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The Challenge of Cleaning and Maintaining Mathare River in the face of growth of the Mathare Slum Settlements in Nairobi

By

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Declaration of Own Work

I declare that this project report is entirely my own work and has not been submitted for examination in any other university and where any material could be construed as the work of others, it is fully cited and referenced, and/or with appropriate acknowledgement given.

Name of student: Osore Brian Omondi Signature……..

Having reviewed this project report, I hereby do declare that this report is entirely the researcher's work and has not been presented for examination in any other university.

Name of supervisor: Professor Simon Onywere Signature……

Abstract

Due to the increasing forms of environmental degradation, many countries have realized the importance of safeguarding their natural resource bases and have made such management actions like river rehabilitation their priority. This project report explores and analyses the challenge of cleaning and maintaining Mathare River in the face of the Mathare slum settlements in Nairobi. It was carried out between September 2013 and April 2014. Mathare River is one of the three rivers within the Nairobi River Basin with the other two being Motoine/Ngong River and Nairobi River. The research was based on three specific objectives, which are; finding out the approaches applied in cleaning and maintaining the river; finding out why the slums are a challenge to the rehabilitation process and to find out whether it is practically possible to restore and maintain a 30m meter riparian zone in the presence of the Mathare slum. Household questionnaires, focus group discussions, direct observation and field photography were the primary sources of data while the secondary sources of data included institutional interviews, published reports, magazines, journals and websites. The findings showed that the NRBP was a multi-stakeholder initiative. The Mathare slum settlements pose a challenge to the cleaning and maintenance of the river in a number of ways including by encroaching into the riparian zone, improper waste disposal (evidenced by the 77% and 81% of the respondents who dispose solid waste and liquid/fecal waste directly into the river respectively) and unsustainable uses of the river. Another major finding was that residents who have stayed in the area for over 20 years have developed a sense of attachment to the land. This therefore would make it a daunting task to evict these residents for the clean-up project to be successful and sustainable. Finally, the report does recommend some feasible alternatives to some of the approaches highlighted by the NRBP.

These include among others the implementation of Integrated Village-Level Planning to facilitate the provision of essential infrastructure within the Mathare slums.

Dedication

I dedicate this work to Mama Mary Karanja and her extended family for inspiring me to do a project on one of many problems facing the Mathare Valley Community. I also dedicate this work to my parents, Mr. and Mrs. Osore and the rest of my family for their unrelenting support.

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I also like to show my appreciation to my parents Mr. and Mrs. Osore for not only sponsoring the project but also for their continued support and encouragements throughout the research period. Finally, last but certainly not least, thanks to my supervisor, Professor Simon Onywere, Kenyatta University, who provided much guidance, support and encouragement, and made valuable comments on earlier drafts.

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List of Acronyms

EMCA	Environmental Management and Coordination Act
IWRM	Integrated Water Resource Management
NCC	Nairobi County Council
NRBP	Nairobi River Basin Program
MEWNR	Ministry of Environment Water and Natural Resources
MSW	Municipal Solid Waste
UN	United Nations
UNEP	United Nations Environment Program
URRC	**URBAN RIVER REHABILITATION CENTERS**

1 Introduction

1.1 Background of the Problem

Many countries have made river restoration their priority because of the increasing awareness of environmental degradation. Over the past 20 years, since the restoration of rivers began, many approaches have been considered, and they have ranged from the idealist objective to re-establish the pre-disturbance aquatic functions and related physical, chemical and biological characteristics, removing all human impacts to a more realistic approach that considers restoration to be the human-assisted improvement of river integrity (Gonza´lez, Garcı´a, & Roma´n, 2012). This is through the recovery of natural hydrologic, geomorphic and ecological processes, assuming the many financial, political, social, natural and scientific constraints that are unavoidable in human-dominated systems (Gonza´lez *et al*., 2012)

According to (Kithiia, 2012) degradation trends in water quality within river systems worldwide are mainly due to changes and intensity in land use activities. These activities range from industrial, agricultural, transportation as well as residential uses. Informal settlements as a form of residential areas, chiefly contributes to the degradation of river waters in many cities of the world (Kithiia, 2012). This has therefore prompted governments of affected countries to take action with regards to the restoration and rehabilitation of riparian ecosystems in order to manage them. This problem stems from inadequate land use planning within river resources for better quantity and quality of water.

Spain underwent extensive economic development during the last 25 years with an associated significant environmental impoverishment (Gonza´lez *et al*., 2012). This lead to major landscape

transformations such as the construction of many large dams implying significant river degradation caused by intensive flow regulation, river channelization and water pollution. The Spanish government through (Gonza´lez *et al*., 2012) the Ministry of Environment, prepared River Basins Management Plans (RBMPs) like the National Strategy for River Restoration in 2006. Several years later after the organization of this strategy, many actions and restoration projects were implemented with varying ecological relevance and degrees of success. During 2008–2010 the European research project FORECASTER (Facilitating the application of Output from Research and Case Studies on Eco-logical Responses to hydro-morphological degradation and rehabilitation) sixty restoration case-studies undergone in Spanish rivers were analyzed. The results showed a clear tendency of enhancing river structure (e.g., riparian vegetation or fish-passes) without considering other options addressed to ameliorating river processes (e.g., environmental flow regimes, enlarging dimensions of the active floodplain, improving land-use planning for better quantity and quality of water).

Nairobi River Basin is a complex of several parallel streams that flow in an eastward direction and meet Athi River eventually flowing to the Indian Ocean 600 km away (Makathimo & Guthiga, 2010). The main rivers of the Nairobi river system are namely; Motoine/ Ngong River, Nairobi River and the Mathare River. The perceived open access of these riparian zones (Charles, 2006) triggers dense settlement devoid of supporting infrastructure whose ultimate effect on the receiving environment is degrading. The riparian reserves of these rivers are currently vulnerable to degradation as a result of human induced activities mainly driven by the settlement of human populations in these zones (UNEP, 1999).

A number of legislations in Kenya provide for the protection of riparian zones and riparian ecosystems. For instance, EMCA (1999) provides for the protection of rivers as crucial

ecosystems by stipulating that a uniform width of 30 meters should be left from the bank of the rivers as a riparian reserve to enhance conservation of the river ecosystem. The Nairobi County Council (NCC) by-laws as well, withhold the principle of riparian ecosystem conservation by proposing that 30 meters width be left from the river banks of the rivers. Equally, the Physical Planning Act cap 286 and the Agricultural Act also provide for a 30 meter conservation width from the highest water mark of a river.

In 1999, the government of Kenya and other stakeholders launched the Nairobi River Basin Program to "restore, rehabilitate and manage the Nairobi River basin's ecosystem". The Ministry of Environment and Mineral Resources, the Ministry of Nairobi Metropolitan Development-which is none existent today-, the National Environmental Management Agency, the Ministry of Local Government, the Nairobi City Council, UN agencies and the private sector are among the organizations involved (Amnesty International, 2009).

In November 2008 the government announced that the latest phase of the program would involve a two-year river clean-up process. To achieve this, thousands of homes and businesses were to be demolished in a number of informal settlements within a 30 meters riparian reserve which included the informal settlements of Mathare Valley that is, Kosovo, Mathare No. 10, Mathare 3A, 3B and 3C, Village 2 and Kiamutisya. A number of schools, health centers and markets used by residents would also be demolished (Amnesty International, 2009).

However, according to the United Nations Environment Program (UNEP), the affected members have not been adequately consulted by the government or other stakeholders and fears of eviction from this land only leaves them wondering where they would seek alternative accommodation and livelihoods. This only serves to trigger resistance to the eviction by the slum

dwellers and the rejection of the entire cleanup program. Given this fact, and the fact that slums contribute significantly to the degradation of the river ecosystem, a major challenge to the clean-up of the Mathare River therefore presents itself (Musembi, 2009).

1.2 Statement of the Problem

The Nairobi River-basin has over the years been heavily polluted leading to the degradation of the riparian ecosystem. Among the key agents responsible for the degradation is the presence of slums along the riparian zone. Mathare River is one of the most affected by the expanding slum settlements along the river to the extent of rendering it a dead ecosystem.

The government's efforts to clean up the river such as eviction of the slum dwellers, has yielded no tangible fruits yet. This is manifested by the current state of Mathare river waters which is choking with solid and liquid waste. This waste is coming from the slums which do not have solid waste management and sanitation services. The government's approach in rehabilitating this river has not worked because of lack of participation and active consultation of the affected communities in decision making process and the in-exploration of other feasible alternatives to eviction such as the provision of essential services in the slums particularly water, proper sanitation and solid waste management services. The government must urgently address these issues if the river clean-up program is to be sustainable and compliant with international standards.

1.3 Research Questions

1. What approaches have been employed by the government in cleaning the Mathare River?
2. Why do slums pose a challenge in the clean-up program of Mathare River?
3. Is it possible to restore and maintain a 30m riparian zone in the presence of the Mathare slum?

1.4 Research Objectives

1. To find out the approaches applied by the government in cleaning Mathare River.
2. To find out why the slums are a challenge in cleaning and maintaining Mathare River.
3. To find out whether it is practically possible to restore and maintain a 30m riparian zone in the presence of the slums.

1.5 Research Premises

1. The approaches applied by the government in cleaning and maintaining Mathare River are ineffective.
2. Conditions in the slum settlements pose a significant threat to the success of the Mathare River Clean-up project.
3. It is not practically possible to restore and maintain a 30m riparian zone given the presence of the Mathare slum settlements.

1.6 Justification for the Project

This project will document the inadequacies of the approaches employed by the government in cleaning of the Mathare River in the face of the adjacent informal settlements in particular Kosovo, Mathare No. 10, Mathare 3A, 3B and 3C, and Village 2. It will also show the importance of the exploration of feasible alternatives in cleaning and maintaining the river as well as the importance of employing a bottom up approach in managing the river ecosystem.

1.7 Significance of the Study

The government in cleaning up Mathare River through efforts such as the eviction of the slum dwellers has not yet yielded tangible results. This is because of the alienation of the affected people living and earning their livelihoods within the slum from the decision making process and the in-exploration of other feasible alternatives.

This work therefore aims to promote the exploration of the provision of essential services within the slums in particular proper sanitation, liquid and solid waste management services as well as clean tapped water. This is a feasible alternative that will contribute greatly in cleaning and maintaining the Mathare River and in extension the entire Nairobi River basin facing the same problem. This will enable the government to provide a clean and safe environment for all its citizens, a right protected by the Constitution of Kenya 2010.

1.8 Scope and Limitation of the Study

The study focuses on the challenge posed by the growth and development of slum settlements along the riparian zone of Mathare River-particularly six settlements namely; Kosovo, Village 2,

3A, 3B, 3C and Mathare No. 10- to the restoration and rehabilitation program of the river. In addition, it explores the current approaches being applied by the government in the program, as well as why the slums pose a challenge in the clean-up program and whether it is practically possible to reclaim and maintain a 30m riparian zone.

All these activities were aimed at establishing a suitable approach to the Mathare River clean-up program in order to ensure the process is sustainable. This will be through the adoption of feasible alternatives that are environment friendly and have the slum dwellers' best interests in mind.

However the cleaning and maintenance program on Mathare River is not only challenged by the presence of slums along the riparian zone. A host of other land-use activities also contribute to this challenge particularly industrial and agricultural land-use within the riparian zone upstream. Even though this work does not focus on these two activities, their significance cannot be ignored.

Various challenges were also experienced in the entire duration of the project. Among them was the issue of insecurity within and unfamiliarity with the study area. This did not provide a conducive environment for data collection as the researcher had to limit the use of photography to collect vital primary data especially in Mathare No. 10. This problem together with unfamiliarity with the study area was overcome by enlisting the help of two friends who hail from this area. Another challenge was language barrier as some respondents could not read or communicate properly in either English or Swahili but once again the two assistants came in handy.

