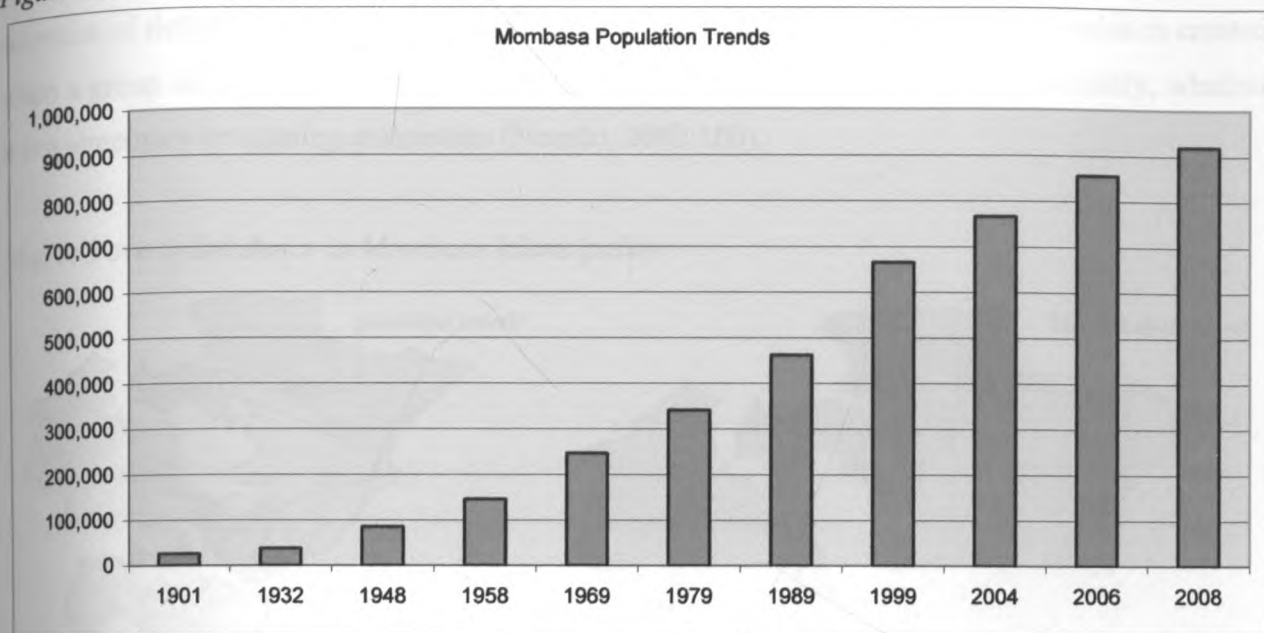
(Source: Author, 2005)

Table 7: Population trends

1901	1932	1948	1958	1969	1979	1989	1999	2004	2006	2008
26,300	38,300	84,746	145,386	247,073	341,149	461,760	665,018	766,571	856,209	920,313

(Source: Kenya, 2002)

Figure 10: Mombasa Population Trends



(Source: Author, 2005)

### (ii) Unit Development Density

There may be positive relation between the number of, or the percentage, of housing units destroyed, and housing unit density (number of housing units per square km) (Lewis, 1999:100). Divisions with highest number of housing units have the higher vulnerability indicator. Nevertheless, when high-density divisions suffer lower percentages of destruction, it can be partly explained in terms of higher quality of construction, that is, in terms of mutual protection of houses, since buildings protect each other. But generally, there is close compatibility between housing unit density and vulnerability (Lewis, 1999:104). The housing unit density in Mombasa can be summarised, at sub-locational level as in table 5, which gives the density of settlement in the whole of Mombasa. This is categorised into three as per the table below:

Table 8: Mombasa Unit Development Density Index

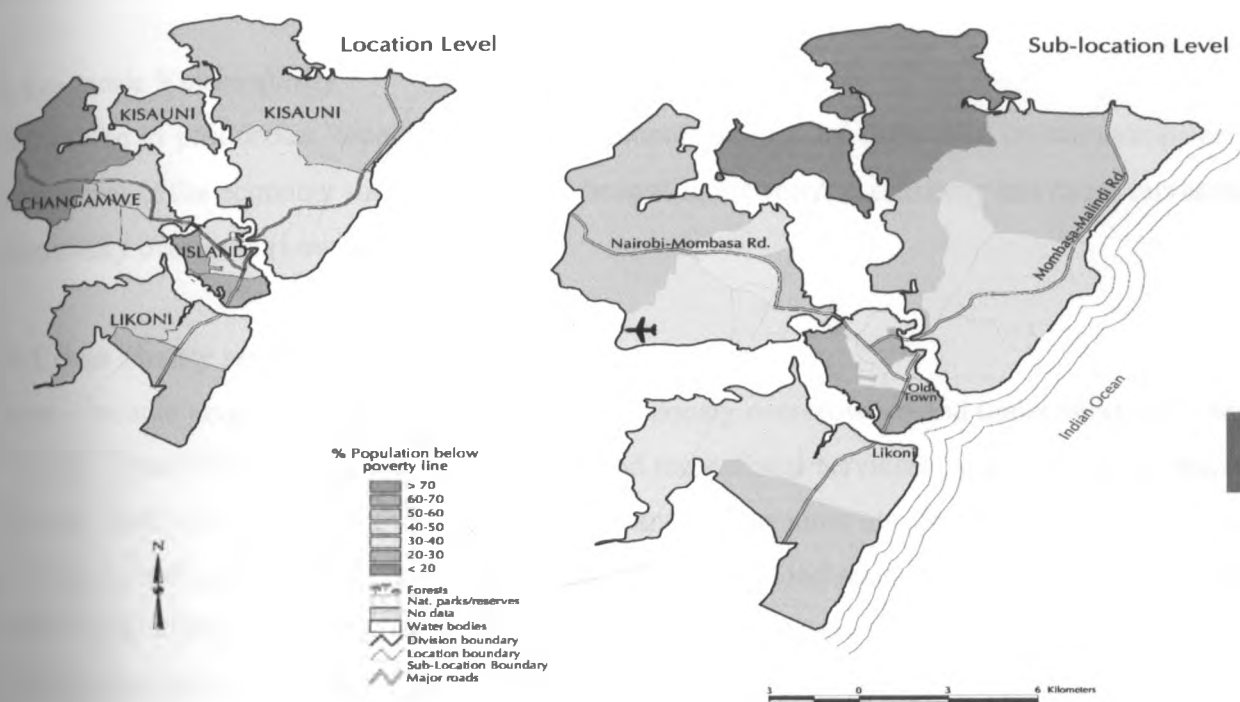
Unit Density Category	Approx Land Area Covered (%)	Unit Density Index (UDI)
High	>60	1
Medium	30-60	2
Low	<30	3

(Source: Author, 2005)

### (iii) Social vulnerability

The vulnerability of communities and people is usually manifest in social groups that may be more vulnerable than others. These may be integral members of a community, such as the very old, or distinctly separate groups identifiable by settlement, ethnicity or religious differences. Poverty and vulnerability are distinct yet inextricably linked. Vulnerability comes not only from being poor, but from being powerless to do anything about vulnerability which may result from the actions and activities of richer, and therefore more powerful groups (Lewis, 1999: 24). Social capital is created when a group of individuals or households organise themselves into a larger social entity, whether it is a temporary or ongoing association (Nomdo, 2002:100).

Map 8: Poverty Incidence in Mombasa Municipality



(Source: CBS, 1999)

Table 9: Mombasa Poverty Index

Poverty Category	Percentage Below Poverty Line (%)	Poverty Index (PI)
Very Low Income	>70	1
Low Income	60-70	2
Lower Middle Income	50-60	3
Middle Income	40-50	4
Upper Middle Income	30-40	5
High Income	20-30	6
Very High Income	<20	7

(Source: CBS, 1999/ Author, 2005)

Poverty analysis of Mombasa at sub-locational level as per the CBS Kenya Poverty Atlas can be seen on Map 8 and the results are categorised into seven (7) categories as in Table 9 above.

#### (iv) Frequency of exposure

The greater the exposure there is to a hazard, the higher potential there is that some impact will result. It becomes a matter of *when* not *if*. Poorer members of urban society tend to be exposed to low-density risks more frequently than those with greater resources at their disposal. This is due to the locational advantages that wealthier urban residents enjoy. The urban poor tend to be located on marginal land, which is usually not in demand as it may be hazardous, or close to industries or other technological and infrastructural hazards in the city (Nomdo, 2002:35).

#### (v) Economic Vulnerability

This may be in production, especially in fragile economies that are dependent on monocrops or a single sector of the economy such as tourism. Changes in the sectoral economy can cause increased vulnerability over time (Lewis, 1999: 25).

#### (vi) Urban Shanty settlements

Lower – income neighbourhoods tend to be simultaneously overcrowded and under serviced. They lack both formal retail facilities and community and recreational services, particularly open spaces (Nomdo, 2002:80). At times of disasters, these shanty settlements are the cause of considerable problems for the Council, since inhabitants have to be evacuated each time so as to avoid heavy losses of life. Torrential rains threaten to wash houses into the ocean. The administration that deals with the shanty dwellers on these occasions, does so only at the level of preparedness, and does so because that is the limit of its capabilities as well as of its comprehension. As a branch of government, it is not part of a developmental sector that might recognise the causes of the growth of migration to shanty towns, as well as having the powers and resources to do anything about it by way of relocation and or rehousing and the creation of employment opportunities. There are similar shantytowns adjacent to the city, on ravines, hillsides and dry riverbeds; all of them are known to be very vulnerable. What is important however is for the reasons for their occupation to be known and understood so that governments may undertake measures others than evacuation and humanitarian assistance. Although their condition often appears to be their fault, mostly, these restrictions will have been imposed for the socio-economic betterment and protection of others, a phenomenon referred to as marginalization (Lewis, 1999: 29).

### (vii) The Vulnerability Index

The socio-economic perspective of this study makes it desirable that the vulnerability index of Mombasa at the sub locational level be created from this section. This is arrived at from the three most important aspects of socio-economic vulnerability namely; population density, poverty and housing unit (developmental) density. A combination of the three factors of vulnerability by getting the product of the three weighted indices i.e Population Density Index (PDI), Poverty Index (PI) and Unit Density Index (UDI) for every sub-location in the district gives the Vulnerability Rating (VR) for each sub-location as shown on table 5, i.e

$$PDI \times PI \times UDI = VR$$

From table 5 the following two important observations come out:

- By getting divisional averages of the Vulnerability Index (VI) the Island Division has the Highest Vulnerability (lowest Vulnerability Index) as shown by the table below:

Table 10: Divisional vulnerability rating

Divisions	Vulnerability Rating (VR)	Average Vulnerability Index (VI)
Island	Very High	2.7
South Mainland	High	3.5
North Mainland	Low	3.8
West Mainland	Very Low	4.4

(Source: Author, 2005)

- All the six (6) sub-locations with a Vulnerability Index of 'Very High' are found within the Island Division.

Table 11: Weighted Vulnerability Indices (VIs) for all the sub-locations:

Vulnerability Category	Vulnerability Rating (VR) Category	Vulnerability Index (VI)
Very High	<10	1
High	11-20	2
Moderate High	21-30	3
Moderate Low	31-40	4
Low	41-50	5
Very Low	>60	6

(Source: Author, 2005)

The four sampled neighbourhoods of Old Town, Majengo, Tudor Estate and Kaloleni are shown below.

*Map 9: Old Town*



(Source: DPP, 2005)

*Map 10: King'orani*



(Source: DPP, 2005)

*Map 11: Tudor Estate*



(Source: DPP, 2005)

*Map 12: Kaloleni*



(Source: DPP, 2005)

#### **4.4 Vulnerability Related to Functionality and Types of Development.**

This set of vulnerabilities relate to the functions the island city of Mombasa plays and the kinds of development it has attracted over time.

### (i) Functional Vulnerability

Mombasa's function is that of a major port and distributive centre and therefore, its industrial development is geared to the export and import trades upon which its prosperity depends. With few exceptions, industrial emphasis is not on manufacture but storage facilities, assembly, packing, sorting, grading and distribution. There are almost no heavy industries. The remaining are light and marine engineering, service and local products industries (Dyer, 1962:24).

### (ii) Developmental Vulnerability

This type of vulnerability results from kinds of development that are considered as being of high vulnerability. The most common of these are:

- High concentration of population;

**Residential:** old and dense built-up areas having timber structure and organic roof materials and involving faulty energy supply installations as is shown below at Kaloleni area.

*Plate 2: Kaloleni housing characteristics*



(Source: Author, 2005)

- Squatter settlements of the technical characteristics described above
- Areas without a water supply network

These are mostly areas of squatter settlements and slums, often illegally developed, very poorly built, and with comparatively high concentration of the poorest portion of an urban population. Development of these settlements is totally or partially illegal, and initiated often by illegal occupation of land. They also often occupy very valuable urban land. As a rule, such areas represent high-risk zones (flood plains, dangerous slopes, along seismic faults, below flood levels, along a coast line, etc.). The probability is very high, therefore, that these areas will be the first



affected during a natural disaster and most vulnerable to the development of a disastrous chain of events as the Muoroto area in Tudor estate, Mombasa seen below.

*Plate 3: Muoroto informal settlement, Tudor Estate*



(Source: Author, 2005)

- Zones of mixed development: poor quality housing, handicraft workshops, and warehouses.

**Single purpose:** places of mass-meetings, schools, theatres, entertainment halls, department stores, markets, hotels.

- High concentration of economic activities (mostly manufacturing);

**Industrial:** old industrialised zones having densely developed plants, equipped with outdated hardware, installations and technology (UN, 1976:37).

- Some specific industries, including: oil processing plants, some chemical plants and pharmaceutical plants, wood processing plants, explosives and fire works manufacturers and distilleries.
- Warehouses, fuel and gas reservoirs, storages of timber, sawdust and coal, garages and organic litter depots. Fuel tanks next to KPA Shimanzi houses below.



(Source: Author, 2005)



(Source: Author, 2005)

- Key communication installations;
- Major transportation junctions;
  - Sea Ports:
  - Airports: A potentially dangerous catastrophe is an aircraft disaster. Most sensitive areas are in the vicinity of major airports along the extension line of runways; most airplane disasters develop on take-off, during landing, or during landing approach manoeuvres.
  - Railway junctions for heavy traffic represent another zone of potential risk. The impact that traffic accidents in these areas have on adjoining zones depends more on the kind of goods being transported than on the accidents themselves.
  - Ferry, an example of potential traffic disaster zone.

Plate 5: Likoni Ferry Crossing, Likoni



(Source: Author, 2005)

- Traffic
- Major defence installations: Those found in Mombasa are the following:
  - 15 Kenya Rifles: Nyali barracks
  - Forward Observation Base: Port Reitz
  - Kenya Navy Base: Mtongwe

A discussion with the commanders showed that they do not pose any threat to the local populations with respect to the way and where ammunition is stored. The only concern is that during war these are the first places to be attacked and any settlement in close proximity would be hit in the process. There has also been encroachment on the vicinity of these installations. The FOB recently lost its access to the sea and fuel storage tanks are constructed in its proximity, considered very dangerous for flight manoeuvres.

- Areas of high socio-economic values: There are two highly sensitive areas in this respect.
  - Administrative offices as found within the Island in Mombasa
  - Cultural places as outlined in Chapter Two

## (ii) Communications

The major problem concerns the island and arises from the fact that two thirds of the existing population live, work and, together with through long distance and industrial traffic, circulate within its confines. All must be done to remove unnecessary traffic from the Island of Mombasa.

This traffic includes:

- All transit traffic which should be made to bypass the Island
- Private vehicles which should be discouraged from accessing the Island
- Matatus which should be made to discharge their passengers outside the Island for them to board mass transit modes of transport
- Excessive road based transport which can be lessened by the development of alternative means (marine and air) of transport.

Map 14: Mombasa Envisioned Long Term Plan Showing Bypasses to the Island



(Source: Kenya, 1971)

#### 4.5 Public Perception of Disaster Preparedness in Mombasa Island

The characteristics of place have a significant bearing on the identification of development strategies anywhere - economically, socially, and culturally. The place would have had its influence upon local culture and vice versa. Local and regional, popular and official perceptions and analysis of them are thus necessary for understanding local and regional influences upon vulnerability and strategies to counter them.

This section expounds on the attitude the residents of Mombasa Island hold about their situation. Further, the inherent problems and challenges in the planning for disasters preparedness is explored and explained with a view to evolving sustainable interventions. The section concludes by looking at the probable way forward as suggested by the community in planning for disaster preparedness.

The perceptions were sampled through four main ways:

- Household questionnaires (32)
- General public questionnaires (27)
- Focus group discussions with all the District Officer, Chiefs, Sub-Chiefs, Headmen and Mitaa representatives from the Island Division held at Majengo Chief's Camp on 07 July 2005 from 1500 to 1700 hrs.
- Key informants interviews as per Appendix I

A percentage of those who responded to the particular question in each case is given:

**(i) The Perception of Vulnerability**

This aspect was captured by asking the respondents to state whether:

- They have had any experience of a hazard in or around their neighbourhood.
- The hazards (causal factors) they feel are the most probable source of threat to them.
- Whether they felt safer outside the island than in the Island.
- Whether the Tsunami of December 2004 had any effect in their perception of their vulnerability.

The results of the survey can be summarised as per table 12 below:

*Table 12: Perception of vulnerability*

Hazard Experience	%	Causal Factors	%	Island Safety	%	Tsunami Effect	%
Yes	52	Fires	73	Yes	60	Yes	54
No	48	Terror Attacks	15	No	28	No	44
		Tsunami	10	No Difference	12		
		Floods	5				
		Industries	54				

(Source: Author, 2005)

The following can be said of the vulnerability perception among the respondents:

- The majority of the respondents had experienced some form of hazards either themselves or by observation around them.
- The most common causal factors of disasters were given as fires and industrial accidents.
- An overwhelming majority of the respondents felt safer outside the island than in it.
- The Tsunami phenomenon of 26 December 2004 heightened the safety consciousness of the majority of the respondents.

## (ii) The Perception of Preparedness

This particular aspect was captured by asking the respondents to state:

- What their first reaction would be in the event of a hazard happening around them.
- How they perceive the quality of response from the concerned authorities.
- Where else they can expect to get help in the event of a failure of the authorities to respond/manage the hazard.
- What they consider to be the most important measures for mitigation of hazards.

The results of the survey can be summarised as per table 13 below:

Table 13: Perception of preparedness

First Reaction	%	Quality of Response	%	Alternative Help Source	%	Important Measure	%
Call Neighbours	60	Good	36	KPA	35	Move Industries out	25
Call fire Dept	8	Not Good	48	Navy	35	Widen Roads	43
Call Police	32	None	16	St John's	30	Public awareness	65
						Empower Fire Dept	55
						Provide Open Spaces	22
						Provide Enough Water	20

(Source: Author, 2005)

As far as the preparedness to disasters is concerned, the following can be read from the respondents' answers:

- The majority 60% of them would turn to their neighbours before they call the police.
- The majority of them felt the response of the authorities to emergencies was poor.
- The respondents were almost equally divided that either the KPA, the Kenya Navy or the St John's Ambulance had equal chances of arriving at the scene to assist.
- The respondents felt that the most important measures in mitigating disasters would be:
  - Public awareness
  - Empowering the fire brigade
  - Widening of roads to enhance traffic flow

## (iii) The Perception of Constraints

The respondents were to point out the conditions (contingent conditions) of their environment that they felt would worsen the situation in the event of a disaster happening.

*Table 14: Perception of Constraints*

<b>Contributing Contingent Conditions</b>	<b>%</b>
Narrow roads	45
Population density	33
Density of settlements	36
Flammable building materials	30
Traffic Jams	25
Lack of Public Awareness	54
Inadequate open areas for evacuation	25

(Source: Author, 2005)

Although substantial number of respondents recognised the contribution of lack of open spaces and traffic jams in disasters, most respondents felt that in the event of a hazard occurring, the contingent conditions that are likely to turn a hazard into a disaster are:

- Lack of public awareness
- Narrow roads that would hinder rapid evacuation
- Density of settlements
- Population density
- Flammable building materials

**(iv) The Perception of Roles**

The residents were to state what they felt were the roles, in respect of disasters preparedness, of:

- The authorities
- The community
- The respondent

The results are summarised in Table 15 below:

*Table 15: Perception of Roles*

<b>Authorities</b>	<b>%</b>	<b>Community</b>	<b>%</b>	<b>Respondent</b>	<b>%</b>
Proper planning	22	Mutual Support	36	Awareness	50
Empower fire dept	24	Respect Planning Laws	42	Respect planning regulations	33
Provide awareness	42	Awareness	44	Be active in the community	17
Prompt response	35	Mutual Interest Lobby Groups	10		

(Source: Author, 2005)

Quite a few of the respondents recognised proper planning and the fire brigade as being important, but most felt the main roles of the local authorities should be:

- Provision of awareness to the public on what to do in the event of a disaster
- Prompt response when disasters happen.

#### (v) The Perception of the Way Forward

The respondents were asked an open question to state the measures, according to them, that would improve the state of preparedness and vulnerability of the island residents. The responses can be summarised as tabulated in table 16 below:

*Table 16: Perception of way forward*

Way Forward	%
Proper planning of the Island	30
Reduce Traffic Jams in the Island	44
Redevelopment of Swahili settlements	35
Provide more connections to Island	45
Public Awareness campaigns	57
Provide adequate open evacuation areas	40

(Source: Author, 2005)

The respondents' perceptions of the way forward were almost equal in importance and they have all been taken as being important given the close margins in the number of respondents.

#### 4.6 Outcomes

Two major issues came out through the public surveys. Firstly, that over and above other important factors, community education and mobilisation is crucial for the initiation, and continued implementation, of disaster preparedness programmes. In the Philippines, for example, National Disaster Consciousness Month is normally celebrated every year to create awareness to the general public and the celebrations are led by the National Disaster Coordinating Council, with the President in attendance (PDRSA, 2005).

Secondly, communities know what affects them and they have their solutions that only need to be articulated by the planners and authorities. What is often missing, but is critical to any successful disaster preparedness planning, is the lack of understanding by those intervening in disasters that there exists grassroots awareness of vulnerability and existing grassroots adjustment to natural



hazard. On this regard, the following need to be kept in mind when dealing with communities in disaster preparedness:

- That community involvement is needed in order to gain greater insight into the individual and collective perception of development and risk
- To revive, apply and share traditional methods
- To strengthen the resilience and self-confidence of local communities
- The need to regain a level of wide and inclusive national participation.

To be totally effective, however, development planning must include an analysis of the existing socio-economic condition of the population. This argument does not detract from the advances in the study and application of pre-disaster planning that have been made in very recent years, but seeks to ensure recognition of the context in which they continue to take place. The processes of increasing vulnerability, the basic cause of disaster, will not be reversed by any technical methodology. The processes of 'development' must first become enlightened with regard to disaster probability and recognize their capacity for a most dangerous role in disaster cause and exacerbation. Next, disaster preparedness planning must be incorporated into development planning if it is to have any lasting value; for if as a process it is applied in isolation it will become merely a palliative dealing with the symptoms and not the causes of disaster.

