

Smart and sustainable transitioning for coastal cities in the face of global environmental change: Prototyping transdisciplinary networks for peer-to-peer learning for Mombasa (Kenya) and eThekweni/Durban (South Africa)

Smart and sustainable transitioning for coastal cities in the face of global environmental change: Prototyping for Transformative Change Within Action Research Approach



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Abbreviations and Acronyms

CCA	County Climate Change and Adaptation
CEBA	Community Ecosystems Based Adaptation
CGM	County Government of Mombasa
CIDP	Country integrated Development Plan
CoI	Co-Investigator
COMRED	Coastal Marine Resources Development
CoMSSA	Covenant of Mayors in Sub-Saharan Africa
CVM	Contingent Valuation Method
ECD	Environment Centred Design
EU	European Union
GDP	Gross Domestic Products
GHG	Greenhouse Gases
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ILP	Integer Linear Programming (ILP)
JICA	Japan International Co-operation Agency
KEMFRI	Kenya Marine and Fisheries institute
MCSF	Mombasa County Sustainable Forum
MOWASCO	Mombasa Water and Sewage Company
NEMA	National Environment Management Authority
NPO	Not for profit Organisation
OECD	organisation for Economic Co-operation and Development
P2P	Peer to Peer
PES	Payment for Environmental Services
ROI	Region of Interest
SDGs	Sustainable Development Goals
SUP	Single Use Plastics
SWM	Solid Waste Management

TRM	Transformative River Management
TWG	Technical working Group
UCLGA	United Cities and Local Governments of Africa
UHI	Urban Heat Island
WaCT	Waste Wise Cities Tool
WB	World Bank
WIO	Western Indian Ocean
WIOMSA	Western Indian Ocean Marine Science Association
WTP	Willingness to pay
WWF	Wild Wide Fund

EXECUTIVE SUMMARY

I. Introduction

The smart and sustainable transitioning for coastal cities in the face of global environmental change (*Miji Bora*) project was implemented over a 3-year period, from 2019-2022. Its main objective was to examine city systems with the overall aim of co-creating and co-designing practical pathways towards a smart and sustainable port city of Mombasa, Kenya when coupled with key insights from eThekweni (Durban) in South Africa. This was pursued through three broad objectives; that is, conducting a situational analysis of the key drivers of urban form; projecting future trajectories based on business-as-usual scenarios, and envisioning; prototyping, and mainstreaming smart and sustainable future pathways. Broadly, the project was implemented through an action-research approach which entails the overarching cycle of Assess/diagnose, Plan/Design, Implement/Action, Reflect/Evaluate (and a repeat of the cycle).

The approach allowed for a transformative process where one of the major outcomes was the formation of the Mombasa Smart and Sustainable City Forum (MSCF) as a key platform for guiding the implementation of smart sustainable city initiatives. The research process thus supported the transformation and empowerment of the actors and their environment in terms of practice and knowledge for continuity of action beyond the funding cycle of *Miji Bora*. Due to the inherent complexities associated with theoretical frameworks and variables around urbanization, sustainability, climate change, futures-thinking, and smart cities, we employed a variety of methodological techniques anchored in multi- and trans-disciplinary approaches. Consequently, we applied an eclectic mix of research designs and approaches to obtain quantitative and interpretive data.

The project activities included engagement in a series of trans-disciplinary peer-to-peer (P2P) learning exchanges between Mombasa and Durban's eThekweni Municipality, where Community Ecosystem Based Adaptation approaches are used in addressing city issues such as Solid Waste, Water and Sanitation, and Energy and Transport. The exchanges offered conducive atmospheres for city officials and academic researchers from both cities to engage in conceptual and practical learning through co-generation and co-creating of knowledge as peers. The exchanges were followed by prototyping where certain interventions were conceptualized and implemented within a clearly demarcated domain of the target system with measurable and demonstrable outcomes. In particular, the Smart City component served as the primary action-research vehicle into which outputs from the other components were integrated.

II. Prototyping Transformative River Management (TRM) at Mtopanga

The P2P exchange showcased the Sihlanzimvelo Transformative River Management in eThekweni Municipality. Representatives from the County Government of Mombasa learned about the successful rehabilitation of the river through stakeholder engagement which transformed the river into an aesthetically appealing tourist attraction. Inspired by lessons learned from this encounter, CGM representatives embarked on prototyping a similar approach in Mombasa for the Mtopanga River. The complexity and nature of issues surrounding the Mtopanga River require an integrated approach. The MSCF has established a Technical Working Group (TWG) on Transformative River Management (TRM) to address the condition of the river. The TWG is tasked with initiating stakeholder dialogues to advance collaborative action towards reversing current degradation and restoring the ecological functions of Mtopanga.

In 2022, the Miji Bora project supported stakeholder engagement with partners in the City of Mombasa to discuss the key issues of Transformative River Management for Mtopanga. The result was the identification of priority actions for integration into county planning programs, including recommendations for the next cycle of the County Integrated Development Plan (CIDP). The project completed a rapid reconnaissance and familiarization visit for the GIZ team and Mtopanga stakeholders on critical issues at different points along the river, the current initiatives on the river, potential priority climate actions, and interventions to address them. GIZ is implementing a city labs project under the Covenant of Mayors in Sub-Saharan Africa (CoMSSA) and has indicated an intention to implement some of the proposed priorities related to climate change mitigation on the Mtopanga River. Likewise, during the P2P exchange visit to Durban, the municipality shared their experience in the development of a Transformative Riverine Management Guide towards business case development and indicated a willingness to collaborate with the City of Mombasa on a similar transformation for Mtopanga.

III. Smart Futures

The project building on previous activities advanced the Smart Futures component. First, based on stakeholder engagement and visioning for Mombasa, participants reflected on the urban drivers and solutions to transition Mombasa into a sustainable city. Second, scenario building using forecasting tools and interactive community processes to predict the future state of key sectors, amidst climate change, under 'business-as-usual' scenarios. The project revisited the key issues in Mombasa in the context of the Sustainable Development Goals (SDGs). The SDGs were adapted to the needs of the city under five thematic technical working groups. Key issues addressed by Miji Bora in Mombasa Scenarios are 1) Plastic & Solid Waste Management, 2) Natural Capital, 3) Transformative River Management, 4) Climate Actions & Transport, and 5) Port & City Planning. Through this process, it was clear that Mijibora's objectives have been addressed in detail SDGs 11 (Sustainable cities and communities), 13 (climate action), 15 (Life on land), 14 (Life below water), 6 (Clean water and sanitation), 4 (Quality Education), 1 (No poverty), 3 (Good health and wellbeing), 7 (Affordable and clean energy), and 9 (Industry, innovation, and Infrastructure) among many. Consequently, each TWG completed their terms of reference (TOR) and shared their work plans and identified priority actions of relevance to county departments. These have been refined for integration into county planning processes such as the CIDP and for submission to the in-coming third County Government of Mombasa.

IV. Climate Change Action

The project inception workshop provided an opportunity for partners to identify the key issues of interest to the County Government of Mombasa (CGM). These issues became the focus of implementing the Miji Bora project, with climate change topping the list. Consequently, the project team led the development of the Climate Change and Adaptation Policy for Mombasa County 2021. The policy was designed to provide an enabling environment for transforming Mombasa County towards a climate-resilient coastal city. The success of this process in achieving a climate change policy outcome based on situational analysis for Mombasa has elicited interest from other counties which looking at adopting the Mombasa model. Furthermore, the Mijibora project initiated a process to develop the Mombasa County Climate Change and Adaptation Plan (CCA Plan) through participatory stakeholder engagement that culminated in the identification of climate actions for Mombasa. This process has since elicited the interest of partners to complete the action plan including the Young Women Christian Association (YWCA) which supported a stakeholder consultation and the World Bank which have taken over the preparation of the action plan

V. Situational Assessment

The project completed an information gap analysis to establish the status of different data and information in the county and a situational assessment of the urban drivers of change in Mombasa city. We found gaps in information-sharing protocols, and a lack of concepts related to the international discourses on smart-sustainable cities in policy documents. The situational assessment was done for all key drivers of urban form prioritized by the county government, i.e. Solid Waste management, Water and Sanitation (which includes clean water supply, urban flooding, and Sewerage Management), and Energy and Transport (which includes energy consumption and Green House Gas (GHG) emissions). The Mombasa County government closed its biggest dump at Kibarani in 2018, reclaimed and converted it into a public park. However, evidence from other areas highlights the risk of landfills and dump sites polluting the surrounding environment for decades following their closure. Miji Bora project in partnership with the Technical University of Mombasa, and the County Government carried out a study to assess the anthropogenic characteristics of the closed dumpsite to provide a better understanding of the scale of the potential pollution risk and identify remedial measures and recommendations. The study entails the identification of the potential receptors of any waste released and its contaminants, determination of leachate components and potential negative impact on soil, groundwater, surface water, and the life of aquatic animals. Information gathering methods included soil sampling and treatment, water sampling around the Kibarani dumpsite, isolation and enumeration of microorganisms from water, and isolation and enumeration of bacteria from soil. Initial data analysis is ongoing.

VI. Student Projects

The Mijibora project integrated six students pursuing lines of inquiries related to the project objectives and components. The students were supervised by various investigators of the project. Three master's students pursued their degrees within themes aligned with the components of the project as follows:

Ms Virginia Mumbua Ngei, Haramaya University Ethiopia looked at Community perceptions and willingness to pay for Mangrove conservation in the context of climate change in Mombasa County. The thesis is completed, Paper development ongoing

Ms Lynne Farrah, Kenyatta University, Kenya investigated the determinants Influencing Performance of Solid Waste Management in Mombasa County, Kenya. The Masters' thesis is completed and graduated in 2022. | Paper development is ongoing

Ms Ashleigh Sakala, University of the Witwatersrand, South Africa, based her study on Zanduspruit Maker culture – Makerspace for 4IR skills in waste salvaging. Master's thesis, completed/graduated 2in 021

Two PhD students defended their research and thesis based on themes and topics closely aligned to the theoretical foundations of the project components:

Ms Irene Ngunjiri, University of the Witwatersrand, researched on Water Governance in Urban Informal Settlements: An Infrastructure Lens Perspective on Mukuru, Nairobi and Kya Sands Johannesburg – completed/graduated 2022

Ms Vipua Rukambe, University of the Witwatersrand studied the Memories of futures-past and visions of future-futures: Liminality through gamification of backcasting in sustainable city transitioning for African cities – under examination

A journal article from one MSc research was published as follows:

Mr Titus Jefwa, Technical University of Mombasa. Route Optimization for Solid Waste Collection using Machine Learning & GIS Techniques. The student has also completed coursework and research for the masters and now at data collection stage with envisaged completion date of 2023.

Abstract of the academic article: Effective management of solid waste remains a key concern in Kenya, particularly in Mombasa County. The application of machine learning towards solving everyday waste management challenges has been on the rise. The paper presents an algorithm for producing an optimal waste collection route for Mombasa. The aim is to solve an integer linear programming (ILP) problem on route optimization using machine learning and graph theory. The study analysed the current solid waste management systems to identify the gaps in the collection, transportation and disposal of waste and develop a model for route optimization of waste collection within Mombasa County.

VII Evaluation and Assessment

Inadequate time for a systematic follow-up on actions within the action-research cycle (evaluation and monitoring stage) to inform second-cycle assessment of outcomes. This would only be possible within a

3 to 5-year period of systematic implementation of the prototyped initiatives. However, in the short term, the key outcomes can be summarised as follows:

IMPLEMENT/ACTION  Towards Transformative Change	REFLECT/EVALUATE OUTCOME: Resultant  Transformation/Change (+ves – what changed for the better, -ves – what remained stubbornly unchanged or changed for the worse & Thus inform subsequent cycle)		
Collaboratively Implementing the Responsive Action	Institutional	Knowledge	Practice
	Transformed institutional structure	Deepening knowledge Through TRANS-Disciplinary Interactions Across knowledge and Practice Boundaries in order to Facilitate Paradigm Change	Discovered and activated new networks not obvious to us at proposal stage Forged innovative communities-of-practice which did not exist prior
Data/evidence (including images)	Data/evidence (including images)	Data/evidence (including images)	Data/evidence (including images)

Figure 1 *Evaluation and assessment of short-term outcomes and impacts using action research*

Table 1 *Evaluation and assessment of short-term outcomes and impacts*

Activity	Outputs/ short-term results	Outcomes/ medium- term results	Impact/long- term results	Evaluation
Identify sources of energy; evaluate energy efficiency; characterise energy consumption, identify energy gaps and potential solutions, evaluate codes and practices on energy regulations for building; evaluate costs and benefits of potential solution	A report on energy sources, reliability, affordability and efficiency	Improved knowledge of the status of energy in Mombasa city	Cost-effective energy policies	The project completed a desktop evaluation of energy sources and GHG emissions in the transport sector. This informed the implementation of sector dialogue that established that identified key issues and priorities for intervention in the city, established a TWG on climate action and Transport, and provided the basis for JKP assessment of sources of GHG emissions in the road transport-up sector, a first in Kenya.

Peer-to-peer learning exchanges between officials and urban researchers in Mombasa and Durban;	A framework on peer-to-peer knowledge transfer; implementation of CEBA in Mombasa.	Improved ecological flows, reduced unemployment rate, more engaged citizens, reduced urban heat island, improved carbon sequestration, improved connectivity; peer learning exchanges	Better ecosystem services/living conditions in coastal cities	2 peer to peer exchanges, 2 webinars were conducted A framework for on peer-to-peer knowledge transfer was developed and a manuscript Key ecosystem services such as water and sanitation were prioritised for retyping. The Mtopanga TRM was initiated
Evaluate city development planning documents and governance frameworks	Report on the relevance and effectiveness of development plans, vision docs and institutional arrangements	A better understanding of the prevailing state of city development planning	Sustainable development planning in coastal cities	A review of policies and planning documents were completed for Mombasa and Durban. The review identified major omissions in sustainability discourse in Mombasa and made key recommendations for inclusion and a manuscript draft

Estimation of GHG emissions from various sources including the built environment and transport systems; identify and map risk-prone areas, Evaluate the level of disaster preparedness and extent of monitoring of critical infrastructure	An inventory of greenhouse gas emissions Provide vulnerability maps Report on the need and scope of using geospatial capabilities	Up-to-date knowledge of the city's GHG emissions; Better monitoring of risk-prone areas and critical infrastructure	Policies on low carbon pathways Disaster preparedness	The project developed an inventory of the GHG emissions in Mombasa and a UHI map for the city The project developed the Climate Change policy and initiate the process of the Climate Change Adaptation plan. The CCAP was taken up for implantation by a world bank funded project including the development a GHG inventory in all sectors The project supported the Climathon Hackathon that resulted in 6 prototypes of climate change solutions
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Identify sources of water, Estimate of supply coverage, establish loss of wastewater Conduct a social and environmental impact assessment of solid waste disposal	Report on the current status of the water, sanitation and waste disposal systems	Up-to-date information on water sources, connection distance, quality, effects of landfill sites on the residents/environment	Sustainable clean water supply Effective policies for waste management Healthy marine environment	The project completed a situational assessment of water, sanitation and waste 1 paper was published on water and sanitation and a manuscript on status of solid waste in the city The project contributed to the Mombasa Solid waste policy The project supported the Solid Waste Hackathon that resulted in 6 prototypes of solid waste management solutions The project completed the characterisation of solid waste infrastructure for Mombasa including mapping of the 2 main dumpsites The project established a TWG on SWM and held 2 sector dialogues The project developed a solid waste management mobile APP and web based dashboard for the monitoring of waste in the county Miji Bora carried out a study to assess the anthropogenic characteristics of the closed Kibarani dumpsite to provide a better Understanding of the potential pollution risk and to provide recommendations.
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Conduct stakeholder workshops to establish the desired future: hold feedback sessions on the status of the city systems, identify gaps that need to be addressed e.g. from peer learning exchanges.	A consolidated report, clearly outlining the pathways to a smart and sustainable city	Improved resilience Improved services Improved energy efficiency Adequate and well-connected green spaces	Resilient Smart Sustainable city	The project supported 2 stakeholder workshops that led to the establishment of a multi-stakeholder multi-sectorial MSCF and established 5 TWGs to guide the city to transition to sustainability
Indicators	Number of reports; number of Frameworks; number of inventories and maps,	Number and frequency of monitoring; number of residents employed in the CEBA programme; length of water connection distance; level of contaminants in the water; amount of sewage lose through the systems;	Number and types of policies; ease of movement; number of disruptive events prevented; life expectancy; acreage of green spaces	
Beneficiaries	City government; residents; visitors; business people and investors			

VII. Conclusion and Limitations

The Miji Bora project examined key urban drivers of the port city of Mombasa while relevantly using eThekweni Municipality in Durban city to draw lessons on practical approaches to sustainable growth. For effective implementation, issues pertinent to the project's broad objectives were categorised into 5 components; namely, situation analysis, peer-to-peer learning, institutional repositioning, stakeholder engagement and Smart futures thinking. Each component consisted of activities from which information relevant to the stated project objectives, was collated, analysed, and reported.

The overarching methodological approach employed by the project was evidently transformative of practice by, and knowledge of, the city officials and other stakeholders with regard to transitioning Mombasa into a smart, sustainable port city. For example, an outcome of the peer-to-peer learning exchanges involving city officials from Mombasa city and eThekweni municipality is the ongoing Mtopanga river transformation program. The program will address practical issues related to riverine settlement, acute encroachment, accumulated waste, and unfavourable human activities along the river systems. Additionally, a structured stakeholder engagement led to both the co-production of a desirable future for the city of Mombasa and a citywide forum through which smart-sustainable initiatives could be discussed, prioritised, coasted, and implemented. With regard to solid waste management, a targeted situational analysis not only examined problems associated with the lack of solid waste management data, but also led to the transformative action involving the development of a solid waste mobile application and dashboard. The mobile app and dashboard will help in monitoring the movement of waste from generation to dumpsite, inform recyclers at real-time, and the monitor flow/ efficiency of collection. Overall, the adopted methodological approach was instrumental in determining the extent to which the project achieved transformative outcomes, which outcomes would collectively contribute towards transitioning Mombasa into a smart-sustainable city.

Gender imbalance in the city's political economy and in all spheres of urban growth and development was apparent from the outset. For example, the female gender is underrepresented right across the city governance systems. Although comprehensive sex-disaggregated data was not available, a study conducted in Mombasa by the project team to evaluate the impact of covid-19 during project implementation showed that women were disproportionately impacted by the restrictions. This is mainly because women make up over 65% of the small-scale traders/domestic workers and are mostly employed in the informal sector which suffered immensely due to restrictions of movement imposed by the government. In general, gender inequality among the coastal communities in Kenya, and indeed the entire Western Indian Ocean (WIO) region is imbued with culture, religion, and unresponsive gender policies. While the issue of gender participation in the smart-sustainable transitioning of cities within the WIO remains largely unexplored, anecdotal evidence points to the low salience attached to the participation of the female gender.

IX Recommendations

From the onset, the foundational reasoning behind the *Mijibora* project was to implement transformative activities whose impact would be apparent in both practice and knowledge transmission. This was a challenging undertaking given the history of research within the Western Indian Ocean region, and indeed in Africa, where practitioners lack an advanced understanding of research implementation, let alone the effectiveness of implementation strategies. A well-thought-out action research approach was able to serve the twin purpose of ensuring methodological rigour while providing the necessary preconditions (mainly through prototyping), for attaining subsequent sustainable outcomes within the areas of application. The participatory nature of the action research afforded city officials the opportunity to see the links between their specialisations and smart-sustainable development and enhanced their interest, confidence, and motivation to engage with the city's smart-sustainable growth. Future projects and studies should aim at to build on this momentum to ensure these benefits are not only sustained but also enhanced. In particular, projects relating to urban sustainability and global environmental change should consider going through the current and future sustainability forums such as the Mombasa sustainable city forum which was a key outcome of the *Mijibora* project.