Ad hearing to the project time table was also not possible as interview schedules had to be reorganized to fit the appointments I could secure at various institutions visited.

1.9 Definition of Terms

Environment- This refers to the totality of conditions and influences that affect the way things live and develop. It includes both the biotic, a biotic factors and built or man-made factors.

Development within the riparian zone- Used to refer to a piece of land (riparian zone) with new buildings on it as well as the process of using an area of land especially to make profit by building on it.

River Basin- Refers to a portion of land drained by a river and its tributaries. It encompasses the entire land surface dissected and drained by streams that flow downhill into one another, and eventually into one river. The final destination is an estuary or an ocean.

Riparian Zone- Refers to the interface between land and a flowing surface water body (river).

Ecosystem- This refers to all the flora and fauna together with the non-living organisms (a biotic factor) in a particular area considered, that is, the Mathare River ecosystem in relation to their physical environment.

Pollution-Refers to the introduction of contaminants into the natural environment resulting to adverse effects.

Riparian Degradation- This denotes the interference with the normal functioning of a riparian zone through activities that destroy the riparian life.

Rehabilitation-This is a process which can be defined as the partial functional and/or structural return to a former or pre-degradation condition of rivers or putting them back to good working order.

Restoration of the Mathare River Ecosystem- Refers to the work of recreating the pristine physical, chemical and biological state of rivers. In its purest sense it means a full structural and functional return to a pre-disturbance state.

Informal Settlements/ Slums- The term informal settlement is often used in preference to that of slum, but in this report the terms are synonymous. Using the UNHABITAT definition, a slum is a contiguous settlement where inhabitants have inadequate housing and basic services, is often not recognized nor addressed by public authorities as an integral or equal part of the city, and where residents living under the same roof lack one or more of the following: access to safe water; access to sanitation; secure tenure; durability of housing and sufficient living area.

Encroachment- Refers to the illegal intrusion into a highway or a navigable river, with or without obstruction.

Encroachment of Riparian Zones- In this context, the phrase means the entrance within the domain of this interface of land by human activities such as construction, illegally mostly by the urban poor.

2 Literature Review

2.1 Introduction

After a very long period of adopting streams and rivers as well as their catchments to agricultural, domestic, drinking water and industrial needs amongst others, people became aware of the damage being caused by these alterations (Verdnoschot, Lapinska, & Zalewski, 2008).

A multitude of overlapping river water uses in urban areas interferes with river ecology and can lead to negative conditions for urban development. In addition uses have competing needs and spatial requirements. In the view of (Schanze,, Olfert, Tourbier, Ines, & Schwager, 2004) such conflicts for instance do exist between drinking water supply and wastewater discharge, flood protection and ecological functions, historic preservation and waterfront development as well as between recreation areas and river navigation locks. (Schanze, et al., 2004) further expound that societal demands can thus form effective obstacles for river rehabilitation enhancement activities demanding a high level of effort from all planning participants.

According to (Kithiia, 2012) and (Verdnoschot et al., 2008) recently, physical stream restoration has become a priority for local, regional, national and international authorities.

In the Netherlands, only about 4% of the streams still have a natural morphology and a (more or less) natural hydrology. In Denmark, only 2% is more or less natural and in Germany the respective value is between 2 and 5% (Verdnoschot et al., 2008). Environmental awareness, concern for the loss of stream and floodplain habitats and biodiversity provided the (political) route for stream rehabilitation and restoration (Verdnoschot et al., 2008). This chapter therefore

explores the following themes in line with the challenge of cleaning and maintaining river basins in the face of growth and development of informal settlements.

2.2 Approaches Applied by Governments in Cleaning and Maintenance of Rivers.

(Verdnoschot et al., 2008) argue that from a scientific point of view, there are many possibilities for physical stream restoration, for example restoration of flood plain, restoration of meanders, removal of dams and bank fixation. New innovative approaches include the adding of coarse woody debris, the removal of sediment deposits in flood plains and various other methods to combat deep cutting of streams.

Stream ecosystems are considered to be complex because their functioning is not limited to the stream itself and the banks but it stretches out all over the catchment. Stream restoration in Europe is rising very fast (Verdnoschot et al., 2008). For example in the Netherlands in 1991, 70 projects were performed, in 1993 this had risen to 170, and by 1998 it was up to 206 (Verdonschot & Nijboer, 2002).

A long history of extensive human interventions in rivers has shaped urban riverscapes. Today they are characterized by anthropogenic impairments and spatial constraints in an artificial environment (Schanze, Olfert, Tourbier, Ines & Schwager, 2004).River restoration and waterfront development are in the mode, ranging from Europe over the American continent to Australia (Schanze, Olfert, Tourbier, Ines & Schwager, 2004).Goals for stream enhancement projects vary both spatially and temporally(Booth, 2005). Against the background of the European Water Framework Directive (WFD), within enhancement, ecological conditions are

considered of special weight. River restoration centers have been formed to offer assistance and guidelines (Adams, Perrow, & Carpenter, 2004).

In France for example, the problem of mixed sewer overflows in the municipality of Grézieu laVarenne into the river La Chaudanne (tributary of the Yzeron River) was solved by a partnership developed for inter-municipal basin management. The surface and waste water systems were separated, and storm water retaining, treatment and infiltration structures installed.

The SAGYRC (Syndicat d'Aménagement et de Gestion de l'Yzeron –Cooperation board for the Management of the Yzeron river basin) presents an interesting organizational model for planning and implementing effective management and rehabilitation of water courses. This scheme already has proved its functionality in terms of reducing sewer overflow, though little definite can be stated about the ecological effects (Schanze, et al., 2004). This rehabilitation project was comprehensive in its approach in that it covered ecological and social, as well as security aspects, utilization of a reference and testing section.

In Germany, in the course of the reuse of a degraded Elbe harbor facility in Hamburg, as a new neighborhood park, parts of the harbor basin were in filled. The head of the former shipping dock was turned into a sloping, green riparian zone. The success of this measure was put into question when residents started a public "Bathing in the dock" campaign that conflicts with the original goal of recreating a natural habitat. This project was carried out by the City board for Environment and Health, Hamburg (Schanze, et al., 2004).

In Addis Ababa Ethiopia, the Addis Ababa Environment Protection Bureau, Urban Planning Office, and local partners initiated a project proposal on Sustainable use of River and Riverbanks in 2008 for four years. According to (Tigabu & Girma, 2008) the objective of the project was to

improve the environmental conditions and encourage sustainable usage of Addis Ababa's river and riverbank area. The activities (Tigabu & Girma, 2008) included to; develop a comprehensive river environment plan, in coordination with residents, local businesses, that adequately deals with existing usage; awareness creation, capacity building, sensitization of all actors, regulations development and Build soil and water conservation structures and greenery and plantation.

Kenya implemented its own river restoration program in 1999 under the name Nairobi River Basin Program (NRBP) (Kithiia, 2012) and (Charles, 2006). The vision of the program was '*a* restored riverine eco-system with clean water for the capital city and a healthier environment for the people of Nairobi' while its objective was to rehabilitate, restore and manage the Nairobi River ecosystem in order to provide improved livelihoods (especially for the poor) enhanced biodiversity, and a sustainable supply of water for domestic and industrial, recreational and emergency uses (Kuria, 1999). NRBP as an initiative was launched by UNEP as a three-phased program as follows (Kuria, 1999);

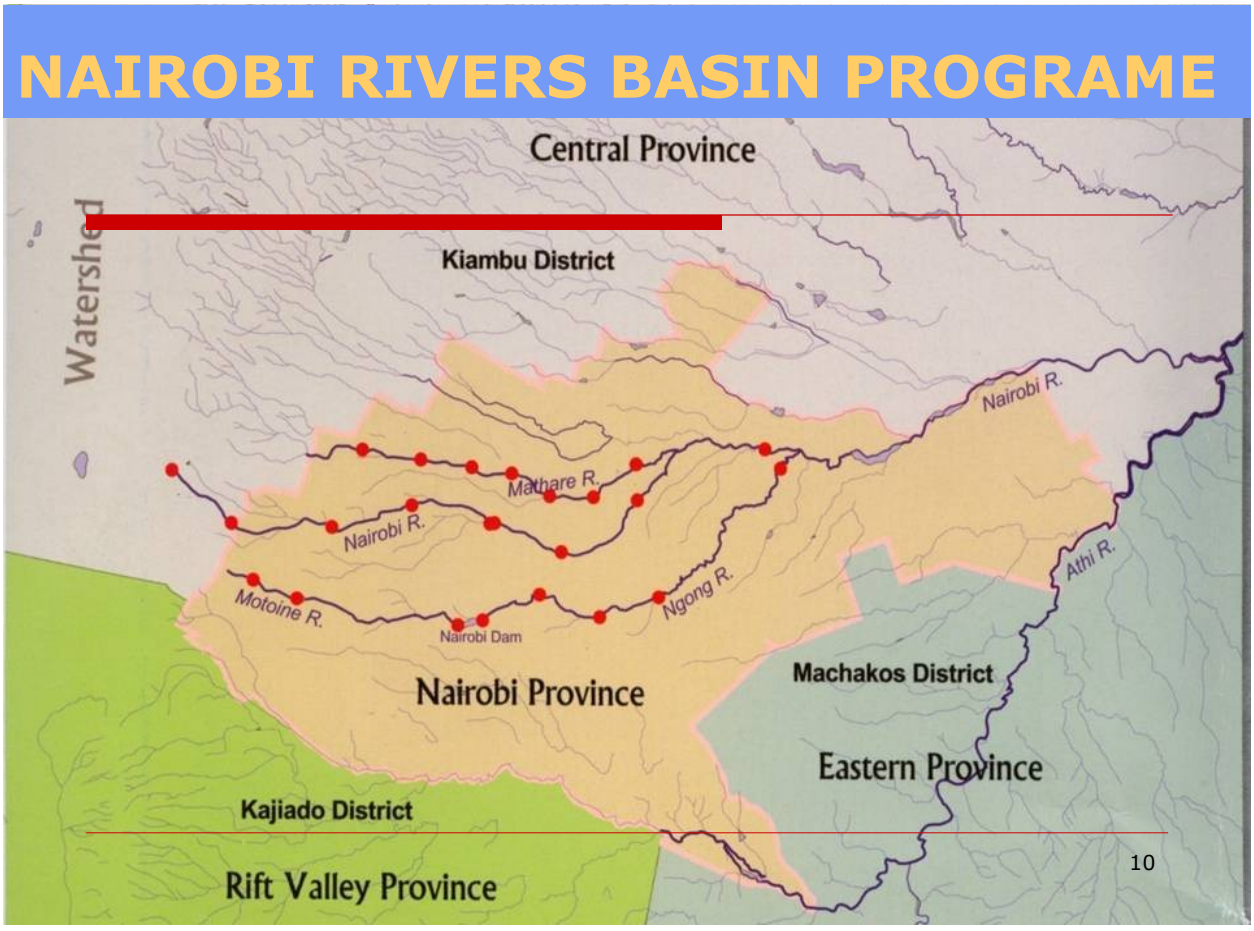
Phase I (October 1999 to March 2000) constituted a situation assessment of water quality, a preliminary public awareness and education campaign, community outreach through pilot income generation projects, and capacity building amongst stakeholders. It also developed an Environmental Management Information System (EMIS)

Phase II (June 2001 to December 2003) was a pilot initiative focusing on a tributary of the Nairobi River system – the Motoine/Ngong River. Pollution monitoring and assessment was limited to a section of the Motoine/Ngong River basin 22 km upstream of Nairobi Dam, the Dam itself, and 25 km downstream to the confluence with the Athi River. The aim of this phase was

not only to address the problem of pollution in Nairobi's rivers but also to put in place community education and information programs to enable capacity building amongst key grassroots stakeholders.