#### **4.7 Planning Matrix**

For the disaster preparedness development planning of Mombasa, a Planning Matrix for Integrating Disaster Preparedness for the Sustainable Physical Development of the Island City of Mombasa, and potentially any other urban area, has been developed. It captures all salient issues discussed in this chapter and others that would assist planners in their decision making as shown below:

*Table 17: Planning Matrix for Integrating Disaster Preparedness in Mombasa (page 113)*

CRITERIA	LOCATION	PROBLEMS	OBJECTIVES	CONSTRAINTS	STRATEGIES	PROGRAMMES	PRIORITIES	AREAS	AGENCIES
NATURAL CONDITIONS		ISOLATION OF COASTAL TOWN	<p>TO REDUCE REMOTENESS OF MOMBASA TOWN</p> <p>TO PROVIDE FAST TRANSPORT SERVICES</p> <p>TO PROTECT THE TOWN FROM SEAWARD ATTACKS</p> <p>TO PROTECT THE TOWN FROM SEABORNE STRONG PHENOMENA</p>	<p>CLOSEST TOWNS TOO SMALL AND INEFFECTUAL TO OFFER ANY ASSISTANCE IN THE EVENT OF NEED</p> <p>INADEQUATE CONNECTIONS TO OTHER MAJOR TOWNS</p> <p>LONG AND POROUS COASTLINE</p> <p>EXPOSURE OF TOWN TO THE SEA</p>	<p>PROVIDE FOR CLOSE TOWNS TO GROW AND OFFER COMPARABLE SERVICES</p> <p>IMPROVE CONNECTIONS TO OTHER MAJOR TOWNS</p> <p>INTRODUCE ALTERNATIVE FORMS OF TRANSPORT BETWEEN COASTAL TOWNS</p> <p>PLAN FOR ELABORATE SURVEILLANCE OF THE COASTLINE</p> <p>TO DEVELOP EARLY WARNING SYSTEMS TO DETECT ANY NATURAL PHENOMENA ESPECIALLY FROM THE SEA</p>	<p>DISPERSE SERVICES AND EMPLOYMENT OPPORTUNITIES TO SMALLER TOWNS</p> <p>WIDEN AND MAINTAIN GOOD ROADS BETWEEN TOWNS</p> <p>INTRODUCE MARINE TRANSPORT BETWEEN COASTAL TOWNS</p> <p>PROPER PLAN OF THE MARINE SURVEILLANCE RADAR STATIONS ALONG THE COASTLINE AND STRENGTHENING OF MARINE POLICE UNIT</p> <p>MODERNISE WEATHER FORECASTING AND DEVELOP REGIONAL EARLY WARNING SYSTEMS INITIATIVES FOR THE WESTERN INDIAN OCEAN COUNTRIES</p>	<p>EDUCATION, HEALTH AND LIGHT INDUSTRIES</p> <p>DUALISE ROADS TO TOWNS</p> <p>BOAT TRANSPORT TO TOWNS</p> <p>BUILD, EQUIP AND STAFF MASURA STATIONS</p> <p>DEVELOP CAPACITY OF WEATHER FORECASTING</p>	<p>DIANI, VOI, MAZERAS, KILIFI, MALINDI</p> <p>DIANI, MAZERAS, MALINDI</p> <p>DIANI, KILIFI, MALINDI</p> <p>ENTIRE COASTLINE</p> <p>ENTIRE COASTLINE</p>	<p>MOE, MOH, EPZ, CDA, PS</p> <p>MOW, KRB, MMC, CDA, PS</p> <p>KFS, KPA, MOTPT, PS</p> <p>KN, KP</p> <p>MET, REGION</p>
	PHYSIOLOGY	LIMITED ACCESSIBILITY TO ISLAND	<p>TO IMPROVE ACCESSIBILITY</p>	<p>INADEQUATE CONNECTIONS TO ISLAND</p> <p>LACK OF ALTERNATIVE MEANS OF ACCESSES TO THE ISLAND</p>	<p>IMPROVE LAND CONNECTIONS TO THE ISLAND</p> <p>PROVIDE FOR ALTERNATIVE MEANS OF ACCESS TO THE ISLAND</p>	<p>INTRODUCE TUNNELS, ADDITIONAL BRIDGES AND CAUSEWAYS TO THE ISLAND FROM THE MAINLANDS</p> <p>INTRODUCE AIR AND ADDITIONAL WATER BASED TRANSPORT CONNECTIONS TO THE ISLAND</p>	<p>CONSTRUCT TUNNEL</p> <p>WIDEN EXISTING CAUSEWAYS TO TAKE MORE TRAFFIC</p> <p>ROTOR AIR TRANSPORT ON ISLAND</p> <p>WATER TRANSPORT TO ISLAND</p>	<p>LIKONI CROSSING</p> <p>KIPEVU, MAKUPA</p> <p>MAMA NGINA, SPORTS GROUNDS,</p> <p>SHELLY BEACH, FORT JESUS, MKOMANI</p>	<p>MMC, MOTPT, KPA, PS</p> <p>MMC, MOW, KPA, PS</p> <p>KAA, DCA, MMC, MOT, PS</p> <p>KPA, MMC, MOTPT, KFS, PS</p>
	GEOLOGY	CORAL REEF JURASSIC SHALE	<p>TO LIMIT SEEPAGE OF SEA WATER</p> <p>TO REDUCE</p>	DIGGING OF BORE HOLES TO ACCESS UNDERGROUND WATER	CONTROL DIGGING OF BOREHOLES AND WELLS IN THE ISLAND	BAN DIGGING OF BOREHOLES AND WELLS IN THE ISLAND AND PROVIDE	IMMEDIATE BAN	ALL ISLAND	MMC, GOK, PS

			TO IMPROVE STABILITY OF SOILS TO DISCOURAGE SETTLEMENT ON UNSTABLE AREAS	LATRINES DUE TO LACK OF A CENTRAL SEWER SYSTEM PRESSURE ON LAND FOR HOUSING POVERTY WEAK ENFORCEMENT OF BUILDING REGULATIONS LACK OF VULNERABILITY ASSESSMENT OF SETTLEMENT AREAS	IMPROVE ECONOMIC WELLBEING PROVIDE FOR SERVICED LAND OUTSIDE THE ISLAND ENFORCE BUILDING REGULATIONS CONDUCT MANDATORY VULNERABILITY ASSESSMENT ON ALL SETTLEMENT AREAS	BAN DIGGING OF PIT LATRINES AND COVER ENTIRE ISLAND WITH CENTRAL SEWER CREATE EMPLOYMENT OPPORTUNITIES SERVICE THE LAND ON THE ALL THE THREE MAINLANDS STRENGTHEN BUILDING INSPECTORATE UNIT MAKE VA PREREQUISITE FOR ANY DEVELOPMENT	IMMEDIATE BAN SEPTIC TANKS ATTRACT INVESTMENT AVAIL PLANNED SERVICED PLOTS ENFORCE BUILDING REGULATIONS INCLUDE VA WITHIN EIA	ALL ISLAND  ALL MUNICIPALITY NORTH, WEST, SOUTH ENTIRE MUNICIPALITY ENTIRE MUNICIPALITY	MMC, PS  MMC, CDA, EPZ, PS MMC, MOL, CDA, PS DDMC, MMC, MMC, DDMC, DEO
	ENVIRONMENT	COASTAL ENVIRONMENTAL DEGRADATION	TO IMPROVE COASTAL ENVIRONMENTAL CONSERVATION	UNCONTROLLED BEACH FRONT DEVELOPMENTS INDISCRIMINATE CLEARANCE OF MANGROVE FORESTS FOR BUILDING MATERIALS	TO CONTROL AND REGULATE BEACH FRONT DEVELOPMENTS TO CONTROL AND REGULATE CUTTING OF MANGROVES FORESTS TO AFFOREST BEACH FRONTS WITH MANGROVE	ENFORCE PLANNING REGULATIONS REGARDING BEACH FRONT DEVELOPMENT ENFORCE FORESTS AND NEMA ACT WORK WITH BEACH COMMUNITIES TO CONSERVE BEACH	OBSERVE BUILDING LINES ALONG BEACH FRONT APPLY EXISTING LAWS USE PARTICIPATORY APPROACH	ENTIRE BEACH FRONT ENTIRE BEACH FRONT ENTIRE BEACH FRONTS	MOL, MMC, MOTSM  MOENV, MMC MOENV, MMC
	CLIMATE	GLOBAL WARMING STRONG WINDS UNPREDICTABLE WEATHER	TO AVOID FLOODING EFFECTS OF SEA LEVEL RISE LIMIT EFFECTS OF SERONG WINDS TO IMPROVE PREDICTABILITY OF WEATHER	OCCUPATION OF FLOOD PRONE AREAS INDISCRIMINATE CLEARANCE OF MANGROVE FORESTS FOR BUILDING MATERIALS NO RELIABLE WETHER FORECASTING SYSTEM	DISCOURAGE OCCUPATION OF FLOOD PRONE AREAS TO CONTROL AND REGULATE CUTTING OF MANGROVES FORESTS TO DEVELOP RELIABLE WETHER FORECASTING SYSTEM	ZONE OFF AREAS CLASSIFIED AS VULNERABLE TO SETTLEMENT ENFORCE FOREST AND NEMA ACT MODERNISE WEATHER FORECASTING AND DEVELOP REGIONAL EARLY WARNING SYSTEMS INITIATIVES FOR THE WESTERN INDIAN OCEAN COUNTRIES	ZONE OFF FLOOD ZONES REGULATE CUTTING OF MANGROVES DEVELOP CAPACITY OF WEATHER FORECASTING	MUOROTO, KAA CHONJO, KR SHIMANZI ALONG ALL SHORELINES ENTIRE COASTLINE	MMC, KR MMC, MOENV MET, REGION

		DISTRIBUTION DENSITY	GROWTH TO ENCOURAGE BALANCED DISTRIBUTION OF POPULATION  TO DISCOURAGE HIGH POPULATION DENSITY	MIGRATION NATURAL POPULATION GROWTH SERVICES OVERLY CONCENTRATED IN THE ISLAND  EMPLOYMENT OPPORTUNITIES CONCENTRATED ON THE ISLAND	MIGRATION ENCOURAGE FAMILY PLANNING DECENTRALISE SERVICES TO THE MAINLANDS  DEVELOP EMPLOYMENT OPPORTUNITIES ON THE MAINLANDS	REGIONAL BALANCED DEVELOPMENT TEACH FAMILY LIFE TO COMMUNITY  PUT UP MORE SCHOOLS AND HEALTH CENTRES ON THE MAINLANDS  GIVE INCENTIVES FOR STARTING INDUSTRIES AND BUSINESSES ON THE MAINLANDS	GENERAL WORK AREAS FAMILY HEALTH EDUCATION  SCHOOLS, HEALTH CENTRES  OFFER TAX INCENTIVES	ENTIRE COASTAL REGION ENTIRE REGION  NORTH, WEST, SOUTH  NORTH, WEST, SOUTH	MM, LA MOH, CDA, MMC, LA  MOEDN, MMC, CDA  MMC, EPZA, CDA
	HOUSING	MATERIALS DENSITY OCCUPANCY DESIGN SITING	TO ENCOURAGE USE OF NON FLAMMABLE BUILDING MATERIALS  TO DISCOURAGE VERY HIGH HOUSING DENSITY  TO DISCOURAGE VERY HIGH OCCUPANCY RATES  TO ENCOURAGE DISASTER RESISTANT DESIGNS  TO DISCOURAGE SITING OF SETTLEMENTS IN VULNERABLE AREAS	POVERTY  INADEQUATE RESEARCH ON REDUCING FLAMMABILITY OF MATERIALS  HIGH LEVEL OF SERVICES IN ISLAND  HISTORICAL DENSE SWAHILI SETTLEMENTS  PROXIMITY OF EMPLOYMENT OPPORTUNITIES IN THE ISLAND  INADEQUATE REGULATORY FRAMEWORK BY MUNICIPALITY  LACK OF VULNERABILITY ASSESSMENT OF DEVELOPMENTS	IMPROVE ECONOMIC WELLBEING  TO DEVELOP RESEARCH ON HOW TO REDUCE FLAMMABILITY OF BUILDING MATERIALS  DECENTRALISE SERVICES TO THE MAINLANDS  IMPROVE CONDITIONS WITHIN THE DENSE SETTLEMENTS  ISOLATE AND LOCALISE POTENTIAL DISASTERS  OFFER EMPLOYMENT OPPORTUNITIES ON THE MAINLANDS  STRENGTHEN REGULATORY FRAMEWORK  CONDUCT MANDATORY VULNERABILITY ASSESSMENT ON ALL DEVELOPMENTS	PROVIDE EMPLOYMENT OPPORTUNITIES  TO RESEARCH ON MAKUTI AND REDUCE THEIR FLAMMABILITY  PUT UP MORE SCHOOLS AND HEALTH CENTRES ON THE MAINLANDS  IMPROVE ON HYGIENIC AND ACCESSIBILITY IN DENSE SETTLEMENTS  INTRODUCE OPEN/GREEN BELTS BETWEEN DEVELOPMENTS  GIVE INCENTIVES FOR STARTING INDUSTRIES AND BUSINESSES ON THE MAINLANDS  PREPARE MUNICIPALITY VULNERABILITY ASSESSMENT PLAN  MAKE VA PREREQUISITE TO ALL DEVELOPMENTS	ATTRACT INVESTMENT  USE NON FLAMMABLE MATERIALS  SCHOOLS, HEALTH CENTRES  ACCESS ROADS, DRAINAGE, SEWER  TAX INCENTIVES  ZONE OFF AREAS CLASSIFIED AS VULNERABLE TO SETTLEMENT  INCLUDE VA WITHIN EIA	ENTIRE MUNICIPALITY  ENTIRE MUNICIPALITY  NORTH, WEST, SOUTH  OLD TOWN, KALOLENI, MAJENGO, KING'ORANI,  NORTH, WEST, SOUTH  ENTIRE MUNICIPALITY  ENTIRE MUNICIPALITY	MMC, CDA, EPZA  MMC, MOW  MOEDN, MMC, CDA  MMC  MMC, CDA, EPZA  MMC, DDMC  MMC, DDMC, DEO
	SOCIETY	AWARENESS RELATIONS POVERTY	TO IMPROVE SOCIETY AWARENESS ON DISASTERS	INADEQUATE INFORMATION DISSEMINATION  NO SENSE OF	DEVELOP PROGRAMS FOR DISSEMINATION OF INFORMATION TO THE PUBLIC ON	USE MASS MEDIA, BARAZAS AND PRACTICAL SCENARIO SIMULATIONS	USE TV, RADIO, NEWSPAPERS, PUBLIC PERFORMANCES	ENTIRE MUNICIPALITY	MMC, MOI, PS

			TO ENCOURAGE CLOSER SOCIAL RELATIONS TO REDUCE LEVELS OF POVERTY	REDUCING HIGH UNEMPLOYMENT LEVELS TOO HIGH	TO ENCOURAGE CLOSER SOCIAL TIES AND SENSE OF COMMUNITY TO CREATE EMPLOYMENT OPPORTUNITIES	INTRODUCE SOCIAL AND COMMUNITY SPACES IN NEIGHBOURHOODS INTRODUCE INTERPRENEURAL SKILLS AND OFFER AFFORDABLE CREDIT	OPEN SPACES ENCOURAGE SETTING UP OF SMALL BUSINESSES	OLD TOWN, KALOLENI, KING'ORANI, MAJENGO ENTIRE MUNICIPALITY	MMC, PS
DEVELOPMENT FACTORS	RESIDENTIAL	INADEQUATE LAND INCOMPATIBLE LAND USE	TO PROVIDE MORE LAND FOR RESIDENTIAL TO ENCOURAGE PROPER ZONING OF RESIDENTIAL LAND USE	INADEQUATE LAND IN ISLAND PRESSURE FOR COMMERCIAL LAND	DENSIFICATION OF RESIDENTIAL LAND IN THE ISLAND TO ECONOMIC LEVELS TO PROVIDE RESIDENTIAL LAND FOR ISLAND SPILLOVER IN THE MAINLANDS TO INCOURAGE RESIDENTIAL SETTLEMENT OUTSIDE THE ISLAND	DENSIFY SEMI PERMANENT SETTLEMENTS IN THE ISLAND AVAIL PLANNED SERVICED LAND IN THE MAINLANDS PLAN FOR RESIDENTIAL AREAS CLOSE TO EMPLOYMENT OPPORTUNITIES OUTSIDE THE ISLAND	PROPERLY ECONOMICALLY AND SOCIALLY PLANNED FLATS AVAIL PLANNED SERVICED PLOTS ENCOURAGE SMALL AND COTTAGE INDUSTRIES CLOSE TO RESIDENTIAL AREAS	KALOLENI, KING'ORANI, MAJENGO ALL THE MAINLANDS ALL THE MAINLANDS	MMC, PS, MOL MMC, PS, MOL MMC, PS, CDA
	INDUSTRIAL	OBNOXIOUS INFLAMMABLE EXPLOSIVE EFFLUENT POLLUTION	TO LIMIT DEVELOPMENT OF OBNOXIOUS INDUSTRIES TO LIMIT INFLAMMABLE INDUSTRIES TO LIMIT EXPLOSIVE INDUSTRIES TO LIMIT POLLUTION FROM EFFLUENT	INADEQUATE SERVICED LAND OUTSIDE THE ISLAND WEAK REGULATORY MECHANISMS WEAK ENFORCEMENT OF NEMA ACT	TO ADEQUATELY SERVICE LAND OUTSIDE THE ISLAND STRENGTHEN REGULATORY MECHANISM TO STRENGTHEN ENFORCEMENT OF NEMA ACT TO PROGRAM FOR EVENTUAL RELOCATION OF RISKY INDUSTRIES FROM THE ISLAND	PROVIDE POWER, ROADS, WATER AND TELEPHONE SERVICES TO INDUSTRIAL LAND OUTSIDE THE ISLAND CONDUCT REGULAR VA TO RISKY INDUSTRIES IMMEDIATE STOP TO LICENCING OF RISKY INDUSTRIES IN THE ISLAND GIVE TIME LINE FOR RELOCATION OF RISKY INDUSTRIES FROM THE ISLAND	SURVIVE AND GIVE INCENTIVES TO DESIGNATED INDUSTRIAL LAND IN MAINLANDS MANDATORY VA YEARLY IDENTIFICATION AND BAN OF RISKY INDUSTRIES IN ISLAND RISKY INDUSTRIES INCLUDING OIL ATORAGE TO RELOCATE FROM ISLAND	WEST MAINLANDS (MIRITINI), SOUTH MAINLANDS (TSUNZA) ALL INDUSTRY ENTIRE ISLAND ENTIRE ISLAND	MMC, KPA, PS MMC, MOENV MMC, MOIND MMC, MOIND, KPA, KR
	TRANSPORT	ACCIDENTS TRAFFIC JAMS	TO REDUCE ACCIDENTS TO IMPROVE TRAFFIC FLOW	NARROW ROADS TOO MUCH TRAFFIC IN ISLAND RISKY FERRY SERVICES	TO WIDEN THE ROADS OPEN MORE ROADS LIMIT TRAFFIC TO THE ISLAND	MAKE MAIN ROADS DUAL CARRIAGE WAYS AND SINGLE ROADS ONE WAY DEVELOP EXISTING UNDEVELOPED ROAD	DUAL CARRIAGE WAYS AND SINGLE ROADS ONE WAY DEVELOP RESERVES FOR	ENTIRE ISLAND ENTIRE ISLAND CONSTRUCT TERMINION	MMC, MMC,

				<p>SETTLEMENTS CLOSE TO RAILWAY LINES</p> <p>NO ALTERNATIVE MODES OF TRANSPORT</p> <p>HIGH SHIPPING TRAFFIC IN KILINDINI PORT</p>	<p>BYPASS THE ISLAND</p> <p>IMPROVE FERRY SERVICES</p> <p>TO RESTRICT DEVELOPMENT BELOW FLIGHT PATH</p> <p>RESTRICT DEVELOPMENT WITHIN RAILWAY RESERVES</p> <p>INTRODUCE ALTERNATIVE MODES OF TRANSPORT</p> <p>ENCOURAGE NON MOTORISED TRANSPORT</p> <p>EASE SHIPPING TRAFFIC AT KILINDINI PORT</p>	<p>ALLOW ONLY MASS TRANSIT INSIDE THE ISLAND</p> <p>CONSTRUCT ROAD BY-PASSES ESAROUND THE ISLAND</p> <p>SEPARATE FERRY PEDESTRIAN FROM VEHICLES AT EVERY STAGE OF THE CROSSING</p> <p>TO REQUIRE VA ON ALL DEVELOPMENT</p> <p>INTRODUCE MARINE TRANSPORTATION</p> <p>PROVIDE FOR PEDESTRIAN TRAFFIC</p> <p>PROVIDE FOR BICYCLE TRAFFIC</p> <p>DEVELOP ALTERNATIVE PORTS</p> <p>DEVELOP PIPELINE TRANSPORT FOR RISKY OILS AND FUELS</p>	<p>BAN TAXIS/ DISCOURAGE PRIVATE VEHICLES INTO ISLAND</p> <p>BRIDGE ACROSS PORT REITZ</p> <p>BUILD DIFFERENT ACCESSES AND EXITS</p> <p>MAKE VA ON PART OF EIA ON DEVELOPMENTS</p> <p>START BOAT SERVICES</p> <p>MAKE ISLAND PEDESTRIAN FRIENDLY</p> <p>PROVIDE BICYCLE LANES</p> <p>DEVELOP EXISTING SMALL PORTS</p> <p>EXTEND AND MODERNISE PIPELINE</p>	<p>OPPORTUNITIES FOR MIXTURES AND PRIVATE</p> <p>DONGO KUNDU</p> <p>LIKONI AND MOMBASA SIDES</p> <p>ENTIRE MUNICIPALITY</p> <p>SHELLY BEACH, FORT JESUS, MKOMANI</p> <p>ENTIRE ISLAND</p> <p>ENTIRE ISLAND</p> <p>OLD PORTS, LAMU, SHIMONI</p> <p>FROM MOMBASA</p>	<p>MMC</p> <p>MOW, MMC, KPA</p> <p>MMC, KFS</p> <p>MMC, DEO</p> <p>MMC, KFS</p> <p>MMC</p> <p>MMC</p> <p>KPA, MMC, MOT KPC</p>
EDUCATIONAL	CONCENTRATION TRAFFIC JAMS CHILDREN	<p>TO ALLOW FOR FAST EVACUATION OF INSTITUTIONS</p> <p>TO LOCATE SCHOOLS CLOSEST TO RESIDENTIAL AREAS</p> <p>TO MAINTAIN CONSTANT SURVAILLANCE ON CHILDREN</p>	<p>NARROW ROADS</p> <p>LIMITED ACCESSES</p> <p>LACK OF OPEN ARES IN VICINITY OF INSTITUTIONS</p> <p>FEW SCHOOLS</p> <p>VARIABILITY OF QUALITY OF SCHOOLS</p> <p>SCHOOLS LOCATED ON BUSY ROADS</p>	<p>WIDEN ROADS</p> <p>IMPROVE ON ACCESSES TO INSTITUTIONS</p> <p>PROVIDE OPEN AREAS NEAR EDUCATION INSTITUTIONS</p> <p>DEVELOP NEW SCHOOLS</p> <p>REDUCE INEQUALITY OF SCHOOLS PERFORMANCE</p> <p>TRAFFIC CALMING IN THE PROXIMITY TO SCHOOLS</p>	<p>MAKE MAIN ROADS DUAL CARRIAGE WAYS AND SINGLE ROADS MULTI LANES</p> <p>PROVIDE ALTERNATIVE ACCESSES</p> <p>DEVELOP OPEN PLAYING FIELDS OR SHARE EXISTING ONES</p> <p>DEVELOP NEW SCHOOLS ON MAINLANDS</p> <p>PROVIDE QUALITY LEARNING ENVIRONMENT TO ALL SCHOOLS</p> <p>SCHOOLS TO PROVIDE OWN TRANSPORT AND RESTRICT PUBLIC</p>	<p>INCREASE LANES ON ROADS</p> <p>DEVELOP MORE THAN ONE ACCESS TO INSTITUTIONS</p> <p>DEVELOP THEM FOR CONGREGATION, EVACUATION</p> <p>GIVE FIRST PRIORITY, INCENTIVE FOR SCHOOLS TO MAINLANDS</p> <p>DEVELOP QUALITY OF ALL SCHOOLS</p>	<p>ENTIRE MUNICIOPALITY</p> <p>ALL INSTITUTIONS</p> <p>ALL INSTITUTIONS</p> <p>ALL MAINLANDS</p> <p>ENTIRE MUNICIOPALITY</p>	<p>MMC</p> <p>MMC, PS</p> <p>MMC, PS</p> <p>MMC, PS</p> <p>MMC, MOEDN, PS</p>	