Stakeholder engagement is a vital activity in any discussion around sustainable growth, not least because it helps to consider the needs and desires of anyone who has a stake in the growth and development of the city. This fosters connections, trust, confidence, and buy-in for sustainability transitions. Successful projects will need to undertake prior stakeholder analysis and engagement. This engagement must be on the stakeholder's own terms to mitigate dissatisfaction, disengagement, and resistance to change. The diversity of stakeholders in the city calls for downward, horizontal, and vertical engagements, hence, a one size fits all approach will not work. As sustainability is a difficult concept to pin down, let alone implement, there is a need to tailor the ways of working with city residents to meet the needs of all the stakeholders concerned. Judging from the reception of the *Mijibora* project by various stakeholders, it was apparent that there is a deep agnosticism for the research community to facilitate the transition from theories to practice (science-policy) in Mombasa. While the *Mijibora* project had great success in building stakeholder confidence through processes and results, future projects should relevantly capitalise on this newfound interest to entrench sustainability thinking, and maintain Mombasa on a smart sustainability pathway. In addition, these efforts should be replicated and scaled up to other jurisdictions within the WIO region.

Implementation of *Mijibora* in Mombasa delivered key outputs bringing to fore a need for replication & scale-up of Smart City Forums to coastal cities within the WIO that still face similar challenges.

A Policy brief on sustainable cities is needed to guide coastal cities of the WIO that have committed to follow a similar trajectory as Mombasa City

X Key learnings

City projects address diverse and complex issues. It is clear that contemporary research approaches would not facilitate the transition from theories to practice within lifespans of short project cycles (e.g. <3yrs). In such instances, **action research** is ideal methodological approach. Its adaptability and effectiveness in guiding actions aligns well with the processes involved in sustainability driven initiatives.

With multiple stakeholders in cities, **stakeholder engagement** in any discussion around sustainable growth is vital. Inclusive decision-making processes where all stakeholders including local leadership are proactively identified, and consistently part of the prioritization of issues, and co-creation of solutions lead to sustained impact of city initiatives and inclusive policies

Peer-to-peer exchanges (P2P) provide city officials and academic researchers from participating cities an opportunity to engage in conceptual and practical learning. Such is followed by the prototyping of certain interventions as conceptualized and prioritised by them. P2P exchanges, therefore, require a clear framework of implementation and a target system to produce measurable and demonstrable outcomes that are transferable to sister cities.

Adoption of **smart futures and visioning** action research serves to integrate innovation and stakeholder participation, in relation to global priorities and issues such as the SDGs and Climate Change, under local settings, by facilitating the integration of sustainability discourses into city planning documents and processes

Building human capacity is a key step needed to make qualitative shifts toward smart-sustainable cities. There is a need to reform the current institutional arrangements to enhance cooperation and coordination among different entities and between the county government and non-state actors, and embrace integrated policy formulation and long-term planning.

XI Sustainability beyond WIOMSA grants & Scalability

The Miji bora project implementation was collaborative. From inception, the project acknowledged the gap in data and information sharing protocols in Mombasa. The project established mechanisms to ensure partners' access to information where each participating institution has access to the datasets and reports for activities they are involved in during implementation. Further, the establishment of MSCF facilitated access among partners and guarantees the availability of information beyond the project implementation cycle.

The project established the Mombasa Smart Sustainable City Forum (MSCF), complete with its structure's and imbedded within the county government frameworks. MSCF through its thematic Technical Working Groups (TWGs) has been instrumental in charting a unique path towards an

environmentally, socially and economically sustainable, and smart City of Mombasa. It is expected to be operational beyond the project implementation cycle. The model of MSCF is replicable to other coastal cities of the WIO region.

Each MSCF TWGs identified priority actions for integration into the county planning programs, including recommendations packaged for the next cycle of the County Integrated Development Plan (CIDP).

The Miji bora project focused on issues of relevance to the county government of Mombasa, most of which have either been selected for continuation or up-scaling by partners. For example, GIZ under the Covenant of Mayors in Sub Saharan Africa (CoMSSA) is implementing a city labs project and has indicated an intention to implement select proposed priorities related to climate change. Likewise, Durban municipality is willing to continue collaborating with the City of Mombasa in the development of Transformative Riverine Management business case and P2P learning exchanges.

The project led the development of the Climate Change and Adaptation Policy for Mombasa County 2021. The policy was accented to by the Mombasa County Governor in September 2022. It is designed to help in transforming Mombasa County towards a climate-resilient coastal city.

XII Gender Considerations

The question of gender equality in national and subnational policies in most African countries is no longer a subject of debate. Gender equality is now well articulated in official policy blueprints. While policy documents, including constitutions of countries such as Kenya such as that of Kenya, have well-articulated principles on gender equality, there are still persistent gender-based disparities, inequalities and exclusions faced by women, particularly among low-income urban residents (see Tolhurst et al 2022). For example, this project found that there existed a gender differentiated response to the impacts of Covid on residents in Mombasa. The findings of our study were confirmatory of an earlier study which revealed that more women than men work in jobs that are vulnerable to disruption. We further established that women tended to operate smaller businesses associated with traditional women roles such as hairdressing, selling fish, trading in vegetables and so on. Such businesses require face to face interactions, little wonder that women were disproportionately impacted by the Covid-19 restrictions (see Kithiia et al, 2020)

There was skewed gender representation in favour of the male gender in all studied areas of the urban form. During a survey to establish the socio-economic impacts of Covid-19, mentioned above, the project team noted gender inequalities related to access to digital and connectivity infrastructure, which disadvantaged women. While men have long been able to surf the web, many women lacked access to the internet even though they might have smartphones. Many women lacked enough money to use the internet with 7 out of 10 online mobile users being men. This was confirmed by our survey, which required respondents to have access to the internet to fill out the questionnaire. Less than 40% of the women completed the survey in a city where gender composition is nearly 50-50. This points to the underlying gender inequality in accessing digital infrastructure. The lack of access to such infrastructure is an

additional stratifier of the gender inequalities that exacerbate differential impacts in access to crucial information, for example, that which is shared through social media and internet platforms.

The continued marginalisation of the female gender affects their contribution to urban development, making them struggle for a place at the table. This struggle takes place at the city, county, and national levels, in governing institutions, local community institutions, and in the women's daily lives and activities. Yet, gender equality is a necessary foundation for a prosperous and sustainable city. The UN Sustainable Development Goals (SDGs), goal 5, is aimed at achieving gender equality and empowering women and girls. Target 5.5 is to ensure women's full and effective participation and equal opportunities for leadership at all levels of decision making in political, economic, and public life. Overall, the project found that the current governing systems, both political and institutional, are yet to recognise that sustainable urban growth must include gender equality and empowerment of women, both as an SDG goal in its own right, as well as a fundamental part of all other goals.

XIII Publications

Kithiia, J., & Majambo, G. (2020). Motion but no speed: Colonial to post-colonial status of water and sanitation service provision in Mombasa city. *Cities*, 107, 102867.

Kithiia, J., Wanyonyi, I., Maina, J., Jefwa, T., & Gamoyo, M. (2020). The socio-economic impacts of Covid-19 restrictions: Data from the coastal city of Mombasa, Kenya. *Data in brief*, 33, 106317.

XIV Project Website

Further details on *Miji Bora* Project can be accessed on our project website: <https://mijibora.org/>. Key highlights of the website are:

- Updates on project implementation
- Project components
- Topical issues on smart/sustainable urban growth
- Partnerships
- Various reports

The website provides cutting-edge information on the state of the coastal city of Mombasa with regard to smart-sustainable growth. The information is not exhaustive, but is intended to outline the progress on the project's work, and provide quick updates on topical issues on urban sustainability.

EXTENDED REPORT

1. Introduction

1.1 Background

The United Nations World Cities Report published in May 2016 (UN, 2016) noted a global trend in which cities have become central to the transformation of the global economy. Urbanisation has also dramatically changed energy consumption patterns, water and sanitation needs, food security and mobility of human beings. And with this change arises unprecedented challenges for city governments and residents alike. Nowhere is this gap more evident than in African cities where consequences of poverty, namely; in informal settlement patterns, economic inequality, high youth unemployment and environmental degradation are pervasive. Climate change is expected to compound the urban problems with coastal cities such as those in the Western Indian Ocean (WIO) region, being disproportionately impacted. Left unaddressed, the impacts would derail the development of these coastal cities, and prevent them from becoming economic engines in the global network of cities, capable of delivering adequate services and quality of life for their growing population.

The challenges facing these African cities call for urgent foregrounding of sustainable planning, and deliberate implementation of sustainable approaches, founded on a solid transformative agenda. National and city governments, the private sector, researcher and development partners have begun conversation which are aimed at tapping into the opportunities that could help fast-track the cities' socio-economic and environmental transformations. For example, a recent gathering of researchers, policy makers, private sector representatives and development partners, held in Kisumu under the auspices of United Cities and Local Governments of Africa (UCLGA) for the 9th edition of *Africities*, sought to deliberate and find lasting solutions to sustainable models of social and economic growth (Koigi, 2022).

Plans to address the challenges of rapid urbanisation through digital technology-enabled urbanisation models are also under consideration. These are aimed at transforming cities to offer better services to residents and visitors. Approaches to such transformations have been evolving in the last few years, from merely focusing on the deployment of technology to enhance service delivery, to improving the quality of life of urban residents through new technologies. Following the latter, the concept of smart city has emerged, and smart city initiatives are being implemented by many cities in both developing and developed countries.

The Miji Bora project was conceptualised as an opportunity to collate, analyse, prototype and report information that is grounded in reality. The project implementation followed a 3 stage process;

- a rigorous evaluation of the state of selected drivers of urban form,
- projection of possible futures based on the business-as-usual scenarios (2100)

-
- Use of participatory back-casting techniques to design and operationalise a desirable future for the city of Mombasa. This also involved investigating the extent to which technology-enabled approaches could be leveraged to address the challenges of rapid urbanisation within the context of a developing country.

1.2 Context and Approach

With unprecedented challenges facing coastal cities in the Western Indian Ocean (WIO) region, through its Cities & Coasts Project, WIOMSA aims to establish and operationalise a regional science-to-policy platform that generates and builds capacity, mobilises resources as well as shares and facilitates scientific and policy-relevant knowledge to deliver on the 2030 Agenda for oceans, islands, coasts, and climate change (cite WIOMSA document or programme website). The main objectives of the Cities & Coast project are to:

- Improve scientific knowledge and stimulate research directed at underpinning effective and efficient responses by coastal cities to current and foreseeable challenges they face. Support will be given only to high quality, demand-driven, and policy-relevant **action research**
- Support and facilitate capacity building in city planning with a focus on coastal cities and **the transfer of knowledge and expertise** to harness the potential of these cities
- Mobilise of planners to collaborate with stakeholders in coastal cities such as local authorities, marine scientists, and policymakers from central government, the private sector, civil society and citizens. In the **co-production of the knowledge and production of decision-support tools**, needed to support the transformation of coastal cities towards sustainability
- Encourage **partnerships among stakeholders** from the academic, practitioner, private sector, civil society, and policy-making communities in enhancing coastal cities and facilitating the blue economy

1.2.1 Objectives and Expected Outcomes

To fulfil the objectives of the Cities & Coast project outlined above, WIOMSA funded several projects within the WIO region. The *Mijibora project* (Smart and sustainable transitioning for coastal cities in the face of global environmental change: Prototyping transdisciplinary networks for peer-to-peer learning for Mombasa (Kenya) and eThekweni/Durban (South Africa)) project is one of those projects. The project was launched on 7th March 2019 in Mombasa, Kenya

The overarching aim of the project was to co-creatively examine city systems in Mombasa, and design practical pathways to possible routes of becoming a smart and sustainable coastal city. Specific objectives pursued include:

- Conducting a situational assessment of key drivers of urban challenges
- Predicting future trajectories based on business-as-usual scenarios
- Envisioning, prototyping and mainstreaming smart and sustainable future pathways

1.3 Project Partners

As shown in Figure 1, Miji Bora project entailed a trans-disciplinary initiative undertaken through collaboration among several key partner organisations as well as an affiliation of critical stakeholders in Mombasa and eThekweni municipality in Durban. The core of the project entailed a collaboration between the County Government of Mombasa and eThekweni municipality. Under this collaboration there were formal interactions and exchanges of which the peer-to-peer (P2P) learning exchange was the primary activity. The co-Investigators from Mombasa County and eThekweni Municipality were Dr Godffrey Nato (County Executive Committee Member, County Government of Mombasa) and Dr Sean O'donoghue (eThekweni Municipality and the University of KwaZulu Natal) respectively.

Smart and sustainable transitioning for coastal cities in the face of global environmental change: Prototyping for Transformative Change Within Action Research Approach



Figure 2 Overall Project partners with WIOMSA as the funding organisation

At a secondary level, co-investigators were drawn from diverse NPOs (not for profit organisations) and think-tanks based in Mombasa and eThekweni. These include:

- COMRED (Coastal and Marine Resource Development- Mombasa), which also served as the key administrative partner, primarily liaising between the research team and the County Government of Mombasa as well as with the Coast & Cities Programme Manager at WIOMSA. The co-Investigator from COMRED was Dr Innocent Wanyonyi
- KMFRI (Kenya Marine and Fisheries Research Institute), Mombasa, whose Co-Investigator was Dr James Kairo

At a tertiary level, formal collaboration between the two cities was also complemented by collaboration among academics from two institutions as follows:

- University of Witwatersrand, School of Architecture & Planning with Prof Daniel Irurah as the co-Investigator
- Macquarie University School of Natural Sciences – Dr Joseph Maina Mbui.

Other stakeholders engaged in various stages and activities of the project (especially the diverse stakeholder workshops undertaken in the course of the project) include:

- Mombasa County
 - Stakeholder Engagement workshop
 - Solid Waste Management Dialogue 1.....
 - Green House Gas emission and Transport Dialogue.....
 - Solid Waste Management Dialogue 2.
 - Solid Waste Hackathon
 - Climate Change Climathon Hackathon
 - Scenarios and Visioning workshop
 - Mtopanga River Stakeholders Reconnaissance
 - Governor’s Youth Leadership Programme- Climate Change Round Table
- eThekweni Municipality
 - University of KwaZulu-Natal in eThekweni
 - Transformative Rivers Management Webinar
 - Durban- Mombasa P2P Exchange
 - Durban-Mombasa- Comoros P2P
 - C40 workshop

1.4 Key Project Components and Co-Investigators

For purposes of ensuring trans-disciplinarity and coherent coverage of scope, the project was structured into four key components with a co-investigator (CI) leading each component. The key components were:

- Situational analysis - CI - Justus Kiithia (also served as Principal Investigator)
- Institutional Repositioning (with a focus on Mombasa County Government) - CI - Dr Godffrey Nato
- Peer-to-Peer learning and exchange - CI - Dr Sean O’donoghue
- Futures-thinking and smart city - CI - Prof Daniel Irurah

1.5 COVID Impacts on the Project

The novel coronavirus (COVID-19) adversely affected the global community and, like most sectors globally, the *Miji Bora* project was not spared. Due to government-imposed restrictions through lockdowns and curfews project implementation was disrupted and most activities were delayed while others were modified to ensure responsive flexibility for implementation under highly restrictive conditions. As a coping mechanism, the peer-to-peer learning (P2P) component adopted the use of virtual hosting of workshops and webinars. By the project closure stage, the component had successfully conducted 4 webinars for P2P-learning among Mombasa and eThekweni city officials. However, most of the delayed

activities were followed up in 2022 subsequent to the gradual lifting of lockdown and severe restrictions during the first quarter of the year. The combination of the coping interventions coupled with the expedited implementation of delayed activities has ensured satisfactory achievement of project objectives and outcomes as initially envisaged.

2. Project Approach and Method of Study

To fulfil the *Miji Bora* project objectives, the overall approach was defined as shown in Fig 3. and described in subsequent sub-sections.

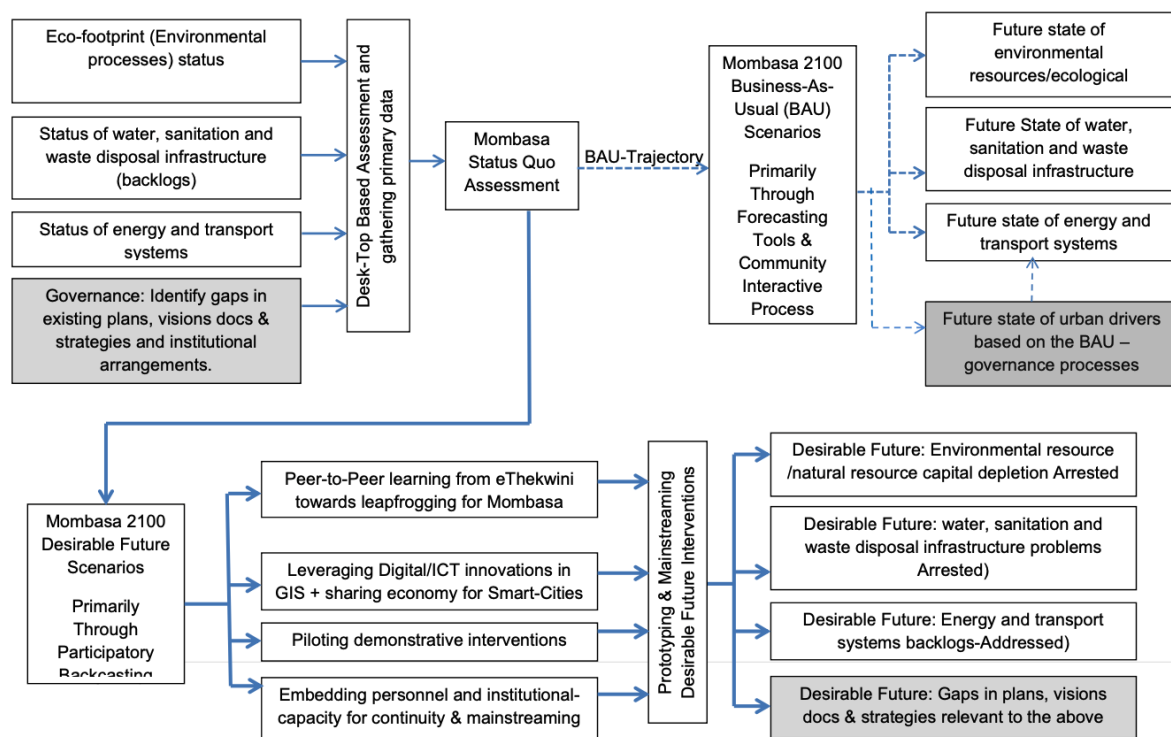


Figure 3 Conceptual Framework for Miji Bora Project

Note: Guided by Action Research as the overall method, the conceptual framework was translated into action research framework as shown in Figure 3.

3. Project Activities

3.1 Activity 1 - Review of Relevant Literature

The method applied to conduct literature review entailed four tasks as depicted in Figure 3 and described as follows:

- Desktop data collection to identify relevant policy documents as well as established think tanks, research centres and international organisations that produce relevant research and policy recommendations;
- Quantitative analysis (statistical analysis) to determine the research landscape, e.g. investigated themes, the most active institutions and researchers, the years when the research was conducted, and contributing disciplines, key features of the identified policy documents, e.g. policy areas and represented countries, among other themes;
- Qualitative analysis to derive main findings from the identified literature. The analyses was done according to key themes derived from the project objectives. The themes include Innovations, Technologies, Drivers, Challenges, Benefits, Stakeholders, Approaches, Values, Risks, Tools, Regions and Governance;
- Synthesis to consolidate key findings on this activity.