Phase III (January 2005 to December 2008) recognizes the benchmarks laid down by NRBP phases I and II as pillars to achieve its long-term vision.

Figure 1: Map showing the Nairobi River Basin



Source: Ministry of Environment, 2008

In November 2008 the government announced that the latest phase of the program would involve a two-year river clean-up process. This would involve the demolition of homes and businesses in

a number of informal settlements within a 30 meters riparian reserve which included the informal settlements of Mathare Valley that is, Kosovo, Mathare No. 10, Mathare 3A, 3B and 3C, Village 2 and Kiamutisya (Amnesty International, 2009).

2.3 Increased housing development and the Challenge it poses in cleaning and maintaining Rivers

Although water shortage is a major threat, water contamination and pollution poses a more immediate serious problem (Duraiappah, 1996). The author further comment that in the past human waste was deposited in natural systems but with increasing populations, the load of human waste has far exceeded the natural systems absorption and cleansing rate. Therefore, without modern sanitation systems to help relieve the natural systems, it is only logical for the natural systems, including water, to become degraded. High rural-urban migration rates have placed existing inadequate and antiquated sanitation and waste disposal facilities in cities in many developing countries under stress (Duraiappah, 1996). By and large, the water contamination problem caused by human waste is an urban problem and has been largely ignored in (Chan, 2010) many developing countries because policymakers do not recognise slums as legal entities. The status of illegality then relinquishes policy makers of any obligation to provide adequate sanitation facilities (Duraiappah, 1996). Similar to industrial waste, if human waste is dumped in amounts excessive to the cleansing rate of the systems, it can only result in an accumulation of waste to toxic levels as well as the deterioration of the water system of its cleansing properties (Chan, 2010).

According to the scientists at the National Environmental Engineering and Research Institute, a staggering 70% of the available water in India is polluted (Nagdeve, 2002). Sewage generated from 25 heavy polluting cities and towns account for about 75 percent of the pollution load in the river. The Yamuna with 200 million liters of untreated muck being dumped in it every day by Delhi's Sewerage System has become one of the most polluted rivers in the world (Nagdeve, 2002).

Due to the blinding eye given to the mushrooming of informal settlements and other forms of developments by city planners in the third world countries, lack of or inadequate provision of essential infrastructure within such these informal set-ups has lead to almost ninety percent of sewage being discharged directly into rivers, lakes, and coastal waters without being treated (Sango, 2007). The 50-year-old sewer system in Cairo originally built to serve 2 million people is completely inadequate for the current 11million (Miller, 1998). The third world has got its slum dwellers accounting for about 17 percent of the world population who have no choice but to use the soiled river or lake water for bathing, washing and even drinking (Sango, 2007) with slum settlements in Zimbabwe's city of Harare adding to this statistic. Slums therefore present a challenge in cleaning and maintaining rivers given their current status.

In the poor suburban zones of Kenya's Nairobi city, indiscriminate disposal of municipal solid and liquid waste at the river side is common (Mutisya & Yarime, 2011). Nairobi River and Nairobi Dam have been victims of MSW pollution from the slums surrounding them such as Kibera (Henry, Yongsheng, & Jun, 2006). The same scenario is witnessed in Mathare River with the adjacent Mathare slums dwellers using the river to get rid of their uncollected solid and liquid

waste. The riparian reserves of the three Nairobi Rivers (Mathare, Ngong, and Nairobi) feature numerous informal settlements (Charles, 2006) without adequate sewerage and sanitation services. More often than not, the rivers are used for discharging raw sewage. This further illustrates that the development and growth of slum settlements brings forth a significant challenge in cleaning and maintaining rivers given the dynamics of slum settlements.

2.4 The Practicality of Restoring and Maintaining a the thirty meter Riparian Zone given the presence of housing development pressures

River restoration has developed significantly as a process and/ or tool for improving degraded watercourses (Mant & Janes, 2008). According to (Armin, Roulier, Schager, Weber, & Woosley, 2008) the aim of river restoration projects is often not to return rivers to their original condition, but primarily to restore the essential processes and elements of the degraded riverine ecosystem. The degree of success depends among other things, on the extent to which the goals were formulated at the beginning of the project. The authors further argue that in addition to stakeholder involvement, political acceptance and establishing services for the society, however, restoration projects should have sufficient ecological goals.

An assessment of the River Thur Project of Switzerland revealed medium success (Wolsey et al., 2007). Observable success included among others, the recovery of the degraded riparian zone in terms of the width and degree of naturalness (vegetation, soil composition). There was also a marginal improvement on the degree and type of anthropogenic modification, which according to the project proponents, was a large success (Armin et al., 2008). The core drivers of the

degradation effect on the entire riparian ecosystem of the Thur River was the wide-ranging engineering works over recent decades which sought to transform rivers and streams into straight, embanked ecosystems. The most obvious consequences for streams were that interactions with the riparian habitat and the groundwater were lacking. In addition, the streams became fragmented by numerous migration barriers for aquatic organisms, specifically for fish species with poor swimming and jumping abilities (Armin et al., 2008)

However (Redmond M, 2004) argues that restoration is not practically possible. In her thesis, she records that "there are practical and theoretical objections to the concept of restoration – whether it aims in this case to restore the 'natural' functioning of a river, or to recreate a historical river course. To call these activities restoration is rather optimistic; most would more properly be defined as 'rehabilitation' – the partial return to a more natural state."The return to a historical channel course in urban areas is rarely possible because of the restriction imposed by nearby homes and businesses (Nolan and Guthrie, 1998, Eden *et al*, 1999 cited by Redmond M, 2004).
For example, the River Restoration Project (RRP) in its 1994 document considered
'the term *restoration* to be important in the sense that it conveys a *visionary* target of pristine rivers that are wholly returned to an undisturbed state. In practice, this target will rarely be achievable and restoration will comprise a *sustainable* balance between the essential needs of people and the natural environment. In practice restoration will comprise a programme of *rehabilitation* and *enhancement*'(quoted in Eden and Tapsell, 2000 and cited by Redmond M, 2004)

Bettess & Bain, (2005) are also of this school of thought, in their report on '*Decision Support Framework for Assessing and Managing River Rehabilitation*' they claim that the term river

rehabilitation is used rather than river restoration as it may not be possible or desirable, within the constraints of an urban environment, to return the river to its natural state, as is implied by the use of the term 'restoration'. Instead, rehabilitation aims to improve particular aspects of the river, so a rehabilitation project may aim to improve the morphology, water quality, ecology, amenity, aesthetics or flood conveyance functions of the river.

Therefore in conclusion restoration of the entire river ecosystem is not practically possible instead focus should be on river rehabilitation whose Common drivers are to increase the value of the land in close proximity to the river (riparian zone) and also to increase the amenity in an urban space and improve the quality of living for the urban community. This scenario suites the Mathare River case Cleaning and Maintenance programme.

2.5 Gap Identification

Globally, it is clear that, the main priority of governments in the restoration of flood plains is to enhance ecological conditions. However there is a consistent lack of adequate planning of urban spaces including planning for urban river basins. Development planning has also been seen to be done exclusive of environmental considerations.

Incorporation of environmental planning and management is vital in urban development proposals as this will reduce possible conflicts with and constraints on all environmental `resources including urban river basins. There is need for the establishment of relevant institutions specializing in urban river basins management and enhancement especially in developing countries if development in the future is to be sustainable. River Rehabilitation and Management Centers established to this effect would go a long way in realizing rehabilitation

efforts of these governments. Such centers will be responsible in guiding the sustainable use of urban rivers.

Secondly, the failure to recognize slum dwellings as legal entities and thus plan for them further aggravates the problem of pollution of urban rivers in developing countries such as Kenya. This is because of the obvious fact of the absence of necessary infrastructure such as proper waste management and sanitation facilities. There is therefore a greater need to implement recommended action plans which are flexible and not inconsistent as the widely employed master plans in developing countries.

2.6 Theoretical Framework

2.6.1 Integrated Water Resource Management Theory

Integrated Water Resources Management (IWRM) can be described as the coordinated development and management of water, land, and related resources to maximize the resulting economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Roy, Jane, & Venema, 2011). This theory was advanced by UNEP-DHI Center for Water and Environment and popularized by the Dublin principles adopted at an international conference in Dublin in 1992. It promotes a participatory approach to integrated resource management on a watershed basis and promotes the recognition of the economic benefits of managing water and related resources.

IWRM is one form of the *ecosystem approach* as a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way (Millennium Ecosystem Assessment 2005 quoted by Roy et al., 2011).

Ecosystems are dynamic complexes of plant, animal, and microorganism communities and their nonliving environment, interacting as a functional unit. Ecosystems vary enormously in size, and can range from microorganisms to large international ocean basins (Roy et al., 2011). According to the Convention on Biological Diversity, *the ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.* IWRM, as described by the Global Water Partnership, highlights the interdependence of natural and social systems and provides a practical framework for such integration on a watershed basis.

(Al-Jayyousi and Bergkamp, 2008) explain that the ecosystem approach in watersheds is based on the notion that water, biodiversity, and environmental protection require establishing interdisciplinary, inter-sectoral and inter-institutional initiatives. They note that these initiatives define strategies for actions and investments based on the needs and priorities of watershed inhabitants.

The IWRM theory can be applied to ameliorate the current environmental degradation problem in Mathare River. Inter- disciplinary and inter-sectoral coordination is necessary for the proper management of the Mathare River ecosystem. Community participation in the project is also necessary to ensure its success. This would lead to the maximization of the resulting economic and social welfare in an equitable manner**.** According to (Roy et al., 2011) the strengths and weaknesses of the theory are as follows:

2.6.1.1 Strengths and Weaknesses of the IWRM Theory

Strengths

a) It recognizes the economic benefits of managing water related resources in an integrated manner through the provision of high level of Ecosystem Services.
b) It is an important Climate Change Adaptation Strategy (Intergovernmental Panel on Climate Change)
c) Provides additional social and economic benefits including local livelihoods and alleviating poverty within river basins

Weaknesses

a) Implementation is costly as it requires a substantial investment in both institutional framework and infrastructure which can be overwhelming for developing countries
b) Inter-sectoral integration may be hampered by differing sector specific goals

2.6.2 The Ecosystem Modeling Theory

This theory relies on the development of suitable system models to achieve restoration of ecosystems (Zedler, 2005). According to the author, in many cases these models focus on structural components- what people want to see- while in others, the focus is on the function. System models are therefore used to guide stakeholders in specifying the desired outcome of restoration. Therefore models are developed for restoring rivers and their ecosystems. For example, for the Ayuiquila River Valley in Jalisco, Mexico, a community based restoration effort involves treating sewage before discharge to the river and reforesting river banks by planting trees. The multiple objectives are to please the adjacent land owners, stabilize the banks to reduce erosion and slow eutriphication, shade the river to cool the water and improve water quality for downstream communities who depend on the river for subsistence (Allen, 2004). Functional goals (water quality improvement) outweigh appearances (Zedler, 2005)

Therefore the ecosystem theory suggests that a degraded site can be designed and modified to mimic some model. Suitable models can be based on historical information (Egan & Howell, 2001) and on data from remnants of naturally occurring ecosystems, also known as reference sites (White & Walker, 1997).