						TO IMPROVE SCHOOLS	FUND SCHOOLS TO OFFER TRANSPORT	ENTIRE MUNICIPALITY	MMC, MOEDN, PS
	RECREATIONAL	CONCENTRATION TRAFFIC JAMS	TO ALLOW FOR FAST EVACUATION OF AREAS  TO IMPROVE TRAFFIC FLOW	NARROW ROADS  LIMITED ACCESSES	WIDEN ROADS  IMPROVE ON ACCESSES  OFFER ALTERNATIVE ACCESSE	MAKE MAIN ROADS DUAL CARRIAGE WAYS AND SINGLE ROADS ONE WAY  INTRODUCE MARINE TRANSPORT BETWEEN COASTAL RECREATION AREAS	DUAL CARRIAGE WAYS AND WIDE ROADS TO RECREATION AREAS  BOAT SERVICES	BAMBURI, SHELLY BEACH,  BAMBURI, FORT JESUS, SHELLY BEACH	MMC  MMC
	PUBLIC PURPOSE	LIMITED ACCESSIBILITY TO HEALTH SERVICES  INSECURITY  SLOW RESPONSE TO EMERGENCIES  EXPOSURE TO DANGER FROM PUBLIC FACILITIES	TO IMPROVE ON LEVEL OF HEALTH SERVICES  TO IMPROVE PROVISION OF SECURITY  TO IMPROVE RESPONSE TO EMERGENCIES  TO LIMIT ADVERSE EFFECTS EMANATING FROM PUBLIC FACILITIES	INADEQUATE HEALTH FACILITIES  INADEQUATE POLICE FACILITIES  INADEQUATE EMERGENCY RESPONSE FACILITIES  PULL EFFECT OF PUBLIC FACILITIES DUE TO EMPLOYMENT POTENTIALS AND SERVICES  WEAK PLAN ZONING	POVIDE MORE HEALTH FACILITIES  DISTRIBUTE HEALTH FACILITIES EQUITABLY  MAKE HOSPITALS MORE ACCESSIBLE  PROVIDE MORE POLICE FACILITIES  DISTRIBUTE POLICE FACILITIES EQUITABLY  PROVIDE MORE EMERGENCY RESPONSE FACILITIES  DISTRIBUTE EMERGENCY RESPONSE FACILITIES MORE EQUITABLY  TO ENFORCE PLANNING REGULATIONS ON PROXIMITY TO RISKY PUBLIC FACILITIES  TO ENFORCE ZONING RULES	BUILD MORE HEALTH FACILITIES ON THE MAINLANDS  EQUIP HEALTH CENTRES TO EASE PRESSURE ON HOSPITALS  ALLOW FOR ALTRNATIVE ACCESS TO HOSPITALS  BUILD MORE POLICE STATIONS ON THE MAINLANDS  MAKE EACH OF THE MAINLANDS A POLICE DIVISION  BUILD MORE EMERGENCY RESPONSE UNITS ON ISLAND AND EACH OF THE MAINLANDS  TO RESTRICT DEVELOPMENTS IN THE PROXIMITY OF MILITARY INSTALLATIONS  TO REQUIRE VA ON ALL DEVELOPMENT	PRIORITISE EXPANSION OF HEALTH FACILITIES TO THE MAINLANDS  PARTNER MMC AND MOH ON HEALTH CENTRES  DEVELOP MARINE AND AIR ACCESS FOR EASE OF EVACUATION  BUILD MORE STATIONS/POSTS TO IMPROVE RESPONSE  MAKE MAINLANDS INDEPENDENT POLICE DIVISIONS  BUILD ADDITIONAL FIRE STATIONS ON ISLAND AND MAINLANDS  ENFORCE PLANNING RULES ON MILITARY INSTALLATIONS  MAKE VA PART OF EIA	LIKONI, KISAUNI  ENTIRE MUNICIPALITY  CPGH, MOMBASA, PORT REITZ, MSAMBWENI, KILIFI, VOI, MARIAKANI  ALL MAINLADS  LIKONI, CHANGAMWE, KISAUNI  SHIMANZI, TUDOR, KISAUNI, BAMBURI, MIRITINI, LIKONĠ  NYALI BARRACKS, KN MTONGWE, FOB PORT REITZ  ENTIRE MUNICIPALITY	MMC, MOH  MMC, MOH  MMC, MOH, KN, KAF  MMC, OP  MMC, OP  MMC, MDDMC  MMC, DOD  MMC, DEO

			TRAFFIC FLOWS	INADEQUATE ON SITE PARKING	TO ENCOURAGE DEVELOPERS TO CONTAIN DEVELOPMENT SPECIFIC PARKING	DUAL CARRIAGEWAYS AND SINGLE ROADS ONE WAY	INCREASE LANES ON ROADS	ENTIRE ISLAND	
					TO ENCOURAGE DEVELOPERS TO CONTAIN DEVELOPMENT SPECIFIC PARKING	OPEN UNDEVELOPED ROAD RESERVES	OPEN RESERVES	ENTIRE ISLAND	MMC
					PROVIDE MORE PUBLIC PARKING	REQUIRE DEVELOPERS TO CONTAIN TENANTS AND CLIENTS WITHIN PREMISES	REQUIRE DEVELOPERS TO PROVIDE ENOUGH PARKING FOR TENANTS AND CLIENTS WITHIN PREMISES	ALL DEVELOPMENTS	MMC
					DISCOURAGE LONG TERM PARKING IN PUBLIC	PROVIDE INNOVATIVE PARKING WITHIN OPEN AREAS	DEVELOP MORE PARKING	ALL AREAS	MMC
						MAKE LONG TERM PARKING ON PUBLIC AREAS EXPENSIVE	CHARGE PROGRESSIVELY FOR PARKING TIME	PUBLIC PARKING IN ISLAND	MMC
PUBLIC UTILITIES	INADEQUATE DRAINAGE SYSTEM INADEQUATE WATER SUPPLY INADEQUATE SOLID WASTE DISPOSAL POOR TELEPHONE SERVICE UNRELIABLE AND INADEQUATE POWER SUPPLY INADEQUATE SEWERAGE SYSTEM	TO IMPROVE FLOW OF STORM WATER DRAINAGE TO IMPROVE WATER SUPPLY TO IMPROVE MANAGEMENT OF SOLID WASTE TO IMPROVE TELEPHONE SERVICE TO IMPROVE ON POWER SUPPLY TO IMPROVE ON SEWERAGE DISPOSAL SYSTEM	DRAINAGE WHERE EXISTS OVERTAKEN BY DEVELOPMENT FEW SOURCES OF WATER INADEQUATE CAPACITY OF SUPPLY INADEQUATE SOLID WASTE MANAGEMENT BY MUNICIPALITY INADEQUATE CAPACITY IN TELE COMMUNICATIONS LOW CAPACITY OF POWER SOURCES NO COMPREHENSIVE SEWER SYSTEM	TO INCREASE AND MODERNISE DRAINAGE SYSTEM TO DIVERSIFY WATER SOURCES TO BOOST WATER SUPPLY SYSTEM TO IMPROVE CAPACITY FOR HANDLING WASTE TO IMPROVE AND DIVERSIFY TELE COMMUNICATION TO IMPROVE AND DIVERSIFY POWER SOURCES	TO DRAIN THE ENTIRE ISLAND ELABORATELY TO DESALINATE SEA WATER FOR USE TO MODERNISE WATER SUPPLY SYSTEM TO PRIVATISE, COMMERCIALISE WASTE MANAGEMENT TO MAKE WIRELESS TELEPHONY MORE AFFORDABLE DEVELOP SOLAR, WIND, TIDAL ENERGY	MAINTAIN AND EXTEND DRAINAGE DESALINATE SEA WATER FOR USE MODERNISE WATER SUPPLY SYSTEM PRIVATISE, COMMERCIALISE WASTE MANAGEMENT USE MOBILE AND RADIO PHONES FOR EMERGENCIES ENCOURAGE USE OF SOLAR, WIND, TIDAL ENERGY	ENTIRE ISLAND ENTIRE MUNICIPALITY ENTIRE MUNICIPALITY ENTIRE MUNICIPALITY ENTIRE MUNICIPALITY ENTIRE MUNICIPALITY	MMC MMC MMC MMC MMC, MDDMC MMC,	



## CHAPTER FIVE

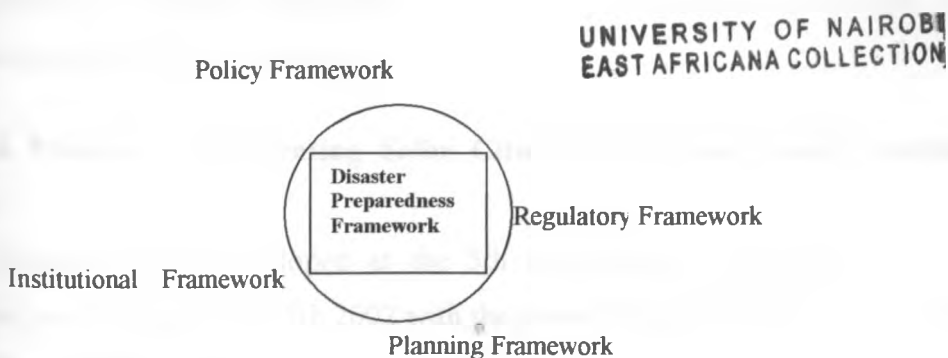
### FRAMEWORK FOR DISASTER PREPAREDNESS IN THE ISLAND CITY OF MOMBASA

#### 5.0 Introduction

Urban governance involves multiple agents, groupings, networks and coalitions, including formal institutions such as local governments, private sector and civil society organisations, as well as a broad range of more or less informal community networks and pressure groups (Nomdo, 2002:34). For instance, agreements may be reached with local authorities to make use of public facilities for social and cultural activities (Nomdo, 2002:96). Governance can be taken as a broader concept than government, and includes all the formal and informal processes through which interests and access to assets and opportunities are negotiated and mediated (Nomdo, 2002:158).

Policy-making, allocation of resources and monitoring of implementation is the responsibility of central/national governments. Local governments are responsible for implementation of policy. However, in most cases, local governments are considered almost as recipients. A solution to this situation is to clearly define and learn to respect the agreed roles and responsibilities of each level (Nomdo, 2002:63). Currently, local government in Kenya is undergoing a process of transformation. In terms of the proposed Draft Constitution, local government is a distinct sphere of government, not a smaller version of national and provincial governments, as has hitherto been the case. They have their own structures, powers and functions, complementary to those of the national and provincial government. In the ongoing course of decentralization, many more functions are being delegated from provincial and national government to local authorities. If ever the new constitution were enacted, a fully transformed local government system would have been established. This study recognizes four (4) types of frameworks in the management of disaster preparedness, namely: planning, policy, regulatory and institutional frameworks. These frameworks and their implications for disaster preparedness will now be discussed in detail.

Figure 11: Disaster preparedness frameworks



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## 5.1 Planning Framework: Guidelines for Integrating Disaster Preparedness

These guidelines, developed over the last three decades by the international community, spearheaded by the UN, set forth the most basic principles in the field of disaster preparedness related to physical planning, building and the management of human settlements. They are primarily concerned with the planning of new and rapidly expanding settlements in developing countries. To be specific, they are intended to be tailored for the specific needs of individual countries and settlements. The guidelines are here framed within the concept of Disaster Preparedness. Prevention, Mitigation and Evacuation are implied since they impact on the inclusive concept of preparedness. Early warning, relief, Post-disaster planning and reconstruction have been largely omitted, since these subjects need to be separately examined in separate studies (UN, 1976: iv).

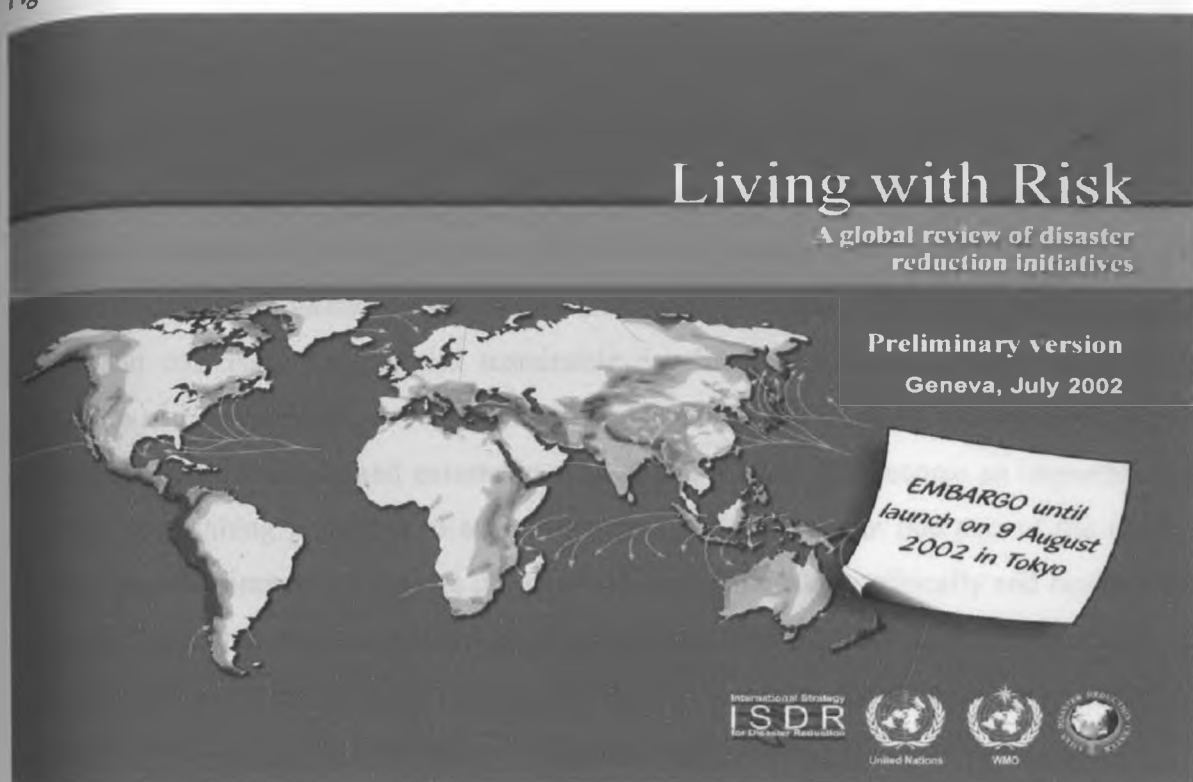
### (i) International Action Level

Bilateral and multilateral cooperation have been developed to co-ordinate some aspects of economic development and to establish joint physical development schemes both for border regions and for broad parts of adjacent countries. From the viewpoint of protection against natural disasters, such plans may be important for such issues as flood protection. International initiatives in this field have been many, mainly spearheaded by the United Nations through initiatives such as Safer Cities and others. The latest has been through the UIA 2005 Istanbul XXII World Congress of Architecture a Panel Forum 'Architecture in Historic Cities Which are Threatened by Earthquakes' recognised, with reference to the City of Skopje, that 'Prevention begins with planning and that many of the objectives of Development Planning are exactly the same as of Disaster Management' (TMMOB, 2005: 3). The most notable international initiative however, as per this study, is the one by the Local Authorities for Confronting Disasters and Emergencies (LACDE), which defines its mission as '*To increase the effectiveness of Local Authorities/Governments in preparing for and confronting potential disasters and emergencies, natural and man-made*'. This is out of the realization that every urban planning decision has implications for emergency and disaster planning, from mitigation to response and reconstruction (Geis, 2002). This initiative has come up with principles that can have far reaching effects as guidelines for disaster preparedness. It is these principles, as an example of international framework that this study will now discuss.

### **The Shanghai Principles for Creating Safer Cities & Societies through Sustainable Urban Development:**

These broad principles were developed at the 5th International Conference of LACDE held in Shanghai, China, on October 15th- 17th 2002 with the theme 'Reducing Risks & Vulnerability through Sustainable Urban Development'.

Figure 12: Living with Risk: Global Risky Zones



(Source: UNISDR, 2001)

The following 10 theme-principles that evolved from the Conference represent what are felt as the most relevant issues. They are where attention must be focused, and strategies developed for cities now and in future.

### 1) Research, Education and Application

The research- application- education relationship and function is essential toward this effort. These three subjects are integrally connected as a process. In the new Culture of Safety and Security, they are essential to working toward and achieving the study's objectives. They are the foundation and Road Map on which to guide and build programs. Of all the principles, these are the ones that relate to all the rest and where the greatest attention must be given. It will be necessary to develop a research agenda consisting of selected specific priorities. To accomplish this, a framework of universities, research organizations, local authorities, businesses and disaster emergency practitioners will have to be organized and utilized within this context. Since resources will be needed to assist in this effort, private and public groups with mutual interests will have to be identified, contacted and brought on board as partners in this effort. Such potential funding groups might include insurance, power companies, telecommunication and information technological organizations, financial networks, and food producers and suppliers. In Mombasa, the Oil Spill Management Action Group (OSMAG)

headed by the Kenya Ports Authority is an example of a Mutual Interest Group that should be encouraged.

## **2) Working Together—A Local, National And Global Connection.**

Much more attention needs to be given to this principle. It is vital to recognize and expand the definition of hazard mitigation and emergency-disaster management to include multidisciplinary and interdisciplinary considerations: education, involvement with policy and political development, benefits and cost issues, social and sustainable development elements, public awareness, resource distribution and services, etc. it is also important to rethink and improve the organizational-functional frameworks, both internally and externally. The global context has become an important paradigm in this effort. Everything is related to everything else, and an event in one part of the world can have great and growing impact on the rest of the world—economically, politically and health-wise. A large earthquake's possible impact on financial communication networks is one example of this along with epidemics such as SARS, terrorism and nuclear spills. Mombasa should develop an Island-mainlands-regional-national and global connection to disaster preparedness.

## **3) The Integral Relationship between Creating Safer Cities, Sustainable Development and the Urban Design-Planning Process.**

This essential relationship is at the forefront. Safe and healthy communities and sustainable development cannot occur without building bridges between the two. It is important to remember that almost every sustainable and urban planning decision has implications for emergency and disaster planning, from mitigation to response and reconstruction. This includes issues such as infrastructure planning, location of health, police and fire facilities, the protection of power facilities, land use, and general functioning. It is necessary to give more attention to these areas, their role and relationship to each other, and their practical application. This Study provides one conceptual application model that can be valuable in this effort.

Years of research and experience have shown that there is an integral relationship between the design of cities and their capacity to minimize and to keep hazards from rising to the level of emergencies and disasters. For a city like Mombasa, its design and development must consider:

- the relationship of development to natural (ecological and geological) systems,
- development and redevelopment patterns,
- configuration, scale and capacity of public infrastructure,
- the design, location and service capacity of community facilities,
- neighbourhood and commercial district design, and

in general, the overall capacity, functioning and relationship of the various components and systems of communities.

#### **4) Risk, Vulnerability Assessment & Mitigation for Creating Safer Development**

The process of creating safer communities provides the best means for developing the most effective disaster and emergency management programs possible. This includes risk and vulnerability assessments, as well as optimizing the use of mitigation principles and techniques. It also can serve to enhance the effectiveness of the other components of the disaster management process-- preparedness, response and recovery. And, at a time when more and more resources and players are becoming involved in disaster management, the safer-sustainable development approach can also provide a valuable planning vehicle for organizing, relating and optimizing the various roles in this process— emergency managers, community planners, health and safety officials, elected officials, and citizen and business groups. In this context, comprehensively understanding the risks and vulnerabilities is the first and essential step in minimizing disasters. Communities must therefore give more attention to defining these risks and vulnerabilities, their relationship to each other, and particularly to the means to accomplish this.

#### **5) Infrastructure**

Infrastructure, be it transportation, water-food distribution systems, power, communication or location of health and safety facilities, has evolved as one of, if not the most important consideration of this study. It is a subject that relates to almost everything else, and should be the highest of priorities for research, educational and application efforts. Properly designed and located infrastructure is particularly critical in both mitigation and disaster-emergency management. It may well be the single most important tool available in minimizing risk and vulnerability, because it has so much influence on everything else. Safe and sustainable infrastructure and development enhance the functioning of a nation and local authority, resulting in more efficient circulation for automobiles, public transportation, and more workable natural and social infrastructure.

#### **6) Respecting, Understanding & Utilizing Nature**

The natural systems and their role and importance in the context of risk and vulnerability are recognised by this study. In the natural hazard context, the first and foremost step in creating safer cities and societies is to respect and understand the workings of the natural environment, ecologically, hydrologically and geologically, and then guide development to compliment these systems and their functioning, not interfere with them, as occurs in most cases. The majority of human and property losses and associated social and economic disruption from a natural extreme event occurs as a result of

not following this criterion, resulting with inappropriate development that significantly contributes to the problem rather than to the solution. The initial losses and subsequent longer-term costs from an extreme natural event such as flooding and cyclones are directly proportional to the degree of change that occurs to the natural systems as a result of development. To design sustainable, safe cities and societies requires understanding the inherent characteristics and functioning of the various systems of nature: drainage-absorption patterns; watersheds; hydrologic systems and cycles; wetlands and marshes; the coastal beach and dune systems; slope and soil characteristics, and the general flora and fauna habitats. Development should be designed and built so that its functioning, capacity, scale, and density are in balance with the capacity, scale and limits of the natural environment of which it is a part. The objective then becomes in effect one of helping nature help development planning by providing the initial framework and direction for appropriate and safe development which will, by its nature, minimize vulnerability and risk.

#### **7) Community/Local Focus**

While national and province/state involvement is necessary to develop effective emergency and disaster planning, the local community/authority is the fundamental entity where the program foundation must be built. These plans must therefore be tailored to the local authorities if they are to be effective. This study lends itself to this goal. If safer cities, development and societies are to be created, they will have to be created at the local government level. It is only here at the local level where most development and legal tools required to implement such an effort exists, particularly the planning-development process. It is essential to keep in mind that almost every planning and development decision made at the local level regarding the built environment (development) has implications for creating more sustainable, less vulnerable and, therefore, safer, more secure communities and societies. The principles and techniques associated with minimizing risk and creating safer communities must be integrated into the local political, cultural and planning development framework many times already in place in each community. They should be perceived as enhancing existing programs, not just creating new ones and respecting the unique qualities of each local authority. Knowledge, technical information, best practices, support and the demonstrated benefits, if needed and asked for, can be framed at the regional level but each community must be encouraged and empowered to implement their own programs, in their own way.

#### **8) Overcoming Obstacles to Creating Safer Cities is Good Business for Local Authorities**

Safer cities, ones that minimize risk and vulnerabilities, are simply better communities to attract and do business with, as well as provide a better quality-of-life for their residents. It is probably the one that can pay the most dividends, for the local authorities and their societies. More research programs

should explore and specifically define the relationship between developing safer cities and economic viability. Thus, to a national and local government that places increasing value on safety, health, economic development, and quality of life, creating safer cities, by minimizing vulnerability, represents an important investment, one that will help it attract new investment, business and citizenry.