ASSESS/DIAGNOSE – Status Quo Concerns/Needs for Transformative Change	PLAN/DESIGN - For Responsive Transformative Change	IMPLEMENT/ACTION Towards Transformative Change	REFLECT/EVALUATE OUTCOME: Resultant Transformation/Change (+ves – what changed for the better, -ves – what remained stubbornly unchanged or changed for the worse & Thus inform subsequent cycle)		
			Institutional	Knowledge	Practice
Participatory processes of identifying the key drivers contributing to the undesirable status quo and hence calling for change	Co-creatively conceptualizing and planning responsive ACTION towards transformative change	Collaboratively Implementing the Responsive Action	Transformed institutional structure	Deepening knowledge Through TRANS-Disciplinary Interactions Across knowledge and Practice Boundaries in order to Facilitate Paradigm Change	Discovered and activated new networks not obvious to us at proposal stage Forged innovative communities-of-practice which did not exist prior
Data/evidence (including images)	Data/Evidence (including images)	Data/evidence (including images)	Data/evidence (including images)	Data/evidence (including images)	Data/evidence (including images)

Figure 4 Action research approach for Miji Bora Project

3.2 Activity 2 – Situational Analysis

3.2.1 Policy Analysis

Mombasa city is not only Kenya's second largest city after Nairobi, but is also one of the most prominent coastal cities in the western Indian Ocean region. The administrative city and county borders coincide such that in a way Mombasa can be thought of as a city-county where 100% of its population is considered as urbanised. According to Kenya's national population census of 2019 (cite actual source), Mombasa County is home to about 1.2 million people. Responsibility for city governance is placed under the County

Government with the county assembly as the local legislative body. The County Governor is the executive head of the government (see Figure 4 and County Governments Act, No 17 of 2012)

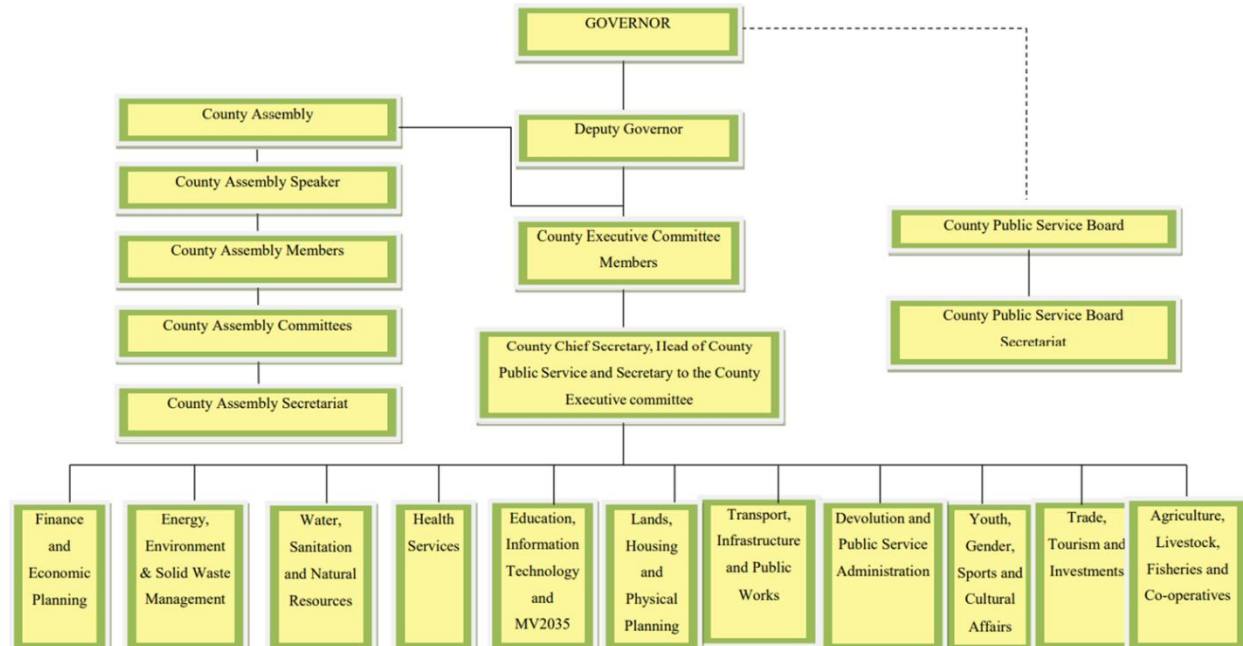


Figure 4: Governance structure for Mombasa County (source: CIDP 2018)

The process of county governance is underpinned by policies which play a key role in guiding economic, social and environmental transformations. Hence, they are central to the sustainability debate especially because a lot of hope is being placed on the capacity and competence of cities to lead in the transformational efforts towards sustainable development, globally.

As a set of rules or regulations on governance processes, policy documents essentially capture development priorities as well as mechanisms by which such priorities are to be pursued. To be effective in meeting the objectives for which they are designed, policies/policy documents must complement each other not least because of the need to have a seamless use of scarce resources and avoid working at cross purposes. Take for example the SDG's. The goals of SDGs are designed such that no one goal should be prioritised over the other. Yet, as we enter a decade of action on SDGs, the opportunity to rethink, rewire and repurpose cities such as Mombasa for a more sustainable future is fast slipping away. Persistent problems such as water and sanitation, solid waste management, infrastructure and, now Covid-19, continue to receive more attention and budget, but with minimal progress towards goal attainment.

Arising from the analyses of policy documents, the following were identified as the key gaps:

- Inadequate level of regulatory harmonisation coupled with contradictory aspirations
- Absence of conceptual and empirical studies which map trajectories of WIO cities
- Aspirational visions are contradicted by regulatory agendas which roll back planning mechanisms by which such visions are to be achieved,

- The interventionist nature of international partners (such as circumventing planned activities in order to provide funding directly for specific projects of their own choice),
- Evidence of a clear divide between political decision making versus evidence-based processes commonly favoured by bureaucrats in government

Overarching questions:

- Based on targets 17.3 and 17.4 of the SDGs, to what extent has external funding for projects affected policy coherence for sustainable growth in Mombasa city?
- Which inherent contextual factors in Mombasa city's governing/development policies and plans can influence sustainable growth?
- What mechanisms and practices exist for promoting policy coherence for sustainability?

SDG Target 17:4 is therefore important because international agencies and donor countries can/do significantly alter policy trajectory anticipated by city plans with a tendency towards embracing mega-infrastructure and highly visible projects which would not be feasible within domestic funding. The economic justification for these mega-infrastructure projects is foregrounded on economic outcomes with social and environmental impacts pushed to the background.

The goal of this section is to explore the extent to which the designed milieu of policy landscape addressed smart sustainable growth in the coastal cities of Mombasa, Kenya and Durban, South Africa. The key issues which guided the investigation were as follows:

- establish extent to which policy frameworks are directed towards accepted international discourses on sustainability, and especially the SDGs
- assess extent to which external funding is aligned with facilitating implementation of policy intent or if it is ad hoc and unrelated to existing policy - does it sit within the existing vision of the cities/align with predetermined vision
- determine if externally funded projects shift city planning priorities and trajectories and if they disrupt sustainability interventions as a result

3.2.2 Methodological techniques employed

Policy analysis was based on a multi-method approach which ensured that the strength of one technique offsets the limits of another. The study used content analysis to investigate socio-political and contextual truth via inference, objective and systematic classification with regard to meaning. This enabled us to understand the 'between the lines' messages and subject the content to interrogation. A gap analysis was conducted to compare actual performance with what is desired/expected. This technique provides a way of identifying suboptimal or missing strategy, opportunities, structure, and practices that would help to guide sustainable city transitioning.

3.2.3 Findings

Findings on the situational analysis of the policy environment highlighted that collaborative engagement across Mombasa governance system is erratic and inconsistent primarily due to the following contributing factors:

-
- System thinking approach as prioritised in sustainable development is not reflected in the prevailing compartmentalized policy making and weak cross-sectorial collaboration within elements of the city government. This clash was evident in collaborative events organised by the project team especially during stakeholder engagement workshops and P2P learning exchanges
 - Lessons from two conferences organised by the Kenya Institute of Planners (see annex 13) during the project period, and in which the project team was represented, explored how collaborative cross-sectorial planning has contributed to elegant solutions, especially since the start of devolved governments. However, it was still evident that such initiatives are difficult to operationalise in real policy contexts imbued with individuals, sectors, agencies and their values as well as a tendency to fall back to the BAU policy formulation approaches inherited from the old order (planning prior to the change of constitution in 2010)
 - Strong presence and engagements with international not-for-profit organisations and UN bodies, which predates county governments created client list relationships at the city level. For example, many of the major projects and research work in the city have either been funded by the World Bank (WB) UN Habitat, JICA and EU or a combination of these international organisations). This explains the lack of enthusiasm towards embracing collaborative cross-sectorial policy formulation, as different sectors try to outdo each other in attracting donor funding to run their own programs owing to insufficient exchequer allocations. Despite the apparent awareness amongst city level decision makers that coherence in policy formulation is vital for sustainable development, the entrenched patronage by international donors has ensured that the status quo is maintained. For city politicians, attracting donor support to undertake large-scale projects not only provides an effective currency with which to secure voter loyalty, it is also an opportunity for corrupt city officials to engage in rent-seeking. However, as has been opined by several authors (see for example, (Arreortua, 2016; Rode, 2018; Travers, 2015; Muñoz, Amador, Llamas, Hernandez, & Sancho, 2017; de Sousa & Moriconi, 2013; Transparency International, 2015) the issues of available budget versus the array and scope of responsibilities undertaken by cities are just a part of the story. The political and fiscal empowerment and autonomy of institutions, the coordination of strategies and interventions at the city level and the steady supply of skills necessary to deal with the complexities of urban governance are all constraints which may lead to exploitation and corruption.
 - Clear evidence in Mombasa that sustainability thinking is at odds with organisational and institutional culture (hence our prioritisation of institutional repositioning as a key component of the project). As a key example, though the law requires community consultation in all aspects of urban governance, it was evident that in most cases either the solicited community input failed to find its way to the final formal policy documents such as the budget paper, or city officials sought community approval on the basis of preconceived projects which entailed limited engagement as opposed to the recommended co-production approach.

-
- Prevailing discourse in local policy favoured addressing present contingencies based on a reactive approach. For example, in the course of the *Miji Bora* project implementation, the county had an ambitious plan to desalinate sea water to address perennial water shortages. Also, on the cards was a plan to rehabilitate the main sewage treatment plant-. Whereas most of such projects cannot be actualised through county-level funding, external funding calls for sustainability thinking based on a clear future orientation. This insight drew a clear appreciation that even with the noblest intentions, county governments do not operate in a vacuum. City policy-makers and officials negotiate through policy process while being subject to the influence of the national government as well as the need to steer or co-ordinate with other authorities, lobbyists and other democratic concerns (Mossberger & Stoker, 2001; Stone, 1989, 1993).
 - City officials charged with policy implementation are forced to deal with immediate problems, and not attending to these can have tangible negative consequences for their careers. For example, during the project period, the Mombasa Governor relieved all County Executive Committee Members (CECM), also known as 'County ministers' of their duties. A few of them were later reappointed after a 3 month absence, and allocated large portfolios, putting into question their ability to effectively deliver their mandates.
 - Despite the rhetoric, there was no systematic evidence of co-design/co-production approaches applied in policy or program design. Instead, policies are designed 'for' rather than 'with' the people. In particular, power differences are neither acknowledged nor addressed, hence, city officials or funding agencies who have the most power inevitably exercise the most influence over decisions regardless of quality or knowledge over issues calling for attention
 - Without sharing power, there can be no co-design, yet addressing transitioning barriers to urban sustainability requires horizontal and vertical relationships, social connections and trust among city officials, funders, politicians and other internal and external stakeholders. This paves the way for conversations where potentially controversial issues can be confronted as planning experts become coaches to enable everyone to have something to teach and something to learn.
 - Despite the much hyped stakeholder or community consultations during the budgeting processes, there are no guaranteed service outcome nor mechanisms for seeking, providing or acting on stakeholder feedback
 - Investing in and embracing local leadership is, by default, relegated to local community-based organisations which lack strong vertical connection to power and influence for feeding in their grassroots expectations and ideas to bureaucrats and politicians as key policy-makers.

-
- Broken promises, especially by elected political representatives, have given way to scepticism due to weak socio-political relationships which are no longer conducive for consensus in pursuing expectations of the electorate

The root causes of the above problems are varied and are subject to speculation, but it is generally agreed that the level of public participation in policy design is equated with fairness of policy outcomes. Urban researchers, activists and other interest groups emphasise the importance of community voice and decentralization of decision-making in the name of democracy. But how does this square with cities increasingly having to manage systems and international issues that are not necessarily amenable to popular input? It is unlikely that such issues would be addressed without significant investments from external funding. To the extent that the silo approach in planning and implementation of policies and programs remains the norm, without institutional arrangements which can help a city such as Mombasa to address complexities of social, environmental, and economic issues, external influence through funding opportunities is bound to continue.

3.1.3 Leveraging opportunities in Mombasa city

Inclusionary policy-making and implementation for sustainability transitioning could be leveraged through the following key initiatives as shown in Figure 5:

- Evolving approaches towards co-designing of policies as well as collaborative implementation
- Prioritising quality of inclusion bearing in mind diversity among stakeholders
- Brokering/strengthening strategic partnership
- Employing smart technology
- Building institutional capability
- Ensuring platforms to challenge the norm and suggest solutions as well as strengthening governance frameworks

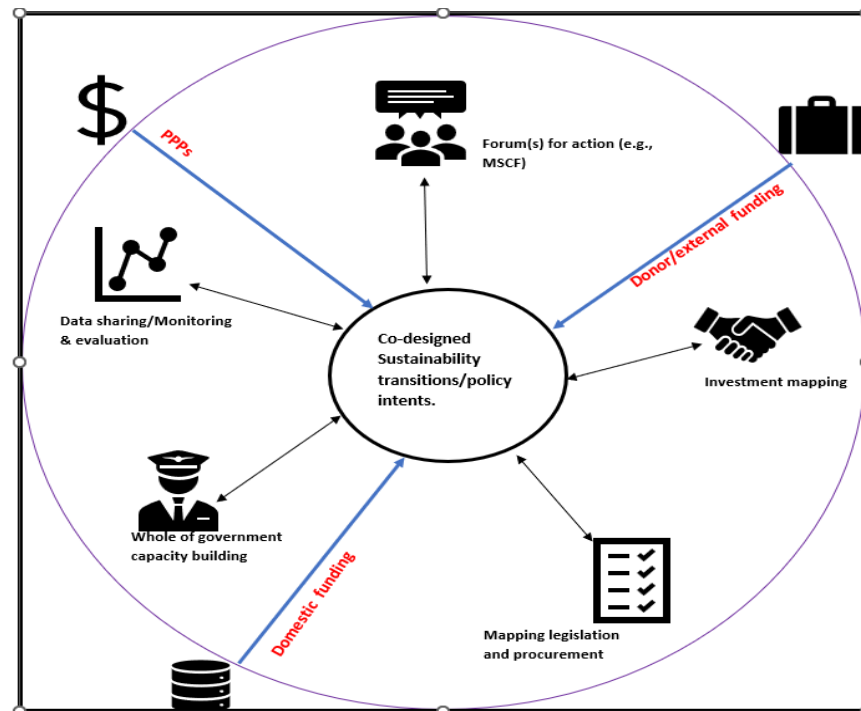


Figure 5: Key approaches towards sustainable city transitioning

a) Priority Area 1: Investment mapping

Residents cannot provide useful input without access to information on planned investment coming into their neighbourhood, hence the need to map investment delivery expenditure to provide this critical information for residents. This would facilitate oversight on current and proposed projects for both residents and county government and thus optimise on future investments while minimising wasteful duplication of initiatives.

b) Priority Area 2: Data sharing for monitoring and evaluation

Data sharing would promote transparency and also give city residents a comprehensive picture of what is happening in their communities. This would be crucial in co-designing of monitoring and evaluation frameworks to ensure services are meeting community needs. Access to data would enable communities to participate as equal partners in policy decisions. City government would then be accountable to users and residents in relation to services delivered. Issues of data sovereignty and the need to evolve data management strategy therefore needs to be addressed. Mombasa city does not currently have a formal data policy aligned to this critical need.

c) Priority Area 3: Starting up a citywide forum for action

A forum/platform for sustainability decision making that is recognized by residents and the county government, resulting in improved co-ordination and help deliver sustainability initiatives which resonate with community needs. As part of the project process, *Miji Bora* prototyped and launched the Mombasa Smart and Sustainable City Forum (MSCF) with Mombasa County Government as one of the key partners. The organogram of MSCF is shown in Figure 6.

d) Priority Area 4: Whole of government capacity building

Build capacity on sustainability and futures-thinking to enable city officials to engage each other and co-ordinate the delivery of sustainable programs based on sustainability and desirable future lens in their programming.

Our Findings 1. Activated Mombasa Sustainable City forum (MSCF)

- Formalised MSCF based on Articles of Collaboration among partners and established 5 Technical Working Groups (TWGs) on Plastic & Solid Waste, Climate Action & Transport, Natural Capital, Mtopanga TRM, Port City Planning

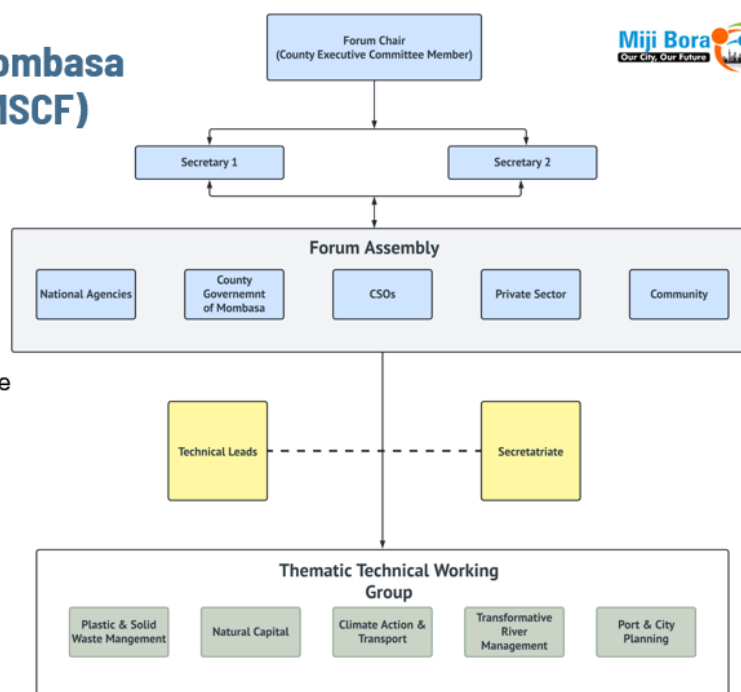


Figure 5 MSCF Organogram

e) Priority Area 5: Mapping existing legislative and procurement frameworks

To ensure legislation is coordinated in a more comprehensive manner to position Mombasa on its path to a sustainable future

3.2.2 Stakeholder Analysis

Stakeholder values and knowledge are important in shaping a smart and sustainable Mombasa city. The *Miji Bora* project aimed to facilitate learning, co-generation and co-creation of knowledge among policy

makers, urban researchers and other stakeholders. The project collated up-to-date information on the status on critical city systems and charted pathways to a smart and sustainable coastal city of Mombasa. As part of its situational assessment and stakeholder engagement component, the project primarily focused on stakeholder engagement across various sectors as their participation was integral to the success of the project.