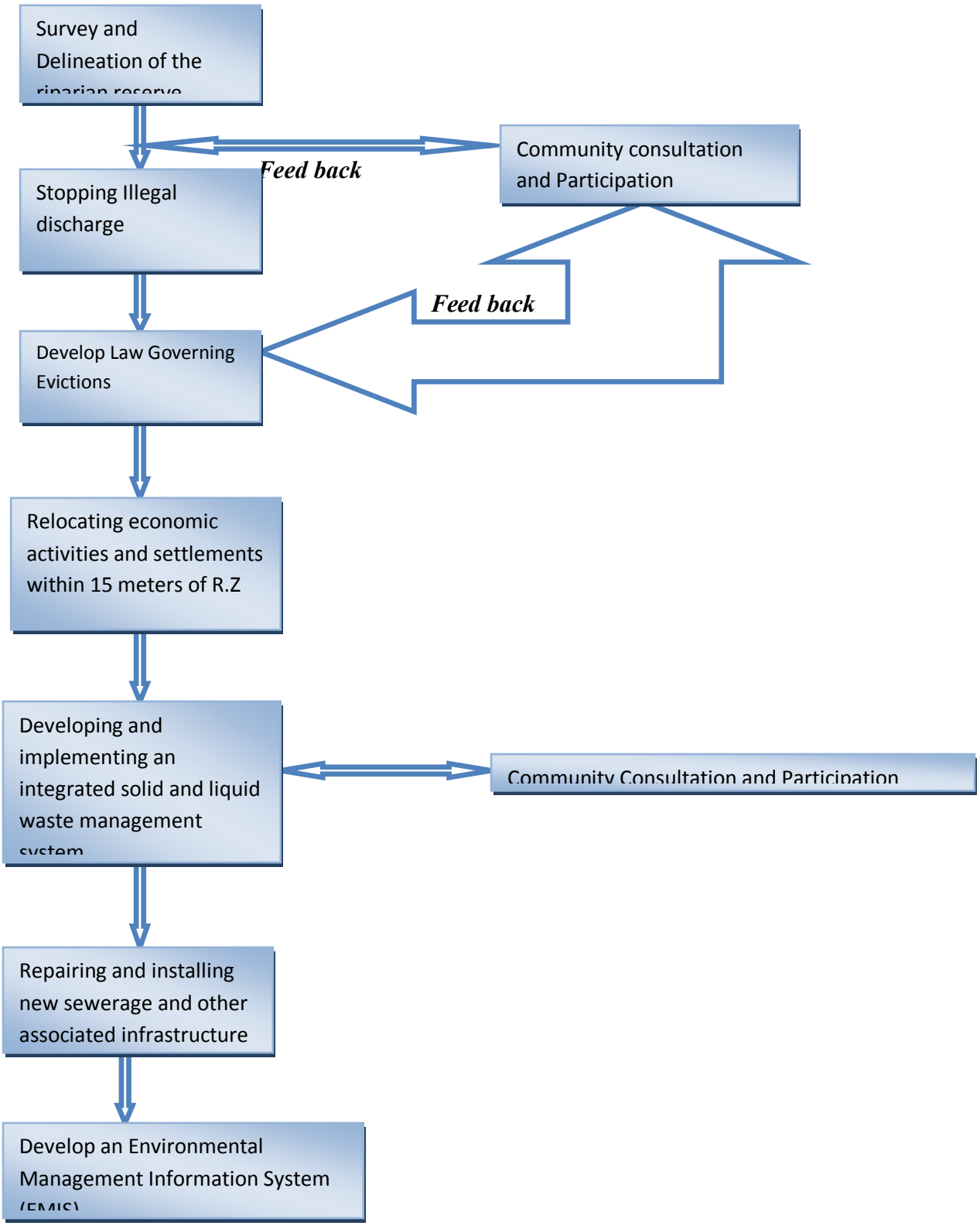
A suitable reference site (model) typically has little evidence of perturbation plus attributes that are desirable, such as high species richness, an abundance of rare species, high water quality (very low turbidity levels) as well as very low riparian encroachment levels for the case of rivers.

The model must recognize and embrace environmental variability across space and time (Simberloff, L, Trombulak, M, & D, 1999). In some cases the model is a sophisticated simulation of how species composition and productivity will change once restoration is underway (Zedler, 2005).

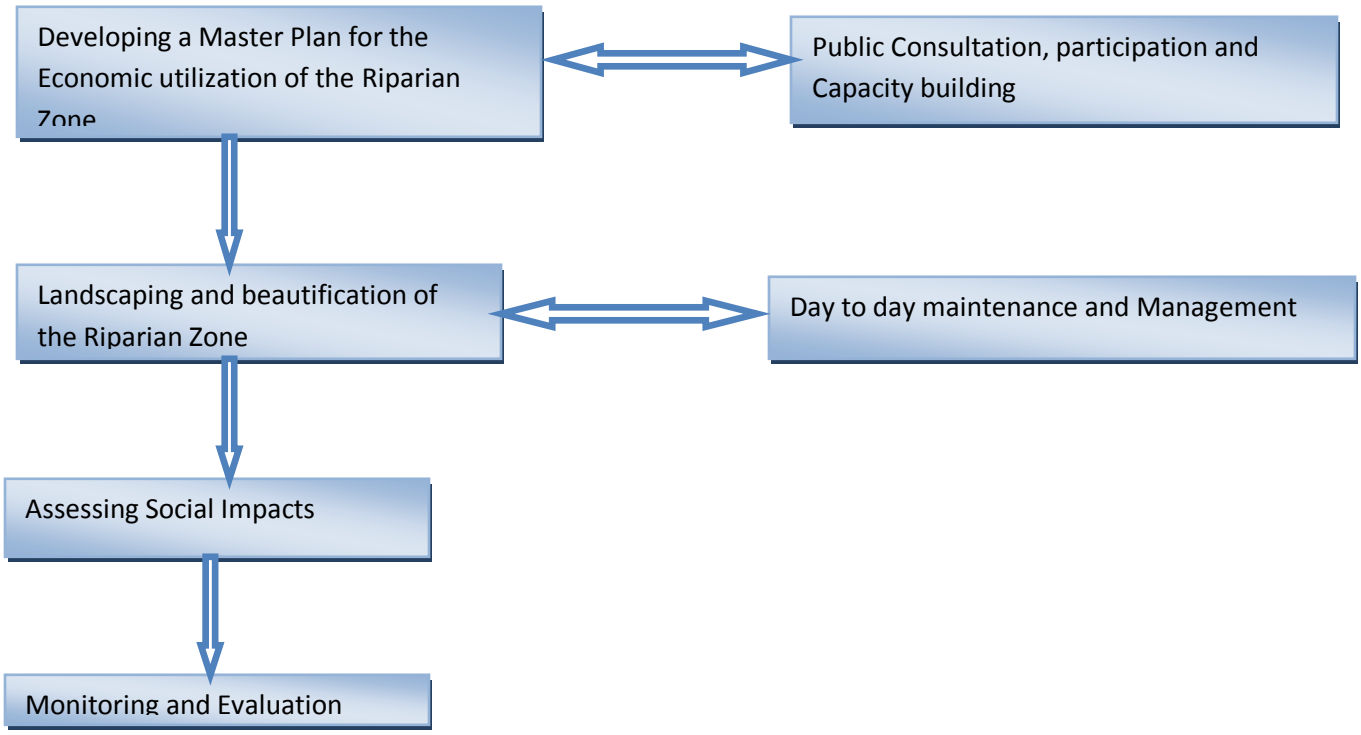
This theory can be applied in the cleaning and maintenance programme of Mathare River, through the use of the success story of the 2.5 kilometer pilot stretch between the Museum Hill roundabout and the Racecourse bridge as a reference site (model) in the NRBP.

2.7 Conceptual Framework

Phase 1



Phase 2


Developing a Master Plan for the Economic utilization of the Riparian Zone
Public Consultation, participation and Capacity building
Landscaping and beautification of the Riparian Zone
Day to day maintenance and Management
Assessing Social Impacts
Monitoring and Evaluation

3 Area of Study

3.1 Introduction

In Nairobi, Kenya, Mathare Valley is an informal settlement that is home to nearly 200,000 people confronting a range of challenges. Mathare is one of the largest slums in Nairobi; a city where over half the approximately 3.5 million residents lives in over 180 different slums. Before 1950s, Asians owned much of Mathare and extracted its stones for building projects. In the late 1950s, it was dominated by Mau Mau freedom fighters, which hid weapons and conducted oathing ceremonies there.

Like many informal settlements, Mathare is characterized by unsafe and overcrowded housing, elevated exposure to environmental hazards, high prevalence of communicable diseases, and a lack of access to essential services, such as sanitation, water and electricity.
Mathare is one of the oldest and largest informal settlements in Nairobi.

3.2 The Physical Set-up

3.2.1 Location and Extent

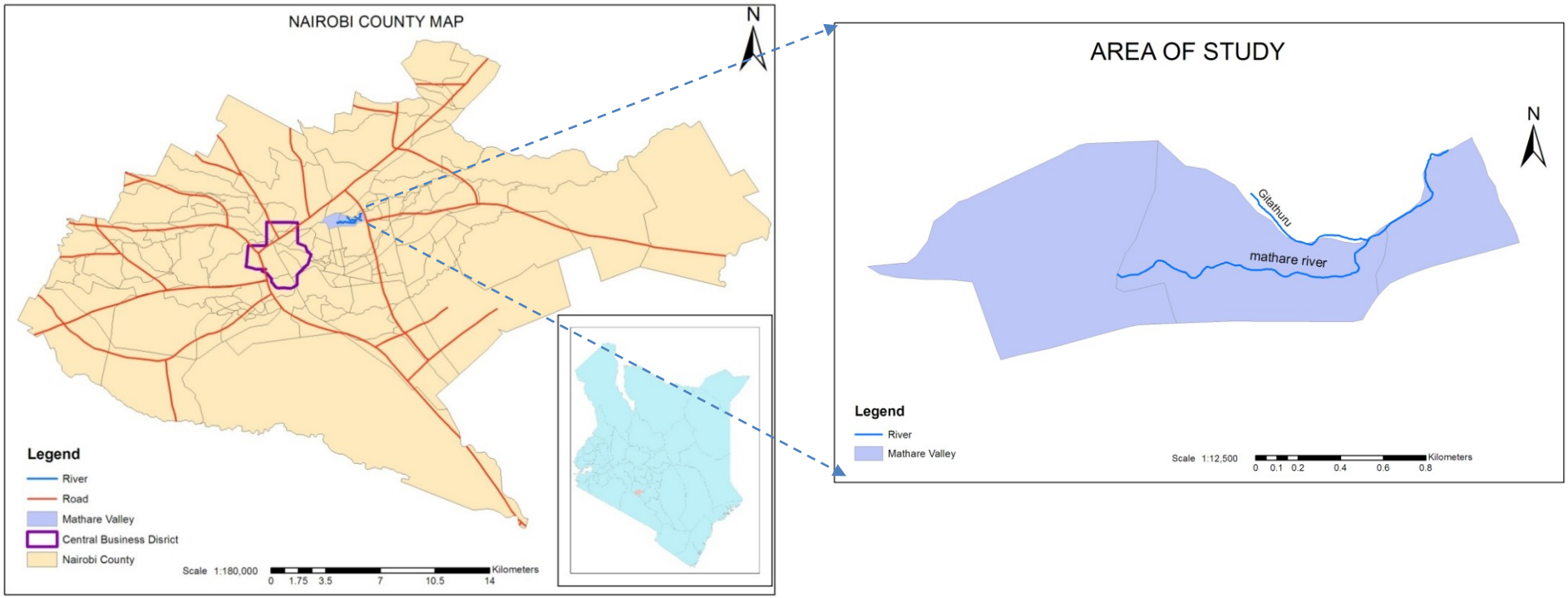
Mathare Valley lies approximately 6 kilometers to the northeast of Nairobi's central business district and is bordered by Thika Road to the north and Juja Road to the south. The settlement sits within a valley of the Mathare and Gitathuru Rivers. Mathare Valley is enclosed by Pangani on the West. On the north, it is enclosed by the police depot, Mathare primary school, and Mathare Mental Hospital. Juja Road borders Mathare on the south, separating it from Eastleigh,

an estate dominated by Somali immigrants and entrepreneurs. To the east, it borders Huruma estate.