### 9) Politics, Policy, and Governmental Responsibility.

The first and primary responsibility of governments, no matter what form that government takes, is to protect the health, safety and well being of all its citizens. Minimizing risk and vulnerability from natural and human induced hazards fall directly into that responsibility. Living in communities as safe as possible from natural and human induced hazards is not a luxury, or a bonus. Living in such communities should be considered a basic necessity. They should in fact be thought of as a basic human right, associated with the inherent health, safety and public welfare responsibility that governments—national, state and local—are charged with providing. Nothing significant can ever be accomplished in the area of creating safer cities and societies without the support and initiative of governments and responsible political leaders—locally, nationally and globally.

### 10) The New Leadership Role

As discussed, the disaster-emergency management field is entering a new renaissance and much will have to be reinvented. It is a new culture—one of safety and security taking a new and much enhanced role. Professionals will have to become much more proactive in their approach, an approach that will help develop more of a public awareness of the importance to the rest of citizenry and political and business leaders. Research, education and implementation must reveal:

- The implications of these principles on the very nature of cities, nations and societies, and on the personal and professional roles.
- The specific goals and the best means of achieving them.
- The strategies that will work most effectively, and perhaps most importantly,
- How to get the private, business community more involved.

**Conclusion:** Planners have to ensure that they remain familiar with the best practices of the field, and will have to work much closer with each other and with a wider range of interdisciplinary associates—economists, policy specialists, ecologists, urban designers and the like, at both the local and national level, as well as within the global community. They will have to become researchers and become more aware of the relationship of hazard issues with sustainable development and the urban planning process. It will be essential to work as much with the private business community as the public community, because, the private side often has more to lose, and thus to gain, and has more resources.

The challenge will be to build bridges between Local Authorities (LAs) and Mutual Interests Groups (MIGs) of the business community. It is also important to explore the role of and relationships between natural hazards, such as flooding and hurricanes, and the human induced ones such as terrorism and infectious diseases such as SARS, to ensure that resources are optimised. LAs will have to explore more fully the role of City Design and planning including the implications of centralization and /or decentralization. They will have to ensure equity, making sure that all people of varying economic conditions are protected. And finally, it is much more important to specifically focus on tailoring these principles and strategies for local authorities (Geis, 2003).

### (ii) National and/or Regional Action Level

National and regional physical development plans are prepared on various scales. Their nature demands generalization of planning decisions and of development patterns at this level. National projects hardly ever include details of development patterns or of land-uses. Basic survey maps at this scale should offer information on geological structure, geomorphology and on broad patterns of the relief of the earth's surface. When planning physical development patterns on both national and regional levels, several measures should be undertaken and should be adopted as context for local development policy (UN, 1976:22).

**Definition of High Risk Areas and Kinds of Development of High Vulnerability:** These areas must be clearly defined on the National/regional physical development plan.

**High risk areas:** These include:

- Seismically active zones and seismic faults;
- River flood plains;
- Tidal wave flood plains;
- Zones presenting special risks of tropical storms; and
- The vicinity of active volcanoes.

No one kind of natural disaster risk is distributed evenly throughout the area of a country or of a wider region. Some areas are more vulnerable than others; therefore, the planner should have at his disposal maps evaluating the kind of risk and specifying zones of different catastrophe probability levels. For Mombasa, these would include areas such as the Port Tudor and Port Reitz basins and the entire sea front of the coastline.

**Kinds of High Vulnerability Development:** The most common of these in Mombasa are:

- High concentration of population (stadia, schools, mosques, churches, entertainment areas);
- High concentration of economic activities, mostly manufacturing (Shimanzi, industrial area);



- Key communication installations (GPO, Extelcoms, KBC, ground stations and MASURA);
- Major transportation junctions (causeways, bridges, ferries); and
- Major defence installations (15 KR Nyali, FOB Port Reitz, KN Base Mtongwe, MASURA).

The criteria for considering some kinds of development as highly vulnerable may take into account humanitarian, technical, economic and even political factors. No single general formula may therefore be suggested. Local socio-economic conditions must be taken into account when recommending any hierarchy and detailed criteria for vulnerability (UN, 1976:23).

### **Planning Measures:**

**Definition of Areas Excluded From All or Some Kinds of Development:** As a general rule, areas of highest risk must be closed to the development of highly vulnerable activities and investments. On the basis of maps evaluating zones of various risk-levels (e.g. seismic zoning maps) the planner may take the following steps, which are most important from the viewpoint of national interest:

- Locating new cities and towns in areas of lowest possible risk (i.e. zones of lower earthquake probability, above flood-plains, etc.);
- Limiting further expansion of existing settlements located in high risk zones; and
- Avoiding location of new manufacturing plants and ware-houses in high risk zones.

**Decentralization of Population and of Economic Activities:** Within regions having high risk equally distributed (an even probability of catastrophe in most parts of the region), it is imperative to avoid concentration of population and economic activities in one or a few areas. When a natural catastrophe occurs in such an area the consequences will be disastrous both to life and to the economy of a region or country (UN, 1976:24). Particularly dangerous forms of urban development in many disaster-prone developing countries are represented by so-called "primate cities". When population and economic activities are distributed evenly throughout a region in a number of smaller cities and towns, the risk of frequency of catastrophe will be increased, but the probable quantity and severity of loss and damage to the economy will be much lower on each occasion.

Effective policy towards decentralization of population and economic activities calls for :

- A socio-economic and physical-planning concept for a national or regional settlements network, and
- Careful location of new industrial plants to induce the development of an appropriate and desired settlements pattern.

For Mombasa, both population and economic activity need to be decentralised from the Island, first to the adjacent mainlands, then to the nearby regional centres such as Malindi, Kilifi, Diani, Mazaras etc.

**Regional Transportation Network:** This system is not only highly vulnerable and subject to destruction by natural forces but, when paralysed, may prevent or stop any large-scale rescue operation. The design of this system should follow, whenever possible, the following general guidelines:

- Major roads and railways of regional and national importance should avoid flood-plains and other areas of high risk;
- When crossing high-risk areas, alternative routes and crossings should be made available (UN, 1976:25).

Regionally for Mombasa, development of Shimoni and Lamu ports with their separate road and rail networks is necessary. Development of Malindi and Diani airports is also recommended for the same reasons.

**Regional Telecommunications Systems:** Telecommunications systems are essential as a part of early warning systems and as an important vehicle of information at the time of catastrophe. They should be developed on a regional scale and linked to all major concentrations of activities and population. The technical characteristics of these systems must ensure their operational capability, when conventional energy sources are interrupted and when external installations (e.g. aerials) may be broken by torrential rains or winds. Some level of linkage of postal, telecommunication together with police and defence installation should be achieved for early warning.

**Regional or national systems of power supply:** To avoid city or region-wide black-outs, which can be fatal during times of natural catastrophe, in the follow-up period or rescue operations and for the survival of productive activities, regional and national power-supply systems must be integrated and should offer alternative sources of supply and alternative transmission (high-tension) lines (UN, 1976:26). The integration of power mains with the diesel generators at Kipevu is good for Mombasa. To diversify further, measures to reconnect the Tanzanian grid should be considered.

**Establishment of Regional Centres for Emergency Actions:** A disaster-prone region should be equipped with a number of emergency centres. The role of such centres should be to maintain in stock emergency supplies in:

- Food and medicines;
- Building materials and simple building tools;
- Prefabricated elements for construction of temporary housing;
- Building components for repair of engineering structures (bridges, viaducts, etc.);
- Material and equipment needed for emergency flood protection measures; and

- Any other emergency equipment, according to local needs and conditions.

Emergency centres must be located in the safest possible zones within a region. The radii of areas serviced by such centres will depend on accessibility to all vulnerable high-risk areas. They depend on the quality of road networks (UN, 1976:27). Mombasa needs at least four (4) such centres on each of its physical divisions.

**Regional Scenario and System for Emergency Action:** As necessary component of a regional physical-development plan for a disaster-prone area, a plan of action should be developed for emergency measures and facilities needed in the case of catastrophe. The major subject and aim of such a plan should be an emergency population-evacuation scheme. It should define:

- Areas to be evacuated both on an early warning basis and as a follow-up to the catastrophe;
- Routes and means of evacuation; and
- Locations or sites for temporary shelter and accommodation (UN, 1976:28).

For Mombasa Island, alternative means of evacuation, marine and air, should be developed open areas such as Mama Ngina Drive, Central Sports Ground, Railway Garden and Municipal Stadium are to be maintained ready for temporary congregation, shelter, accommodation and rapid evacuation.

### (iii) Local Action Level of Physical Planning against Disasters

The most popular and best recognized aspect of physical planning is the general physical development plan (or master plan) for a city or a town which defines land-use patterns, zoning, systems of distribution networks, and also guides and controls the processes of physical development. Contents of the "Master Plan" vary depending on the local conditions. It can be a very precise and effective document, or simply a rough guide, but the quality of a "Master Plan" lies in its efficiency of implementation. It constitutes a guideline for a city's development. It is therefore imperative that all means of physical development to protect a city against any kind of natural or man-made catastrophe, or to mitigate the effects of disastrous phenomena, must be incorporated within a master plan and must constitute its integral and mandatory components (UN, 1976:29). Mombasa does not have a current Master Plan. As a matter of priority, one that will incorporate all those aspects of disaster preparedness needs to be developed.

### (iv) Areas of Potential Natural Risk

When planning physical development patterns of any settlement, one of the most important initial steps will be the evaluation of existing tectonic, geologic, physiographic and climatic conditions for the purpose of defining areas (zones) of potential risk and of differentiated risk levels. This information will serve as a fundamental guideline for land-use planning, for site selection in various development programmes, and for the location of buildings and other structures. Evaluation of existing

conditions is a highly responsible task and must be performed with highest available professional standards. Areas of potential risk are then defined and described in the context of disaster type. For this reason, a detailed vulnerability analysis map is needed for Mombasa as a matter of urgency.

**Earthquake:** At a regional level, a seismic zoning map and is not sufficient for the development of a Master or Detailed Physical Plan since it gives general characteristics of a broad area. To be able to select the safest sites for the most important and/or vulnerable components of urban development, a much more detailed investigation must be conducted and more detailed documentation has to be prepared. This results in the development of a seismic micro-zoning map (UN, 1976:30). This is more precise than the regional seismic zoning map on probable earthquake intensity, and takes into account local conditions and their diversity within limited zones and sites for potential development. It takes into account site geology, soil structure and bearing quality, underground water regime and possible changes of water level, and should present conclusions on the probability and level of risk and/or recommendations on building-structure design. In any physical planning design for an earthquake-prone area, such a map will be used as a fundamental guide for the design of land-use patterns. In this regard, a detailed geological survey map is needed for Mombasa Island as a matter of priority.

**Land-slides, avalanches:** It is necessary to identify hill slopes that have potential landslide risk, due to geomorphologic and/or geological weakness, and to define avalanche zones. It is equally important to define hill base areas that may be affected by sliding layers of soil and rocks. Attention must be given to the possibility that the risk of land-slide may increase due to engineering works being carried out on the top or at the base of hills (e.g. road construction, drainage etc.), and as a result of changes in water regime. The potential risk is aggravated in earthquake prone areas (UN, 1976:31). The dissected shale hills on the west mainland of Mombasa fall under this category. They need to be mapped and appropriate regulations put in place for their development where feasible.

**Tropical storms:** Storms induce two types of disaster: devastation due to high winds and flooding in streams and rivers due to heavy rainfall. The effect of high winds and their probability of occurrence are widespread. It is therefore difficult to distinguish high and low risk zones within small areas. Some indication can be given on occasion. Between 90 to 95% of storm damage is caused by floodwaters. Development in low-lying areas should be avoided wherever possible. For the above reasons, in Mombasa, development of the Port Reitz and Port Tudor basins should be regulated.

**Tsunami and Tidal Wave:** The tsunami is a tidal wave initiated by an earthquake and probably the most dangerous natural by-product of an earthquake. It may attack areas located even thousands of

kilometres away from the epicentre and from active seismic zones (howstuffworks.com, 2005). When the offshore waters are shallow, and especially when there are shallow inlets, the sea first goes out a long way and then rushes back to destroy all in its path with tremendous force. Tsunamis hit areas located far away from the initial natural catastrophe, without any kind of local warning, often catching people totally unaware. Two important criteria of tsunami waves are the overland flood discharges and the elevation of floodwaters. Analysis of historical data (when available) is important to determine probable magnitude of flood discharges and to define a safe elevation (altitude) of land above sea level (UN, 1976:33). On December 26, 2004, the world's most powerful earthquake in more than 40 years struck deep under the Indian Ocean off the west coast of Sumatra, triggering a massive tsunami. One of the things that made this event particularly destructive is that the tsunamis struck relatively well-populated areas in the middle of the tourist-packed holiday season (howstuffworks.com, 2005). An efficient warning system needs to be developed along the Indian Ocean coast, especially in the wake of the December 26, 2004 tsunami.

**Flood:** The definition of a flood-plain zone and surface water flood limit for potential floods of various severity and frequency is important. Within urbanized and/or intensive development areas a more detailed definition of flood-risk is recommended. Subdivision of a flood-plain zone into a flood-way zone (reserved for passage of flood flows) and a flood fringe zone (where development of some kind may be allowed to take place when appropriate local protection is provided) is an important feature in planned disaster prevention (UN, 1976:34). The Kaa Chonjo and Muoroto settlements in Tudor, Mombasa, fall under these zones. So does part of the Shimanzi KR Estate.

**Summary risk map:** A map should be developed to summarize the conclusions of all investigations of natural conditions and areas of potential risk. It should indicate kind and level (probability) of risk. Such a map helps to define the integrated effect of all limitations and illustrates general exclusion of various areas from development. The map should help to establish local limitations for development in terms of siting, and to define technical and economic thresholds for development. In some areas of comparatively higher risk, for instance, building may be permitted with additional structural and other protective measures which will call for additional cost. Incorporation of the risk-probability factor into cost-benefit analysis of development projects is a most useful exercise in all risk analyses.

#### (v) Areas of Potential Man-Made Risk

The potential for anthropogenous catastrophe exists primarily within already developed and built-up areas. Evaluation of safety conditions within those areas therefore should be seen as a first task before initiating any urban renewal or urban expansion projects. A built-up area survey should result in

identifying existing sites and locations as sources of potential catastrophe. Some kinds of new development may also represent risk both to themselves and to the surrounding area. These facts must be taken into account when planning urban physical development (UN, 1976:34). Major kinds of anthropogenous catastrophe and potential risk-zones are as follows:

**Dam Failure – Flood:** High-risk areas may be pin-pointed by defining topographic contours downstream of a dam which will be reached by the waters of flood-waves caused by sudden release of water from a reservoir.

**Mining Damage:** High risk exists on and in ground below which mining has taken place and when back fill of mine workings has not been practiced. It is imperative to coordinate plans for underground mining exploitation with ground level development. Mining and industrial refuse tips represent a further potential risk. Consistency and structure of tips may not be fully stabilized and may give rise to slips under the influence of some external factor, such as torrential rain, air shock wave, supersonic boom etc. the consequences may be similar to those of a natural landslide (UN, 1976:36). The Kibarani refuse dump in Mombasa needs such assessment before any development can take place.

**Explosions:** High-risk areas may be defined as those existing within the vicinity of chemical plants subject to explosion risk (e.g. production of explosives, technical gases, light-liquids, oil-processing etc), or within the vicinity of fuel storage and gas tanks, and along gas mains, etc. The Mineral oil safety regulations, for instance, state that 'no person shall place any building in which naked fire is lit within a distance of 150 feet from a fuel storage area or a dangerous area'. The photo below shows fuel storage tanks just behind Nakumatt Suprmarket Likoni.

**Fire:** The most common catastrophe caused by human carelessness, faulty action, or faulty technology and techniques is that of fire. Every developed and built-up area involves potential fire risk. The level of that risk is highly differentiated by the type of existing development and the activities involved.

Plate 6: Fuel tanks behind Nakumatt, Likoni



(Source: Author, 2005)

#### (vi) Built-Up Areas of High Risk

**Residential:** old and dense built-up areas having timber structure and organic roof materials and involving faulty energy supply installations.

- Squatter settlements of the technical characteristics described above
- Areas without a water supply network
- Zones of mixed development: poor quality housing, handicraft workshops, and warehouses.

Photo below shows areas in Majengo Mombasa with mixed developments

Plate 7: Residences mixed with industries, Majengo



**Industrial:** old industrialised zones having densely developed plants, equipped with outdated hardware, installations and technology (UN, 1976:37).

- Some specific industries, including: oil processing plants, some chemical plants and

pharmaceutical plants, wood processing plants, explosives and fire works manufacturers and distilleries.

- Warehouses, fuel and gas reservoirs, storages of timber, sawdust and coal, garages and organic litter depots. Photo below shows coconut oil storage warehouses next to Majengo residential area

*Plate 8: Residences mixed with industries, Majengo*



(Source: Author, 2005)

**Single purpose:** places of mass-meetings, schools, theatres, entertainment halls, department stores, markets, hotels. There are many such places within the Island.

#### (vii) Medium Risk Areas

Older parts of city centres, residential zones of higher technical standards, most industries.

#### (viii) Low risk Areas

- Modern residential development for middle or high income groups with low density and appropriate building technologies. This represents areas such as Kizingo, Ganjoni and Tudor Four in the Island.
- Modern industrial parks
- Modern parts of city-centres

#### (ix) Large-Scale Traffic and Transportation Catastrophes

A potentially dangerous catastrophe is an aircraft disaster. Most sensitive areas are in the vicinity of major airports along the extension line of runways; most airplane disasters develop on take-off, during landing, or during landing approach manoeuvres. Railway junctions for heavy traffic represent another zone of potential risk. The impact that traffic accidents in these areas have on adjoining zones depends more on the kind of goods being transported than on the accidents themselves. The Likoni Ferry crossing is an example of potential traffic disaster zone in Mombasa.



*Plate 9: Ferry: an accident prone area, Likoni*



(Source: Author, 2005)

### **(x) Areas of High Social and/or Economic Risk**

These are mostly areas of squatter settlements and slums, often illegally developed, very poorly built, and with comparatively high concentration of the poorest portion of an urban population. Development of these settlements is totally or partially illegal, and initiated often by illegal occupation of land. They also often occupy very valuable urban land. As a rule, such areas represent high-risk zones (flood plains, dangerous slopes, along seismic faults, below flood levels, along a coast line, etc.). The probability is very high, therefore, that these areas will be the first affected during a natural disaster and most vulnerable to the development of a disastrous chain of events. Consequences of a catastrophe in these areas will be:

- Probability of a high death toll
- Probability of epidemic diseases and famine
- Human misery
- Possibility of social unrest
- The placing of an immediate and heavy burden on a disintegrated local economy, because of the lack of local resources for reconstruction, etc (UN, 1976:40).

The settlements of Kaa Chonjo, Muoroto and Kaloleni in the Island of Mombasa come to mind.

### **(xi) Major Kinds Of Physical Planning And Development Tasks**

The need for and the opportunity and freedom of introducing appropriate preventive measures in the physical planning of a city depend on the character of development or modernization task. In physical planning for urban development it is possible to distinguish four exercises whose characteristics are listed below.

**Building a new city:** This task is characterised by:

- Broad freedom and responsibility in selecting a site (decision to be made on national or regional level)

- No other existing limits and thresholds, besides economic feasibility, for adopting all the necessary safety measures in planning
- A broad freedom in planning and especially in defining land-use patterns.

**Urban renewal:** Existing built-up areas often call for the most urgent planning and corrective intervention. The task varies within different built-up areas:

- Areas of high and low potential risk
- Areas of different consequences of potential disasters
- Areas of different degrees of difficulty in introducing protective measures (UN, 1976:43).

The planner is most strongly limited in his conceptual work by existing structures, land-ownership patterns, conflicting interests and economic factors. To move away from the highest risk areas may be unrealistic. Mombasa Island basically exhibits this kind of development task.

**Expansion of existing city:** Some limited freedom is necessary in selecting new sites for city expansion. There is some similarity to New City development in the opportunity for introducing all necessary safety measures in zones of new development. Limitations arise from the need for joining and expanding in a continuous way the existing networks of transportation, infrastructure, etc. Combining and coordinating expansion schemes with the urban renewal projects is strongly recommended. Most protective measures at a general plan level should be adopted; all measures at a detailed plan level must be adopted. Mombasa is due for expansion, according to the Municipal planner; to Kombani to the south, Mazeras to the west and Mtwapa to the north. These measures will then be relevant for Mombasa.

**Reconstruction of a Destroyed City:** A specific challenge of the planning operation is the unique opportunity to improve a city's shape through the general reconstruction process. Major components to be improved include:

- Land-use and functional patterns;
- Densities of development; and
- Transportation networks (UN, 1976:44).

Throughout the present century only a distinct minority of cities destroyed by natural causes or by war have been rebuilt in a planned and improved way. The opportunity unfortunately offered by catastrophe has been missed. In most cases, the pressure of immediate needs and the opportunism of local authorities have resulted in the retention of most former errors and absurdities in a city's shape. Rebuilding has followed the vulnerable patterns that existed before the destruction. The city of Kobe, as discussed in Chapter 3, succeeded to rebuild in a better way. It was revived, not to restored.

### **(xii) Efficiency of planning protective measures**

Can a city be made disaster-proof or only disaster-resistant? An answer to this most important question must be that from the point of view of location it might be possible to site a city in an area with a minimum disaster risk, but it is impossible to plan a fully disaster-proof city when, like Mombasa, it is poorly located. In practical terms, however, it is impossible on a global or a national scale to abandon disaster-prone regions totally. Selecting the less dangerous site from available choices and developing measures for disaster resistance will therefore be of primary importance. From a technical point of view, we have enough knowledge to construct all buildings disaster-proof, but it is not economically feasible (UN, 1976:45).

### **(xiii) Land-Use Patterns**

**Definition:** Land-use patterns in an urban master-plan define requirements for residential, industrial, recreational, transportation, mixed and other kinds of development and the way these development programmes should be formed. In other words, a land-use map should determine the kind of use and the density of use for every piece of ground within a planned area. Land-use maps may also be called zoning maps, and may illustrate further differentiation into Functional Zoning (Kind) and Built-up Zoning (Density). Mombasa does not have a zoning map. Given its historical development, it is important to preserve the character of Mombasa. However, some level of zoning is necessary to avoid close proximity of incompatible activities.

**Basic Maps for Land-Use Planning:** It is recommended that the following studies and maps should be prepared in advance of a planning operation for Mombasa:

- Seismic micro-zoning map, giving information on
  - Soil structure
  - Soil bearing capacities
  - Seismic characteristics
- Contour map, to define flood plains, flood fringe districts, and safety altitudes
- Physiographic maps to define ground and soil conditions, underground water regimes and to define, as a consequence:
  - Potentially sliding slopes
  - Dangerous areas at the foot of hills or slopes
  - Grounds where the change of underground water level may affect the bearing capacity (rising due to floods, sinking due to river regulation or improvement works) (UN, 1976:48).

When planning land-use patterns for Mombasa, the following should be taken into consideration:

- Avoiding risk of mixed development, and of the physical proximity of some functions and kinds of development. The mixture of residential functions with the productive ones (workshops, industrial plants etc.), as in Majengo and King'orani, increases the potential risk of explosion or fire and of a conflagration, as a result of an initial catastrophe or as a result of subsequent effects of natural disasters. The location of workshops in residential zones may be permitted if they do not constitute a risk of explosion and fire and where their production is not noxious. Physical proximity of units with high concentration of people (markets, theatres, public halls, schools, etc.) to industrial plants or even to residential buildings may aggravate the situation in the case of an initial catastrophe and should be avoided.