Stakeholder analysis therefore entailed the following key tasks:

- Identify roles, challenges and relationships of key stakeholders in addressing the main drivers of sustainability transitioning for Mombasa. Even though not all stakeholders shared the same interest, capabilities, or influence on all issues of concern in view of the project's goals, their differing knowledge and/or opinions were engaged at multiple stages of the project process
- Assemble knowledge and experiences among different stakeholders to identify the most pressing issues with regard to key sustainability for Mombasa. The key urban drivers identified then constituted the basis for conceptualising approaches to smart and sustainable city as applied in the futures scenario workshops
- Create the basis for developing stakeholder engagement strategy that addresses all the different stakeholder perspectives.
- Elaborate on and establish an appropriate and inclusive framework for stakeholders to guide future engagement in a smart and sustainable setting. This was the task which led to the prototyping and launch of the forum (MSCF)

The study applied a two step-approach to achieve the first objective: stakeholder identification and analysis. In an iterative process, a list of relevant stakeholders was generated via literature search and expert consultation. In addition, we used the knowledge and experience of workshop-participants to ensure ongoing update of the stakeholder list. Consequently, the initial workshop particularly focused on the soliciting stakeholder roles, interests and influences (see Annex on workshop programme and participants)

At its inception stages, the project identified the key issues of interest to the County Government of Mombasa (CGM). The key sustainability concerns as prioritized by the CGM were noted as follows - solid waste management, water and sanitation (includes clean water supply, urban flooding and sewerage management), energy and transport (includes energy consumption analysis/greenhouse gas emission (GHG) reduction. The project team linked the key issues to sustainable smart cities and communities, and climate action as the main themes for action research. Stakeholders were therefore organised into aligned sector working groups to facilitate strategic planning for responsive action. A key factor in stakeholder placement in working groups was the level of influence and interest in relation to the particular issues identified.

One of key observations noted from the review of policy statements, development plans and vision documents is the need to identify additional sources of information to complement the situational analyses/assessment. In order to fill the identified information gaps from the relevant documents, the project obtained first hand baseline data and follow-up with validation through field consultations with stakeholders, face-to-face focus groups and surveys as well as virtual interviews through digital webinars

and social media primarily in response to COVID 19 restrictions. Annex Presents schedules of key workshops and webinars as well as lists of stakeholders and their respective departments or organisations.

One of the key findings was that most of the stakeholders have a high interest and influence on several thematic areas. As shown in Figure 7, with solid waste and urban flooding as key examples, several stakeholder organisations demonstrated high interest but lacking capacity to influence change. County and national government agencies demonstrate relatively high influence across most issues and hence key interest in the project outcomes. In contrast, private sector and research organizations demonstrated markedly lower influence even though their interest remains high across most of the thematic issues. To ensure successful transition to a smart and sustainable Mombasa city, close stakeholder collaboration during and beyond the project process emerged as one of the critical priorities. Diverse methods and tools of stakeholder engagement were therefore evolved and implemented as part of the project process. One of the innovative tools implemented under the project was the solid waste *hackathon* as well as *climathon* (see Annex for related programmes and outcomes).



Figure 7: Interest versus influence matrix for stakeholder involvement on thematic areas - transport, rising sea level, urban flooding, solid waste management, sewerage management. Source workshop xx (dates??? - see Annex ... for further details)

Figure 6 Stakeholder Influence- Involvement Matrix

City stakeholders acknowledged clear awareness of prevailing modus operandi where county departments and stakeholders were operating in silos with minimal collaborative planning and information sharing on priority issues in the city. As a result, operations and service delivery in the city were not pursued efficiently.

Opportunities for improved efficiency and ability to engineer solutions under the thematic areas were reviewed based on a *world cafe* approach (see Loehr, Weinhardt and Sieber, (2020) for approach and method). As a result of the interactive sessions, inadequate stakeholder engagement in county decision making and policy processes and communications emerged as the key barrier towards improving efficiency in service delivery by the County Government. *World Cafe* participants were therefore structured into 2 groups which reviewed prevailing gaps and proposed interventions towards improving departmental and cross-sectorial collaboration. The *world cafe* process thus contributed towards the prototyping of MSCF to kick start the pursuit of smart sustainable city vision for Mombasa.

3.2.3 Solid Waste Assessment

Half the world's population currently lives in urban areas, and it is anticipated that almost all regions of the world will be predominantly urban by the middle of this century and slightly after 2050 in Eastern Africa (UN-HABITAT, 2017). Urbanization levels are higher in high-consuming (developed) countries compared to low-consuming (developing) countries. As engines of economic growth, cities generate diverse types of solid waste depending on various urban socio-economic dynamics (production and consumption) versus levels of waste management services by various stakeholders (Lehmann, 2011). The multidimensional nature of the problem of Solid Waste Management (SWM) is reconsidered in the context of rapid urbanization (Oteng-Ababio, 2010).

With increasing economic prosperity, increasing population and subsequent urbanization, county governments in Kenya are further challenged by collection, recycling, treatment and disposal of the ever-increasing quantities of solid waste. Most counties have zoned specific areas for waste operation, but continue facing challenges in waste management, mainly due to inadequate financing, poor infrastructure and technology, lack of public awareness of sustainable waste management practices as well as inadequate institutional structures as well as legal and regulatory frameworks. Several counties are therefore yet to upgrade to landfills and therefore still rely on dumping sites for waste management with minimal collection of garbage from undesignated dumpsites especially within informal settlements (NEMA, 2015).

For the County Government of Mombasa (CGM) specific key challenges include lack of vehicles to transport waste, leading to the privatization of some SWM services such as collection and transportation to disposal sites (Tan, 2012), poor road networks especially in poor neighbourhoods and those leading to the dumpsites, resulting in indiscriminate dumping of waste on streets and open grounds (Faye et al., 2016). In Mombasa, waste is collected and disposed in the city's open dumpsites while the remainder is dumped on roadsides, open spaces and along the shoreline or burnt (Tan, 2012). Poor waste-related infrastructure in most areas is due to congestion and inadequate planning in neighbourhoods such as Bangladesh, Kaa Chonjo and other informal settlements.

In addition, there are no systematic initiatives towards social inclusivity in solid waste management to allow participation of diverse stakeholders in the collection and disposal of solid waste. Low or limited capital investment in SWM systems such as waste collection bins and waste collection containers is a major factor affecting waste disposal in Mombasa especially among the low-income residential areas that have no access to waste disposal services. Prevailing inadequacy in waste disposal services coupled with limited investment in solid waste recycling and recovery systems in the county have intensified public nuisance

due to indiscriminate dumping of waste as well as littering in public open spaces. Most solid waste is discarded in the form it was generated with no systematic initiatives towards recovery for reuse or recycling.

The study project assessed data on actual waste generated, collection system and legal systems on solid waste management in Mombasa and identified the gaps towards transitioning to sustainable solid waste management. Data were collected and collated based on desktop review of previous studies. Key findings were then distilled as follows:

- Of the solid waste generated in Mombasa, more than half is collected by the county government and private companies. The remaining portion is uncollected and thus accumulates to a level of posing public menace and health risk to resident
- Disparity on actual amount of solid waste generated per day as different sources of data indicate incongruent amounts as shown in Table 1

Table 2 Varying levels of daily waste generation for Mombasa

Study	Year of Study	Waste Generation (tonnes/day)
Palfreman J. et. al.	2015	875
Ministry of Environment and Forestry	2019	2000
National Environment Management Authority	2014	2200
UN-HABITAT	2019	879

Currently CGM has adopted the following elements:

- kerbside,
- transfer station,
- container/ collection point,
- material recovery facility (MRF)

In addition, there is an increasing number of both private companies and community-based organisations (CBOs) offering the waste collection service (Muindi, K., et al., 2020). The more established companies typically offer services to households in wealthier neighbourhoods while CBOs and youth groups are mostly found in low-income areas, where they compensate for both the irregular collection by county government and the unavailability of services from the well-established private waste-service providers. The middle-income areas are serviced by a hybrid composition of CBOs and private companies who use door-to-door waste collection method. Some of their transportation equipment include wheelbarrows, tricycles, push carts, open-back trucks, side and rear compactors as well as trailers.

From a policy perspective, Mombasa has established and developed a County Solid Waste Management Policy, 2019 which provides the guiding framework for effective, efficient and sustainable services in solid waste management. The policy was later adopted as the Mombasa County Solid Waste Management Bill, 2021. It stipulates management action plans, standards of handling, storage, transportation, segregation and destruction of any waste. The county also supports the implementation of Waste Wise Cities Tool (WaCT) from UN-HABITAT. The tool addresses the strategy of reduction-at-source to tackle the rapidly increasing waste generation but lack of reliable data limits capacity for cities to develop effective and

sustainable waste management systems. This leads to overflowing dumpsites and leakage of waste into the environment, where, in the case of Mombasa, this includes the Indian Ocean. Mombasa County is also part of the new Global Covenant of Mayors for Climate & Energy (a network of the world's megacities committed to addressing climate change) that implements diverse programmes under the C40-framework (see C40 website for further details - <https://www.c40.org/>).

The county has also spearheaded the formation of a multi-stakeholder forum dubbed 'Mombasa Sustainable Smart City Forum' (MSCF) which puts in place mechanisms and frameworks for enhancement of stakeholder collaboration through dialogue, effective communication among stakeholders, multilateral actions between stakeholders and promoting public participation through transparent information sharing systems. The forum is envisaged to function in a similar model to an urban lab.

3.2.4 Water and Sanitation

Cities across Africa face unprecedented water and sanitation challenges. Amidst climate change coastal cities in Africa will be disproportionately impacted by water and sanitation problems owing to the predicted submergence and flooding of coastal land, saltwater intrusion into freshwater aquifers and increased coastal erosion. For coastal cities such as Mombasa, such problems are further compounded by increasing prevalence of informal economies and settlements superimposed on western style governance systems. Yet, right from colonisation to the present, water supply and sewage systems have been characterised by a series of inequalities in access, with investment decisions being driven by metropolitan capitalism concerns and interests which fail to factor in access challenges faced by the increasing number of residents in informal settlements and communities.

The project reviewed water and sanitation backlogs in Mombasa since colonial times and post-colonial period to the present. In addition, the project reviewed possible sustainable interventions. Key findings are that any analysis of the water and sanitation challenges in Mombasa would be inadequate if they do not consider the motive of the development of the infrastructure during the colonial times. A good understanding of both historical inadequacies and current investments would help in designing sustainable interventions going forward. The project further concludes that sustainable water and sanitation services are likely to remain a mirage unless the issues of funding, cost recovery, data availability and the overall governance are fully addressed. Similarly, prospects of attaining the UN Sustainable Development Goal (SDG) 6, namely; access to safe and clean water and adequate sanitation, will remain gloomy if public officials in Mombasa do not refocus from fixing the existing large-scale systems to facilitating a diverse system of service provision for water and sanitation.

The study adopted a descriptive qualitative meta-analysis in the review of relevant literature. A meta-analysis uses qualitative findings reported in previous studies as building blocks for gaining deeper understanding of a phenomenon (see Chertok & Haile, 2018). The study confined its searches to Scopus, Google scholar and google.com and used terms related to water and sanitation service provision. Using a line argument technique, we identified different aspects of the literature on water and sanitation services in cities in order to come up with new interpretations. Additional information on the current status of water and sanitation services in Mombasa was obtained during a meeting with the department of Water, Sanitation and Natural Resources and the Mombasa Water and Sewage Company (MOWASCO) held in November ..., 2019. Complementary information was obtained through direct observation of water and sanitation

services in the city in an exercise consistent with prototyping ground truthing. The findings of multiple qualitative information on water and sanitation have the benefit of providing insights into the reasons why interventions have succeeded or failed (Atkins et al 2008). The review therefore informed the search for intervention programmes on water and sanitation in the city county of Mombasa.

The findings also highlight high levels of losses which can be attributed to dilapidated infrastructure that create physical losses, poor metering and customer management systems that generate financial losses. For example, the county and national government institution customers do not always pay their bills on time and there is reluctance to disconnect their supply, even though they account for over a third of the billing amounts. These unpaid bills erode the financial viability of the local utility company (MOWASCO), further frustrating water service provision. The poor financial performance of the utility company disproportionately affects service provision to the poor households, as it seeks to minimize their losses by concentrating on providing services to and collecting revenues from more affluent residents.

3.2.5 Natural Capital (Mangrove)

Mombasa County is a major hub for commercial enterprises and a key engine for economic development in Kenya as well as the overall eastern African region. With its neoliberal planning, rapid growth of the county is putting pressure on natural capital particularly its mangrove forests, as they are perceived to be competing with development needs. Climate change is impacting the remaining mangrove areas particularly through sea-level rise and increased sedimentation. The study objectives was to assess the status and conditions of mangroves in Mombasa County, identify threats facing the mangroves in Mombasa and trends, document locations of mangrove reforestation activities, areal extent and choice of species planted in Mombasa, assess growth performance of replanted mangroves in terms of survival rates and biomass increment, and assess community perceptions on mangrove ecosystem services and their Willingness to Pay (WTP) for mangrove conservation.

The study adopted mixed approaches to achieve the stated objectives. This included GIS techniques for mapping, site visits for vegetation cover assessment and Contingent Valuation Method (CVM) for analysing WTP. Eight major mangrove classes were derived from 2019/2020 Observation Landsat Imagery (see Figure 8). These classes further guided the generation of validation points and the fieldwork process. It is from these classes that the mangrove species formation was obtained. During the fieldwork campaign, data on mangrove species formation, drivers of mangrove cover change and Region of Interest (ROI) were collected and applied to guide the classification process.

One of the key findings was a 17% increase of mangrove cover over the study period spanning from 2010 to 2020. On the other hand, about 8% of forest cover was lost between 2010 to 2015, while a 25% gain was recorded from 2015 to 2020. This validates the field observation where young and recovering forest was noted from different sites visited within the Mombasa mangrove system. Fortunately, with ongoing awareness initiatives on the great role played by mangrove cover, the prohibition/banning of mangrove harvest by the government as well as the restoration and conservation effort by NGOs and forest adjacent communities seems to be contributing towards increasing gain in mangrove cover.

The study further identified lack of awareness about mangroves as a key contributing factor to preventable threats, unsustainable development activities and inadequate commitment at all levels from individuals to

communities and various levels of government to sustainably manage these critically important coastal ecosystems. Land use change remains the leading human cause of mangrove deforestation and degradation along the coastal lands of the county. Moreover, climate change and its associated impacts such as sea level rise and extreme events presents an emerging and perhaps even greater long-term threat. While reforestation activities to compensate for the loss and degradation of mangroves are gaining momentum, mixed results seem to be the most prevalent pattern.

On this issue, the *Mijibora* project has laid the foundation towards a better understanding of how mangrove-human interaction can influence sustainable development in Mombasa. Despite the fact that mangrove reforestation efforts in the county are gaining momentum, such initiatives remain at a relatively small scale mainly dominated by enrichment planting on degraded sites within existing natural mangrove forest. While the planting efforts have presented mixed results of both success and failures, there are high chances of enhancing restoration success provided that best restoration practices are applied. This will involve the application of ecological principles of restoration as well as involving adjacent local communities at the core of participation. While we acknowledge the presence of concerted efforts by local stakeholders at different levels, strengthening the present collaboration and participation will play a key role in future management and sustainability.

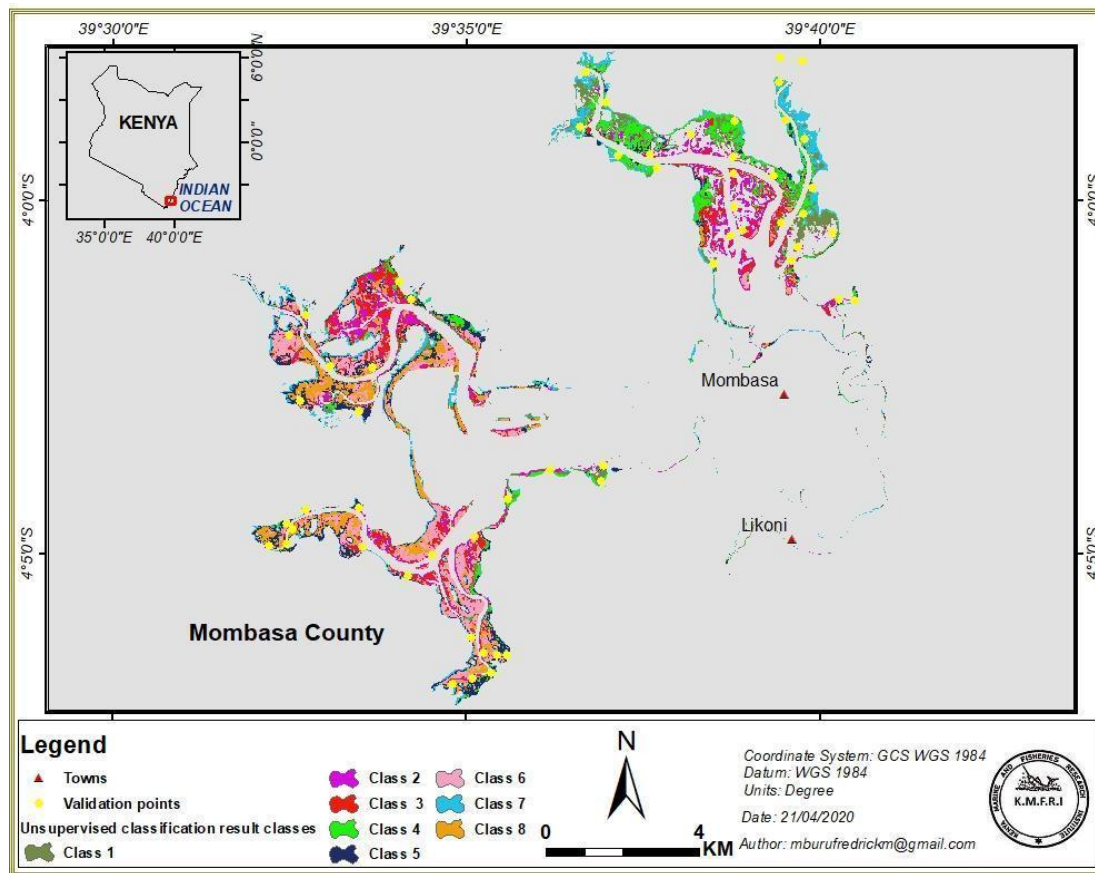


Table 3 Mangrove ecosystem classes in Mombasa (source: KMFRI, p...)

In this regard, a number of concluding points were derived as follows:

-
- To a certain extent, Mombasa's mangrove ecosystem is relatively young and its recovery could be enhanced through reforestation and more systematic interventions geared towards conservation
 - There is still a great deal of misunderstanding amongst the wider community on what mangroves actually contribute towards sustainability for coastal regions such as Mombasa County. This situational analysis thus presented a unique and timely opportunity to increase awareness on the value of mangroves in order to strengthen conservation efforts and promote sustainable long-term management of Mombasa's mangrove ecosystems
 - Mangrove restoration through artificial regeneration has a high potential of success in Mombasa provided that key ecological principles and best practices are observed in future
 - Techniques of propagating alternative mangrove species should be explored and harnessed to reduce preference of the same species as well as site selection and thus minimise the risk of species mismatch during reforestation establishments
 - Need for regular and long-term monitoring to track the performance of the mangrove restoration projects. Citizen science can play a key role where communities are equipped with knowledge and skills on data collection towards evidence-based monitoring
 - There is a need to enhance capacity at all levels on ecological mangrove restoration in order to build a dynamic community of practitioners
 - There is a need to strengthen collaboration between government, NGOs, and private entities at all levels
 - Incorporate monitoring/evaluation of mangrove restoration programs into implementation of county urban plans, and especially the CIDP (county integrated development plan)
 - Successful mangrove restoration and management need to be promoted through responsive economic benefits and incentives guided by Payment for Environmental Services (PES) principles which would increase community willingness to participate and thus contribute towards long term sustainability
 - Create an ethical imperative for mangrove conservation and restoration as an obligation to the public (individuals, communities and organisations in various sectors) through the creation of awareness on the importance of mangrove forests and the negative effects of their deterioration and loss

3.2.6 Energy and GHG

The investigation of GHG-emissions due to road transport is a complex and confounding task mainly because of the wide range of vehicles in the sector ranging from private cars, public transport buses, auto rickshaws (*tuktuks*), cargo vehicles and trucks. This highlights the critical significance of transport as the leading sector in terms of unsustainable levels of GHG-emission. Yet, in view of intensifying urbanisation and rapid economic development, Mombasa suffers from insufficient transport infrastructure and services which can be expected to translate into increased energy consumption for the sector in future. This would result in serious energy security problems and also escalate environmental pressures such as GHG-emissions (Goetz, 2019). Overall, GHG-emissions due to road transport is yet to be systematically documented, especially due to the fact that demand for vehicles continues to rise. The high demand of road transport has also led to ongoing increase in the number of private vehicles which has outpaced the public transport in terms of buses and *matatus* (minibus taxis) thus causing high levels of traffic jam especially

during peak hours. This translates to longer average travel times, increased air pollution, escalation in traffic fatalities and outdated data on related GHG-emissions of the sector (Dingil, 2019).