The Mathare Valley area is comprised of 13 villages: Mashimoni, Mabatini, Village No. 10, Village 2, Kosovo, 3A, 3B, 3C, 4A, 4B, Gitathuru, Kiamutisya, and Kwa Kariuki.

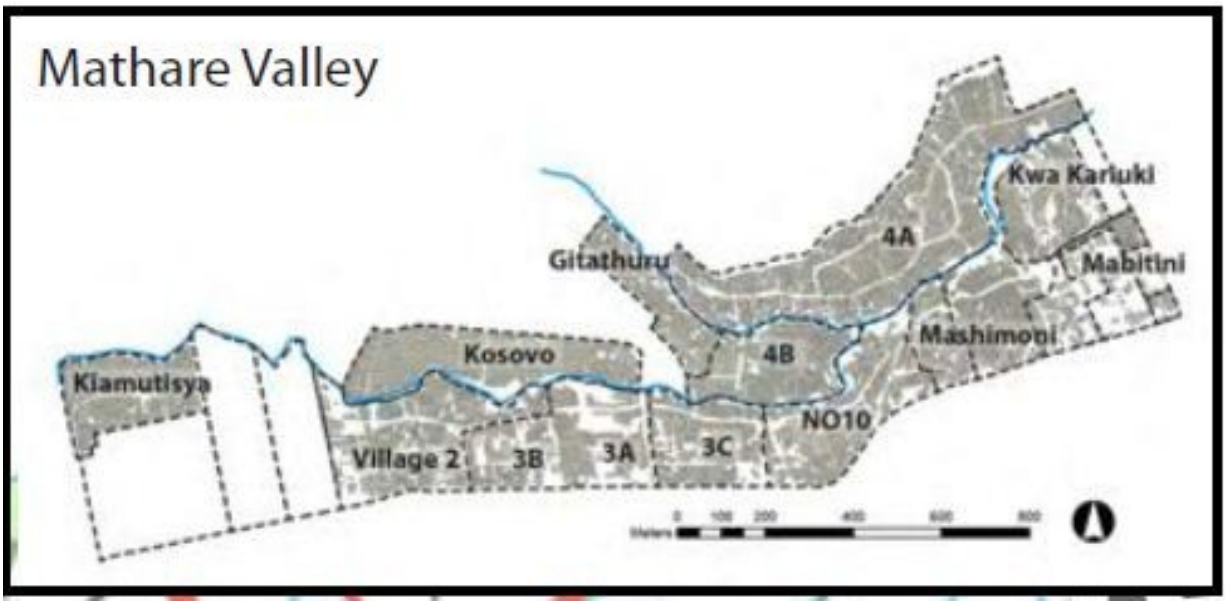
However the villages on the fringes of the Mathare River are seven that is Kosovo to the north which is the largest and to the south are Kiamutisya, Village 2, 3B, 3C, 3A and No. 10. These villages cover a combine area of approximately 0.42 sq. kilometers.

Figure 2: Nairobi Context Map and Extent of Study Area respectively



Source: Field Survey, 2014

Figure 3: Map showing the physical Location of villages along the fringes of Mathare River



Source: The Mathare Zonal Plan, 2012

3.2.2 Topography and Drainage

The area as the name Mathare Valley suggests lies predominantly in a depression which was a former stone quarry, and is surrounded by short five to ten meter rocky hills. The area is drained by the Mathare River which is one of the three major rivers forming the Nairobi River basin. The river drains the slum in an eastwards direction before it eventually drains into Athi River on its way to the Indian Ocean.

3.2.3 Geology and Soils

The river bed sits on million-year-old Late Tertiary volcanic rocks. Technically speaking, the common rock forms are volcanic tuffs with intercalated flows of basaltic larva. Soil is very deep, ridding brown clayely loam with slow but free profile drainage. Such soils become particularly

sticky when wet, yet dry very quickly with a tendency to shrink and crack. The upper few inches of soil are usually stained dark brown with incorporated humus.

3.2.4 Climate

The Mathare Valley slum area, as Nairobi, has two wet seasons: April to June and October to December. In July and August it is cool, cloudy and dry. From August to0 December it is sunny and dry. January, February and early March are hot and dry months.

The average monthly rainfall is 930 mm (37 inches), varying from 1250 mm (50 inches) during El Nino periods to 350 mm (14 inches) during dry spells. The peak rain months are April, May and November. Temperatures through the year vary according to seasons, cloud and sunshine.

3.3 Ecological Set-up

3.3.1 Vegetation

Mathare catchments are densely inhabited by natural and agro forest trees composed of Eucalyptus plantations, *Croton, Cyprus, Grevillea*, Bamboo and shrubs of *Lantana camara* amongst others. There are a few of natural wetlands that still exist in the Mathare River's basin. Some of the plant genera found in the valley bottom wetlands are *Typha* and *Cyperus* sp with Napier grass in the surrounding. Flourishing Banana plantations can be found along the Mathare River banks at outer ring road bridge Dandora area.

3.3.2 Wildlife

The faunal communities include Fish such as *Tilapia*, Catfish, *Barbus* and Mudfish. Birds like Sacred ibis, Cattle egrets, pied kingfisher and African fish eagle can be found in the polluted water along Mathare River. Snakes, rats and lizards are some of the reptiles that can be found along the river bank as well.

3.4 The Economic Set up

3.4.1 Agriculture

The upper catchments of Mathare River are intensively farmed lands. Most of the farms are smallholder ones with subsistence farming for cereals and pulses. Its upper reaches are areas of intensive tea and coffee farming all the way to the Nairobi City boundary.

3.4.2 Trade Commerce and Industry

Commerce is vibrant and thriving within the slum – many stores, businesses – depicting a fully self contained community. Bars, food stands, clothing vendors, butchers, pool halls, and even dry cleaners exist to serve the local community (Reback, 2007). Most families in Mathare do not operate microenterprises but instead rely on casual labor (Corburn, Ngau, Karanja, & Makau, 2012).

3.5 The Social Set-up

3.5.1 Population

Mathare is an informal settlement that is home to nearly two hundred thousand people (2009, Kenya Population census) with the composition in the study villages being as follows;

Table 1: Population Distribution of the Study Area

Village Name	Total Population	Female	Male	No. Households	Area Sq. Km
Kosovo	8085	3642	4443	2846	0.0835
Village 2	7875	3658	4217	2854	0.072
No. 10	2594	1350	1604	994	0.0272
3a	4059	1896	2163	1530	0.0536
3b	7433	3256	4177	2681	0.0497
3c	5316	2430	2886	1925	0.0761
Total Population	**35362**	**16232**	**19490**	**12830**	**0.3621**

Source: 2009 Kenya Census- National Bureau of Statistics

3.5.2 Education

There are many educational institutions in the study area both public and private. The primary schools mostly public are densely populated owing to the Free Primary Education Program and the large population of the inhabitants. These include Kiboro Public Primary school, St. Teresa Girls Public Primary and Secondary School, St. James a non-formal mixed school, Mathare Youth Polytechnic among others. Most residents in the study area have not gone beyond primary school level of education for reasons varying from peer pressure, drugs to lack of fees for subsequent levels.

Facilities, such as, clinics, and community centers exist as part of the community's broader social network.

4 Study Methodology

4.1 Introduction

This chapter represents the methodology employed in the research project. It aims to specify on the following: research design, variables, scope of study; respondents, data collection instruments for the area of study, data collection procedures and data analysis, as well as methods of presentation. The focus of the methodology is on the challenges of cleaning and maintaining Mathare River in the face of the presence of the Mathare Slum settlement within the river's ecosystem in Mathare Valley, Nairobi County.

4.2 Research Design

This is a diagnostic research which sets to assess the challenges the growth and development of slums pose to the cleaning and maintenance programme of Mathare River. This approach was adopted to cater for the collection of qualitative data as well as the use of descriptive survey design as it sought to establish and describe a prevailing phenomenon. Apart from reporting the current status, the collected data was used to determine whether and to what extent relationships exist between and among the variables considered in the study.

4.3 Study Variables

- The dependent Variable;

This refers to the successful cleaning and maintenance of Mathare River, hence reclamation of riparian zone

- The Independent Variable;

Consisting of the knowledge, attitude, awareness, perception, socio-demographic, socio-economic and socio cultural factors.

4.4 Nature Data

For the purposes of deeply understanding the problem and achieving the objectives, qualitative data was collected. The qualitative data was obtained from the perceptions of the respondents with respect to their activities on the riparian zone of Mathare River and their attitude towards the approach employed in the clean-up program of the river.

Table 2: How the objectives were achieved

Objective	**Activity**
To find out the approaches applied in the cleaning and maintenance of Mathare River	• Outsourced data through interviews, discussions and assembling publications about the Nairobi River Basin program from the lead agencies involved including; ➢ The Cabinet Office for Environment, Water and Natural resources, ➢ The NEMA website, ➢ Publications such as magazines and holding discussions as a lead agency ➢ Nairobi County Government offices (department of Environmental Planning and

	Management)
To find out why the slums are a challenge in cleaning and maintaining Mathare River.	• Observed the solid and waste management mechanisms by the house holds • House hold questionnaires for the households to find out each household's mechanism in dealing with solid and liquid wastes • Found out whether the slum dwellers were aware of the clean-up projects • Found out whether they have been involved in the decision making process.
To find out whether it is practically possible to rehabilitate and maintain a 30m riparian zone for the river given the presence of the sum settlements	• Used photographs to document the proximity of the slum settlements to the river • Found out from the household questionnaire when the dwellers settled, what made them settle and whether they would be willing to relocate if need be. • Found out intervention measures implemented and investigated their measure of success against prior set goals from NRBP custodians, that is the county

	authorities, Ministries involved and other partners • Found out the constraints faced in the implementation of the 30m riparian reserve regulation from the implementing agencies that is, NEMA, Physical Planning departments of the ministry of lands as well as the Nairobi County Council

4.5 Sources of Data

Both primary sources and secondary sources of data were used to acquire data. Primary was first hand information on the ground while secondary data included information from field experts and professionals as well as published and unpublished reports.

4.5.1 Primary Sources of Data

This was information obtained from respondents who were living in Kosovo village and Mathare No.10. The information was obtained through carrying out a standardized household questionnaire surveys of residents in the two villages. Focus group discussions were also held in both of the villages facilitated by the researcher. Field photographs were used to document evidence of riparian zone encroachment and the various mechanisms of waste management by the residents.

4.5.2 Secondary Sources of Data

Secondary data was collected from the Nairobi County Council office, The Physical Planning Office and The National Bureau of Statistics, Ministry of Environment, water and Natural Resources, Water Resource Management Authority (WARMA), NEMA website, international and non-governmental bodies' published works, past publications, unpublished reports and journals, newspapers and magazines.

4.6 Data Collection Instruments

The instruments that were employed in collecting data included household questionnaires, institutional interview schedules, focus groups discussions, direct observation and field photography.