- Isolating, by open spaces (green belts), high-risk developments from urban development areas (UN, 1976:49). This relates to all industrial plants representing a potential risk of explosion, to storage areas and facilities for storing combustible materials and substances, to major railroad and highway junctions, and to airports. For airports very special measures should be adopted along projection lines of runways. Within belts of land encompassed by these projection lines, heights of structures must be limited and, apart from agricultural uses, storage is the only other use to be recommended. Housing developments must be prohibited. Green belts may be considered between Majengo/King'orani residential and industrial concerns by knocking the first row of houses and replacing them with greenery. The flight zone between Mikindani and Jomvu should also be considered for greening.

- Decentralising key economic and administrative facilities within a city. In disaster prone areas, to diminish the risk of total paralysis of productive or administrative (governmental) activities, industrial as well as business zones should preferably be decentralized, and those functions should be distributed through the broader urbanized area within a number of industrial districts or within a number of administrative and business centres (UN, 1976:50). Essentially each of the four physical areas of Mombasa must be able to function relatively independent and self sustaining by having, to some degree, all productive, economic, administrative and social services. They must develop as satellite towns from the Island.

- Keeping densities of development low. The general rule may be lesser the density, the lower the level of risk and vulnerability. Such a rule is difficult to implement because it may be in conflict with economic criteria (cost of land and infrastructure) or with functional demands (accessibility, proximity). A sound compromise should be found for every case, taking into account level and

character of risk and local economic, social and technical conditions. To find the appropriate compromise a feasibility study may be made to interrelate density, building technology, height of buildings, infrastructure cost and level of risk. The density may be expressed mostly by two well-known indicators:

- The number of people per area unit (square kilometre, hectare) or
- By the proportion between the area of a building lot and the sum of the usable floor areas of buildings on the lot.

The first indicator illustrates the level of danger to human life and the magnitude of rescue facilities and operations required (i.e. – the number of people to be evacuated, capacity of evacuation roads and fields); the second indicator signifies the level of risk due to over-concentration of buildings. Both these indicators together with poverty have been used for vulnerability analysis of Mombasa (see Chapter 4). Some reports indicate that population density, when exceeding two hundred people per hectare within residential zones, substantially increases the risk of massive losses due to an earthquake and aggravates rescue operations. Other reports indicate that the development of a firestorm is facilitated when over 1/3 of the ground is under roofs (UN, 1976:51).

- Formulating zoning regulations based on the quality of building materials and structures. In most cases, local planning authorities are empowered to establish regulatory standards of the kind and quality of building materials and structural design related to every land-use zone defined by a physical-development plan. In planning, standards should be used in combination with regulations on development densities. (lower density may permit a lower resistance quality of building materials.)
- Defining Objects and/or Developments Calling for Special Attention: In Mombasa, these will include:
  - Administrative disposition centres
  - Centres of communication
  - Key supply facilities
  - Historical and cultural landmarks as earlier discussed (Chapter 3)

**Land-Reserves:** Land-use patterns for urban development should retain some land resources free from development to act as sites for emergency use following a disaster. Such uses will be those of temporary shelter and temporary facilities, including maintenance of individual and public health, food distribution, storage for emergency equipment and materials, etc (UN, 1976:52). The location of these reserves of land within the general scheme of urban development should correspond with the planned patterns for evacuation facilities and emergency supply systems, and should constitute part of a

scenario for emergency activities. The reserves should be organized in the form of various kinds of green and open spaces.

**Cemeteries:** Other than the major green and open areas in Mombasa Island earlier mentioned, and given the acute shortage of land, this study proposes a freeze of all burials within the Island. Alternative burial sites should be planned for on the three mainlands. The existing cemeteries in the Island, and they are a number, should be integrated as open and green areas. In the medium term, they can be used for recreational activities.

#### (xiv) Roles of Open Spaces

**General role:** Open spaces will play a significant role in mitigating the scope and consequences of a majority of natural and man-made disasters. Their role at the time of a catastrophe is two-fold:

- To isolate one zone of potential risk from another and therefore to localize the action of destructive forces and to prohibit expansion of a disastrous chain of events (i.e. earthquake – fire – conflagration)
- To serve as an emergency access, escape and accommodation facility.

**System of open spaces:** The efficiency of action of open spaces within the urbanized zone as a disaster-mitigating device and as an emergency facility depends:

- On the amount of those areas,
- On equal distribution throughout the urban area, and
- On the continuity of a system of green areas.

Open spaces of various uses should be linked together to build up a kind of grid, penetrating through the entire built-up area, subdividing it into smaller units (UN, 1976:53).

**Role of isolating belts:** Isolating belts should be introduced between different land-uses to divide large development areas into smaller units.

The role of isolating belts is

- Protection against spread of fire
- Protection against explosions
- Protection against noxious industries
- Areas for evacuation of people
- Reserves of land for temporary emergency structures.

**Planned land-use for isolating belts:** Open areas cannot be retained as land without any use. On the contrary, a number of necessary urban functions are interrelated with green and open spaces. Major planned functions for open spaces should be:

- Recreational areas, parks, sport-ground
- Agriculture cultivation and gardening
- Forest belts

Easy access to all of those areas for emergency situations must be observed (i.e. heavy fences must be prohibited).

**High risk areas:** All major high-risk areas, as described previously, may be developed with open green spaces. Parks, sport grounds, gardens etc. may be sited along known seismic faults, within flood plains, below safe altitudes along sea-shores, etc. whenever such areas are designated as evacuation areas or evacuation routes, care must be taken to ensure that their use is safe from the effects of disaster (UN, 1976:54).

#### (xv) Infrastructure Networks

**Road network:** General rules should ensure that:

- Every urban district or part of an urbanized zone should have no less than two access roads. For economic reasons, alternative access roads may be developed in a simple (less expensive) manner when feasible.
- Major roads and streets should be integrated into one system affecting alternative thoroughfares, alternative access to major focal points in the city, and alternative junctions with the regional or national roads.
- The right of way of major roads should be wide enough to avoid blockage of traffic lines by collapsed buildings.
- Major thoroughfares should avoid crossing areas of high risk, when feasible.
- Evacuation and emergency routes should be specifically marked and protected against any incidental blockage (UN, 1976:55).

Specially sensitive bottlenecks and points of high potential risk within road networks that need special care are:

- Underpasses and overpasses
- Bridges and viaducts
- Tunnels

The collapse of any of these structures, or the flooding of an underpass or tunnel, may paralyse vital parts of the transportation system and may contribute to the expansion of the disastrous effects of a catastrophe. It may dramatically delay emergency actions (evacuation) and risk operations. To diminish the above risk, all potential bottlenecks should be supported by emergency by-passes and alternative routes.

**Railroad:** Railway junctions should be developed as a through, or better, as a circular system having numerous connections with the national or regional railway network in a manner similar to the road network system. Terminal stations and systems of terminal ends of railway lines represent a high risk of easy elimination of its operational capacity even due to minor accidents on an approaching line or due to a break in such a line. They should therefore be avoided (UN, 1976:56). Sites of marshalling yards should be placed within locally available areas of lowest risk, isolated from other development zones by green belts. The right of way or railway lines should be broad enough to protect the lines from the impact of falling structures, trees, electric and telephone poles and from the effects of fires within nearby built-up zones.

**Water Supply:** A major task is to secure the water supply during an emergency situation. A breakdown of the water supply on such occasions may be fatal and can cause spread of further catastrophe and its consequences. In an emergency situation water is needed for consumption and for fire extinguishing. The system of urban water supply should safeguard both needs, even when partially broken. Major conditions to fulfil these demands are the provision of:

- More than one water-supply source
- Alternative, emergency supply sources (e.g. deep wells (artesian) (UN, 1976:57).
- "Closed circuit" systems of mains and of supply pipelines for every distinguishable part of the urbanized area. The closed circuit system as opposed to the "dead end" one offers the chance that when one particular pipeline is broken, supply may continue from another direction.

Broken mains and other pipelines present a potential danger of flooding for road underpasses, tunnels (subways), ditches, and the basements of buildings. When tracing mains, care should be taken to lay them at some appropriate distance from the tunnels and other sensitive underground spaces.

Contamination of water at the supply source or through broken pipes may be fatal. Supply sources should be protected against contamination due to flood, fire and explosion, by applying protective isolating belts of open but inaccessible space and by appropriate protective engineering works (UN, 1976:58).



Safeguarding the emergency water supply for fire extinguishing is imperative in all high risk areas, whether equipped with a water supply system or not; important industrial plants and the most vulnerable public buildings whenever possible, should have their own emergency water supply sources. In residential areas the problem may be partially solved by building open-air water reservoirs; some swimming pools may be used for that purpose as well. European experience from the period of World War II shows that in densely built-up areas the radius for service by one reservoir area should not exceed 500 meters, and the capacity should be 150-250 cubic meters.

**Sewage and drainage:** In earthquake-prone and in flood-prone areas separate systems for domestic sewage and rainfall drainage seem to be more favourable than combined ones. In regions subject to torrential rains and where an earthquake may destroy drainage system, emergency open-air ditches is recommended for surface waters.

**Power supply:** Local power-supply systems should, wherever possible, be incorporated into the broader system on a regional or national scale. If this is not possible, more than one supply source should be made available to the system. High-tension power supply lines should have a safe guarded right of way in the form of an open belt of terrain, without any buildings. It is imperative to prohibit such lines from passing over roofs of residential buildings, industrial establishment and over storage areas. Overhead lines of power supply in regions subject to tropical storm should be avoided wherever possible. Public buildings, hospitals and other sensitive element of the city should have their own emergency power supply sources. Major thoroughfares and evacuation roads should have emergency illumination systems supplied from an independent source.

#### (xvi) Acquisition of Land

Public disposition of land, or at least, public control of the land-market and of land value is a pre-requisite for:

- Design of appropriate land-use patterns and adoption of physical planning protective measures.
- Successful implementation of plans.

Public disposition of land is crucial for successful urban development operations on a very broad scale, such as:

- New town development.
- Expansion of an existing city.
- Reconstruction after a disaster.

Possible ways of acquiring land include:

- Expropriation under emergency rules.

- Acquisition at controlled or market prices, paid by bonds or cash, for reselling or long-term lease after a new development scheme has been designed.
- Takeover of a fixed part of every private development land for public purposes
- Pre-emption rights (UN, 1976:61).

#### (xvii) Detailed Design Level of Physical Planning against Disasters

**Scope and Character:** Detailed Physical Planning or Design is the very last level of Town Planning and represents an important link between the Master Plan and architectural or engineering design for a single building or any other structure. Detailed Physical Development Plans, elaborated most often at scales of 1:2000, 1:1000, or 1:500, may be of a two-fold character:

- Regulatory plans are prepared by local authorities and endowed with legal power. These plans, depending on local planning and building rules, may define:
  - Detailed delimitation of different land-uses,
  - Subdivision of land into building lots.
  - Right of way for all or only major streets,
  - Building lines,
  - Intensity of development and heights of buildings,
  - Permissible building materials, and
  - A number of additional recommendations (i.e., horizontal shapes of buildings, landscaping etc.). Generally, these plans develop and expand regulatory elements of a zoning and land-use plan (UN, 1976:62).
- Pre-investment physical development studies are often prepared by a developer for a broader complex of buildings or for another broader development programme. These plans must follow regulatory elements from the Master Plan or from a Regulatory Detailed Plan, or may be presented to local authorities for approval as a substitute for non-existent regulatory plans.

Detailed plans are prepared in the majority of cases of modern physical planning only for those areas having expected immediate and concentrated development activity, and for areas of special interest (i.e. high risk areas, renewal areas, etc.) where precise guidelines for any further design and building activity are imperative. Because of the scope and character of development problems which a detailed plan may define and regulate, it becomes indispensable to a local authority when formulating and implementing physical planning protective measures against various kinds of catastrophe.

### **(xviii) General Rules for Protective Measures**

The following general rules should guide every detailed physical planning exercise aimed at disaster-protection measures in any town including Mombasa:

- To locate buildings and other engineering structures on those areas and on those grounds which offer the lowest risk of catastrophe due to local natural conditions (UN, 1976:63).
- To share buildings, other structures and landscape in such a way as to create minimum obstruction to the free flow of natural elements and forces (e.g. the flood, flood ways and hurricane ways) and therefore to help avoid an accumulation of destructive forces within built-up areas.
- To beware of situations where collapse of one structure may damage or paralyse another structure or vital elements of urban-service networks.
- To design lay-outs for the development of a single project and of a city district, in such a manner that they are easily comprehended by lay-people, to avoid confusion and panic at times of catastrophe and emergency evacuations.

### **(xix) Safety Standards and Norms**

Local standards and norms, based on local conditions (type and level of risk, social conditions, and economic feasibility,) should serve as a basis for elaborating detailed plans and building blueprints.

These standards and norms should relate to:

- Population density.
- Concentration of population in open spaces and in public buildings.
- Intensity of development.
- Right of way standards for evacuation roads
- Fire protection codes (UN, 1976:64).

**Buildings:** Exemplary and significant criteria of building design are to be as follows:

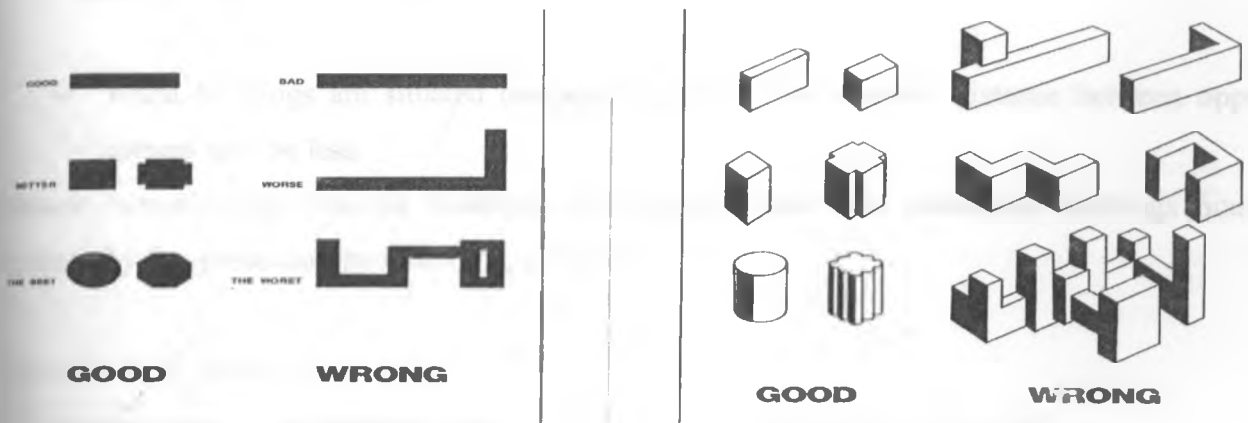
#### **Height of buildings:**

- Possible building height depends on vibration characteristics of soil and the dynamic response of the building, especially in seismically active zones.
- In flood-plain zones, taller buildings are advantageous when built of water resistant building materials and when sufficiently strong, since they may serve as very important temporary refuges for evacuation.
- Wind resistance of tall buildings should be checked carefully in every region subjected to strong, violent winds (UN, 1976:65).

**Shape of buildings:** The horizontal shape of a building is of cardinal importance for survival during a disaster. Shapes should be as simple as possible. A theoretical optimal is the round tower, but the square or short rectangular horizontal shape of building may also be recommended. The following shapes should be avoided:

- Very long buildings
- L-shapes and zigzag shapes
- Wings added to a main unit
- Internal courtyards

Figure 13: Shapes of buildings



(Source: UN, 1976)

The vertical shape of a building should be as simple as possible. The following shapes should be avoided:

- Big differentiations in heights of parts of the same building.
- Heavy towers and other decorative elements placed on the top of a building.

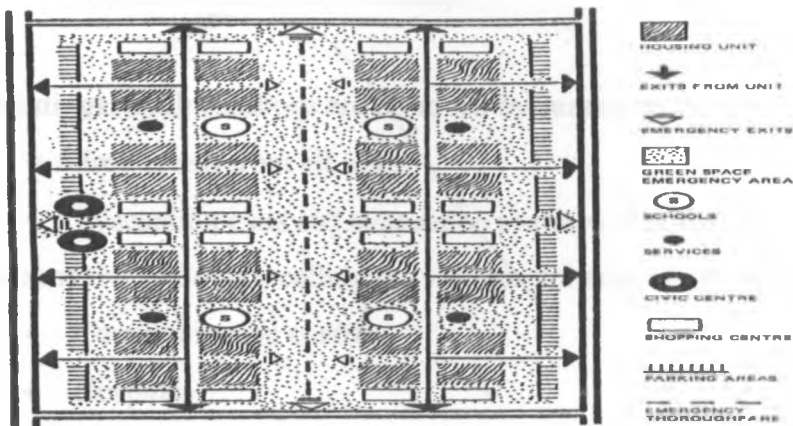
**Decorative elements:** Avoidance of decorative elements is important, since such elements are subject to fracture and will fall. Especially vulnerable are:

- Free-hanging balconies
- Plaster decorative elements
- Heavy cornices etc.

**Groups of Buildings:** Distance between buildings must be determined to avoid the impact of one building on another when it collapses. Distance should also be sufficient to guarantee that open space between buildings will not be totally covered by collapsing structures. Recommended distances are:

- Not less than one and a half times the sum of heights of two opposing buildings, or better still, twice the sum of heights.

Figure 14: Organisation of space and exits in residential areas

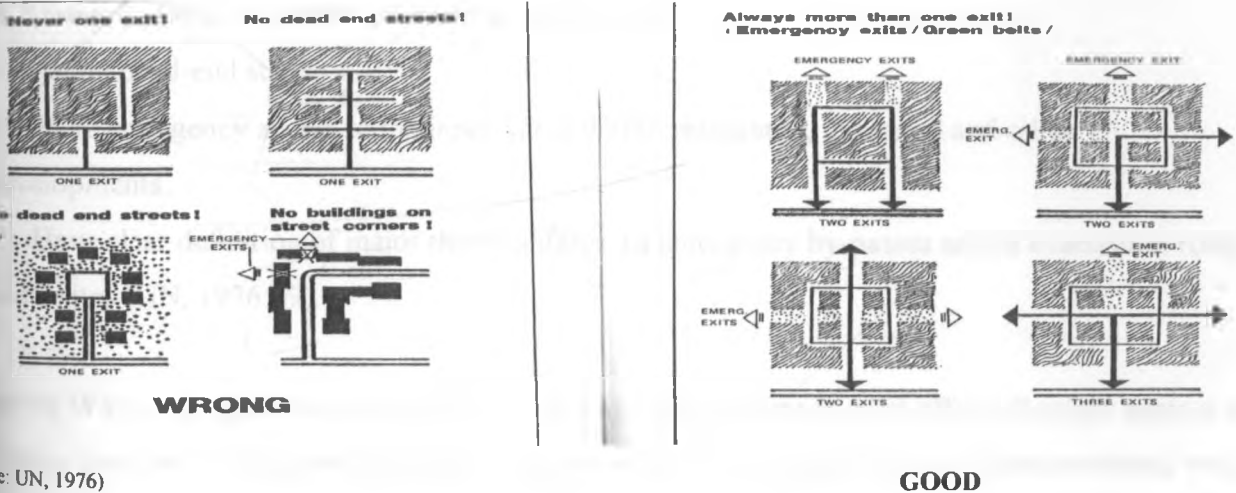


(Source: UN, 1976)

- When buildings are situated diagonally opposite one another, distance between opposite corners may be less.

Distance between high fire-risk buildings and between these and residential buildings must be regulated by fire-protection by-laws (UN, 1976:67).

Figure 15: Exits from housing units



(Source: UN, 1976)

**Spatial interrelation within a group of buildings** should be designed allowing for the obstructive effect they may create to the free through-flow of wind.

**(ix) Other Safety Measures**

Some safety measures will depend on the role and function of the buildings, on the level of risk to human life and on the risk of interrupting vital economic, social and administrative activities.

**Residential Buildings:** Apartment blocks need:

- Exits from staircases on both sides of a building

- Fire escapes or emergency staircases and free access to every apartment block from two opposite sides (UN, 1976:68).

**Public Buildings:** Such buildings are designed for mass-concentrations of people. Requirements are:

- Free access from all sides
- Evacuation exits and evacuation routes within and around the building

Especially sensitive buildings, calling for very careful and catastrophe-resistant design are:

- Communication centres
- Hospitals
- Schools (may be used for emergency accommodation)
- Central management, administrative and civic offices
- Hotels, restaurants, and dance halls
- Department stores and supermarkets

**Industrial Buildings:** Every building within an industrial park must have easy access and design must allow for this.

**Road Network:** Detailed pattern of street networks should:

- Avoid dead-end streets.
- Have emergency access to the inner-yards within residential, industrial and other developments.
- Have clear definition of major thoroughfares, of emergency by-passes and of evacuation roads and routes (UN, 1976:69).

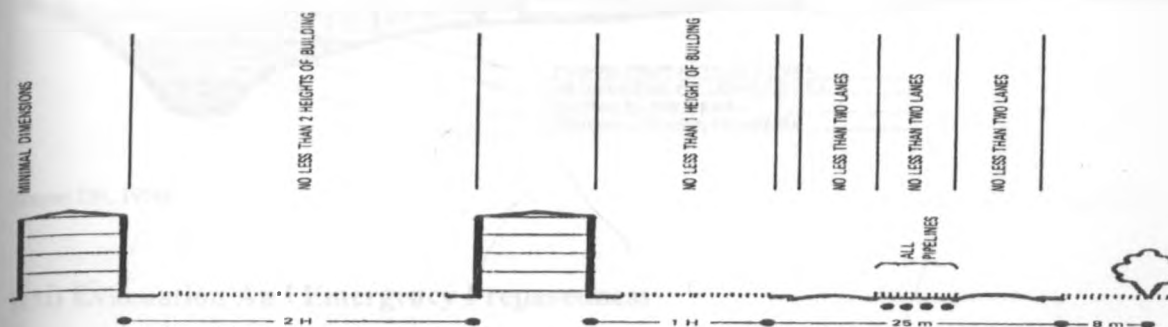
**Rights of Way:** As a general rule, the lay-out of major through-roads must offer full safety against the road being blocked by collapsed buildings, other structures, accidental flooding, fallen overhead wires, fallen trees and accidental traffic jams. Cross-sections of major streets to be used as emergency access roads and evacuation roads may be designed along the following patterns:

- Distance of the buildings from the traffic line should be equal to the building's height or more.
- Two separate traffic lines are recommended.
- Median green belt between traffic lines, when feasible, should be equal to one traffic line or more to be used in an emergency as an additional traffic line, or for pedestrian traffic (evacuation) or as an emergency storage area.
- Water pipelines and other infrastructure elements should be placed under the median strip and

not under traffic lines, to avoid accidental closing of traffic.

- Trees along main roads should be planted at a distance from the traffic lines to avoid blocking them by falling ones (UN, 1976:70).

Figure 16: Street cross section



(Source: UN, 1976)

**Street Furniture:** As a general rule:

- Positioning of street furniture must be such as to avoid any easily falling or flying objects, (i.e. overhead billboards, marquees etc.).
- Whenever feasible, put all power lines under the ground.
- Lamp poles must be made strong enough to resist wind and earth tremors.