Whereas little has been done on GHG-emission due to transport in the county. GHG-emission can be envisaged to remain as the key contributor to climate change impacts primarily due to the increasing number of vehicles in the county. Understanding energy consumption by different vehicle-types based on their daily operation and maintenance practices is a critical component towards developing effective management strategies for regulating GHG-emissions in the sector not only in Mombasa but also other counties.

Assessment of GHG-emissions and energy consumption in the sector served as a baseline for understanding the complex daily emission of each vehicle-category operating on Mombasa's roads. In addition, knowledge of GHG-emission of each vehicle-type also acted as a baseline for developing the proper GHG mitigation measures as well as implementation of actions to cut down initial energy consumptions, replace fossil fuels and facilitating high energy-efficiency in the sector.

The project conducted a stakeholder workshop to get updated information on energy-use for the sector and responses to GHG-emissions (see Annex..... for details on programme and participants). The workshop evaluated all legal requirements and standards as well as future plans on reduction of GHG-emissions. Workshop participants devoted most of their time and effort towards developing a clear roadmap for integration of GHG and energy considerations into sector programmes. Lastly, participants established a technical working group (TWG) for GHG-emission in the transport sector. The workshop aimed to discuss priorities for energy sources and GHG-emissions, and co-design and prototype the assessment of GHG-emission in the transport sector in Mombasa.

Key highlights from the workshop were as follows:

- Conspicuous lack of standards for assessing GHG-emissions in transport sector
- Lack of capacity to do GHG-emission assessment for Mombasa
- Lack of monitoring of emissions from idle running engines of heavy commercial vehicles around the port area
- Lack of infrastructure to provide alternative sources of energy for transport among stakeholders willing to switch from fossil fuels to alternatives such as electric vehicles or non-motorised mobility such as walking and cycling
- The need to shift urban form from building cities for cars towards building cities for people

The workshop also captured some of the key actions the county could pursue as follows:

- Operationalize air quality regulations with respect to moving objects
- Standardization in monitoring and reporting of GHG-emissions from motorized vehicles
- Formulation of policies to govern emission control for motorcycles and 3 wheelers
- Policy formulation on fuel efficiency standards and scrapping regulations in motor-trade sub-sector
- Investment in infrastructure for public transport and non-motorized transport (NMT)
- Setting up of '*jua kali*' workshops in all six sub counties to leverage on used *tuk-tuk* parts

Activity 3 – Peer to Peer (P2P) Learning Exchange

Prior to the launch of the *Miji Bora* project in 2019, Durban (eThekweni Municipality) had already engaged in a framework for P2P learning exchange with other cities and had already achieved a set of outcomes from previous exchange visits conducted between 2013 and 2019. However, none of these initiatives had been subjected to critical peer review. *Miji Bora* project, particularly due to its trans-disciplinary focus, provided the perfect living laboratory to:

- Formally enhance Durban's P2P learning exchange component as a project deliverable
- Underpin the framework with a peer-reviewed publication investigating the efficacy of this learning approach

At its most simplest, the initiative consists of officials in two cities engaging in formal visits to each other through delegations of professionals and mid-management personnel in order to share climate change challenges and responsive solutions in terms of mitigation and adaptations. With both cities being located on the WIO (West Indian Ocean) coast, it was inevitable that issues like sea level rise would be of common concern. However, there were a number of other urban development challenges which were exacerbated by climate change and were thus included as part of the key focus areas. These include solid waste management, water provision, sanitation and adopting nature-based solutions for ecosystem-based adaptation.

Figure 9 shows a step-wise schematic framework of typical P2P learning exchange visits. Whereas some activities are critical and time bound (for example logistical arrangements), others are adaptable to individual needs of hosting and visiting cities. Important considerations for exchange visits are doing the necessary preliminary political protocols at the start of the event (and thus enable proceedings to happen on an equal peer level), ensuring presentations are clear, compliant to time/programme, appropriate for the agreed topics of the session and delivered in a way that is audible and accessible to exchange partners. During site visits (field trips), time taken to travel to projects needs to be carefully considered to avoid hours spent in the vehicle and safety and security arrangements need to be in place. Most important during the visits there is the need to maintain a positive, friendly and open environment to encourage participation, questions and learning opportunities. An important part of the conclusion of the exchange visits is planning for future visits as well as a systematic evaluation of the exchange experience and outcomes in order to reflect on success or shortfalls of the initiative. Finally, it is critical that reports to various stakeholders (including funding organisations) and project plans to support follow-up partnerships should be articulated. Agreeing on follow up meetings to monitor progress and identify further training needs is important. Such meetings can be in person through mutual attendance to local or international events (workshops, conferences and formal training sessions which might entail certification).

The first P2P learning exchange between officials of eThekweni Municipality and the County Government of Mombasa took place from 11 – 13th November 2019 in Mombasa, Kenya (see Annex ... for programme and participants). The two coastal cities share many similarities and challenges, and both have committed to improving the functioning of their governments and addressing climate change through engaging in a series of learning exchanges.

The first visit coincided with unusually persistent rainfall in Mombasa. The so-called short rains of October and November were noted by many as resembling the long rains of April to June. This was due to the state of the Indian Ocean Dipole (analogous to the better known El Nino event). Impacts of the increased rainfall

served to highlight challenges around transport and drainage, which in of itself was useful, but was also an impediment to visiting the scheduled sites. For example, access to the new landfill site was not possible during persistent rains, and several CGM officials were not able to attend some of the meetings due to flooding of roads which rendered it impossible for them to make it to the venues.

Despite these challenges, there was a real commitment from, and an interest shown by CGM officials in the peer learning process, and the meetings exceeded expectations in terms of highlighting topics and projects for the second exchange in Durban which was planned for March 2020. The exchange visit culminated in a visit to the Mombasa County Government Committee Clerk's office and the opportunity to present to the Environment, Solid Waste and Energy Committee. The exchange programme and details of discussions for each meeting for the first learning exchange can be found in the project report on the *Miji Bora* project website: <https://mijibora.org/>.



Figure 7 Overall P2P learning exchange framework

During 2020, a return exchange by a Mombasa delegation to Durban was planned for March, and all preparations were complete when, a week before the planned event, *Miji Bora* project team met and agreed to postpone the event due to Covid-19. By June, it was apparent that the return exchange would not be held any time during 2020. An alternative approach was therefore planned based on a series of webinars covering topics that would have been dealt with during the in-person exchange. The two live exchanges focused on Transformative River Management and Sustainable Waste Water Solutions. A third recorded webinar focusing on the green economy based on Durban's Solid Waste was made available to officials in County Government Mombasa (see Annex for dates and programme/agenda for the webinars).

In response, Mombasa officials hosted a series of online workshops to develop the county's sustainability and smart city plans, which culminated in the launch of Mombasa Smart and Sustainability County Forum (MSCF), and climate change policy. Due to uncertainties around Covid-19, and especially with the onset of the Delta and Omicron variants in 2021, it was not possible to complete the return in-person visit to Durban. Despite this, a number of achievements were noted during the WIOMSA annual grantees meeting in December 2021. The key highlights were as follows:

- Mombasa County Government had established the Mombasa Smart and Sustainable County Forum (MSCF), analogous with Durban's inter-sectorial approach to tackling climate change. The forum has a number of sector-specific working groups dealing with climate change challenges
- Mombasa County climate change and adaptation policy, including the Climate and Ocean Risk Vulnerability index assessment, have been approved and will be used to develop the County's climate change adaptation strategy through the *Miji Bora* project and other stakeholders engaging with the County Government in the MSCF
- Following the P2P exchange visits, Mombasa initiated the following programmes:
 - EPIC Mombasa research programme responding to Covid-19 and the old Railway Park project
 - Mtopanga Transformative River Management Project
- Two draft manuscripts are being finalised for peer review (the second of which, below, puts forward a P2P framework):
 - O'Donoghue, S., T. and D. Roberts (in prep). *Pathways through Adaptation: Lessons from the Durban Adaptation Charter*
 - O'Donoghue, S., Kithiia, J et al (in prep). *Durban Adaptation Charter: proposed city-to-city peer learning framework to support climate change adaptation on the African continent*
- Formal P2P learning framework presented as a project deliverable for the Cities and Coasts Programme
- During 2021, a Master's student completed and defended her thesis within the P2P component of the study. The title of her MSc research was: *Determinants of Solid Waste Management Performance in Mombasa County, Kenya*.



Figure 8 Storm water flooding the streets of Mombasa in Nov. 2019 (Photo courtesy: Sean O'Donoghue)



Figure 9 A courtesy call to the Speaker of the County Assembly of Mombasa by the team from Durban (Photo Courtesy: County official)

Activity 4 – Smart futures thinking

The project prioritised solid waste and GHG-emission in Transport as the more visible and pressing challenges for Mombasa County and thus more relatable among stakeholders since they were consistently highlighted during stakeholder engagements. The project therefore selected the two challenges for follow up action through prototyping.

Sector Dialogues- Solid Waste, Transport and Climate

The world is facing a critical plastic-waste crisis where the status quo is no longer an acceptable option. Plastic pollution is a serious issue of global concern which requires an urgent and international response involving all relevant actors at different levels. Many initiatives, projects and governance responses and options have been developed to tackle this major environmental problem, but we are still unable to cope with the amount of plastic we generate. In addition, there is a lack of coordination of responses which could lead to a more effective and efficient response.

In Mombasa County and across the various towns along the Kenyan coastal strip, plastic waste on land and in the ocean is escalating into emergency levels with marine plastic pollution as a critical example. It is poisoning marine life and affecting human health and livelihoods in ways we are only now beginning to understand. Urgent measures are therefore required in order to secure and preserve environmental quality and functions for the inhabitants of Mombasa as well as coastal habitats and ecosystems.

The County Government of Mombasa plays a pivotal role in coordinating all environment and solid waste management activities in the county. In this regard, it is on the forefront in championing a circular economy of materials with plastics as a priority. As a key example of responsive initiatives, the county is setting up the first of a kind material recovery facility that will ensure valuable waste streams are diverted to recycling with only a small percentage ending up in the landfills. WWF-Kenya has led the global *No plastic in nature* initiative, and in Kenya, through the DMDP (.....) the Waste-to-Value project, aimed at enhanced and inclusive plastic recycling across the value chain. Similarly *Hand-in-Hand Eastern Africa* has an objective to promote enterprises that help to reduce single-use plastics (SUP) pollution, create awareness of clean and green environment and support the green enterprises through establishing six recycling centres.

Under COMRED (Coastal and Marine Resource Development), *Miji Bora* Project established the Mombasa Smart Sustainable City Forum (MSCF) as an appropriate and inclusive framework for stakeholders to guide future engagement in pursuit of a smart and sustainable city. As an urban lab, the multi-stakeholder MSCF puts in place mechanisms and a framework for enhancement of collaboration through dialogue, effective communication among stakeholders, multilateral actions between stakeholders and promoting public participation and transparent information sharing systems. The MSCF is coordinated by the County Department of Environment. The forum has members drawn from national agencies, county departments, private sector, civil societies, and communities. As the more permanent local government staff within the county, county directors will be the key component in the long-term functioning of the MSCF initiative. The launch of the forum reflects the need for facilitating continuity of key initiatives beyond the *Miji Bora* project period.

The MSCF has organized a series of sector dialogues ranging from solid waste management, transformative river management, energy and climate change and planning. The first solid waste management sector

dialogue was a joint activity hosted by the County Government of Mombasa on assessing the status and knowledge gaps in the city (see Annexfor programme and participants). With support by WWF, Kenya, Hand-in-Hand Eastern Africa and COMRED, the MSCF event focused on plastics under the overall theme of *'Mombasa Plastic Waste Management Sector Dialogue'*.

Hackathon

Given the escalating challenges threatening development and progress towards better quality of life for all locally and globally, our globally-agreed SDGs are unlikely to be met given the prevailing slow-pace in implementation. The challenges entail both natural/ecological constraints such as climate change and loss of biodiversity as well as negative socio-economic outcomes such as inequality (especially wealth/income inequalities across gender, developing versus developed economies and across generations) as well as resultant insecurity/instability concerns. Increasing population growth and urbanization accompanied by diminishing socio-economic opportunities contribute to escalating levels of unemployment, poverty and inequalities which in turn diminish overall quality of life for all, especially in developing countries.

Cities and city-regions such as Mombasa County are rapidly becoming the focal-points of these multi-faceted crises now confronting humanity, while at the same time offering significant opportunities for leveraging urbanization towards sustainable/equitable development and progress. The resultant dystopia of the historical model of economic growth (especially growth in GDP/GNI) as the key driver for socio-economic progress/development now calls for alternative models and indicators which are more context-responsive as opposed to mere global benchmarking. This demonstrates the need for a more dynamic operational model which balances across top-/trickle-down strategies and expectations of bottom-up needs, responses and initiatives. Technological innovations are also opening-up opportunities for distributed responses (including distributed manufacturing, energy, water/sewage and waste management services which can leverage opportunities emerging from the closed-loop economy). This would be in sharp contrast to our historically centralized production/supply infrastructure-models and thus challenges communities to be more proactively engaged with adoption of context specific ways and means of meeting their needs in terms of infrastructure and services.

One of the emergent platforms for the envisaged collaboration(s) towards transitioning to our desirable/sustainable futures with digital technologies to our rescue is the urban lab, of which innovation-hubs and makers-spaces are two of the multiple dimensions of (see abstract by Sakala 2021, Annex .. for a perspective on hackathon and makers space). With our *Miji Bora* Project for Mombasa, the research team (anchored by COMRED) in partnership with the County Government of Mombasa (CGM) identified the need to enter into an urban lab/makers' pace form of collaboration in order to incubate responsive communities-of-practice (CoP) for propelling the transitioning of Mombasa County to its sustainable/smart county future(s).

As one of the collaborative initiatives, the project facilitated hackathon where participants were introduced to city challenges which called for integration of technology into various issues such as climate change and facilitated them to come up with technological tools that can assess, monitor and measure GHG-emissions in the transport sector. Another hackathon was targeted to technology to monitor and map real time changes in mangrove forest during rehabilitation and conservation programmes. Related resources with regard to interventions that have been developed and constraints in developing

effective solutions around the prioritised challenges were also shared with participants to serve as reference points when developing solutions. Participants were involved in two training sessions namely Environment Centered Design (ECD) and Prototyping Tool (PT) (see Annex..... for programme and participants). The sessions served as a foundation for the solutions participants were to develop primarily with the objective of shifting their mind-set from conventional to more creative ways of viewing the challenges as opportunities in order to stimulate innovative responses.

One of the hackathon which was consistently followed through was the solid-waste hackathon where four prototyping teams were selected for incubation and mentorship towards start-ups which would translate the initial ideas into products and services in the market. Figure 12 presents the poster used for the promotion of the waste-hackathon event while Annex Presents the programme and participants of the waste hackathon.

Finding 4. Prototyping Business Solutions for City Sustainability

- Initiated development of a framework to connect winning innovators to support networks.
- Best 3 innovative solutions awarded and selected for follow-up through the MSCF partners
- Innovators meetings held to facilitate the exchange of ideas for potential collaborations under a community of practice
- MSCF mandated to organise follow-up on mentorships



Figure 10 Waste-hackathon promotion poster

Future Scenarios

The project employed diverse futures-tools (see for example Sunter and Ilbury, 2021) and community interactive processes to map-out future pathways of key sectors in view of climate change, under 'business-as-usual' scenarios. The objective was to build and incorporate futures-thinking approaches into Mombasa County and the MSCF. Through the scenarios workshop, existing scenarios developed for the Western

Indian Ocean Coast (WIOC) (Obura et al, 2018) and a framing of key issues based on the Sustainable Development Goals (SDGs) were adapted to the needs of Mombasa County as identified through situational analyses stage of the project. The approach was used to stimulate engagement among stakeholders and decision-makers on the key issues they jointly identified and to establish common ground for future actions at both city and stakeholder levels.

Comparative table of drivers across the four scenarios

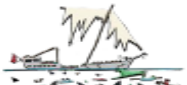
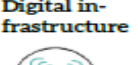
	 Slow but sure	 Riding the wave	 Pirate ship	 All pain no gain
Fisheries 	Mix of small scale and commercial, with good management and compliance	Highly developed and managed, from small to large scale. Sustainable aquaculture developed.	Subsidized industrialized fleets damage poorly managed stocks. Aquaculture expanding with few controls	Fisheries mostly collapsed, driving traditional fishing communities into hardship, high urban migration
Coastal ecosystems 	Strong co-management and restoration	High fragmentation, but being restored for multiple service values	Rampant destruction and fragmentation by coastal development	Degraded and fragmented by unsustainable uses and lack of management
Energy 	High dependence on planted wood for charcoal, imported diesel	Natural gas used in low-carbon power generation, investing in renewables	High use of natural gas and diesel, no low-carbon innovation	Coal used in power generation and kitchens, wood and charcoal depleted.
Education 	Good quality, innovative state education system, but with few resources	Universal education in state system, many private schools	Poor state education, many private schools, but of widely varying quality	Poor state education, low-quality private schools, few elite schools
Health 	Good quality, rural/dispersed community clinics	Excellent hospitals and care from bottom to top, both state and private.	Public health system gutted by corruption, private care widely used but at high cost.	Outdated centralized hospitals, few and poor local clinics, no drugs. Elite go abroad for health care.
Social 	Strong traditional institutions, transforming through modernization	Strong youth/civil society engagement with digital media, internationally connected	Social fabric broken by historical conflict, and ongoing state capture, high social conflict	Social fabric broken by tribal politics, absence of state-care, despair and disillusionment
Gender and youth 	Traditional values modernizing through open dialogue	Modernization of social values and opportunities create space and opportunities for women and youth	Elite capture with little interest in social inclusion, neglect of girls education and youth development	Patriarchal values actively suppress women, youth, and minorities, no policies for inclusion.
Digital infrastructure 	Internet and connectivity basic, but good mobile phone network coverage	High investment in digital infrastructure; lead in 4th industrial revolution in Africa	World-class connectivity in urban centres, but expensive and doesn't cater for the poor	One of the only profitable sectors so coverage reasonable, but quality poor and erratic.