4.7 Sampling Methods

The study area consisted of five villages-within the domain of the problem- as mentioned in the scope of the study. However for purposes of sampling for data collection, the study population chosen was the households in Kosovo village and Mathare No.10. This choice of study population was based on the non-variance in characteristics across the five villages as observed during the pre-visit. Some of these observable characteristics include observable housing characteristics and their distance from the river, household activities, demographics such as age distribution, living conditions etc. In addition to this, the two villages also represent two different extremes among all the villages in terms of area coverage and population size, that is, Kosovo being the most populace and covering the largest area, while Mathare No.10 on the other hand has the smallest population size and covers the smallest area.

Simple random sampling was used for selection of study units on the basis of chance. This is because there is no formal type of planning within the settlements hence rendered the method effective.

The study focused on respondents of not less than twenty one years of age of all gender in order to facilitate the collection of relevant data.

4.8 Data Analysis and Presentation

Data analysis was through generalizing the sample results to the wider population in order to estimate the population characteristics. This was largely through the calculation of percentages. Data presentation employed the use of graphs, tables and pie-charts.

5 Results and Discussions

5.1 Approaches applied by the government in cleaning Mathare River.

To achieve the aim of the programme intervention, focus was on ten key interventions in the three main rivers. The following is a summary of discussions of the proposed ten interventions to rehabilitate and restore the river basin.

- Creating awareness and assessing social impacts
- Survey and delineation of the Riparian reserve
- Stopping Illegal Discharges
- Establishment of a of 2.5 km Demonstration Pilot Site
- Relocating Economic Activities and Informal Settlements
- Developing and Implementing an Integrated Solid Waste Management System
- Repairing and Installing Sewerage and Associated Infrastructure
- Developing a Master Plan for Economic Utilization of Riparian Zone
- Landscaping and Beautification of the Riparian Zone
- Removal of solid wastes inside the river using heavy machinery
- Surveillance to deter any illegal dumping

Another major mechanism employed was multi-stakeholder involvement. The key government ministries that were involved were Ministries of- Environment and Mineral Resources, Lands, Housing, Public Health, Local Government, Nairobi Metropolitan Development, Forestry and Wildlife, Provincial Administration and Water and Irrigation. Other key stakeholders expected to

be involved included, NEMA, WARMA, the UN Agencies, the City Council of Nairobi, the Private Sector; Civil Society and residents.

5.1.1 Roles of different stakeholders in the NRBP

Some of the roles played by some stakeholders were as follows;

Table 3: Roles of Various Stakeholders involved in the NRBP

Stakeholder Name	Role Played
NEMA	Creating awareness of the effects of pollution to the residents to encourage proper environmental management Construction of eco-toilets as a short term plan Enforcing EMCA regulations as part of its education campaign Follow up on illegal discharges Identifying and mapping the sources of pollution To do an assessment of the source point pollution
Ministry of Environment and Mineral resources	Securing grants from the donor community Assessment of the water and environmental quality along the riparian reserves

	Delineation of the riparian reserve Avail skilled labor for the various activities to be undertaken
The Nairobi City Council (NCC)	Formulation and enforcement of relevant by-laws Stop and follow-up on illegal discharge Development of an integrated waste management strategy Stop illegal constructions within the 30m riparian reserve Landscaping and day to day maintenance of the Riparian reserve
Provincial Administration	Required by law to enforce regulations when called upon such as the evacuation of settlements within the 30m riparian reserve
Residents/Community	Provide semi-skilled and unskilled labor through the Kazi Kwa Vijana Initiative

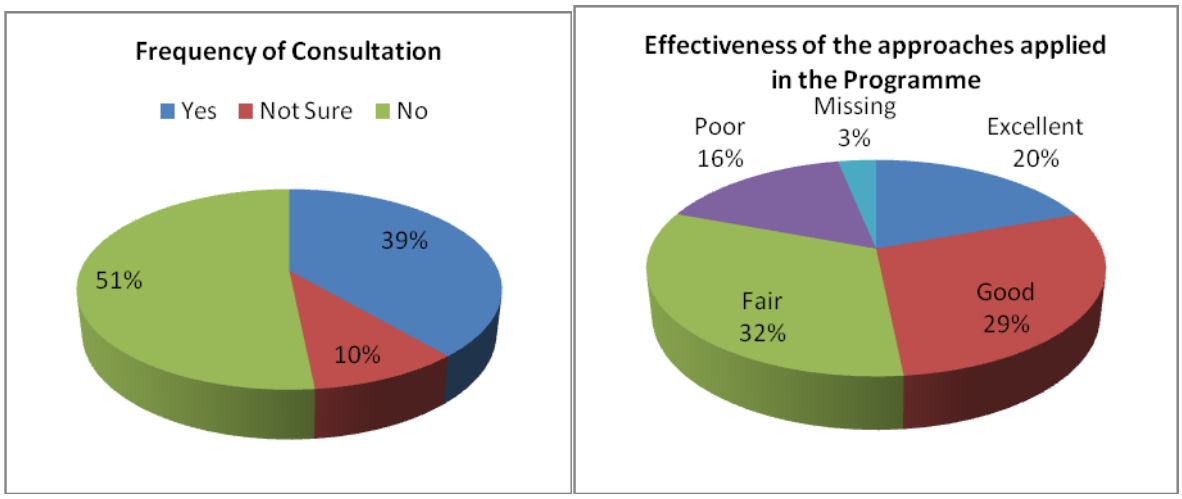
5.1.2 Community Consultation and Participation

The programme's listed achievements so far include the generation of "sufficient public interest on environmental awareness" and "involvement of the private sector in the programme's

interventions such as water quality monitoring and waste management" (Amnesty International). However, according to the United Nations Environment Programme (UNEP), the affected members have not been adequately consulted by the government or other stakeholders in the programme and fears of eviction from this land only leaves them wondering where they would seek alternative accommodation and livelihoods.

Data from the field survey through household questionnaires echoes the above findings. For instance, of the thirty one respondents, only 38.7% said they were consulted while 9.7% of them were not sure where as the majority of them, which represented 51.6%, said they have never been consulted. Consultation largely involved the inclusion of residents' opinions and concerns over the project as well as their active participation from the project identification stage all the way through planning and implementation.

Figure 4: Frequency of Consultation & Effectiveness of Approaches applied respectively



Source: Field Survey, 2014

However, the respondents' opinion on the level of effectiveness of the mechanisms applied in the NRBP with reference to Mathare River was as illustrated in the latter chart. Those who held that the approaches applied by the government were fair represented 32% of the respondents which is slightly more than those who thought that the approaches were good at 29%. Those who thought that the approaches were excellent represented 20% of the respondents while 16% of them thought the approaches were poor.

5.1.3 Measures of Success put in Place

The proposed activities including those that have already been set in motion to ensure the success of the cleaning and maintenance programme are as follows;

Table 4: Measures of Success of the NRBP

Indicators of success (Activities)	Proposed Activities
Construction of a trunk sewer line within a number of villages in Mathare valley	Surveying exercise on the residents within the 30m riparian reserve to establish the level of awareness on the existence of the buffer zone by NEMA
Secured some open spaces downstream e.g. at Outering road bridge in Ruaraka	Hiring of up to five thousand youths to rehabilitate the river and its ecosystem
Continuous flow of the river has been successfully achieved	
Involvement of UNEP and UN-Habitat shows there was a lot of trust and goodwill	

with the government.	

However, currently nothing is being done for Mathare River especially. This is because there is no active engagement with the rest of the community and the whole project has taken a socio-political dimension. Data from the field indicates that bias in the recruitment exercise-based on friendship and family ties with either the local leaders or the local administration- of the youths led to the rejection and subsequent collapse of the programme. Funding limitations also contributed to this as it reduced the possibility of hiring five thousand youths to only one thousand. According to the department of Environmental Planning and Management of the Nairobi County Government, the NRBP stalled towards the end of 2011. This was because of a number of reasons, among them;

- The absence of clear leadership
- No follow up on the pilot project on Nairobi River
- Bulk of the funds came from UN agencies and private sector who were mainly interested in integrity, accountability and transparency issues
- The new structures of the Jubilee government led to the relocation of various relevant department notably, Urban Planning department from the Local government ministry to the ministry of lands and the relocation of the Nairobi Water Company which was an independent company under the Min. of Water and Environment now under the Local Government according to the Fourth Schedule.

5.2 Challenges the Mathare Slums pose to the cleaning and maintenance of Mathare River

The Mathare slum settlements/villages pose a major challenge to the cleaning and maintenance programme of the river in the following manner;

5.2.1 Encroachment into the Riparian Reserve

Nairobi City has been expanding without proper environmental planning. Expansion of city's infrastructure in terms of urban services has not matched the growth of its population. Population explosions coupled with unplanned development are the responsible agents for the situation within the Mathare slum. Settlements have encroached into the riparian reserve regardless of the existence of laws that prohibit any kind of development within the riparian zone.

The thirty meter riparian reserve for Mathare River has not been enforced at all. The enforcement of this rule according to findings from the field survey has not been successful because of a number of reasons which include;

- Lack of awareness and high levels of poverty among the families living within the riparian reserve (they prefer survival to environmental protection)
- Complacency on the part of the local authorities to control development within the area
- Lack of coordination between NEMA and the local authorities on the same
- Land owners with illegal title deeds within the riparian reserve
- Landlords benefiting from the slum dwellers who in turn benefit from cheap services being offered such as illegal water and electricity connection

- Lack of political will from the political class who fear a political back lash from the slum dwellers who are also the voters.

Plate 1: Photographs showing extent of encroachment into the riparian zone

Source: Field Survey, 2014

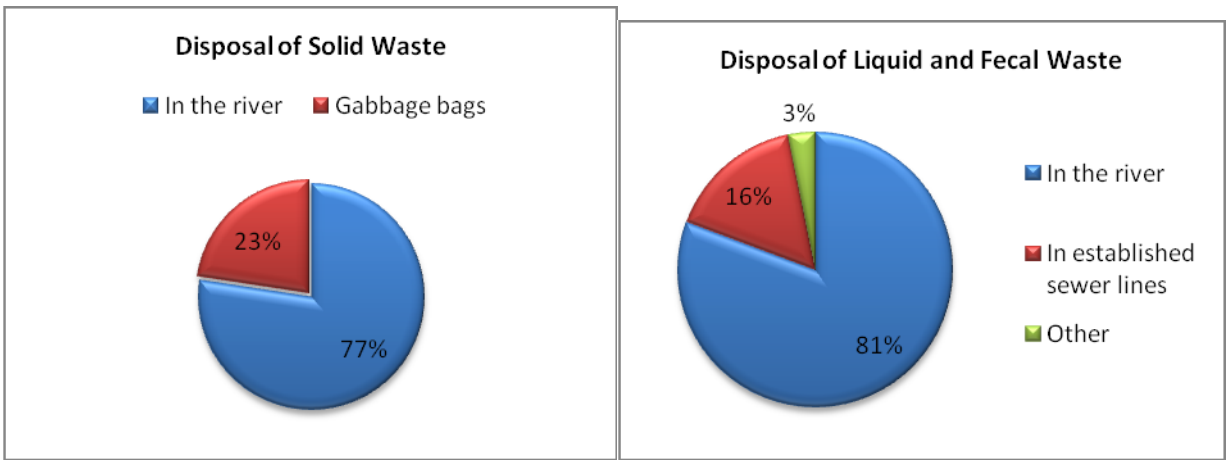
5.2.2 Awareness and Attitudes of the community towards the NRBP

However, the programme's secretariat records that among its successes is the holding of over ten public Barazas on awareness to sensitize the public on the programme and lobby their support. This statement was found to be consistent with the findings from the household questionnaires and the focus group discussions. From the field survey, 61% of the respondents were aware of the project, while only 7% were not sure as 32% of them had never heard of the project before. Even so, one major challenge was experienced; that of reluctance of the community to accept a change in the status quo. This was according to the NRBP secretariat at the Ministry of Environment, Water and Natural resources.