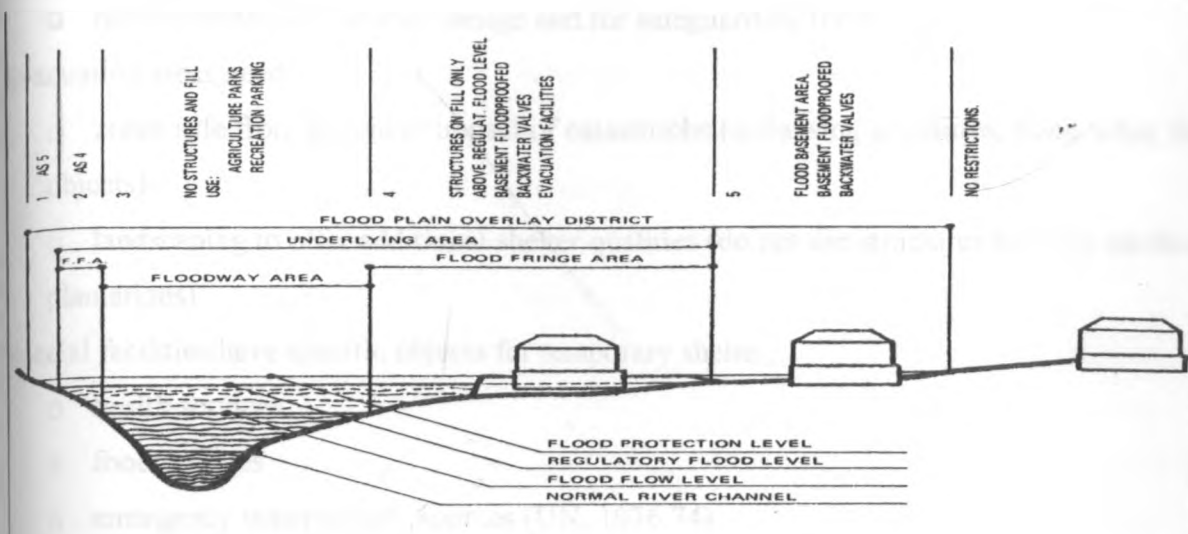
**Guidelines for Landscaping:** The following factors can be considered:

- Groups of trees on river banks and within a flood-way district should be avoided.
- Continuous belts of trees elsewhere are suitable.
- Trees along the street should be placed at an appropriate distance from traffic lines.
- Trees and bushes should not be grown at street inter-sections (UN, 1976:72).

**Artificial ground landscaping should:**

- Facilitate flow of rainfall and floodwaters
- Create some protective measures against floods
- Build up artificial hills to an altitude higher than the envisaged flood-level as refuge for the population.

Figure 17: Flood protection



(Source: UN, 1976)

### (xxi) Evacuation And Emergency Preparedness

**Evacuation System and Facilities:** Effectiveness and operational efficiency of an evacuation system has the following features:

- It is of crucial importance for the mitigation of a catastrophe.
- The system starts at single building level, extends up to district, city and regional levels.

The aims of the system are:

- To remove people from buildings before their collapse.
- To remove people from structures and areas under the direct impact of:
  - flood waves.
  - fire and poisonous fumes.
  - violent winds and other elemental forces, and to
  - accommodate people temporarily in structures and in areas which may offer protection against natural and elemental forces to facilitate other rescue operations by removing people from disaster-affected areas (UN, 1976:73).

**Particular Recommendations:** Buildings (residential), public need:

- fire escapes
- exits from the buildings, i.e. to avoid exits to closed or fenced courtyards
- building roofs as the first “natural” evacuation in the case of flood.

Evacuation routes need:

- immediate rallying points
- network of evacuation roads



- their identification
- recommendations for their design and for safeguarding them

Evacuation areas need:

- zones safe from the direct impact of catastrophe (collapsing structures, flood ways, fire, flying objects)
- landscaping to offer additional shelter qualities (do not use structures but only earthworks and plantations)

Special facilities have specific objects for temporary shelter;

- health services
- food services
- emergency water-supply sources (UN, 1976:74).

Plans of action must include the design of local emergency evacuation plans giving alternatives for:

- kinds of disaster
- magnitude of disaster
- time of the day when disaster is likely to occur.

#### (xxii) Technical Documentation for Emergency Preparedness

Issues of emergency preparedness documentation are the subject of another section (see MANDISA Case Study, Chapter Two). Attention here is limited to the enumeration of fundamental documents from the physical-planning field and related management issues. To have these documents available for any emergency situation is vital for effective response of authorities and for prompt action.

**Duties of the Office of Urban Planning:** The Mombasa town planning department in cooperation with the Mombasa DDMC should prepare and keep up-to-date the following sets of technical documents:

- Maps and special surveys on:
  - identification of all areas particularly vulnerable to disasters
  - geological maps
  - seismic micro-regionalisation maps
  - geodetic survey maps
  - built-up areas survey maps
  - infrastructure networks maps
  - maps indicating all emergency facilities (UN, 1976:75).

▪ **Data Bank:** A data bank should have up-to-date information on mombasa's:

- population, its structure and distribution
- economic activities, their character, location, equipment, risk level
- buildings, their structure, function, capacity, age
- infrastructure facilities, their technical characteristics, capacities
- transportation facilities and networks
- services: capacities, equipment, locations
- articles for potential emergency use
- emergency relief organizations and equipment-character, capacity, location

▪ **Scenarios for potential catastrophe and relief operations:** All preparedness measures are useless if they are not simulated through scenarios. An example is when Army officers took part in a Kenya Airways emergency landing exercise at Nairobi's Moi Air Base. The drill was aimed at ascertaining if the Air Base could be used for emergency landing in case of a problem at Jomo Kenyatta International Airport (Daily Nation, 2005). For the same reasons, in Mombasa, the old Port should be prepared for emergency docking of ships. A scenario consists of:

- Predicted models of potential catastrophes
- Plans for prevention and minimization of injury and damage caused by disaster
- Plans for emergency relief including plans for prompt response to disaster
- Plans for cooperation with appropriate government departments and with other public and private organizations in relief operation.
- Plans for organization of volunteer disaster workers (UN, 1976:76).

### (xxiii) The Challenge and Responsibility of Reconstruction

In concluding these guidelines some aspects of reconstruction may be mentioned (the detailed aspects have been dealt with in the Kobe Revival Case Study, Chapter Two) such as the unique opportunity and responsibility and the complex character of the challenges, which would be needed for a city like Mombasa:

- A definition of broad innovative concepts;
- The improvement of the city;
- The harmonization of reconstruction and development programmes;
- Answering immediate needs;
- Trading-off short and long-term needs and possibilities;
- Resisting pressure-groups;
- Using limited resources in the most effective way; and
- Ensuring popular participation and involvement.

Other guidelines for the reconstruction blueprint should define;

- the assessment of major shortcomings and deficiencies of the pre-disaster city;
- major issues for improvement;
- social and economic aims;
- decentralization vs. concentration;
- limited reconstruction or expanded development, and
- major tools for successful operation.

The above topics should be developed further in other studies in this area of post-disaster action.

## 5.2 Policy Framework for Disaster Management in Kenya

Kenya does not have a Policy Framework for management of disasters. The National Disaster Operation Centre is, currently, in the Office of the President. A draft national policy on disaster management has been prepared and validated and currently awaits cabinet approval to form the basis for the development of an integrated and coordinated national disaster risk management system. This study will now discuss the elements of the Draft Policy, which, apparently, is already guiding the existing administrative framework on disaster management in the country. The Draft Policy provides for the transformation of the current National Disaster Operation Centre into a **National Disaster Management Authority (NADIMA)**, with multi-stakeholder membership, to be responsible for setting policy and managing the national system and to establish a **National Disaster Trust Fund**, among other functions. At the local level, District Disaster Management Committees have already been set up.

### (i) Situation Analysis

Kenya has experienced several kinds of disasters. The country has a recorded history of disasters dating back to 1899 (US Central Command, 2003), which present a definite pattern of occurrences. Disasters that hit Kenya in recent years came from a diversity of hazards, such as droughts, fire, floods, terrorism, collapsing buildings, accidents in the transport industry and diseases i.e. epidemics.

It is evident that most of the disasters that have occurred in Kenya are mainly related to:

- Extreme climate events,
- Improper land use and
- Professional negligence.

### (ii) Lessons Leant From Past Experiences

This study recognizes that a number of lessons have been learnt from past disaster experiences in Kenya, notable of which are:

- That disaster management must include all key actors in a multi-agency approach;
  - That there is need for effective early warning and quick dissemination of information to all actors in order to elicit quick response to emerging crises.
  - That the disaster management system needs long-term funding, through a combination of government, donor, NGO and community resources.
  - That the disaster management system needs flexible budgeting and rapid financial disbursement procedures.
  - That the system must facilitate community participation and community capacity building in all aspects of disaster management, considering that communities already have their coping mechanisms and most lives are saved in the first few hours using simple and inexpensive precautions.
  - That the system must be able to collect, collate, document and disseminate information emphasizing on lessons learnt and undertake research in order to improve preparedness activities at all levels.
  - That the system must emphasize public education and awareness on disaster management.
  - That more investments should be made into factoring climate in disaster management as the bulk of disasters in Kenya have so far been climate-related.
- That the consultative process and the approach of inclusiveness be encouraged in enlisting participation and ownership of both the process and the policies.
- That disaster risk reduction strategy should be institutionalized in all aspects of development planning at all levels to move from relief to sustainable development.

### (iii) Linkage to Existing Policies

**Economic Recovery Strategy for Wealth and employment Creation, 2003-2007:** The four pillars of the recovery strategy are: strengthening the macro economic environment; governance and democratic institutions; rehabilitation and expansion of physical infrastructure, and investment in the human capital for the poor.

**The National Development Plan 2002-2008:** The national development plan recognizes that about 56% of the Kenyan populations live below the poverty line. Poor people are not only more vulnerable to disasters; disasters can push more people below the poverty line or increase impoverishment of the existing poor. Hence an effective disaster management system is vital to achieving the aims of the national development plan.

**The Poverty Reduction Strategy 2000-2015:** The strategy recognizes that the poor are particularly vulnerable to natural disasters. It identifies some of the hazards faced by the poor to be famine, social unrest and crime. It also outlines mitigation and response activities such as the establishment of social safety nets, establishment and maintenance of strategic water resources and an anti-poverty fund. These strategies are in convergence with the disaster management as envisaged by this study.

**National Food Policy-1994:** The national food policy provides for a sufficient supply of nutritionally balanced food in all parts of the country. It also provides for enhanced food production and strategic grain reserve and an equivalent cash reserve earmarked for emergency cereal purchases.

**International Treaties and Agreements:** The policy recognizes international agreements, treaties and conventions that Kenya is a signatory to and which facilitate disaster management.

### 5.3 Legal and Regulatory Framework

There is currently no legal framework for disaster management in the country. Scattered regulatory guidelines exist but are weak due to the absence of a legal backing. A Draft Bill is currently under review. It seeks to establish a legal framework through an act of parliament that will provide for:-

- The establishment of the National Disaster Management Agency.
- The powers, functions and funding of the Agency.
- The activities of disaster management plans to provide immediate assistance to disaster victims even in the absence of a disaster declaration.

#### Linkages to Existing Legislation:

the proposed regulatory framework for disaster management will work in close linkages with some of the following existing legislation:

**The Physical Planning Act (Cap 286):** The Act sets out the framework for land use planning. As earlier mentioned, this study recognises the fact that most disasters in Kenya have had to do with improper land use.

**The Physical Planners Registration of 1996:** This Act regulates the professionals within the physical planning discipline. As earlier mentioned, this study acknowledges that quite a substantial number of disasters result from professional negligence.

**The Environmental Management and Coordination Act No 8 of 1999:** The Environmental Management And Coordination Act of 1999 established a National Environment Management Authority, which has, amongst its responsibilities, to prevent hazards that may harm the environment and to work to reverse the effects of these hazards.

**The Kenya Red Cross Society Act (Cap 256):** The study acknowledges that the Kenya Red Cross Society is a voluntary aid society, The objectives of the Kenya Red Cross Society are clearly geared at dealing with or responding to emergencies.

**The Water Act (Cap 372):** The study recognizes the role of the water resources authority in the ministry responsible for water, in investigating the water resources of Kenya, in regards to the improvement, preservation, conservation, utilization, control and apportionment of water resources. The control of pollution and contamination of water resources is also an important responsibility for the water resources authority.

**Grass Fire Act (Cap 327):** The Grass Fire Act empowers a local authority to declare a state of danger in respect of any area within its jurisdiction, to prohibit the burning of vegetation within the whole or any part of such area. The local authority may also call upon the owners or occupiers of land to construct and maintain firebreaks that will guard against spread of fire beyond the boundaries of such land. However, there is a Draft Fire Policy for the enactment of the Fire Precaution and Services bill to strengthen the local authorities to deal with urban and rural fires. These provisions are in conformity with the objectives of this study.

**Petroleum Act (Cap 116):** The Petroleum Act seeks to prevent pollution of the environment. It prohibits, inter alia: parking of vehicles containing petroleum within 100 metres of any building and spilling of petroleum into any drain, sewer, harbour, or watercourse. The study proposes that the provisions of this act are enforced.

**The Explosive Act (cap 115):** The explosives act provides that every occupier of a factory shall make special rules for regulating the persons employed in the factory with a view to securing the safety and proper discipline of the employees and the safety of the public. This act is in agreement with this study objectives.

**St. Johns Ambulance of Kenya Act (cap 514):** One of the objectives of St. Johns Ambulance of Kenya Act is to render first aid to the sick and wounded in war or in times of peace. The Act provides

for a reserve of technical staff that supplements the medical services of the government during times of disasters.

**Factories and Other Places of Work Act (Cap 514):** The Act is in convergence with the study as it makes provisions for:

- Effective and suitable circulation of fresh air in each workroom.
- Clean factories, free from effluvia arising from any drain.
- Sanitary convenience or accumulation of dirt.
- Precautions with respect to explosives or inflammable dust or gases.

**The Local Authority Act (Cap 265):** The Local Government Act (Cap. 265) is the Act of parliament that establishes local authorities and defines their functions. The Act is currently under review. The draft bill has made provisions for the establishment of a disaster management office in every local authority with special powers including resource mobilization that may be used in the event of a local disaster.

**The Chiefs Act (Cap128):** The act provides that the minister, if he finds it necessary, authorizes any chief in writing to issue orders to persons within his jurisdiction requiring any able-bodied adult persons to work or render services specified in the order in response to an emergency.

**Other Acts:** This study recognizes other acts of parliament that empower government agencies to regulate the operations and activities of the public and private sectors. These departments or agencies, in the course of their activities, address disaster management issues.

The Armed Forces Act	
The Police Act	Cap 84
The Public Health Act	Cap 242
The Pharmacy and Poisons Act	Cap 244
The Medical Practitioners and Dentists Board Act	Cap 253
The Kenya Ports Authority Act	Cap 391
The Civil Aviation Act	Cap 394
The Transport and Licensing Board Act	Cap 404
The Animal Diseases Act	Cap 364
The Kenya Railways Act	Cap 354
The Forest Act	Cap 385

The Trade Disputes Act	Cap 234
The Agricultural Act	Cap 318
The Kenya Bureau of Standards Act	
The Exchequer and Audit (Strategic Grain Reserve Trust Fund) Regulations 2000	
The Preservation of Public Security Act	
Insurance Act	

**Comment:** The proposed policy does not seem to recognise The Physical Planning Act as one of the acts it must draw from. It tells how disaster management in this country is perceived to be a management rather than a planning issue.

#### **5.4 Institutional Framework**

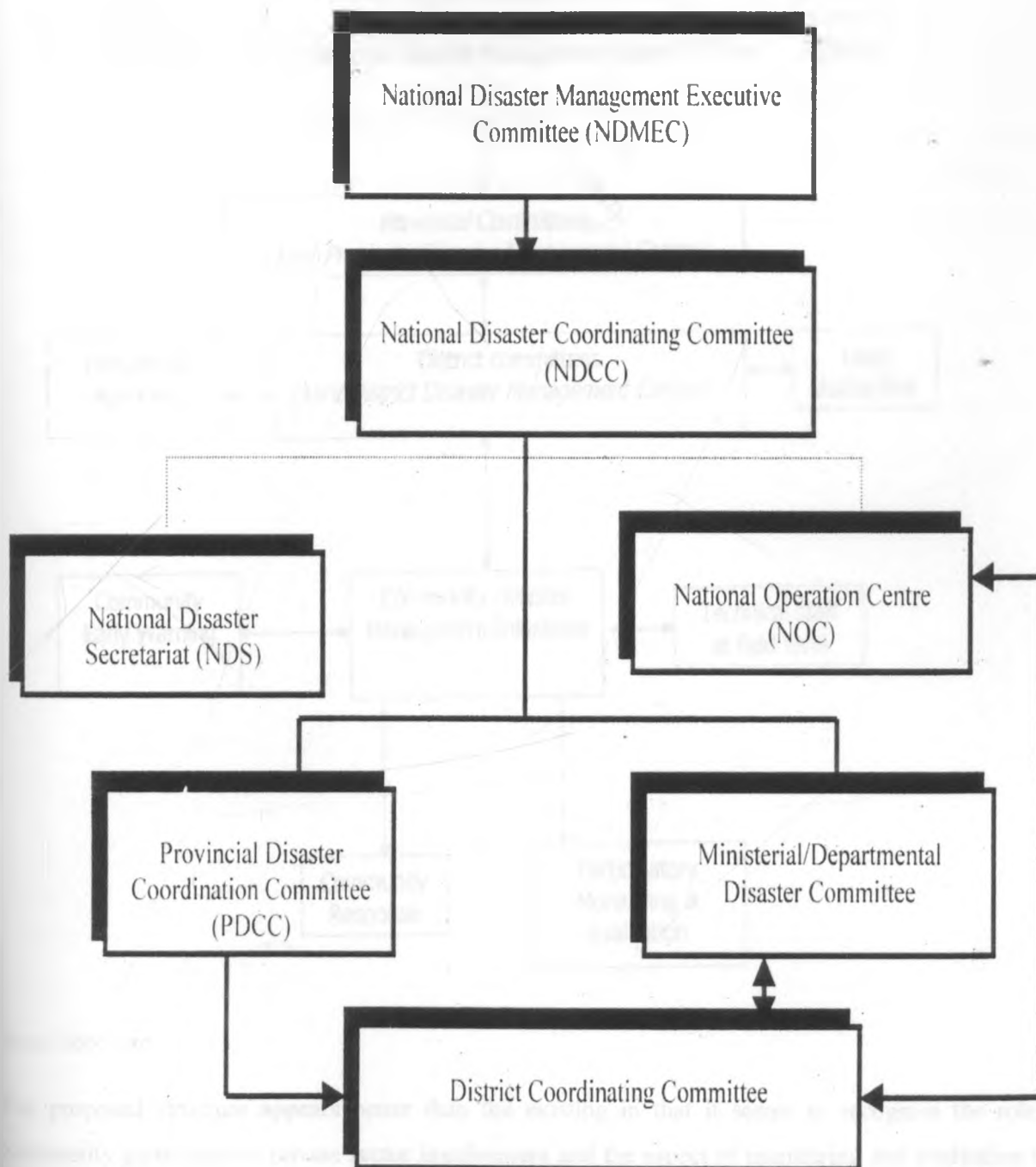
##### **(i) Existing and Proposed National Institutions in Disaster Management**

The country has existing institutions dealing with disaster related activities but these institutions are not working within a coordinated framework. In the office of the president there are the National Disaster Operations Centre, Arid Lands Resource Management Project, the Department of Relief and Rehabilitation and the National Aids Control Council. There are also specialized units, which have roles in search, rescue, anti-terrorism, evacuation, planning and management, enforcement of crowd control, conflict resolution and fire fighting. These units include Police, the Department of Defence, National Youth Service, Local Authorities' Fire Brigades, hospitals, the Directorate of Labour, Occupational Health and Safety Services and the Kenya Wildlife Service. It is acknowledged that the Ministries responsible for Agriculture and Regional Development, Environment and Natural Resources, Labour and Human Resource Development, Trade and Industry, Health, Roads and Public Works, Transport, Information and Communication, Tourism and Wildlife, Energy, Finance, Planning and National Development, Lands and Housing, Education, Science and Technology are involved in disaster management. This study recognizes their roles and seeks for their harmonization of their disaster management operations. In addition, IGAD, UN Agencies and other bilateral partners and international NGOs play a significant role in disaster management in Kenya.



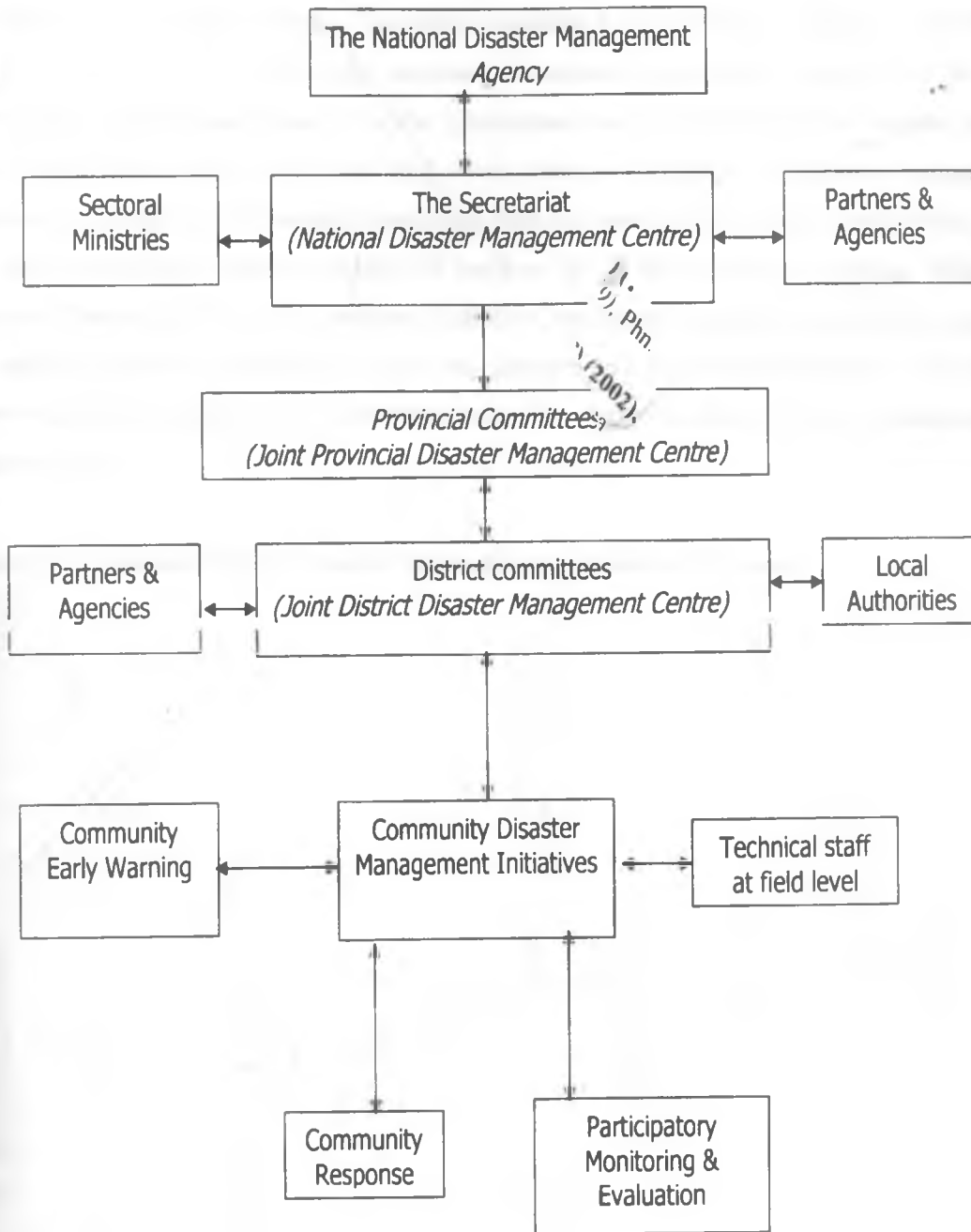
Figure 18: Existing National Institutional Framework

## INSTITUTIONAL FRAMEWORK OF DISASTER MANAGEMENT IN KENYA



(Source: NDOC, 2003)