Figure 11 West Indian Ocean Coast (WIOC) scenarios (source: Obura et al, 2018, p6)

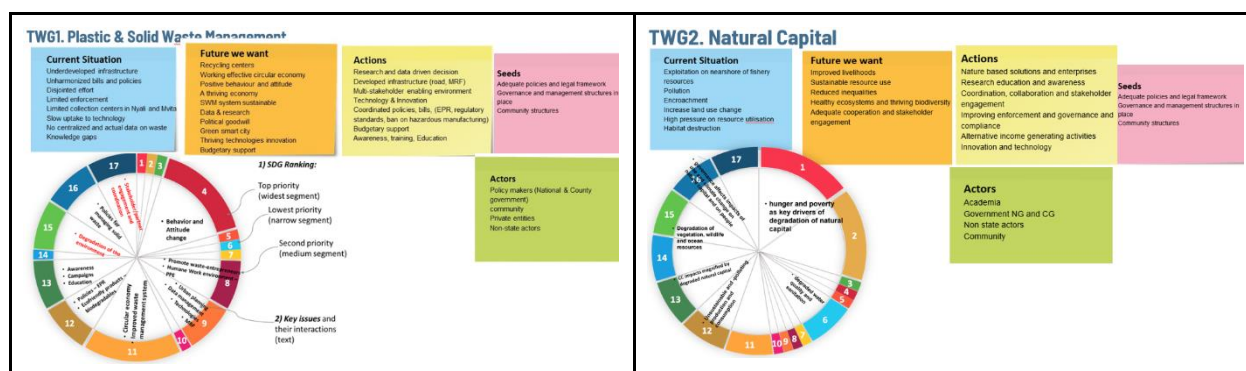
The workshop introduced futures-thinking approach based on scenarios and potential SDG outcomes (positive and negative) for Mombasa. This was achieved by correlating SDGs to the identified priority issues and key thematic areas of focus which were - solid waste, natural capital, and transformative river management, GHG-emissions in transport and climate change.

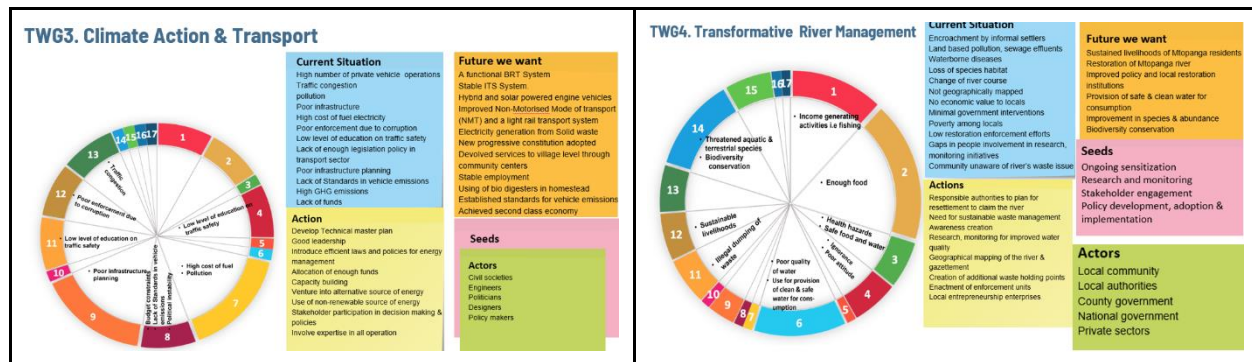
The scenario workshop framed and aligned key issues based on adaptation of SDGs and WIO-scenarios for Mombasa. The first activity of the workshop was to link SDGs to the identified themes thus ensuring local expression. This was followed by ranking and drawing relations in the context of scenarios for Mombasa with reference to the WIO-scenarios. The discussions brought about key areas of interventions that the county of Mombasa could prioritise. Under each of the identified themes the outputs had different targets as follows:

- Identification of all SDGs and proposing the appropriate wording for them in local expression. TWGs (technical working groups) thus agreed on the SDG language for the context of Mombasa. There was a need to identify the key SDGs in relation to the specified themes, after which they were aggregated and ranked in order of priority
- This activity involved formulating relationships between the top 5 prioritized SDGs and understanding the linkages among them with reference to key themes
- The process then focused on understanding and adapting WIO scenarios in the context of Mombasa County. The target was to draw relations and possible scenarios/issues likely to appear in relation to the identified themes
- Based on the identified issues for Mombasa scenarios, each TWG identified two priority issues in the scenarios and created a possible scenario for Mombasa
- The activity involved understanding the situation presently, resources available, what needs to be done and possible actors that can bring about positive change

The key outcomes of the workshop are summarised in Table 2.

Table 4 SDG-linked thematic working groups and key scenario outcomes for Mombasa





Addressing City Challenges through Smart Technologies: Route Optimization in Waste Collection Based on Machine Learning

Effective management of solid waste remains a key concern in Kenya, particularly for Mombasa County which has recorded an increase in uncontrolled, unmonitored and open dumping of solid waste. This is propelled by the lack of effective and efficient systems for collection and disposal of waste. Given that application of machine learning towards solving everyday challenges has been on the rise, planning of city waste management operations calls for reliable spatial and temporal data to facilitate intelligent data-driven insights for decision-making. Application of GIS (Geographic Information System) facilitates capacity for multi factor analysis as well as visualisation of data in real-time in order to guide decision-making processes.

Based on a research project towards qualification at a masters level, this action line of *Miji Bora* aimed at prototyping and evolving an algorithm for guiding optimal waste collection routes for Mombasa. The algorithm was conceptualised as an integer linear programming (ILP) problem on route optimization using machine learning and graph theory. It applies a network analyst extension vehicle routing problem solver in ArcGIS which leverages optimal factors in GIS. As a result, the system can optimise waste collection services based on the shortest path among other parameters. According to the policy, transportation of solid waste is important and optimization of collection paths can have a positive impact on a range of sectors and stakeholders in the county (Mombasa County Government, 2019). The algorithm uses GIS on city architecture, number of trucks and their capacities as well as distance travelled. It is envisaged that findings of the research would help inform further studies towards AI in waste management and thus contribute towards improved waste management services in the county. It therefore constitutes a key input towards a platform for route optimization on solid waste collection with the aim of improving municipal waste management services.

Activity 5 – Students' Research Projects

Theoretical foundations and principles underpinning the Miji Bora Project were enhanced through a variety of masters and PhD research and thesis by three students at University of Witwatersrand, School of Architecture & Planning. One of the studies was at masters' level in Architecture and focused on evolving

a makers' space as a newly emerging building-typology which facilitates the integration of physical and digital prototyping for innovative waste-based products driven by start-ups. The context and site for the thesis project was an informal settlement in Johannesburg, South Africa. Several of the insights of the study were applied towards the conceptualisation and implementation of the solid-waste hackathon under the Miji Bora Project as covered in Section 5.2.

The other two studies entailed research towards PhD qualification with one of them focusing on water governance in informal settlements (with two case studies from Johannesburg, South Africa and Nairobi, Kenya) and the other one on futures-thinking for sustainable city transitioning. Insights from the study on water governance in informal settlements informed the situational analysis component of the Miji Bora project, especially with regard to water services in Mombasa. The futures-thinking study generated insights which informed futures-thinking and scenarios for Mombasa as presented in Section 5.3.

Titles and other details of the studies are as follows:

Master's Thesis: Ms Ashleigh Sakala, School of Architecture & Planning, University of the Witwatersrand, School of Architecture & Planning. Zanduspruit: Maker culture – Makespace for 4IR skills in waste salvaging. Master's thesis, completed/graduated 2021 (see Annex for the abstract)

PhD Studies:

Ms Irene Ngunjiri, School of Architecture & Planning, University of the Witwatersrand, Water governance in urban informal settlements: An infrastructure lens perspective on Mukuru, Nairobi and Kya Sands, Johannesburg – completed/graduated 2022 (see Annex for the abstract)

Ms Vipua Rukambe, School of Architecture & Planning, University of the Witwatersrand. Memories of futures-past and visions of future-futures: Liminality through gamification of back-casting in sustainable city transitioning for African cities. Currently under examination (see Annex for abstract)

One of the chapters in Vipua's dissertation was published as a book-chapter in 2021 (Rukambe, V. & Irurah, D. (2021) - see reference list for publication details).

In addition, three masters' students pursued their research and thesis within themes aligned to the components of the project as follows:

Ms Virginia Mumbua Ngei, Haramaya University. Community perceptions and willingness to pay for mangrove conservation in the context of climate change in Mombasa County. Thesis completed, paper development ongoing (see Annex ... for abstract)

Ms Lynne Farrah, Kenyatta University. Determinants influencing performance of solid waste management in Mombasa County, Kenya. Thesis and paper development is ongoing with envisaged completion date as

Mr Titus Jefwa, Technical University of Mombasa. Route optimization for solid waste collection using machine learning and GIS techniques. Completed coursework and research is at data collection stage with envisaged completion date as

Activity 6 – Prototypes and MSCF

This subsection presents an overview of prototypes developed as part of the action-stage of the project process.

Solid waste management dashboard

Solid waste management (SWM) remains one of the major challenges for the County Government of Mombasa (CGM). Over time, Mombasa has experienced inadequacy of data on waste generated, recycled, disposed as well as the different types of waste. Leveraging on this opportunity the project prototyped a waste management system based on mobile application to facilitate data visualisation for representation on a dashboard format. The system aimed at improving monitoring of the flow/efficiency of collection, inform recyclers in real time on amount of waste, waste characterization, and follow waste movement from generation to dumpsite.

The dashboard system was built with the latest version of PHP v7.4 which is an open-source web scripting language. Data will be stored in a MySQL version 8.0 database, which will also open source. The user interface will be developed in HTML5, CSS3, and JavaScript. The dashboard will employ components from standard and commonly accepted libraries such as PHP Laravel and jQuery or Vue for JavaScript. PHP dependencies will be managed via the Composer package manager. The application will be able to run on any web server that supports PHP v7.4 and higher and has a MySQL database. Data collection is based on an open data kit, where, through consultation with the department responsible, the project co-designed forms as tools to guide the development of the mobile platform. The system of information flow is shown in Figures 14 and 15.

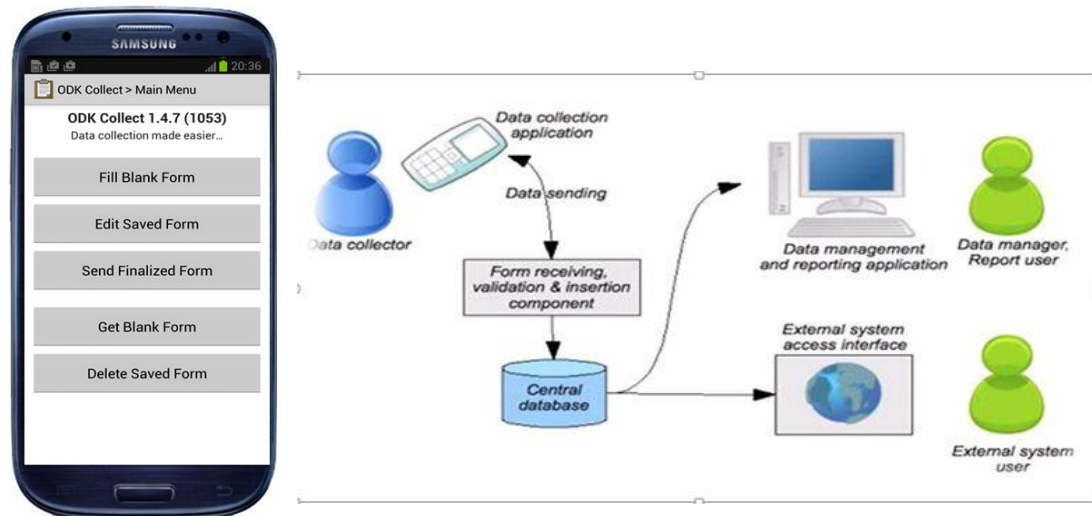


Figure 12 System and process for the waste-management dashboard prototype

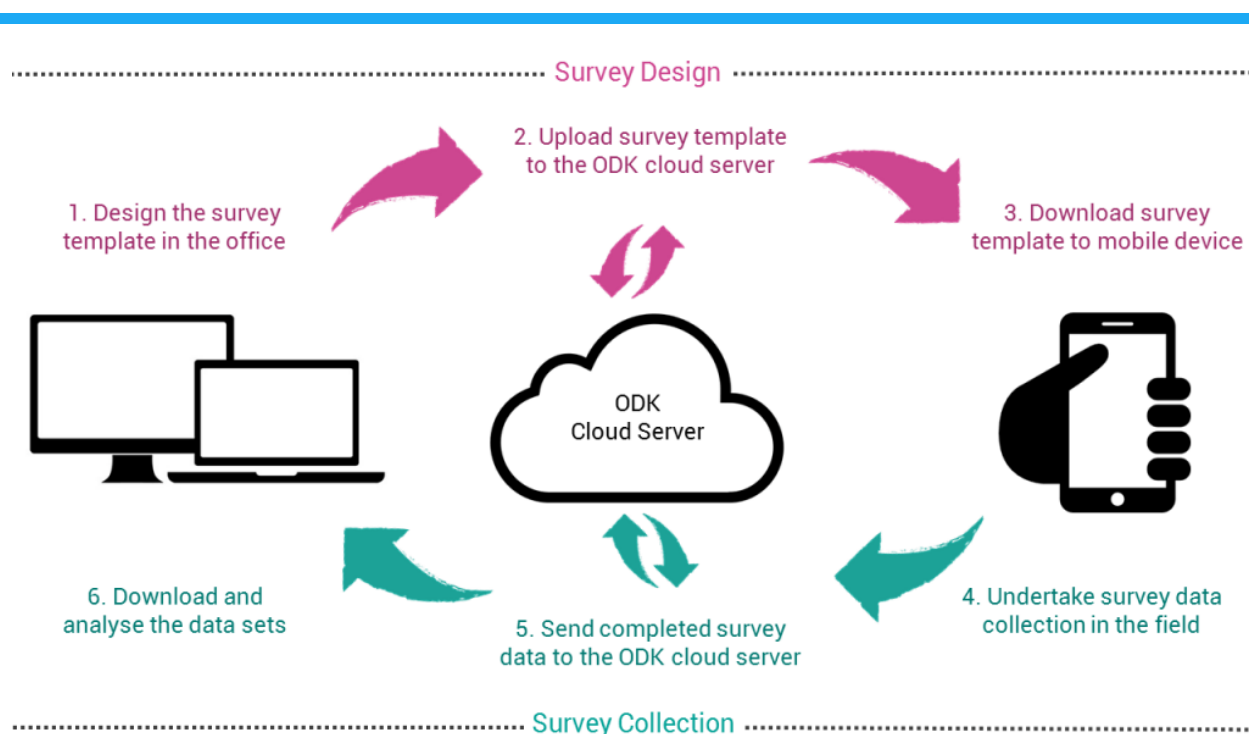


Figure 13 Data collection model for solid waste collection dashboard

Transformative river management

The *Miji Bora* project undertook P2P learning exchange visits between officials from Mombasa and Durban with the aim of developing and testing shared learning between the two cities. As one of the key outcomes, the County Government of Mombasa developed interest in e'Thekwini Municipality city-wide implementation of Transformative Riverine Management and decided to prototype a similar approach for the seasonal Mtopanga River.

The river is within Kisauni sub-county and has an estimated length of 7km. Over the years, due to intensification of settlement, the river has been heavily impacted by acute encroachment, accumulated obstructions such as waste which has significantly reduced areas of intact riverine vegetation along the river system. In marking World Environment Day in June 2020, CGM pledged to clean the Mtopanga River as part of the county's development initiatives and restoration of natural ecosystems. A transect walk was conducted on 13th September 2020 from the mouth of the river to where all the river tributaries converge.

The main objective of the transect walk was to conduct a reconnaissance survey of the whole river system. The activity involved county officials from four departments, researchers and other stakeholders. It provided an understanding of the water resources, wastewater flows, effluents and accumulated obstruction, their diversity and associated problems as well as assessment of opportunities for rehabilitation and conservation. This transect walk also informed the development of a field guide to serve as a tool for data collection, designing a monitoring guide, and strategies for engagement of stakeholders with interest in rehabilitating the river. In addition, it provided a good cross-section of information that can be used for specific purposes of verification and appraisal.

The overall initiative was led by the County Government of Mombasa, Department of Environment, Energy and Solid Waste Management, Department of Transport and Roads & Infrastructure, and Department of Water and Sanitation. Private sector stakeholders also committed to start an initiative towards rehabilitating Mtopanga River. Some of the issues encountered by the multisectoral team were as follows:

- Acute encroachment through human settlement with houses built along the river banks thus impeding its natural flow
- Accumulated obstructions due to dumping of waste. This was seen in most parts of the river with household waste, plastic waste, and other solid waste that has blocked water flows especially through culverts.
- The team identified areas of intact riverine vegetation as well as sections with heavily invasive species within the river system causing blockages as shown in Figure 16?????

During the walk, participants discussed their experiences which brought out diverse views such as:

- Major water sources - it was evident that the community relied on fresh water from outside the county and borehole water
- Wastewater/effluents collection and treatment (septic tanks) - most of the households channelled their wastewater to the river,
- Lack of proper waste management - presence of pockets of waste dumps at different points along the river
- Poor physical infrastructure within the community was evident - key example was construction of buildings over the river system which renders the buildings vulnerable to disaster in periods of extreme weather events such as flooding

The team collected information by direct observations (with photographs and notes as the key tools), taking location data using GPS tools, and interviewing members of the community. This enabled the project team to identify major problems and opportunities such as access to resources as well as explaining the cause and effect in related issues such as various water sources, waste recovery, and treatment of wastewater as key strategies towards rehabilitation of the river.

As a way-forward, the team recommended the use of drone technology to capture aerial photos of the whole river system. Resultant images would then inform the planning and development of transformative initiatives in collaboration with other stakeholders. In addition, stakeholders recommended that *Miji Bora* project should facilitate a stakeholder workshop involving private sector, non-governmental organizations, community-based organizations and other organized groups to facilitate building of synergies on best approaches to responsive river management.

A technical working group (TWG) on Mtopanga Transformative River Management was later established within the auspices of Mombasa Smart Sustainable City Forum (MSCF). The TWG would be led by Bamburi Cement Lafarge Ecosystems, County Government of Mombasa, Department of Environment, Energy and Solid Waste Management, and WWF Kenya under the coordination of COMRED as the principal partner of *Miji Bora* Project.

Mombasa Smart City Forum MSCF

One of the emergent platforms for the envisaged collaboration(s) towards transitioning to our desirable/sustainable futures with digital technologies to our rescue is the Urban Labs, of which Innovation-Hubs and Makers' spaces are two of the multiple dimensions of Urban Labs. Since 2019, COMRED and partners have spearheaded smart and sustainable transitioning for coastal cities in the face of global environmental change. The project examines city systems with the overall aim of co-creating and co-designing practical pathways towards a smart and sustainable port city of Mombasa. In partnership with the County Government of Mombasa (CGM), the project identified the need to enter into an Urban Lab/Makers' space form of collaboration in order to incubate responsive communities-of-practice (CoP) for propelling the transitioning of Mombasa County to its sustainable/smart county future(s).

Miji Bora project used Stakeholder Analysis (SA) to identify potential partners with shared vision to enable common understanding, and to evaluate the potential of shared learning and discourse on present and future areas of synergy. The project stakeholder workshop provided partners an opportunity to identify key issues of interest to the County Government of Mombasa (CGM). Stakeholders articulated and prioritised key urban challenges as solid waste management, water and sanitation (which includes clean water supply, urban flooding, and sewerage management), energy and transport (which includes energy consumption and GHG-emissions, population, and sea level rise. The process was geared towards an understanding of stakeholder levels of influence and interest in relation to each of the identified challenges. Furthermore, the analysis set out to understand the attributes, interrelationships and interfaces among stakeholders. The workshop discussed the appropriate and inclusive framework for stakeholders to guide future engagements and interactions towards smart and sustainable city futures.