5.2.3 Mechanisms of Waste Management

The disposal mechanisms of solid, liquid and fecal waste are a major challenge to the cleaning efforts of the river. The settlements lack proper solid waste collection facilities as well as sewerage facilities. This situation has led to the disposal of these types of waste into the river by most of the respondents thereby polluting the water leading to the degradation of the entire Mathare river ecosystem. The study shows that 77% of the population disposes their solid waste into the river direct1ly, while only 23% of them use garbage bags. On the other hand a whopping 81% of the population disposes their liquid and fecal matter directly into the river without any form of treatment while only a meager 16% of the population use established sewer lines. 3% of the population uses other forms of disposal such as pit latrines, exhausters as well as flying toilets. Figures 7 and 8 illustrate the findings respectively.

Figure 5: Mechanisms of solid waste disposal & Mechanisms of Liquid and Fecal waste disposal respectively



Source: Field Survey, 2014

Interestingly, from the focus group discussions the waste disposed into the river do not only originate from t-he households within the 30m riparian reserve. Households well beyond the buffer zone use the river as a medium for disposal of their waste as it represents a more cost effective option than paying for such services to the registered service providers.

Plate 2: Photographs showing the disposal of solid & disposal of liquid and fecal waste into the river respectively

Source: Field Survey, 2014

5.2.4 Other Benefits of the river and its ecosystem to the Residents of the Mathare slums

Apart from the disposal of solid and liquid waste, 67.7% of the respondents in the study area do not find Mathare River and its ecosystem beneficial at all while only 32.3% find it beneficial. Never the less, those who find the river and its ecosystem beneficial sited the following income generation activities;

a) Chang'aa brewing (especially in Mathare No. 10 area)
b) Small scale agriculture and
c) Charcoal and brick making

Plate 3: Photo showing small scale agricultural activities along the Mathare River riparian zone

Source: Field Survey, 2014

5.3 Possibility of Rehabilitating and Maintaining a 30m Riparian Reserve

The practicality of reclaiming the entire Mathare River riparian reserve given the current situation is a question of varied responses from both the community itself and the other stakeholders involved in the cleaning and maintenance programme. For instance, the MEWNR, believe that this might not be possible so long as people still leave within the area. The following reasons were sighted;

a) The size of the population within the riparian reserve is already too big to be displaced, which is also protected by the constitution.
b) Finding land to resettle the population to be displaced is proving to be a big challenge.
c) Social-political challenges that may arise for example transferring one community to another area occupied by another different community, who might not welcome or accept the new comers or the political class may view it as a transfer of potential votes from their strong holds.
d) Some members of the community may resist relocation because of the proximity to their sources of livelihoods

In contrast to this however, most members of the community believe that reclamation of the entire riparian reserve is possible even with their continued existence in the area. 80% of the respondents say it is possible, while 10% of them are not sure whether it is possible and another 10% thinks that it is not possible.

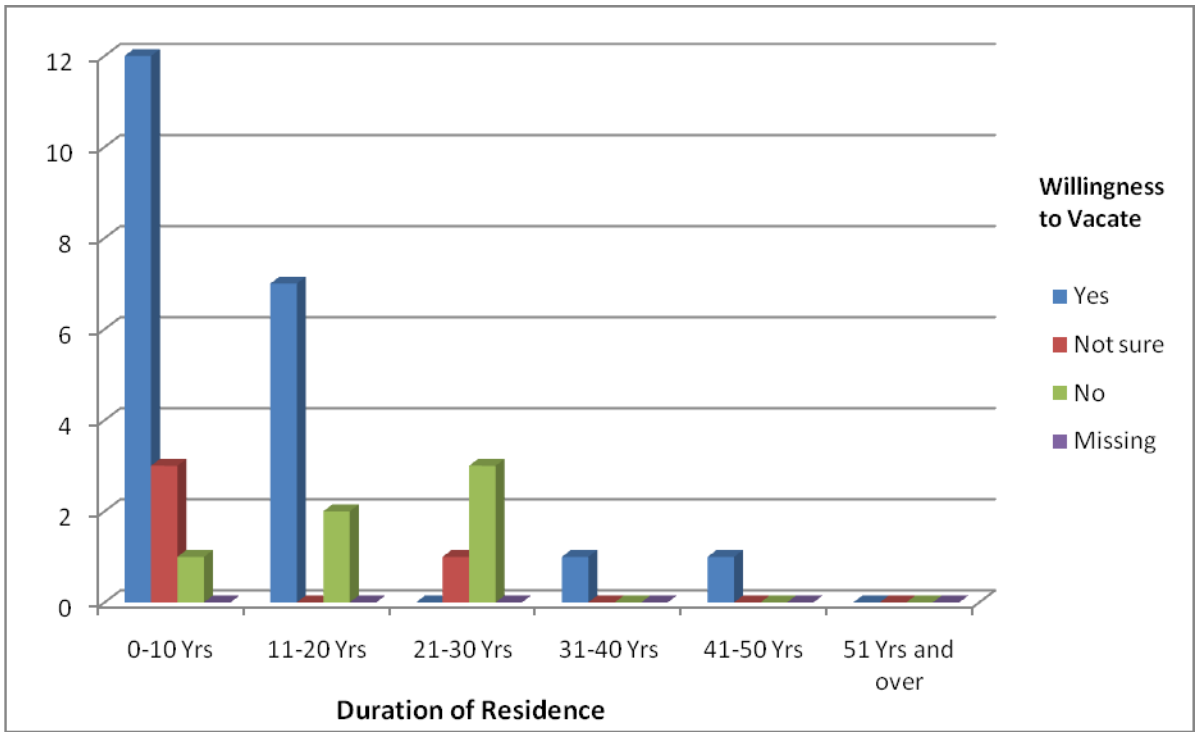
Other stakeholders think that it is possible to reclaim the entire 30m riparian reserve because of the following reasons;

a) Example of the Nairobi River riparian reserve which was successfully reclaimed with goodwill of the government and other partners
b) Moving people is possible through a multi-sectoral approach, that is working together with the housing, water, environment and planning sector
c) Using the law to convince the slum dwellers to evacuate as the courts are bound to uphold the law and instigate compensation
d) Convincing the members of the community of the benefits of reclaiming the riparian zone
e) The gains of rehabilitating the riparian ecosystem is far much greater than the cost of the evictions
f) Finally, the land belongs to the government and not to any other holders of any titles

5.3.1 Willingness to vacate the area

From the field survey findings, there emerged a rather not so peculiar relationship between the respondents' willingness to vacate the area- should it be mandatory to do so in order for the cleaning and maintenance programme on Mathare River to be successful- and the duration of residence within the area. This was regardless of there being compensation or not. The range of responses required was either yes, not sure or no. The figure below illustrates this relationship.

Figure 6: A graph showing the relationship between the willingness to vacate and the duration of residence within the riparian reserve



Source: Field Survey, 2014

The graph shows that there is an indirect relationship between the two tested variables. The trend is such that, the longer one has resided in the area, the less likely he/she is willing to vacate the same area. This implies that there already exists a sense of attachment to the land by the community members.

5.3.2 Other Feasible Alternatives to Forced Evictions

There are a number of feasible alternatives to the forced evictions and the subsequent demolition of houses within the riparian reserve. These include;

a) Dialoguing with the community members and convincing them to move as they are settled illegally.
b) Considering operating on the threshold riparian reserve of only 6 meters
c) Still pursuing the Kenya Slum Upgrading Programme to provide housing alternatives, though there are challenges to this
d) Canalling or building of embankments to reduce pollution
e) Construction of sewer lines and public toilet facilities within the settlement together with proper drainage facilities
f) Awareness creation
g) Enforcement of relevant legislation to deter the discharge of waste into the river

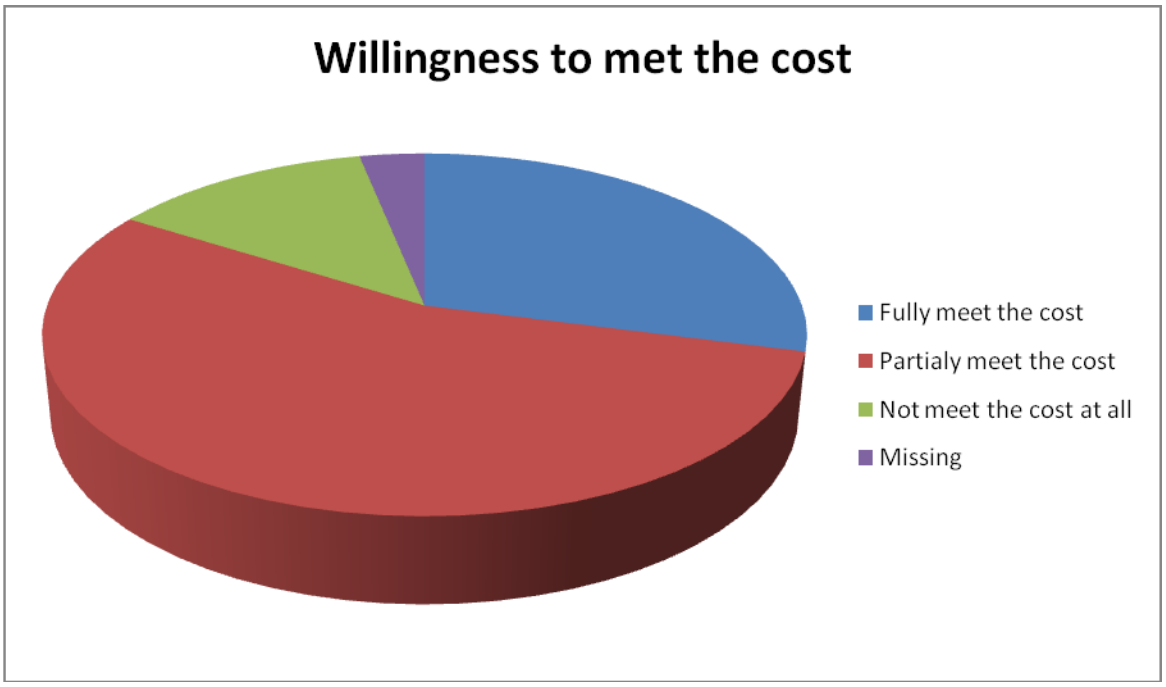
Plate 4: Photographs showing lack of infrastructure within the Mathare settlement

Source: Field Survey, 2014

The field survey also indicates that a majority the residents readily welcome these feasible alternatives to eviction such as alternative solid and liquid waste management mechanisms, sewerage services as well as meet the cost for these services. On the possibility to meet the cost 29% were willing to fully meet the cost, while a majority of them which represented 54% of the

respondents would partially meet the cost and proposed that the cost be subsidized while 22.9% would not pay for the services if they were offered as 3% of the respondents did not answer the question.

Figure 7: Chart showing level of Willingness to pay for alternative waste management services



Source: Field Survey, 2014

Those who said they would not meet the cost sited reasons such as inadequate income to cater for the same as well as the increased cost of living and absence of source of income due to unemployment.

6 Conclusions and Recommendations

6.1 Conclusion

Conclusions are drawn from the findings based on the objectives set out earlier. This was so as to justify the premises adopted by the researcher in order to enhance the significance of the project. The conclusions are therefore as follows;

6.1.1 Approaches Applied in Cleaning and Maintaining Mathare River

The NRBP is a multi-stakeholder project involving the government, private sector, NGOs and the members of the community each with specific roles. The Nairobi County government however plays the key role of initiating all physical processes that were involved in the river rehabilitation and the maintenance of the desired outcome. The government's role through the MEWNR was mainly tasked to secure grants and the procurement of services for the project. The private sector and donor agencies were involved through the provision of various grants and monitoring their use to ensure integrity of the whole project. Members of the public, which included residents within the riparian community, were involved through the provision of both semi-skilled and unskilled labor in the restoration process. This multi-stakeholder approach is therefore commendable as far as the sustainability of the project is concerned.