Figure 19: NADIMA Proposed Institutional Structure



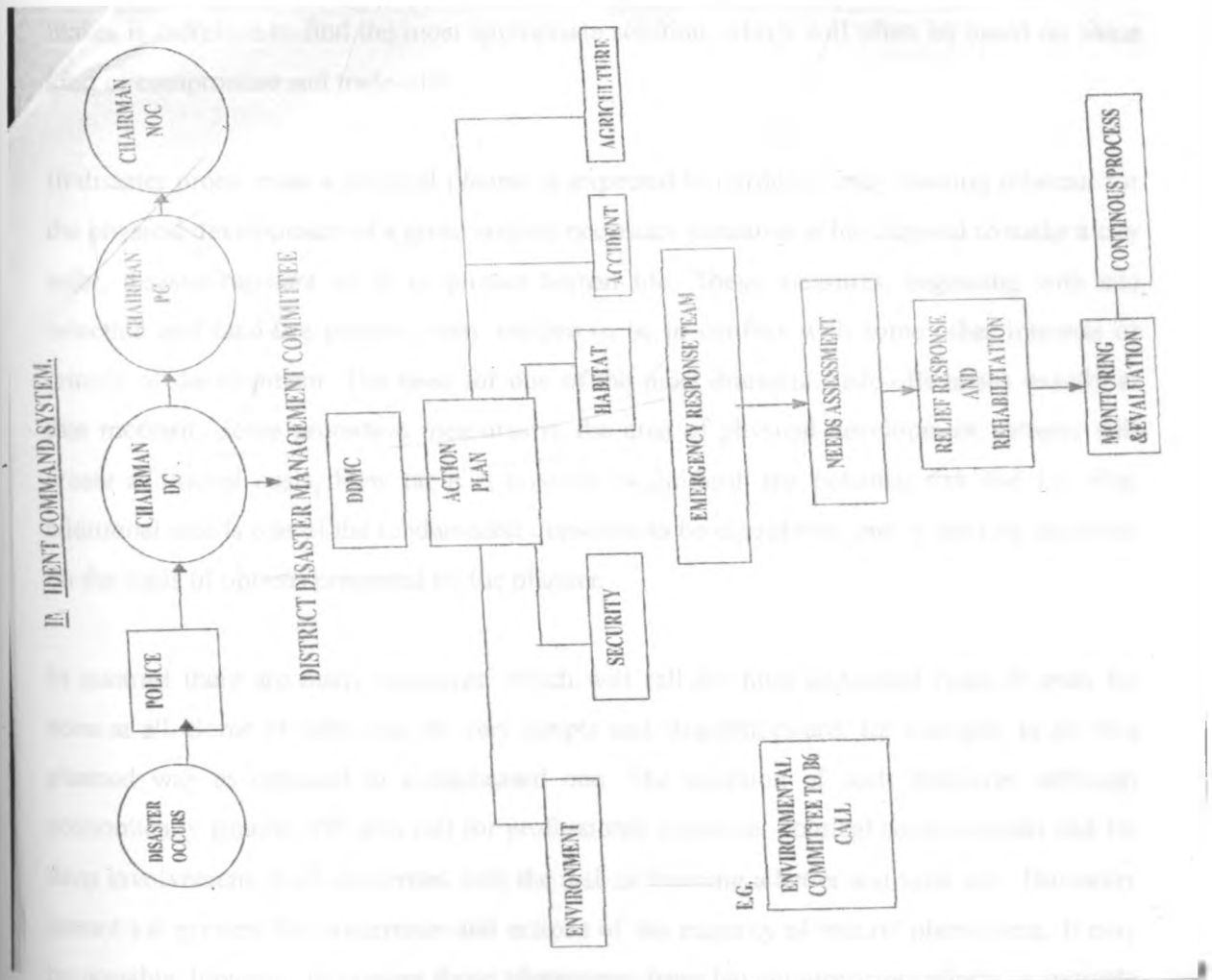
(Source: NDOC, 2003)

The proposed structure appears better than the existing in that it seems to recognise the role of community participation, private sector involvement and the aspect of monitoring and evaluation that one hopes will include liaison with plan approving authorities and Vulnerability Analysis inclusion in Environmental Impact Assessments. The existing structure appears to treat disaster management as a Government affair only.

**(ii) Mombasa Institutional Framework**

The Mombasa District Disaster Management structure clearly shows the thinking behind the Committee's perception of disaster. The entire operation is triggered by a disaster event. It is as though when there are no disasters, the entire structure is dormant. During the fieldwork for the study, it was confirmed by several stakeholders that the Committee had not met for several months, the secretariat phones were not working and there had never been any attempt to organise scenarios or public awareness campaigns. The Disaster Committee does not seem to have much liaison with, or input into, the actual development planning approvals both at the District Physical Planning Office and at the Municipal Planning Offices. It is proposed that the Committee have active liaison and representation in the planning approval processes of both the District and Municipal Planning Offices through the Monitoring and Evaluation Sub-Committees so that it can play an active role in evaluation the safety of settlements plans.

*Figure 20: Mombasa District Disaster Management Committee Structure*



Source: MDDMC, 2003)

## CHAPTER SIX

### CONCLUSION AND RECOMMENDATIONS

#### 6.0 Introduction

The general task of physical planning and design is to translate the social and economic aims of development into physical patterns of land-use and to achieve an appropriate quality of organised environment necessary for human activities, well being and satisfaction. The purpose of physical planning is therefore to coordinate different aspects and components of the complex process of development and to orchestrate environment-shaping activities towards a harmonious result.

In the process of planning, policy-makers and planners meet a number of conflicting situations, conflicting demands and criteria, and conflicts of interest between individual citizens and between various social and interest groups. The task of the planner and policy maker is therefore to find the most appropriate solution, which will often be based on some kind of compromise and trade-offs.

In disaster prone areas a physical planner is expected to introduce into planning schemes for the physical development of a given area all necessary measures at his disposal to make a city safer, disaster-resistant so as to protect human life. These measures, beginning with site selection and land-use patterns, may happen to be in conflict with some other interests or criteria of development. The need for one of the most dramatic trade-offs arises exactly at that moment. Some protective measures in the area of physical development patterns will create additional costs. How far it is possible to diminish the potential risk and for what additional cost is one of the fundamental questions to be considered, and it must be answered on the basis of options presented by the planner.

In contrast there are many measures, which will call for little additional costs or even for none at all. Some of them may be very simple and straightforward; for example, to act in a planned way as opposed to a haphazard one. The adoption of such measures, although economically simple, will also call for professional expertise, political consciousness and for deep involvement of all concerned with the task of building a better and safer city. Humanity cannot yet prevent the occurrence and actions of the majority of natural phenomena. It may be possible, however, to prevent those phenomena from having disastrous effects or mitigate

consequences when knowing their patterns of behaviour and the areas exposed to risk. This study is premised on the latter aspect of mitigating disasters by analyzing Mombasa from its spatial exposure to risk.

### **6.1 A Summary of Research Findings**

The study has established that the direct aims of physical planning as a preventive tool against natural and man-made disasters must be to achieve:

- Decrease in the level of potential risk.
- Mitigation of the consequences of disastrous actions.
- Mitigation or prevention of the development of a chain of disastrous events.
- Localization and limitation of the scope of catastrophes.
- Facilitation of rescue operations.
- Facilitation in organising general habitation during the first post-disaster period.
- Facilitation and hastening of rehabilitation and reconstruction activities.

Priorities of importance may differ from one case to another and will depend on local socio-political conditions, levels of technical and economic development, and even on the potential frequency and probability of a catastrophe. However, this study having taken a socio-economic leaning on its definition of disaster, it can rank the three general priorities in disaster preparedness planning as follows:

- First, is to save human lives.
- Secondly, to safeguard the means necessary for survival after a catastrophe.
- Thirdly, to protect the most valuable buildings and property.

This study has further established that if physical planning is to be an effective tool for land-use control and for mitigating of disasters, it must not only be active in the steering of development process, it should, more importantly, be interdependent with economic development planning and should reflect national socio-economic policies for development. More so, disaster preparedness will have little impact unless it is conducted in concert with normal development activities.

This study has further established that infrastructural and administrative development of the Mainlands in Mombasa must be planned to provide communication links, health and educational services. The absence of these services in the Mainlands is a significant cause of

overpopulation on the Island. Such additional services in the Mainlands will reinforce the Island's resources in the event of major disaster, in addition to encouraging populations to live off the extremely vulnerable and hazardous Island.

This study has also established that population distribution within the Island is the first indicator of vulnerability to disaster. With an even spread of risk of occurrence assumed for the time being, where concentration of populations are greatest, vulnerability to loss is also greatest. Migration of population, as well as any natural increase, may therefore lead to the exacerbation of that vulnerability.

This study has established that being an island city with limited accessibility, Mombasa Island City needs, as much as possible to be self sufficient in disastrous situations where time would be of essence in containing such situations before external assistance arrives. It also needs to have alternative means of access in the form of air and water based transport to strengthen its accessibility so as to remove the over dependence on the road links.

The study also found out that Mombasa being the largest seaport with its hinterland covering the entire East and Central Africa with such vital installations like the only oil refinery in the region, it occupies a specially critical place among the urban centres. Any disaster in Mombasa will reverberate beyond the borders of Kenya.

Tourism is currently the number one foreign exchange earner in Kenya. Mombasa is the centre of the tourism industry in the country. To continue with this tradition, the town needs to have all the necessary facilities to promote the sense of safety to both its occupants, visitors and passers by.

The development of Mombasa, from its genesis has closely been associated with safety. Its original name, Kisiwa cha Mvita, meaning 'Island of War' implies the many battles that were fought in its defence. Fort Jesus is testimony to its impregnability for centuries. Although the current threats are different from those of yesteryears, they are still, if not more, important and need to be understood so as to be countered systematically and sustainably.

The global community, Kenya included, is still trying to come to terms with the tsunami disaster of 26 December 2004 that still sends shock waves throughout the Indian Ocean, after

causing incalculable damage both in human life and property thousands of miles away from its epicentre. The events of September 11, the Bomb Blast of August 7, and the Paradise Hotel bombing close to the Island and the deluge on New Orleans by Hurricane Katrina in September 2005, have heightened safety consciousness all over the world.

Mombasa has an isolated position in Kenya, almost 500 km from the next large town. The small nearby towns are completely ineffectual in so far as offering any substantial help in the event of a disaster is concerned.

The Draft Mombasa Physical Development Plan projected that in the long term future, the whole island will most likely perform the function of a CBD after much of its residential and industrial activities are pushed to the North, West and South Mainlands. A high rise, high density development is envisioned, making the island prone to great losses of both persons and property in the wake of a sudden destructive event. These projections still hold true today.

This study has also established that disasters are the monitors of development. What happens in disaster is the manifest failure of development that is not ideally socio-environmentally oriented.

## **6.2 Conclusion**

To be totally effective, disaster preparedness planning must include an analysis of the existing socio-economic condition of the population. This is because, as established in this study disasters are social events not physical phenomena. The factor of people and their vulnerability is the most important aspect when dealing with disasters since only their presence transforms hazards into disasters. Since hazards, both natural and man-made, are sure to occur, the contingent conditions are what should preoccupy those wishing to reduce the effects of disasters by systematically seeking to eliminate them.

Secondly, that development is the root of disasters since it is concerned with the activities of man in trying to partly domesticate nature. The development process must, therefore, not be separated from the disaster management process, since disasters are essentially the debts of development; what development forgot to take into consideration, it pays back at a later date. The processes of 'development' must first become enlightened with regard to disaster

probability and recognize their capacity for a most dangerous role in disaster cause and exacerbation. Next, disaster mitigation planning must be incorporated into development planning if it is to have any lasting value; for if as a process it is applied in isolation it will become merely a palliative dealing with the symptoms and not the causes of disaster.

### **6.3 Recommendations**

The recommendations of this study are hinged on the three main initiatives that must happen in Mombasa to mitigate disaster effects and these are:

- To improve regional conditions outside the island so as to manage population densities in the island by reducing the unmitigated pull effect of the island.
- To reduce traffic congestion in the island by first minimising through traffic by bypassing the island and proper planning for the remaining traffic.
- Improve conditions in the island that would contribute in mitigating potentially disastrous conditions.

This being only a preparedness study which looks at issues just prior and post the actual disaster event, it will leave out the long term recommendations of rehabilitation and reconstruction of post disaster period and concentrate on policy objectives that would achieve the following with regard to the island of Mombasa:

- Decreasing the level of potential risk.
- Mitigating the consequences of disastrous actions.
- Localising and limiting the scope of catastrophes.
- Facilitating rescue operations.

#### **(i) Recommendations Related To Natural Conditions**

**Location:** The only sizeable town that can offer help to Mombasa in the event of a disaster is Nairobi, almost 500 km away. To reduce the remoteness of Mombasa town, this study recommends for policy provision to encourage the growth of nearby towns such as Diani, Voi, Mazaras, Kilifi and Malindi so as to equip them to be able to offer substantial assistance in the event of a disaster in Mombasa. This should be achieved by first strengthening their service base and employment opportunities through the establishment of education and health facilities together with industries.

The alternative to overcrowding of population and industries in Mombasa and the uneconomical overspill into the surrounding areas is the encouragement of development in



depth. This study, therefore, recommends that policies be put in place for the growth of such towns on the main trunk roads and railways at such places as Voi, Mariakani, Mazaras, Diani, Kilifi and Malindi to offer requisite services and stop being dormitory towns for Mombasa.

Further, the study recommends that the regional towns must be connected by an efficient, fast and diversified transport system between them and Mombasa. To achieve this, the study recommends for the widening and making of dual carriageways of Mombasa – Malindi road, Mombasa – Diani road and, Mombasa – Mazaras road. This study also calls for the maintaining and upgrading of Diani Airstrip, Malindi Airport and to develop an airport within Mariakani barracks. This study further recommends the establishment of marine transport points from Vanga, Shimoni, Msambweni, Diani, Kilifi and Malindi and Lamu.

Being a coastal town Mombasa is susceptible to both terrorist and enemy attacks from the sea and devastation by sea borne natural phenomena. This study recommends for the proper planning and strengthening of the existing Naval Marine Surveillance Radar Stations along the entire coastline to detect any threat from the sea. This study recognizes the recent establishment of the regional initiative with the United States, the Golden Spear Initiative, which is working towards that end. This study further recommends the strengthening of the Marine Police Unit, especially in light of the recent gazettelement of the Kenya Exclusive Economic Zone in the Indian Ocean.

This study recommends for the development of early warning systems as regards the weather related events so as to detect any natural phenomena especially from the sea by modernizing weather forecasting and developing regional early warning systems initiatives for the western Indian Ocean countries. Recommendation is also made for improved methods of climatic and seismic monitoring to be established so that regional locational vulnerability could be assessed.

**Physiology:** Being an island, Mombasa currently has inadequate connections and lacks planned alternative means of accesses to it. To improve accessibility of the island for its proper functioning and for evacuation during disasters, this study recommends for the improvement of land connections to the island by widening Makupa and Kipevu causeways to accommodate more traffic. This study does not recommend, for now, the direct connection of the south mainland to the island at Likoni since this will most likely worsen the traffic

situation in the island. This study however recommends for the eventual tunnelling or open bridging of the Likoni channel but to redirect the traffic to the western side of the island through Mbaraki, Ganjoni and Shimanzi to connect at Makupa through to Nyali bridge via a ring road to bypass the CBD.

This study further, recommends for the provision of alternative means of access to the Island through introduction of air and water based transport connections from the Mainlands so as to relieve the vehicular traffic to the island in addition to offering alternative evacuation modes in the event of compromising of the bridges and causeways. The public water based termini are proposed at Shelly Beach on the South Mainland and from Mkomani on the North Mainland both to land at the Watergate of Fort Jesus. This will also improve tourist appreciation of the Island town especially Old Town from the sea. Helicopter air transport points should be provided in the Island at designated areas on the southern end of the island at Mama Ngina Drive, at the Central Sports Grounds at Mbaraki and at the garden in front of the Railway Station. For medical emergency evacuation, additional water terminals should be provided at Coast Provincial General Hospital, Mombasa Hospital and Port Reitz Hospital. This study further recommends for the provision of helicopter-landing pads at the Coast Provincial General Hospital and the Municipal Stadium for fast evacuation.

The problem of the Island is largely of redevelopment. However, this study recommends that a policy be developed so that the functions of overspill areas on the Mainlands should change from being purely suburban and dormitory to balanced and largely self-contained satellite towns, so as to contain their own populations. These satellites being distinct with the Island would form a cellular clustered city. Already the physical barriers formed by the creeks in the Mainlands and consequent restrictions on access dictate such a policy. This can be facilitated by provisions of service and light industrial areas on the Mainlands and inclusion of recreational, educational, administrative and residential facilities together with shopping, offices and public buildings within their limits.

**Geology:** Although the rock structure of the island is the structurally stable coral, concern has of late been expressed regarding the increased digging of hundreds of boreholes and shallow well for abstraction of water in addition to pit latrines due to lack of a central sewer covering the island. This study, consequently, recommends that immediate ban should be imposed on the sinking of boreholes, wells and pit latrines anywhere in the island. The authorities should take immediate measures to alleviate the shortage of water in the island, by investing in

desalination plants and augmenting existing water supplies. The authorities should also extend the sewerage system to cover the entire island to eliminate the need for pit latrines.

As for the unstable Jurassic Shale of the western and some parts of the south mainlands where overspill population from the island is expected to be accommodated, vulnerability assessment of the areas should be carried out to result into a vulnerability map that will guide developments and zone off risky areas from developments that would expose populations to risk.

**Environment:** Indiscriminate clearance of mangrove forests for building materials, squatter settlements along beachfronts with mangroves and uncontrolled beach front developments are increasingly stripping the coastline of its natural defenses from sea borne natural events such as tsunamis and strong winds. This study makes the following recommendations with regard to the above situation. The authorities should enforce planning regulations regarding beachfront developments as per existing regulations in conformity to the Physical Planning, Environmental and Forest Acts. The communities bordering these beachfronts should be integrated in improving the mangrove cover of the coastline where it has been depleted. A program should be instituted to phase out any developments that are considered as infringing of the beachfront regulations. Squatter settlements such as Kaa-Chonjo and Muoroto in Tudor Estate should be relocated and the areas left to act as storm water drainage way and mangrove forest respectively.

**Climate:** With the effects of global warming being felt by the day, this study recommends the zoning off of all flood prone areas of the municipality by first conducting a vulnerability mapping of the entire municipality. This study recommends early relocation of clearly susceptible settlements in Mombasa such as part of the Kenya Railway Estate in Shimanzi, Kaa-Chonjo and Muoroto squatter settlements in Tudor Estate.

## **(ii) Socio Economic Conditions**

**Population:** People are the most critical resource to be protected by any preparedness initiative. On this regard the densities as established in Mombasa Island only lend to worsen its vulnerable condition. Any policy to manage, stabilize and reduce the over concentration of population in the island should be initiated. This study, therefore, makes the recommendation that all policy initiatives should be pursued to properly service the mainlands to make them attractive to settlements so as to disperse the population of Mombasa from the island to the

mainlands. This requires continued investment in the mainlands of such services as schools, health facilities and industrial establishments. This study recommends that any expansion or addition of these facilities be done in the mainlands.

**Housing:** The high densities of housing developments in the most vulnerable settlements of Majengo, King'orani and Kaloleni in the island, coupled with flammable materials and lack of accessibility for emergency services need to be ameliorated. Given that individuals are already developing the areas into multi storey flats, there is need to re-plan these settlements so as to be developed economically to justify their high premium land, to provide necessary communal services and accesses, to mix the developments with commercial activities and to preserve and foster the social character prevalent in Mombasa.

In this regard this study recommends the immediate redevelopment of Kaloleni in the Island into a well-planned settlement of multi storey dwellings that will relieve adequate land for accesses and social services on the ground. The residents should be encouraged to embrace sectional ownership of apartments rather than the traditional fixation to land. The land should be wholly owned by the Council after appropriate compensation and trade offs. Partnerships between the Council and private sector in development of the estates should be pursued.

This study recommends that since Majengo and King'orani are already fairly regularly planned, road reserves and open spaces should be reclaimed as an immediate measure and illegal extensions removed to open up the areas to emergency accesses. Further, review of the area planning should be done with a view to bringing the infrastructural utilities to measure up with the ongoing development of the area into multi story apartments.

With respect to the Old Town, this study recommends only light and organic improvements as are being done by the National Museums of Kenya so as to preserve its historic and individual character. The study further recommends calming of traffic in the Old Town to make it more accessible to emergency vehicles. The policy adopted by the Conservation Office of developing open green areas along the beach front and on dilapidated structures that can not be saved should be supported so that adequate breathing spaces in the form of open areas for recreation, rallying and evacuation can also be introduced.

**Society:** This study revealed through the field work that the level of awareness on vulnerability in Mombasa is low, with the result that the majority of the population are not aware of the existence of the District Disaster Management Committee, the distribution of preparedness facilities, their own roles in mitigating losses and the probable disasters they are

exposed to. This study recommends for immediate awareness campaign through all mass media channels, barazas, performing arts and scenario simulation.

Social capital has been established in the study as the one most important aspects of disaster mitigation immediately in the wake of a catastrophe. The Old Town has a high level of this given the old family relationships. This study recommends that this sense of community be fostered in the planning and design of all settlements in the Island.

Poverty as an indicator of vulnerability has been established in the study. This study recommends the improvement of the economic well being of the populations of the Municipality in general and the island in particular. The revitalization of the Old Port in Mombasa will likely improve the economic well being of the Old Town, the most vulnerable part of Mombasa, and should be pursued with this in mind. The redevelopment of Kaloleni, Majengo and King'orani should be mixed with economic activities accessible to the residents to improve their economic well-being.

### **(iii) Developmental and Land Use Factors**

**Residential:** The historically mixed development of activities in Mombasa island has been good for providing employment opportunities closest to areas of residence but has, over time, resulted into weak zoning of residential and other land uses, including incompatible proximity of risky industries to residential areas such as the case for Majengo/King'orani and Shimanzi areas. Consequently, this study makes the following recommendations with regard to such situations. Green belts should be introduced between industries and residential areas. This can be done by removing the first row of houses next to the industries and creating a green belt in its stead as in Majengo and King'orani. Further, industrial activity should not be allowed within the housing developments. Those already established to be either changed to less risky use or program for their eventual relocation.

As for the KPA houses in Shimanzi, this study sees no easy option available. It is the recommendation of this study that the oil storage tanks farm next to the KPA housing estate be relocated with immediate effect, as it is a real and present danger to the residents of the Housing Estate.

This study recommends a redevelopment policy for the Swahili neighbourhoods such as Majengo to more satisfactory, efficient, and economical form of development already taking place in these areas. This will provide greater economy in land use and higher standards of

accommodation but must also aim at recreating the intimate character of Mombasa and high standards of aesthetics.

**Industrial:** The island with its rising populations is currently exposed to all-manner of obnoxious, inflammable and explosive industrial activity. The situation is considered to be unsustainable in the medium and long-term future development of the island. Consequently, this study recommends a clear program to eventually rid the Island of all the heavy and risky industries. This study supports the KPA initiative of relocating the oil storage farms on its land in Shimanzi in the medium term.

This study further recommends the clear zoning of the new industrial areas on the west mainland and the proposed one on the Tsunza area of south mainland to avoid the risky mix as seen in the island. The remaining industries in the island should be devoted to light activities such as packaging and storage.

This study recommends the zoning off of areas close to the oil refinery in the west mainlands and other oil/fuel storage facilities to the safe distances as per the Petroleum Act and the Environmental Management and Coordination Act (EMCA).