Such involvement of stakeholders is not only critical towards creating an atmosphere where everybody feels included and valued, but also mandatory with respect to achieving a smart and sustainable city status. Such an atmosphere is also important to reduce existing power disparities and mitigating under-representation of alternative positions and views. Stakeholder engagement workshop led to the establishment of the Mombasa Smart Sustainable City Forum (MSCF) as a multi-stakeholder mechanism and a framework for ongoing collaboration through dialogue, effective communication among stakeholders, multilateral actions between stakeholders and promoting public participation and transparent information sharing systems.

The stakeholder workshop identified areas of collaboration and facilitated the formation of a multi sectorial collaboration platform incorporating the county government and private sector as well as non-governmental organisations. The MSCF is a multi-stakeholder mechanism and framework for enhancement of collaboration through dialogue, effective communication among stakeholders, multilateral actions between stakeholders and promoting public participation and transparent information sharing systems.

The MSCF is coordinated by the County Department of Environment and managed by the *Miji Bora* project. The forum has members drawn from national agencies, county departments, private sector, civil societies, and communities. As the more permanent local government staff, County Directors constitute the key pillars for ensuring operational continuity of the MSCF. The forum also established thematic Technical Working Groups (TWGs) on key issues including plastic and solid waste, natural capital, transformative river management, climate action on transport sector, and port city planning.

7. Activity 7 – Knowledge Management- Miji Bora Project Website: <https://mijibora.org/>

As one of the key outputs (action areas) Mijibora focused on knowledge management ensuring key information is publicly accessible to its stakeholders. Further details on *Miji Bora* Project can be accessed on our project website: <https://mijibora.org/>. Key highlights of the website are:

Updates on project implementation

Project components

Topical issues on smart/sustainable urban growth

Partnerships

Various reports

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4. ANNEXES

ANNEX 1: Project Workshops & Webinars - Programmes, Participant (Organisations and Sample Images)

Inception Report: See [link](#) to the report



ANNEX 2: Technical Meeting: See [link](#) to the report



Cities and Coasts project: *Miji Bora* Project

Planning Workshop _ County Government of Mombasa Kenya 19th to 20th August
2019 - Draft Programme

Date	Activity	Responsible
Day 1 – Monday 19th August		
Workshop moderator: Hon. Dr. Nato		
0900 – 0930	Welcome & Introduction	Hon Dr Nato/ Prof Justus
0930 – 1000	Debrief the inception meeting	Dr I. Wanyonyi
1000 – 1030	Coffee/Tea Break	All
1030 – 1100	Overview of the proposal	Prof Justus
1100 – 1230	Group discussion- updating the proposal	Prof Irurah
1230 – 1330	Lunch	All
1330 – 1500	Work on individual components	Component Leads
1500 – 1530	Peer to Peer Learning component	Dr Sean O'Donoghue
1530 – 1600	Tea Break	All
1600 – 1620	Spatial information	Dr J. Maina/Dr G. Majambo
1620 – 1700	M & E Framework	?
Day 2 Tuesday 20th August		
0900 – 0920	Smart & city futures thinking	Prof Irurah
0920 – 0950	Situational analysis	Dr. Wanyonyi/Dr. Mwanga/ Prof Justus
0950 - 1010	Stakeholder mgt/partnerships/knowledge mgt	Hon. Dr Nato/Prof Irurah/Jefwa
1010 - 1040	ilabAfrica presentation	Emmanuel/Eunice
1040 – 1100	Tea Break	All
1100 – 1120	The blue economy and coastal urban renewal	Dr J. Kairo
1120 -1230	Harmonising component activities	Dr J. Maina
1230 - 1330	Lunch	All
1330 - 1430	Harmonising component activities	Dr Maina
1430 -1530	Project budgetary allocation Financial matters - Q&A	Ms. Marianne
1530 – 1600	Coffee/Tea break	All
1600 - 1630	Project admin/Project implementation process	Prof Justus
1630 -1730	Discuss and finalise TORs /Core team meeting	Core Team

ANNEX 3:P2P Learning Exchange 1- Mombasa: See link to the report



Cities and Coasts project: Miji Bora Project

Peer-to-Peer Exchange Learning Workshop _ County Government of Mombasa,
Department of Environment, Waste Management & Energy 11th to 13th

November 2019 – Activity Programme

Mombasa, Kenya

Suggested focus areas would include:

- o Water and sanitation,
- o Solid waste management,
- o Landfill site management,
- o Energy (reporting, climate change mitigation efforts)
- o Biodiversity management (and Community Ecosystem Based climate change Adaptation)
- o Governance and partnerships for regional leadership
- o Climate change associated risks and preparedness (storms and floods) - case in point on recent flooding
- o Gaps/opportunities for technology and tools (decision support tools and technology aiding the management)

All within a framework of establishing sustainable approaches within line functions responsible for service delivery, whilst simultaneously addressing climate change needs in MCG.

Date	Activity	Responsible
Day 1 – Monday 11th November 2019 – Solid Waste Management		
(Venue : Sunset Paradise Hotel)		
8:30 – 9:00	Welcome & Introduction	Hon. Dr Nato
9:00 – 10:00	Status Report on the County Solid Waste Management	Hon. Dr Nato
10:00 – 10:30	Status Report on Durban Solid Waste Management	Sean O'donoghue
10:30 – 11:00	Tea Break	All
11:00 – 12:30	Field Visit to show the three waste collection approaches and transportation	All
12:30 – 13:30	Lunch	All
13:30 – 16:00	Field Visit at Mwakirunge Dumpsite	All
16:00 – 16:30	Tea Break	All
16:30 – 17:00	Discussions & Lessons Learned Briefs	All
Day 2 - Tuesday 12th November 2019 – Water & Sanitation		
(Venue: Environment Department boardroom)		
9:00 – 10:00	Status Report on the County Water & Sanitation, storm water management and flood mitigation strategies	
10:00 – 10:30	Status Report on Durban Water & Sanitation	Lungi Zuma
10:30 – 11:00	Coffee/Tea break	All
11:00 - 12:30	Courtesy Call & Field Visit to the Department of Transport & Planning	All
12:30 – 13:30	Lunch	All
13:30 – 16:00	Field Visit to MAWASCO & Department of Water & Sanitation	All
16:00 – 16:30	Tea Break	All
16:30 – 17:00	Discussions & Lessons Learned Briefs	All

ANNEX 4:P2P Learning Exchange 2- SWM Webinar

Recording

Titus Jefwa Charo sean.O'donoghue Justus Kithiia godffreynato Lynne Farrah Tracy Kamau

 **By 2030 eThekweni will be Africa's most caring and liveable city**



The C40 Cities Finance Facility and The Sihlanzimvelo Project, eThekweni.

Geoff Tooley
Senior Manager: Catchment Management

 2020-05-22 11:37:29

Recording Speaker View

Peter Migosi Titus Jefwa Charo sean.O'donoghue Eng Migosi Justus Kithiia

godffreynato Innocent Wanyo... Valerie Brown Lynne Farrah Abdulsalam oma...

Dr June Thomas Chula James Okero USER Geoff Tooley Du...

Tracy Kamau Arafa- Mombasa

Unmute Start Video Participants 17 Chat Share Screen Record Reactions Leave

ANNEX 5:P2P Learning Exchange 3- Transformative River Management Programme (TRMP) Webinar

The Sihlanzimvelo Project



Durban's climate future: Increased flooding and reduced water quality
The Challenge: Solid waste and alien vegetation causing water blockages

The Sihlanzimvelo Project

A Community-based waterway management of public land in high density areas in eThekweni's upper catchments including 100 km of stream in the Umlazi area and 300km in the Inanda, Ntuzuma and Kwa-Mashu (INK) area). The project is expanding to include 1000km of catchments in eThekweni.



Governance:
Structuring,
coordination,
champions and
partners

**Funding and
Resourcing:**
Financial and human

**Implementation
models and
programme
objectives**

**Reporting,
Monitoring and
learning**

- Each co-operative was allocated 5km of stream that they had to clean/clear and maintain.

- Maintenance tasks include removing litter, dumped waste, alien vegetation, grass cutting and clearing blockages.

- Managed by a consultant who employs assessors that are responsible for quality control and performance assessment.

ANNEX 6: P2P Learning Exchange 4 – Durban

10-Mar-20

Ref. PI/MB001/06/20

Dr. Sean O'Donoghue
Senior Manager: Climate Protection
eThekweni Municipality, Durban
South Africa

Hon. Dr. Godfrey Nato
CEC- Environment, Energy and Waste Management
County Government of Mombasa, Mombasa
Kenya

Dear Sean and Godfrey,

RE: Postponement of the 2nd peer-to-peer learning exchange visit to Durban

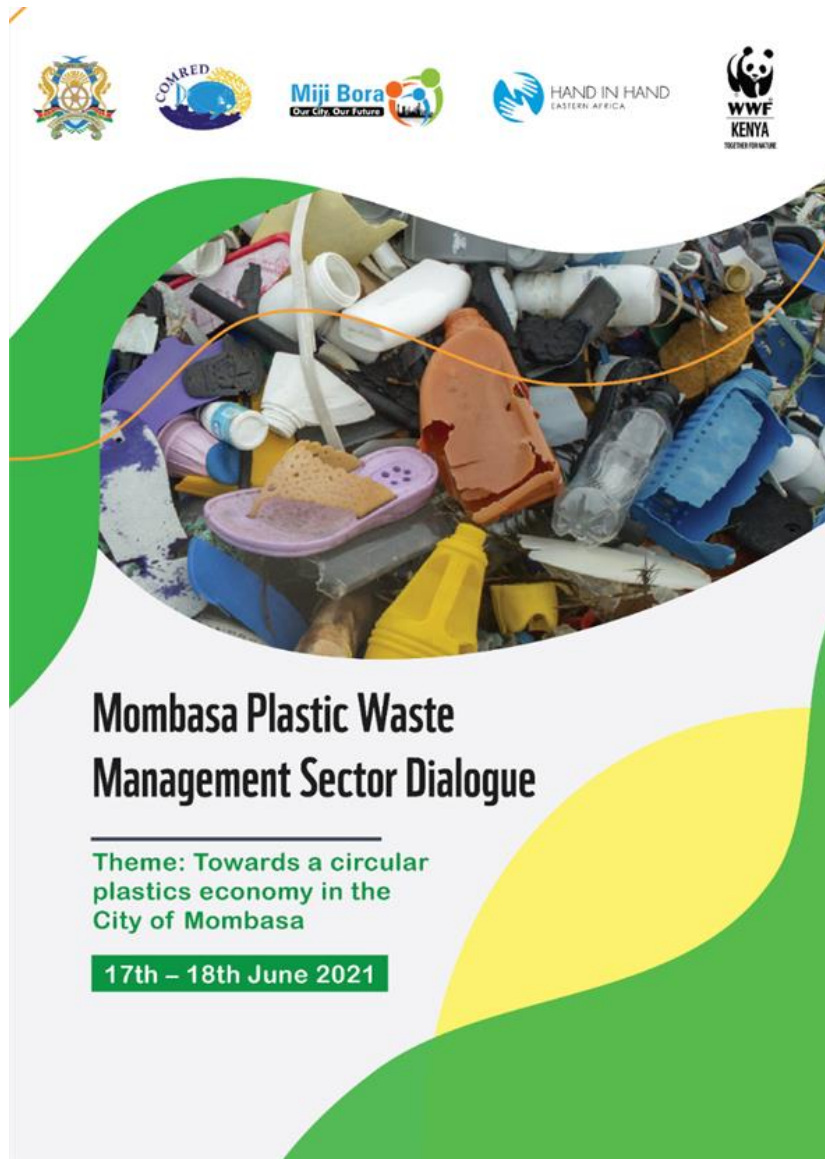
I write to both of you in your capacities as co-organisers of the planned peer to peer learning exchange visit to Durban. As you are well aware, we have spent the last few months planning for this activity, which is linked to the peer-to-peer learning component of the *Miji Bora* project. The activity is scheduled to take place between 16th-20th March 2020.

It has now become necessary, indeed urgent, to reflect on how our planned activity may be affected by the current outbreak of the novel Coronavirus. It has been reported that the virus has spread to 113 countries and territories of the world, infecting 114,300 people and leaving 4,025 others dead. It continues to spread, with new cases being reported every day. The World Health Organization (WHO) has warned that 'this is not a drill'; the disease is serious, and while it is not deadly to most people, it can still kill, as evidenced by the above reported deaths. Needless to say, we're all responsible for reducing our own risk of infection, and if we're infected, for reducing our risk of infecting others.

ANNEX 7: P2P Learning Exchange 5- Water and sanitation webinar: See [link](#) to report

1. COVID-19 challenges : see [link](#) to the report
2. Memorandum of understanding
 - Strathmore University (iLab Africa): See [link](#) to MoU
3. Data and Governance Management (DGM) Policy : See [link](#) to the report
4. Project News brief: See [link](#) below
5. Carbon Footprint
6. Mangrove Assessment : See [link](#) to the report
7. Stakeholder Workshop : See [link](#) to the report
8. Dialogue

ANNEX 8: Stakeholder Dialogue 1- Plastic & Solid Waste Management Dialogue: See [link](#) to the report





ANNEX 9: Stakeholder Dialogue 2- Climate Action & Transport: See [link](#) to the report





Cities and Coasts project: *Miji Bora* Project <https://mijibora.org/>

Transport Sector Dialogue on Energy and GHG Emissions

Venue: Diamond Dreams of Africa, Malindi, Kenya

Monday, 28th June 2021

Time	Activity	Facilitator
8:00 – 8:30 am	Arrival and Registration	
8:30 – 9:00 am	Welcome and Introductions	Eng. Ali Sharif
9:00 – 9:20 am	Overview of Miji Bora Project & Mombasa Sustainable Smart City Forum (MSSCF)	Dr. Godfrey Nato/ Prof Justus Kithia (virtual)
9.20 – 9.40 am	Energy Consumption and GHG emission: Concerns, sustainable solution & case studies	Dr Innocent Wanyonyi/ Jackline Mutisya
9.40 – 10.10 am	Road transport and greenhouse gas emissions in Mombasa	Chris Kost
10.10- 10.30am	Energy consumption and GHG emission in the transport sector in Mombasa: Status, Challenges & Initiatives	Eng Ali Sharif
10:30 – 11:00 am	Legal requirements and National reporting on emissions from vehicles	KEBS
11.00- 11.30 am	Tea break	
11.30 – 12:30 pm	Panel session	
12:30 – 1:30 pm	Lunch	
1:30 – 2:30 pm	Group Discussions ✓ Sources of energy and GHG emissions in sectors ✓ Current status and main challenges ✓ Achieving green cleaner energy/emissions reductions by sectors	Break out session
2:30 – 3:00 pm	Group Discussions; Information and Data sources in Mombasa	Break out Session
3:00 – 3:30 pm	Information and Data sources in Mombasa	Plenary
3:30 – 4:00 pm	Way forward	Plenary
4:00 – 4:30 pm	Tea and Departure	

ANNEX 11: Smart futures thinking- Future Scenarios Workshop

- Partnership : See [link](#)
- Workshop Report : see [link](#) to the report



ANNEX 12: Futures-Thinking Scenarios Workshop - Programme



Cities and Coasts project: *Miji Bora* Project <https://mijibora.org/>

Mombasa Smart Sustainable City Forum

Our City- Our Future

At Kilifi Bay Hotel

Thursday 7th – Friday 8th October 2021.

Day 1 Thursday 7th October 2021

Time	Activity	Facilitator
8:30 am – 9:00 am	Arrival and Registration	Jemimah & Immaculate
9:00 am – 9:30 am	Individual Introductions Welcome and Opening Remarks	Dr. Innocent Wanyonyi Hon. Dr. Luciana Sanzua
9:30 am – 10:15 am	Introduction - To Miji Bora project, MSCF. SDGs/scenario framing (45min)	Dr. Innocent Wanyonyi, Dr. David Obura
10:15 am – 10:30 am	Tea break	
Participants consider/discuss the key priorities for Mombasa, and linked to SD goals (3.5 hrs.)		
Introduction - Dr. David Obura		
10:45 am – 11:15 am	SDG description – local context/expression/wording (30 min)	Break out Session
11:15 am – 1:15 pm	SDG priorities - ranking/ relationships (by COP/TWG); (2.5 hrs.)	Break out Session
1:15 pm – 2:15 pm	Lunch	
Intro to scenarios for Mombasa (2 hrs.) - Dr. David Obura		
2:30 pm – 4:00 pm	The scenarios, framed in Mombasa – 4 scenarios, key sectors (1.5 hrs.)	Break out Session
4:00 pm – 4:30 pm	For each issue, discuss the scenarios (45 mins)	
4:30 pm – 5:00 pm	Tea	

Day 2 Friday 8th October 2021 Enrich Narratives and Scenarios (in working groups, by issue)

Time	Activity	Facilitator
Discuss the SDG narratives and scenarios from Day 1 (1.15 hrs.) – Dr. David & Dr. Innocent		
8:00 am – 9:15 am	Plenary, bringing group to agreement on scenarios and SDGs (1 hrs.)	
	For each issue/SDG, fill summary table;	
Where are we now? Situate each issue in its current state (1.15 hrs.) – Dr. David Obura		
9:15 am – 10:30 am	Key elements of an SDG narrative for each issue – the current baseline (1st horizon)	Break out Session
10:30 am – 10:45 am	Tea break	
Potential futures (horizon 3) - where do we not/want to go? (1.45 hrs.) - Dr. David Obura		
10:45 am – 11:45 pm	Brainstorming – the third horizon – where do we want to get to? (1 hour)	Break out Session
11:45 pm – 12:15 pm	Add some details ... What are the outcomes? Who wins/loses? Drivers/ obstacles? (30 mins)	Break out Session
12:15 pm – 1:15 pm	County planning/institutional frameworks – intro/reminder, for w/s 2 (30 mins)	
1:15 pm – 2:15 pm	Lunch	
2:15 pm – 3:00 pm	Gamification- Circular Economy- Eva	
3:00 pm – 4:00 pm	Feedback	
4:00 pm – 4:30 pm	Closing & Way forward	
4:30 pm – 5:00 pm	Tea	

ANNEX 13: Smart Futures thinking- KIP CONFERENCE



DAY 1

8th NOVEMBER 2021: WORLD TOWN PLANNING DAY

TIME	TOPICS	SPEAKERS
8:00–9:00am	Registration of delegates	KIP Secretariat
OFFICIAL OPENING– MODERATOR: HON. CHARLES KARISA DADU – CECM Health, Kilifi County		
9:00 –12:00 am	Opening Prayer and introduction	Plan. Mildred Ambani– Hon. Secretary KIP
	Convention concept	Plan. Joakim Nyarangi– President KIP
	Opening Remarks	Hon. Grace Tubwira Bagaya– President, Uganda Institute of physical Planners
		Hon. Maureen Mwangovia– Lands & Physical Planning CECM – Kilifi County
		Mr. Emmanuel Njai–CEO – Jumuiya ya Kaunti za Pwani
		H.E Lee Kinyanjui– Chair, Urban Development Planning and Lands Committee
		H.E Amason Kingi– Host Governor
	Keynote Address	Mr. Gershom Otachi– Chairman, National Lands Commission
		Mr. Charles Hinga Mwaura – Principal Secretary Ministry of Transport, Infrastructure, Housing & Urban Development & Public Works
		Ms. Farida Karonep– Cabinet secretary – Lands & Physical Planning
	Official Opening Chief Guest	His Excellency Uhuru Kenyatta– President of the Republic of Kenya
12:00 – 1:00pm EXHIBITION & NETWORKING– LUNCH BREAK		
SESSION MODERATOR: COASTAL PLANNERS : PLAN. MWAITA & PLAN. NAOMI		
1:00am–3:00pm	Public event marking world planning day	- Ministry of Lands & Physical Planning - Ministry of Transport, Infrastructure, Housing & Urban Development & Public Works - National Land Commission - Council of Governors - County Government of Kilifi - Jumuiya ya Kaunti za Pwani - Malindi Municipality - Food & Agriculture Organization (FAO) - UN–HABITAT - The Western Indian Ocean Marine Science Association (WIOMSA) - KURA, KeRRA & KeNHA - All Delegates