Public consultation was however not adequately done. A good number of the community members did not feel sufficiently involved in the project right from identification all the way to implementation. This has since triggered sense of resistance in some members of the community with regards to the approaches proposed in order to achieve the goals of the NRBP. In addition to this, the members of the community are indifferent on the effectiveness of the approaches

applied so far in the attempt of rehabilitating Mathare River. A considerable number of the respondents that is, 48% of them were of the opinion that the approaches were ineffective. Therefore the strategies employed in the project need to be enhanced or changed completely if the cleaning and maintenance project on the river is to gain the complete support of the public hence achieve success.

The state of the environment is presently still very poor despite the interventions put in place so far. The river is still chocking with raw sewage and other forms of liquid waste in addition to solid waste. This has led to the sharp deterioration in the aesthetic and ecological value of Mathare River ecosystem. This ultimately has had a direct negative bearing on its economic value as well.

The project has however currently stalled for a number of reasons. Chief among them is the absence of clear stewardship which largely rests on the shoulders of both the national government as well as the county government. The project as the researcher found out, was never a government project but an initiative launched by UNEP. The lack of commitment on the side of the government and the restructuring of the national government ministries are therefore chiefly to blame for the current situation. Other reasons blamed for this current stalemate include but are not limited to the absence of active engagement of the community members, corruption and funding limitations.

6.1.2 Challenges the Mathare slums pose to the cleaning and maintenance of Mathare River

Conditions in Mathare Valley slum settlements in particular Kosovo, Village 2, Villages 3A, 3B, 3C and No. 10 do pose a significant threat to NRBP with regards to Mathare River. This is through the following ways;

- The indiscriminate encroachment into the riparian zone by the settlements due to a number of reasons such as lack of awareness, high rural-urban migration, the escalating levels of poverty in the area, corruption, lack of enforcement of the law by responsible authorities and so on.
- The community is reluctant to accept the changes from the status quo (NRBP secretariat)
- The community's waste disposal mechanisms that is, through the river, are a major challenge due to lack of adequate facilities for proper waste management.
- Diffuse pollution from households located outside the riparian zone is equally a big challenge.
- The fact that 32.3% of the riparian community find the river beneficial is also a challenge as some of the economic activities they derive from the river are unsustainable such as, chang'aa brewing (mostly in Mathare No. 10), small scale agriculture within the riparian zone, charcoal and brick making.

6.1.3 Possibility of rehabilitating and maintaining a Thirty meter riparian zone

Stakeholders seem to agree that rehabilitation is possible; however some factors may hinder the realization of this goal. They include factors such as, the fact that human population within the riparian zone is already too big to be displaced which is protected by the constitution, the challenge of relocating this population, social-political challenges and some members refusing to relocate for one reason or the other. This means that very creative as well as practical intervention measures have to be implemented given the limitations above if the Mathare River ecosystem rehabilitation is to be sustainable and meet international standards.

Another factor that may hinder the rehabilitation of the riparian land and subsequently the entire Mathare River ecosystem is the issue of attachment to the land by the members of the community for one reason or another. The study showed that the longer a resident had stayed in the slum, the less willing he or she was to vacate the land should it be mandatory to do so. This further illustrates the need for the adoption of feasible alternatives to eviction for the rehabilitation goal is to be achieved.

6.2 Recommendations

This section seeks to highlight feasible alternatives to the approaches already implemented and others that are yet to be implemented such as forced evictions and subsequent demolition of homes and businesses within the thirty meters riparian zone. It however should be noted that these alternatives are to be adopted in addition to the mechanisms mentioned earlier in chapter five which directly relate to the restoration of Mathare River and its ecosystems.

Table 5: Alternative interventions proposed for the Cleaning and Maintenance of Mathare River

Alternative	Purpose	Implications
Integrated Village-Level Land Use Planning	To facilitate infrastructure improvements within the slum settlements/ villages. Focus being on village-level priorities and needs. The infrastructure include roads and pathways, improved water connections, drainage, trunk sewer lines, latrines or community latrines, garbage disposal facilities, improved housing and flood protection.	Significant Monetary investment/allocation Improved harmonious co-existence between the human and ecological environments
Integration of EIA and subsequent EA into the slum improvement infrastructure	To maximize on the benefits of proposed physical enhancement projects and minimize any potential negative impacts	Related costs of the study Ensures the participation of the slum dwellers Saves costs of development through identification of alternatives while ensuring sustainable urban

		development
Proper Community Participation mechanisms	To help in the identification of the most pressing problems and subsequent appropriate intervention measures	Continued support for the proposed programs Availing semi-skilled and un-skilled labor force
Considering operation on a threshold riparian reserve of at least 15 meters	To create a realistic 15 meter buffer zone from the banks of Mathare River to the nearest household so as to protect the river from agents of pollution. To provide space for landscaping works	Enshrining the 15 meter threshold riparian reserve as an exceptional clause by legislation Reduces the need for forced evictions which will be met with resistance from the residents
Development of an EMIS	To provide concise, timely and usable information on Mathare River as well as on the entire NRBP. To support participatory decision making process for the NRBP	Continuous maintenance of the system
Establishment of URRCs	Day to day maintenance of EMIS Assessment of the environmental health of	Better accountability and management of Urban river

	urban river ecosystems and Planning and coordinating various river basin management activities	basins.

All these interventions if implemented would ensure the sustainable process of rehabilitating Mathare River. This would definitely imply huge monetary investments but the long term benefits outweigh the costs involved.

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Appendix 1

KENYATTA UNIVERSITY

Department of Environmental Planning and Management

HOUSE HOLD INTERVIEW QUESTIONNAIRE

INTRODUCTION

I am a Kenyatta University undergraduate student pursuing a Bachelors Degree in Environmental Planning and Management. I am carrying out a research on the challenge of cleaning and maintaining Mathare River given the presence of the Mathare slums. I am kindly requesting for your time to answer a few questions. The information you will provide shall solely be used for academic purposes.

RESPONDENT'S DATA

AGE:

1.21-30 YEARS ☐

2.31-40 YEARS ☐

3.41-50 YEARS ☐

4. OVER 51 YEARS ☐

MARITAL STATUS

1. MARRIED ☐ 2.SINGLE ☐

HOUSEHOLD HEAD (Makes most of the decisions)

1. Male ☐

2. Female ☐

SECTION A: THE RIPARIAN RESERVE

1. For how long have you been living in this area? Would you say between;
   1.0-10 years ☐

   2.11-20 years ☐

   3.21-30 years ☐

   4.31-40 years ☐

   5.41-50 years ☐

   6. Above 51 year ☐

2. How far is your house from the river?
   1.0-10 meters ☐

   2.11-20 meters ☐

   3.21-30 meters ☐

   4. Over 31 meter ☐

3. What influenced your decision to settle in this area was it?

   1. Affordable cost of living/housing ☐

   2. Proximity to CBD/ government services ☐

   3. Proximity to work place ☐

   4. All of the above ☐

   5. None of the above ☐

4. Does Mathare River and its ecosystem benefit you and your household?
   1. Yes ☐ 2.NO ☐

5. If yes, which are some of these benefits?
   ……
   ……
   ……
   ……
   ……
6. Therefore, of how much benefit would you say the river is to you?

   1. Very beneficial ☐

   2. Average ☐

   3. of little benefit ☐

7. How do you dispose of your solid waste?
   1. in the river ☐

   2. In Garbage bags ☐

   3. in open garbage pits ☐

   4. Other Specify ☐

8. How do you get rid of your liquid waste and fecal waste?
   1. in the river ☐

   2. Established sewer lines ☐

   3. Other Specify ☐

9. Are you aware of the law that requires a 30 meter buffer zone from the river for the riparian reserve?

   1. Yes ☐ 2.Not sure ☐ 3.No ☐

SECTION B: THE NAIROBI RIVER BASIN PROGRAMME

10. Have you ever heard of the Nairobi River Basin Programme to restore, rehabilitate and manage all the rivers in Nairobi, including Mathare River?

    1.Yes ☐ 2.Not sure ☐ 3.No ☐

11. Has the community been consulted on and involved in the activities and plans for the cleaning and management of the river?

    1.Yes ☐ 2.Not sure ☐ 3.No ☐

12. If yes, would you say that the level of consultation and involvement was either;

    1.Very good ☐

    2.Good ☐

    3.Poor ☐

    4.Very Poor ☐

13. How effective do you think the approaches applied by the government in cleaning and maintaining Mathare River have been so far? Would you say they have been;

    1.Very effective ☐

    2.Effective ☐

    3.Ineffective ☐

    4.Very ineffective ☐

14. In what ways do you think the responsible authorities can best involve the community in the cleaning and maintenance of Mathare River for it to be sustainable for a long time?

    ……
    ……
    ……
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15. Has your household suffered any health implications related to the current state of the river?

1.Yes ☐ 2.No ☐

SECTION C: FEASIBLE ALTERNATIVES

16. Do you think it is possible to reclaim the riparian zone hence the successful cleaning and maintenance of Mathare River, given the presence of the slums in the riparian reserve?

1.Yes ☐ 2.Not sure ☐ 3.No ☐

17. Should it be mandatory for you and your household to vacate this area in order for the cleaning and maintenance project be successful, would you be willing to do so?

1.Yes ☐ 2.Not sure ☐ 3.No ☐

18. a) If alternative facilities for solid waste management and sanitation facilities were to be provided in order to ensure the success of the program, would you welcome these options?

1.Yes ☐ 2.Not sure ☐ 3.No ☐

b) If yes, how willing will you be to meet the costs associated with such services? Would you say you will either;

1.Fully meet the cost ☐

2.Partialy meet the cost ☐

3.Not meet the cost at all ☐

c) If no, give reason(s)

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……

******************Thank you for your feedback*********************************

Appendix 2: Interview Schedule

KENYATTA UNIVERSITY

Department of Environmental Planning and Management

INSTITUTIONAL INTERVIEW SCHEDULE

INTRODUCTION

I am a Kenyatta University undergraduate student pursuing a Bachelor's Degree in Environmental Planning and Management. I am carrying out a research on the challenge of cleaning and maintaining Mathare River given the presence of the Mathare slums. I am kindly requesting for your time to answer some questions. The information you will provide shall solely be used for academic purposes.

INSTITUTIONAL DATA

Bio Data Information

Date of Interview _____

Name of Institution _____

Respondent(s) Name _____

Respondent(s) Position _____

1. How has the 30 meters width riparian reserve for Mathare River been enforced so far?

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   ……
   ……..

2. What are the challenges you have faced in implementing the 30 meter riparian zone in the face of the presence of the Mathare slums?

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   ……
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   ……
   ……..

3. Is it possible to reclaim and maintain a 30 meter riparian zone along Mathare River given the presence of the slums?

   Yes ☐ No ☐

   Give reason(s) for either answer.

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4. Which are some of the mechanisms employed for the restoration, rehabilitation and management of Mathare River?

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5. What measures of success do you have in place for these mechanisms?

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6. Which mechanisms have been established to encourage the active participation of the Mathare slum dwellers in the Mathare River clean-up program?

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7. What are some of the constraints experienced in relation to the above?

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8. Have you considered other feasible alternatives to eviction and subsequent demolition of houses within the riparian reserve?

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