This study makes further recommendation that within the island itself, careful consideration must be given to the siting of industries. Where redevelopment of those industries requiring minimum services takes place, consideration be given to their removal from the rail served maximum service areas to sites outside the island within or outside Mombasa. This would slowly but surely remove heavy industries from the Island and lessen the pressure there by creating other centres of employment.

**Transport:** The transport problem of the island are caused by the narrow roads, the through traffic that has all to pass through it to and from the mainlands even when the island is not its destination. To alleviate the situation this study makes the following recommendation with regard to transportation:

The Mombasa master plan of 1962 and the Mombasa structure plan of 1971 made detailed recommendations on the overall transport planning for the town, the majority of which are still relevant and should be consulted and modified accordingly. This study, however,

recommends the immediate development of the Port Reitz crossing from the south mainland to the west mainland popularly known as the Dongo Kundu by-pass to redirect traffic between west and south mainland that has no business in the island. In the medium term this should also happen between the west and north mainlands.

The introduction of alternative modes of transport have already been alluded above. This study makes the recommendation that 'matatus' should not be allowed into the island. The island should be served only by mass transit modes of transport. In this regard, three termini are recommended at the point of contact in all the mainlands at Likoni, Changamwe and Kisauni where all matatus will relieve their cargo so as to change mode to mass transit into the Island.

The study, further, recommends the opening up of all the undeveloped road reserves within the island to relieve internal circulation.

With regard to the ferries, it is recommended that the planning of the crossings should minimise contact between vehicles and pedestrians. This initiative is already taking place and should be continued and improved. Emergency facilities should be incorporated in the design of the crossings.

This study further recommends the development of alternative discharge points for the ferries on both the south and north mainlands in addition to the Island to coincide with those proposed for boat transportation at Shelly Beach, Mkomani and Fort Jesus.

The island of Mombasa is largely pedestrian to the residents. This study recommends the encouragement of Non-Motorised transport especially bicycles and pedestrian by providing for their comfortable inclusion into the island's road networks.

This study recommends that the Kilindini Port be decentralised strategically by the development of the already existing smaller ports of Shimoni and Lamu to take some of the load and to ensure continued level of service in the event of a catastrophic event that would compromise operations at Kilindini. This study makes the same recommendation for the same reasons for the Old Port in Old Town.

This study recommends the restriction of land use below the flight path of the Port Reitz Airport especially with regard to residential use. Further, the study recommends strict enforcement of adequate reserves for the railway line as it transports, at times, highly inflammable gases and fuels. In that regard this study recommends the substitution of this mode of transport with pipeline transport, together with its adequate reserves, for the risky inflammables.

**Education:** Schools in Mombasa account for a substantial level of traffic jams since most of them are not within residential areas owing to the little government land. Also the low number of schools in the mainlands means most children have to access schools in the island, also perceived as better served. This study recommends that any new schools be developed on the mainlands and incentives be given to private developers to do it and after their quality is equalised with those in the island, allocation of school spaces be done nearest to the residential areas where the children come from. Within the island accesses to the schools be moved away from the highways where most now face. An example is the Star of the Sea Schools. This study further recommends that schools be facilitated to provide their own transport for their students rather than the current dependence on public transport.

The siting of schools in Mombasa does not coincide with their catchment populations, making the journey to school a contributor of heavy traffic jams in the island. This study recommends the allocation of school places on neighbourhood bases so that children living in any particular neighbourhood generally be allocated places in schools within that neighbourhood.

**Recreational:** Centres of recreation in Mombasa are also centres of concentration of populations. These include the public beaches of Bamburi and Shelly Beach, and other entertainment areas. It is recommended that these areas be well served by alternative means of transport including wide roads, water transport and provisions for air evacuation.

**Main Emergency Facilities:** With regard to the main emergency facilities, Mombasa is poorly served. The following is the situation on the ground:

□ **Medical Facilities:** Medical facilities are the closest insurance immediately after disasters. Field data revealed that these are adequate in quantity in the Island of Mombasa. However, their distribution is not equitable especially with regard to the mainlands. This puts



a great strain on the island facilities, as they have to serve the mainland population as well. The centralization of health services in large general hospitals serves economies of scale in provision and management. They are built to a size commensurate with the area served and the numbers of dependent population. Conversely, the larger the area, the larger the number of people who have greater distances to travel for access to the services they need. On the other hand, decentralized health services, allocated according to distribution of population, would each serve a smaller number of people. Accessibility to services would be more to more people and therefore would be more equitable. This study recommends the upgrading of the health facilities on the mainlands to provide for a fully-fledged hospital on each of the mainlands at Likoni, Changanwe and Kisauni in addition to equipping all the clinics and health centres so as to relieve Coast Provincial General Hospital of unnecessary patient traffic and make it more disaster prepared.. The need to provide for alternative means of transport to the main hospitals has been discussed above.

This study also recommends that while the Coast Provincial General Hospital is relatively well prepared for disasters, it is at the waterfront and events such as the Tsunami can adversely affect it and its services. The two hospitals close to it and close to its level of service; Msambweni and Kilifi are also at the waterfront and would probably be affected too. Consequently, this study recommends the completion of the relatively inland Military Hospital at Mariakani Barracks to act as back up in such a case. This uncompleted hospital has the advantage of being on the Mombasa-Nairobi highway in addition to having adequate land for the development of air evacuation.

□ **Police:** Mombasa has only one police division, while Nairobi has eight, taking into account differences in their populations, size and crime rate, this study supports the sentiments of the OCPD Urban and recommends that given the exclusive geography of Mombasa, with regard to its constituent parts, the district be divided into four Police Divisions so that each of the geographical areas of Likoni, Changanwe, Kisauni and Island be its own Police Division to facilitate command and response time.

□ **Fire Fighting Capabilities:** With only one functioning fire station, the town is quite inadequately prepared for such emergencies. This study agrees with the Chief Fire Officer on the ground and recommends that there be established two extra fire stations in the island; one at Shimanzi to serve the industrial district and another at Tudor to serve the western part of

the island. Further, this study recommends for the completion of the fire station at Shika-Adabu in Likoni and development of another close to the Ferry area in Likoni. With regard to the west Mainlands where one such facility exists, the study recommends the equipping of this fire station to make it functional in addition to the development of another one on the western part of the mainland at Miritini to cater for the industrial area. The north Mainland also needs two stations, one at Shanzu and the other in the Kisauni area.

#### **(iv) Data Management**

This study makes the recommendation that, like the MANDISA project, of Cape Town, South Africa (Chapter Two), there is needed for the Island City of Mombasa to be developed and implemented an innovative geo-spatial computer-based Geographical Information System (GIS), for tracking all hazard incidents and their impacts in Mombasa. The system should be designed to provide crucial information for better planning of risk and disaster management system.

This study proposes a viewpoint, with regard to disasters, that looks at the importance of macro processes as well as micro strategies. It recognizes that the smaller, more frequent hazards have, cumulatively, more impact than the infrequent big events and must be equally captured and their effects documented and analyzed.

This study recommends that the Municipal Council of Mombasa take up its role of dissemination of information, training and warning for community preparedness. The education of the public should be carried out both formally and informally.

#### **6.4 Areas for Further Research**

This study has identified the following areas for further research; firstly, the Cost Benefit Analysis of disaster preparedness planning as a tool for facilitating trade-offs in decision making on alternative plans; secondly, the psychological responses during and in the immediate aftermath of a catastrophe which seem to disorient human actions and in the process tend to exacerbate disasters through a series of erratic behaviour; thirdly, a comparative analysis of the cumulative economic losses of 'normal' small and localised hazards to local economies in comparison to the large but infrequent media catching disasters.

## 6.5 End Note

Public safety is a function of many factors over and above physical planning. Furthermore, achieving complete safety is neither physically feasible nor economically desirable. All that notwithstanding, this study is of the view that the core to physical planning and development policy has always been, and must continue to be, directed towards narrowing the gap between the ideal and the possible.

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## **APPENDICES**

### **APPENDIX I ORGANIZATIONS CONSULTED**

Aga Khan Academy, Mombasa

Allidina Visram High School, Mombasa

Coast Development Authority (CDA), Mombasa

Coast Provincial General Hospital, Mombasa

Department of Physical Planning, Ministry of Lands and Housing. Nairobi

District Headquarters, Mombasa

District Education Office, Mombasa

District Information and Documentation Centre (DIDC), Mombasa

Divisional Headquarters, Island Division, Mombasa

District Physical Planning Office, Mombasa

Divisional Police Headquarters, Mombasa

Electoral Commission of Kenya (ECK). Nairobi

Fire Brigade, Municipal Council of Mombasa (MCM)

Hotel Saffire, Mombasa

Kenya Army (15 Kenya Rifles), Nyali-Mombasa

Kenya Air Force (Forward Observation Base-FOB), Port Reitz-Mombasa

Kenya Navy (Mtongwe Base), Mombasa

Kenya Ferry Services, Mombasa

Kenya Petroleum Refineries Limited (KPRL), Mombasa

Kenya Ports Authority, Mombasa

Locational Headquarters, Majengo Location, Mombasa

Mama Ngina High School, Mombasa

Mobil Oil Depot, Shimanzi-Mombasa

Mombasa Technical Training Institute, Mombasa

Municipal Clerk Office MCM

Municipal Engineer Office, MCM

Municipal Planning Office MCM

Mvita Clinic, Mombasa

National Museums of Kenya, Conservation Office, Mombasa

National Disaster Operation Centre, Office of the President. Nairobi

Regional Centre for Mapping of Resources for Development (RCMRD). Kasarani

Royal Court Hotel, Mombasa

Survey of Kenya, Ministry of Lands and Housing. Ruaraka.

Star of the Sea Schools, Mombasa

St John's Ambulance. Nairobi

**APPENDIX II****METHODOLOGY**

<b>METHODOLOGY</b>
<p style="text-align: center;"><b>INTRODUCTION</b>          Problem identification          Brief formulation          Data sources identification</p>
<p style="text-align: center;"><b>SECONDARY DATA COLLECTION</b>          Literature review          Background information          Secondary data          Base maps</p>
<p style="text-align: center;"><b>ANALYSIS OF SECONDARY DATA</b>          Natural conditions          Socio-Economic Factors          Developments</p>
<p style="text-align: center;"><b>FORMULATION OF OBJECTIVES</b></p> <p>GOAL: To integrate disaster preparedness in the physical development of the Island City of Mombasa</p> <p>Objective 1: To assess the extent to which disaster preparedness has been integrated or not in</p> <p>i) How the population and physical developments relate to vulnerability to probable disasters within the Island City of Mombasa.</p> <p>ii) The provision of disaster preparedness facilities, services and infrastructure in Island City of Mombasa.</p> <p>iii) The level of public awareness, perception and preparedness to disasters in Island City of Mombasa</p> <p>iv) The planning, policy, legal and institutional framework for disaster preparedness within Island City of Mombasa.</p> <p>Objective 2: To bring to the attention of Mombasa Residents and Stakeholders in development processes the lessons learnt in order to provide a base for integrated physical development that mitigates the effects of disasters</p> <p>Objective 3: To propose development approaches that can be used to further integrated development for disaster preparedness</p>
<p style="text-align: center;"><b>RESEARCH DESIGN</b></p> <ul style="list-style-type: none"> <li>•Sampling of Detailed Fieldwork Areas</li> <li>•Household questionnaires</li> <li>•Focus group discussions</li> <li>•Participant observation</li> <li>•Key informants interviews</li> </ul>
<p style="text-align: center;"><b>FIELD WORK</b></p> <p style="text-align: center;"><b>Day1 (01.07.05):</b>          Mombasa District Reconnaissance          District Commissioner Visit          Appointment setting with District Officers          District Education Officer</p> <p style="text-align: center;"><b>Day 2 (02.07.05):</b>          Mombasa Island Reconnaissance          Photo Session Old Town          General Public Questionnaires</p> <p style="text-align: center;"><b>Day 3 (03.07.05):</b>          Photo Session Shimanzi/ Tudor Area          Household Questionnaires (Shimanzi-KPA, KR/Tudor-Muoroto)</p> <p style="text-align: center;"><b>Day 4 (04.07.05):</b>          Municipal Planner          District Physical Planning Officer          Old Town Conservation Officer (NMK)</p> <p style="text-align: center;"><b>Day 5 (05.07.05):</b>          District Officer, Island Division          Kenya Ports Authority (PRO)          Old Town Questionnaires</p> <p style="text-align: center;"><b>Day 6 (06.07.05):</b>          Allidina Visram High School          Mombasa Technical Training Institute          Star of the Sea          Mvita Clinic</p> <p style="text-align: center;"><b>Day 7 (07.07.05):</b></p>

Coast Provincial General Hospital Chief Administrator  
 District Disaster Management Committee Secretary  
 Kenya Navy Base Mtongwe Commanding Officer  
 Focus Group Discussion with All Island Chiefs, with all Mitaa Representatives  
 King'orani Questionnaires  
**Day 8 (08.07.05):**  
 Chief Municipal Fire Officer  
 15 Kenya Rifles Nyali Commanding Officer  
 General Public Questionnaires  
**Day 9 (09.07.05):**  
 Kaloleni Questionnaires  
 Mobil Oil Storage Tank Farm Shimanzi (Plant Engineer)  
 Kenya Ports Authority (Marine Engineer)  
 Photo Session (West Mainland)  
**Day 10 (10.07.05) :**  
 Review of Collected Information  
 Mombasa Diani Road - Visit  
**Day 11 (11.07.05):**  
 Photo Session (South Mainland)  
 Kenya Oil Refinery (Production Engineer)  
**Day 12 (12.07.05):**  
 Mombasa Hospital  
 Kenya Air Force Forward Observation Base, Port Reitz (Officer Commanding)  
**Day 13 (13.07.05):**  
 Kenya Oil Refineries (Safety Officer)  
 Coast development Authority  
 District Information Documentation Centre  
**Day 14 (14.07.05):**  
 Kenya Ferry Services  
 Royal Court Hotel  
**Day 15 (15.07.05):**  
 Officer Commanding Police Division (Urban)  
 Mombasa Malindi Road – Visit  
 Photo Session (North Mainland)  
 Hotel Saffire

**ANALYSIS/SYNTHESIS OF FIELD INFORMATION**

Logical programs  
 Household questionnaire analysis  
 field data analysis

**FORMULATION OF POLICY OBJECTIVES**

- ✓To Decrease the Level of Vulnerability
- ✓To Mitigate the Consequences of Disastrous Events
- ✓To Localize and Limit the Scope of Disasters
- ✓To Facilitate Rescue/Evacuation Operations

**RECOMMENDATIONS/CONCLUSION**

Integrated Plan

**PLAN PRESENTATION TO STAKEHOLDERS**

Departmental Presentation  
 Mombasa District Presentation

**FEED BACK**

**FINAL PLAN**

## APPENDIX III: ANALYTICAL FRAMEWORK

Research objectives	Data type	Source	Method of collection	Methods of Analysis	Expected Results
1. To examine how the population and other physical developments relate to vulnerability to probable disasters within Mombasa Island City.	Total resident population.	ECK CBS	Census Data	EXCEL will be used to make cross tabulations, graphs and charts.	Distribution of population densities.
	Average Day Population.			GIS will be used to locate and show distribution of population and development.	Distribution of development densities.
	Population at sub location.				Challenges and options.
	Resident population density.				
	Day population density.	DPP SURVEY	Maps Plans Aerial photos	GIS will be used to locate, show distribution and recommended buffers.	Compatibility of land uses.
	Sub location population density.	DPP Planning Handbook	Digitized Spatial Data		Challenges
	Distribution of population.	Maps Statutes	Interview		Available options.
	Density of development.	Literature	Literature Review		
	Distribution of development.	Residents	Questionnaires		
	Open areas.				
	Location of industries.				
	Types of industries.				
	Distance to populations.				
Accessibility from fire stations.					
Internal preparedness.					
Compatibility of land uses.					
2. To investigate the adequacy of facilities, services, infrastructure and policy for disaster preparedness of Mombasa Island City.	Location of fire facilities.	Existing Plans	Literature Reviews	GIS will be used to locate, show distribution and Coverage.	Capacity in number and coverage of preparedness facilities within Mombasa Island City and possible challenges and options
	Distribution of fire facilities.	Fire Dept	Interviews	GIS will be used to locate and show distribution	Adequacy of accesses for emergencies and evacuations.
	Coverage of fire facilities.	Public Health Dept.	Literature Reviews		Challenges and Possible options
	Location of medical facilities	Police Dept	Interviews		
	Distribution of medical facilities	Planning Dept			
	Coverage of medical facilities	Businesses			
	Location of police facilities.	Residents			
	Distribution of police facilities.	Existing Plans Transport Min. Municipal Kenya Ferry Defence Dept			
Coverage of police					

	<p>facilities.</p> <p>Location of public facilities.</p> <p>Location of land accesses.</p> <p>Location of air accesses.</p> <p>Location of water accesses.</p>				
<p>3. To assess public perception, awareness and understanding of disaster preparedness within Mombasa Island City.</p>	<p>Types of known threats</p> <p>Ranking of threats</p> <p>Awareness of Preparedness</p>	<p>Residents</p> <p>Tourist facilities</p> <p>Industries</p> <p>Businesses</p> <p>Administrators</p>	<p>Questionnaires</p> <p>Interviews</p> <p>Literature Review</p>	<p>Coding and analysis</p> <p>Information Analysis</p>	<p>Disaster Perception</p> <p>Ranking of Risks</p> <p>Preparedness awareness</p>
<p>4. To propose appropriate policy for integration of disaster preparedness in Mombasa.</p>	<p>Policy on disaster preparedness</p> <p>Legislation on disaster preparedness.</p> <p>Institutions in disaster preparedness.</p> <p>Framework of disaster preparedness</p>	<p>Disaster Dept</p> <p>Municipal</p> <p>ICRC</p> <p>UNOCHA</p>	<p>Literature Reviews</p> <p>Interviews</p>	<p>Synthesis of the information.</p>	<p>Policy and institutional framework.</p> <p>Recommendations.</p>



**UNIVERSITY OF NAIROBI**  
 DEPARTMENT OF URBAN AND REGIONAL PLANNING  
**M. A. THESIS**

**Urban Planning and Public Safety**  
 (Integrating Disaster Preparedness for Sustainable Physical Development of Mombasa Island City)

**QUESTIONNAIRE FOR HEAD OF HOUSEHOLD**

*Confidential: The information provided under the survey shall be used for this study (research) only and not for any other purpose.*

Questionnaire No..... Date.....

**A. HOUSEHOLD INFORMATION**

No.	Age	Sex	Relation with head of household	Education	Occupation	Income	Are You
1							rich
2							
3							Middle
4							
5							Poor
6							

**B. BACKGROUND INFORMATION OF HOUSEHOLD**

2. Resident since (year).....
3. Name of neighbourhood.....
4. Age of the house .....
5. Storey the household is..... out of (total number of storeys).....
6. Size of the household (bed rooms)
7. Materials house is constructed of (roof)..... (walls)..... floor.....

**C. HISTORY OF HAZARDS**

8. Has a hazard ever happened in or around your residence? (Yes/ No).....
9. Which year was it?.....
10. What type of hazard.....
11. If yes, were there losses in the form of
  - Damage to property (approx cost).....
  - Deaths (no.).....
  - Specify.....

12. How was the response from the Council Emergency Department?

- Good
- Not good
- None

**D. INTERNAL DISASTER PREPAREDNESS OF HOUSEHOLD**

13. Is the open space around the residence adequate for emergency evacuation?.....

14. What preparedness measures are available within the residence?

- Water reserve
- Electricity standby generator
- Fire fighting equipment
- Alternative exits (other than front door)
- Other (specify).....

15. Can you say the household is easily accessible from the surrounding roads at all times?

**E. EXTERNAL DISASTER PREPAREDNESS OF HOUSEHOLD**

16. Are you aware of any preparedness facilities around the residence?.....name them.....

17. Which would be the first place you would turn to in the event of a hazard happening in or around your residence?.....

18. In your opinion, are the following preparedness measures by the Council adequate?

- Water mains
- Electricity (KPLC)
- Fire fighting equipment
- Accesses
- Other (specify)

19. How do you rate the Council's general preparedness for emergency evacuation?.....

20. From where else (apart from the Council) do you expect assistance in the event of a disaster?.....

21. What is the name and distance of the closest?:

- Fire station.....
- Hospital.....
- Police station.....
- Road.....

**F. CHALLENGES AND RECOMMENDATIONS**

22. What safety problems do you encounter in this location?.....

23. Do you feel less safe in relation to disasters in the Island than outside it?.....

23. What problems do you have about the neighbourhood of your household?

- Environmental pollution
- Noise pollution

- Insecurity
- Traffic
- Others (specify).....

24. What do you consider as the main threats to the safety of the household?

- Fires
- Tidal waves (Tsunami)
- Terrorists
- Floods
- Other (specify).....

25. What was your reaction/feeling during the recent tsunami? .....are you prepared for another stronger one?

26. Whose responsibility is it to ensure the safety of your household?

27. What do you think should be done to improve the general safety of the neighbourhood?.....

28. Generally, what do you think needs to be done to improve the general safety of the Island?.....

**Thank You**

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**FIRE FIGHTING AUTHORITY OFFICIAL INTERVIEW SCHEDULE**

*Confidential: The information provided under the survey shall be used for this study (research) only and not for any other purpose.*

Questionnaire No..... Date.....

**A. Personal Information of Respondent**

1. Name (optional).....
2. Appointment.....

**B. Background Information of Organisation**

3. Name of organisation.....
4. Official mandate of organisation

.....

.....  
.....  
5. How many fire stations are there in Mombasa and where are they located?

Island..... South

Mainland.....

West Mainland..... North

Mainland.....

6. What can you say about their adequacy in

Number..... Coverage..... Capacity.....

.....  
7. Are there plans to build new fire stations. ....If yes where

.....  
**8. Number of staff (approximately) in the department deployable during an emergency**

.....  
.....  
9. Would you say the organisation is adequately established/staffed for disaster action within its area of operations in Mombasa?

### **C. History of Disaster Action**

10. What are the existing arrangements for the department to confront disaster (fire) situations within the Mombasa Municipal Council?

.....  
.....  
11. Has the organisation responded to a disaster in or around Mombasa Island in the recent past?

12. When exactly was it?.....

13. What type of disaster(s).....

.....  
14. If yes, were there losses in the form of

- Damage to building.....
- Deaths.....
- Specify.....

15. Which other organisations do you work with in the event you cannot cope with an incident?

.....  
16. How can you describe your relationship with them?

- Good
- Not good
- None

Explain.....

### **D. Disaster Preparedness of Mombasa Island City**

17. Can you say the spatial organisation of the Island is facilitative of emergency responses when you are called upon to assist?

.....  
.....  
18. What disaster preparedness measures are available within your Organisation?

- Water reserve
- Electricity standby generators
- Fire fighting equipment
- Alternative methods..... roads..... water..... air..... evacuation
- Medical Supplies and Personnel
- Other (specify).....

19. Can you say all parts of the island are easily accessible at all times?  
.....  
.....

20. How do you rate the Department's general preparedness for emergency evacuation?.....

21. How can you rate the adequacy of the following facilities with regard to disaster operations in the Island?

- Fire stations.....
- Hospitals.....
- Police stations.....
- Roads.....
- Electricity.....
- Communication.....

**F. Challenges and Recommendations**

22. What safety challenges do you encounter in the Island?.....

23. What do you consider as the main threats to the safety of the Island?

- Fires
- Tidal waves (Tsunami)
- Terrorists
- Floods
- Industries
- Other (specify).....

24. Given a chance, what would you consider to be the ideal measures needed in place for the safety of the Island City which would facilitate your operations and the general safety of the Island populations especially as regard disaster preparedness?  
.....  
.....

**Thank You**

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