DAY 2		
1. Land-sea planning development and management		
2. Planning in the midst of pandemic		
TIME	TOPICS	SPEAKERS
8:30am–8:50am	Opening & Agenda setting	Plan. Kelvin Ritho – Ripple Planning Associates Ltd
8:50– 9:30am	Convention Keynote address	Hon. Eugene Wamalwa – Cabinet Secretary, Defense
SESSION MODERATOR: PLAN. DR. VALENTINE OCHANDA– Programme Officer, WIOMSA		
9:30am–10:45am	Land– sea planning management (Keynote)	Dr. Jacqueline Uku– President, WIOMSA; (KEMFRI)
	• Transforming planning science into actionable policy ; Blue urban agenda	Dr. Akunga Nebat Momanyi – Fish Force Academy, WIOMSA
	• Ecosystem-based Management in the Coastal and Marine Environment	Dr. Judith Okello– KEMFRI
	• Coastal planning design and the futuristic thinking.	Prof. Daniel Irurah– WIOMSA Team
10:45am – 11:00am TEA Break		
PLENARY MODERATOR: PLAN. DR. FREDRICK OWINO– Jaramogi Oginga Odinga University of Science and Technology		
11:00am–12:30pm	Panel Discussion	• Dr. Jacqueline Uku • Dr. Akunga Nebat Momanyi • Dr. Judith Okello • Prof Daniel Irurah • Dr. Rose Kitur– Deputy Director Land–use Planning, NLC • Plan. Dr. Kayom Wilson– Physical Planner Specialist – Uganda Support to Municipal Infrastructure Development Project –Uganda
12:30pm–2:00pm LUNCH		
SESSION MODERATOR : PLAN. ANN ACHOM– Physical Planner, Kampala Capital City Authority		
2:00pm–2:45pm	Post covid-19 response and recovery, planning and design pandemic resilience (Keynote)	Eng. Philemon Kandie– Ag. Director General K&R-RA
	• Planning and design of urban settlement for pandemic resilience.	Plan. Solomon Ambwere – Deputy Director UDD
	• Approaches and lessons on response to covid-19 pandemic in settlements.	Plan. Dr. Peris Mang'ira – National Director, KISIP
	• Cross–cutting issues on pandemic and settlements.	Plan. Dr. Emmanuel Midheme – Lecturer, Maseno University
PLENARY MODERATOR: ENG. JECINTA MWANGI– Director Urban Roads Planning and Design, KURA		
2:45pm – 3:15pm	Plenary session	• Eng. Philemon Kandie • Plan. Solomon Ambwere • Plan. Dr. Emmanuel Midheme • Plan. Dr. Peris Mang'ira
3:15pm–3:30pm	Day summation	Plan. Leina Kilesi– Technical University of Kenya
4:00pm	Informal breakout sessions and networking among parties of interest	

DAY 3

1. Effective Plan Implementation to guide Investment and Development Control.		
2. Plan based Land Administration and Information Management: Efficient and Effective Sharing of Geospatial Data and Plans		
3. Planning for sustainable and resilient cities and human settlements development		
TIME	TOPICS	SPEAKERS
8:30am–9:10am	Opening and setting day's agenda	Plan. Rachael Kisiangani – KPLC
SESSION MODERATOR: PLAN. DR. FRIDAH MUGO – Urban & Regional Planning Department Chair, UON		
9:10am–10:15am	Plan Implementation (Keynote)	Eng. Silas Kinoti – Director General, KURA
	• Role of oversight in plan implementation	Plan. Dr. Hebert Musoga – Director land-use Planning, NLC
	• Effective plan implementation to guide investment development control.	Plan. Bisirikiwa Matia – Senior Physical Planner, Makindye Ssabagabo – Uganda
	• Role of Land information system in investments and effective plan implementation	Plan. Augustine Masinde – Director General Physical Planning, Ministry of lands and physical planning
10:15am–10:30am	TEA BREAK	
SESSION MODERATOR: PLAN. MILDRED AMBANI – Lecturer, Kenyatta University		
10:30am–11:30am	Planning and geo-information systems (Keynote)	Mr. Clifford Okembo – CEO ESRI
	• Geo-information system role in planning	Plan. Everlyne Lelei – Solution Engineer, ESRI
	• Upcoming technologies in coastal city planning	Dr. Bridget Mutuma – Nanotech Team
PLENARY MODERATOR: PLAN. CHARLES NYAKWEBARA – Lec. Makerere University, M.D Praid Consultants		
11:30am–12:00pm	Panel Discussion	- Eng. Silas Kinoti - Plan. Dr. Hebert Musoga - Plan. Augustine Masinde - Plan. Bisirikiwa Matia - Mr. Clifford Okembo - Dr. Bridget Mutuma
12:00pm–2:00pm	LUNCH	
SESSION MODERATOR: HON. CHARLES KARISA DADU – CECM health, Kilifi County		
2:00pm–2:45pm	Sustainable and resilient cities (keynote)	Plan. Dr. Charles Konyango – Director UDD
	• Analysis of city level multidimensional housing deprivation	Plan. Charity Kageni – Policy Analyst, KIPRA
	• Spatial Planning for port cities in the Land and Sea interface	Mr. Obakeng' Molelu – Lecturer, Durban University of technology & Majambo Gamoyo (COMRED)
	• Policy approaches to sustainable settlements	Plan. Prof. Lawrence Esho – Chairman, Department of Spatial Planning and Design, TUK
	• Community dynamics in planning construction and use of a contested public place – Malindi Waterfront Project	Kilifi County Planner
PLENARY MODERATOR: PLAN. DR. MOSES KOLA – DIRECTOR GEOPLAN CONSULTANTS		
2:45pm–3:15pm	Plenary discussion	- Plan. Dr. Charles Konyango - Plan. Charity Kageni - Mr. Obakeng' Molelu - Plan. Titus Musungu - Plan. Prof. Lawrence Esho - Kilifi planner
6:45 – 10:00pm	CONVENTION DINNER	
	Co-ordinators: Plan. Ambani, Plan. Kisiangani, Plan. Mburu & Plan. Ritho	
	Chief Guest – Eng. Silas Kinoti, Director General, KURA	

DAY 4

1. Mainstreaming Climate Change Adaptation and Disaster Risk Reduction through Planning		
2. Enhancing public participation in planning and development		
3. Pragmatic planning and development resolutions		
TIME	TOPICS	SPEAKERS
8:30am–9:10am	Opening and setting day's agenda	Plan. Samuel Mburu–Director KREIS, Spatial Planning and Consulting Associates Ltd
SESSION MODERATOR: PLAN. EVERLYNE LELEI – Solution Engineer, ESRI		
9:10am–9:45am	Mainstreaming Climate change (Keynote)	Plan. Husna Mbarak– Programme Director, FAO
	- Climate Change: A Special Set of Emerging Issues and Threats –Advancing oceans and climate vulnerability - Mainstreaming climate change into planning and management of cities	–Jack Stuart– Stimson Centre, CORVI Team Mamo B. Mamo– Director General, NEMA
9:40am–10:15am	Enhancing spatial equity in location planning for affordable housing.	Plan. James Gachanja –Senior Policy Analyst, KIPPRA
10:15am–10:30am	TEA	
10:30am–11:30am	- Role of participation in shaping planning and management of cities - Changing surface of run-off management in rural roads development in Kenya, need for spatial planning	Plan. Byendaimira B. Vincent – Director Physical Planning & Urban Development, Ministry of Lands, Housing and Urban Development– Uganda Mr. Kenneth Wando– Deputy Director (Survey), KeRRA
PLENARY MODERATOR: PLAN. ALEX NTHIWA– Chief Officer Planning, Makuani County		
11:30am–12:00pm	Panel Discussion	- Plan. Husna Mbarak - Mr. Jack Stuart - Mr. Mamo B. Mamo - Plan. James Gachanja - Plan. Byendaimira B. Vincent - Mr. Kenneth Wando
12:45pm–2:00pm	LUNCH	
SESSION MODERATOR: PLAN. ERICK RANDU– Director Physical Planning, Kilifi County		
2:00pm–3:30pm	Go Blue Project - Marine Spatial Framework - Policy approaches to marine spatial planning - Planning, land–sea interface	Go – Blue Project Team
3:30pm–4:00pm	Pragmatic Planning and Development Resolutions	Plan. Jeremiah Ougo – UNHabitat
4:00pm–4:30pm	Conference closure and vote of thanks	KIP President

DAY 5

CONFERENCE TOUR

ANNEX 14 Students Research - Abstracts

Masters Research Report (March (Prof)) by Ashleigh Sakala, completed/graduated 2021

Zandspruit: Maker culture

Makerspace for 4IR skills in waste salvaging



Ashleigh Sakala
1043574

4IR has arrived in South Africa and our workforce is struggling to grapple with its opportunities due to our lack of skills. The technological world will increase the inequality gap and those that will suffer the most are within marginalised communities as they are currently still feeling the long-lasting aftermaths of the apartheid system. The aim of the project is to explore the potential of bridging the gap between the marginalised unemployed youth within the settlement of Zandspruit and the emerging world of 4IR digital technology through a makerspace that focuses on digital skills development, waste salvaging and learning for the pursuit of sustainable social innovation.

This research report investigates the Makerspace as an architectural response for alternative learning of 4IR skills and waste salvaging within a marginalised community, which is based on learning culture, as opposed to the privatised traditional post schooling education systems. The intent of this thesis is to design an architectural intervention based on interactive creative process which will entail the keys stages of understanding and analysis of the context and its built environment, and the skills and knowledge of the community and youth based on salvaged materials. The key issue is understanding how the makerspace typology can enhance the existing context-based learning with access to digital technology in creating sustainable learning and skills for sustainable work. The author utilises the Zandspruit settlement due to its characteristics of creativity, inquisitiveness and adaptability of its people, which is evident within the autonomous built environment (commonly referred to as shacks).

The makerspace is proposed within this thesis to democratise the access to knowledge and information through an alternative learning in response to the existing contexts issues of education and spatial socio-economic disintegration. Knowledge, information and resources should not be a privatised commodity but should be available to all. The way we are learning needs to change within the 21st century as traditional schooling systems have failed us. The makerspace can provide an alternative access to 4IR skills and at the same time empower the youth and its community through sustainable social innovation, networking and entrepreneurship.



Water Governance in Urban Informal Settlements: An Infrastructure Lens Perspective on

Mukuru, Nairobi and Kya Sands, Johannesburg

PhD Research and Dissertation by Irene Ngunjiri (completed/graduated 2022)

Abstract: Through an extended notion of infrastructure as constituted of materials, people (human bodies and social relations) and knowledge, the study explored the diverse elements of infrastructure that residents of informal settlements have to navigate for continued access to water services as well as how the navigation transforms the normative mode of governance of access towards non-normative modes. The study employed a qualitative and comparative case-study approach based on everyday practices in access to water services in the informal settlements of Mukuru (in Nairobi, Kenya) and Kya Sands (in Johannesburg, South Africa). Primary data (from interviews, focus group dialogues–FGDs and transect-

walks for direct observations) were combined with secondary data for thematic analyses guided by *Atlas ti* coupled with matrix-based data coding approach.

Emerging from the extended infrastructure lens coupled with point-of-access manoeuvres, the study contributes towards urban governance discourse through a deepened understanding of how access to water services in informal settlements is mediated through an *assemblage* of human and non-human elements of infrastructure. Overall, the study demonstrates how unwarranted privileging of the “expert” through biasing of formal policies and practices towards normative modes of water governance fails to gain traction on the ground, especially when contested through diverse manoeuvres of everyday practices which transform the normative to non-normative modes of governance.

One of the most salient insights of the study is the elevation of the critical role of *people-as-infrastructure* (in terms of the human body and social relations) in access to water services. Specifically, the study reveals diverse embodied intersectionalities (such as by race, gender and class) of people-as-infrastructure with regard to access to water services especially in the last-mile delivery to residents’ houses. The study further extends the understanding of Simone’s notion of people-as-infrastructure where it primarily translates into *women-as-infrastructure*. Given the ongoing racial inequality in post-apartheid South Africa, the understanding of *women-as-infrastructure* is further intersected by race to form the ‘*black-female-body*’ as infrastructure in the case of Kya Sands. The people-as-infrastructure element thus opened up avenues for non-normative manoeuvres such as contestation/subversion of rules and tampering with material infrastructure by actors in order to ensure access. The study thus foregrounds the perpetual “visibility” of material hydraulic infrastructure in informal settlements contrary to Heidegger’s argument that infrastructure is only visible when it breaks down. Through the knowledge component, the study demonstrates how the normative mode of governance gets inverted/subverted when state officials resort to the situated knowledge of residents to accomplish diverse management roles such as repairs of the material infrastructure where infrastructural knowledge by men becomes more visible as the critical infrastructure element.

Key Words: *access to water services, assemblage, everyday practices, non-material infrastructure, non-normative mode of governance, people-as-infrastructure, state abstinence and absence*

Memories of futures-past and visions of future-futures: Liminality through gamification of back-casting in sustainable city transitioning for African cities

PhD Research and Dissertation by

Vipua I. Rukambe, 2022 (under examination)

Abstract: Ongoing rapid urbanization is intensifying pressure for African cities to engage with sustainable city transitioning towards better city futures. However, prevailing transitioning approaches apply positivistic tools such as forecasting and rigid master plans where human agency over our futures is discounted. Sustainability transitioning studies also continue to focus on the past to discern trends and patterns for objectively informing modelling and theory-building for transitioning with minimal concerns over how such theories translate into practice on the ground. This scenario provoked my study to prioritize futures-studies within which back-casting constitutes the envisioning stage of sustainable city transitioning. Based on “*futurity*” attributes of architecture and back-casting, the study hypothesized a metaphorical

mapping where the architect's process, which is strong in practice, is mapped into the weak-in-practice back-casting process. Architecture was thus applied as the *metaphier* (known domain) and back-casting as the *metaphrand* (yet-to-be-known domain).

The architect's process and tools demonstrated a strong capacity for inducing liminality towards accessing and materializing other-worlds in the form of buildings as key outcomes. There was no systematic evidence of similar *other-world* crafting tools or methods in back-casting. The study therefore hypothesized gamification as the key primary data approach towards filling the gap with Marlboro Gautrain Station Precinct (MGSP) as the empirical case study. Through image selection and placement on a gameboard, the game of Ubuntu Chess was played online over two game cycles. It was anchored on our temporal cognition of status quo (SQ), business-as-usual (BAU) and desirable futures (DF) as well evaluating outcomes in terms of people, place and planet (3Ps-principle). Liminality-cycle criteria such as normal-to-anomaly, disorientation and *communitas*, guided data analyses which demonstrated adequate facilitation of participants to *let-go* of their status quo reality in order to access *other-worlds*. Dialogues over image selection and placement on the game-board also facilitated participants to co-create alternative futures for the MGSP based on a creative futures-crafting approach in contrast to forecasting and master planning. Data from auto-ethnography on conceptualisation, development and execution of the game guided the envisaging of possible fields of liminality-oriented expertise on which responsive communities-of-practice could be incubated and developed. The key fields of expertise identified were game-conceptualisation and development, *liminality-guru* and facilitator, transcribers and data analysts to narrate gamification outcomes into envisioned city futures. Metaphorical mapping of architecture into back-casting facilitated identification of the liminality-gap as well as the conceptualization, development and implementation of Ubuntu Chess which managed to facilitate liminality towards the co-creation of desirable urban futures for the MGSP. Auto-ethnographic data also facilitated the envisaging of communities-of-practice based on roles and tasks I executed as an amateur for purposes of my research. Secondary data on Curitiba, Brazil, guided the study to recommend further research on urban labs as a potential vehicle for the broader communities-of-practice to facilitate translation of envisioned futures into action on the ground.

The study also finds that architecture as a discipline and practice could benefit by systematically recognising its futurity competencies as well as developing related knowledge and expertise. The discipline also needs a more explicit approach to its liminality competencies and tools rather than the current approach of disseminating them in an implicit and subconscious approach. In view of established competency for metaphor through the architect's process, the study recommends systematic architecture-oriented inquiry into this field to align with its growth and development in other fields. In view of neuroscience and neurophenomenology underpinning the neuroconstructivist paradigm assumed in the study, architecture also needs to deepen its inquiry into neurophenomenology as an extension of phenomenology as normally covered under theory of architecture.

Key Words: *African city futures, architect's process; back-casting; communities-of-practice, neuroconstructivism, gamification, liminality, metaphor, sustainable city transitioning.*

“Community perceptions and willingness to pay for Mangrove conservation in the context of climate change in Mombasa County.”

Masters Research Report by Virginia Mumbua Ngei

Abstract:

Key Words:

University “Determinants Influencing Performance of Solid Waste Management in Mombasa County, Kenya”.

Masters Research Report by Lynne Farrah,

Abstract:

Key Words:

“Route Optimization for Solid Waste Collection using Machine Learning & GIS Techniques”

Masters Research Report by Titus Jefwa

Abstract:

Key Words:

ANNEX

Sample Project Stakeholder Partnership MOU – iLab Africa, Strathmore University, Nairobi

Solid waste [dashboard](#)

Hackathon 1- Solid Waste Management Challenge: See [link](#) to the concept

CONCEPT NOTE – IMPLEMENTATION OF SOLID WASTE MANAGEMENT HACKATHON

Sourcing (10 Days Lead Time)

Monday 31st August, 2021 – Friday 10th September, 2021

Objective: To recruit participants who are passionate, creative, teachable and open-minded, with the zeal to be part of the solution to solid waste management in Mombasa

Target: Approx. 40 participants willing to go through the whole cycle – 2 inspiration days and hackathon

How: Reach out to Youth (University/college students; members of youth groups and CBOs; graduates & out of school youth)

- Swahilibox
- Swahilipot Hub
- Pwani Technowgalz
- TUM Innovations/ Top tech students in tertiary institutions in Mombasa
- American Spaces
- Youth Groups – Entrepreneur / Solid Waste Related
- BOOST – Networks?

Inspiration Day 1 (Saturday 11th September, 2021)

Objective: Shape Mind-set: To introduce the participants to Design Thinking Principles and Innovative Mind-set.

How:

- Sessions on Introduction to Immersion/Inspiration, Synthesis, Ideation, Prototyping, How to Pitch
- Introduction to a dummy challenge
- Personality Test?
- Team Building Activity?

Inspiration Day 2 (Saturday 18th September, 2021)

Objectives:

- Immersion – To enable the participants to appreciate and internalize the challenge/ problem.
- Team Building - To enable the participants build teams

How:

Recap on Inspiration Day 1

- Facilitation on Transformative Thinking – How to understand the core of the problem
- Facilitation on team formation (complementary teams of 2-4)
- Fireside chat with the challenge expert
- Trying to not brainstorm on the solutions yet, but to fully understand the problem and asking questions
- Research? Going out of the Room?

Hackathon (2 Days) (Saturday 2nd October, 2021 & Sunday 3rd October, 2021)

Objective:

- Build – To enable the participants brainstorm ideas; build and validate prototypes; and pitch solutions.

How:

- Facilitated brainstorming sessions to spark creativity
- Inspirational talks from ‘successful start-ups’ on the journey
- Prototyping sessions with experts and coaches to validate the ideas
- Testing of the solutions
- Pitching of the solutions

PROGRAMME

THE MOMBASA SOLID WASTE HACKATHON

Programme

Date: Saturday 2nd October, 2021

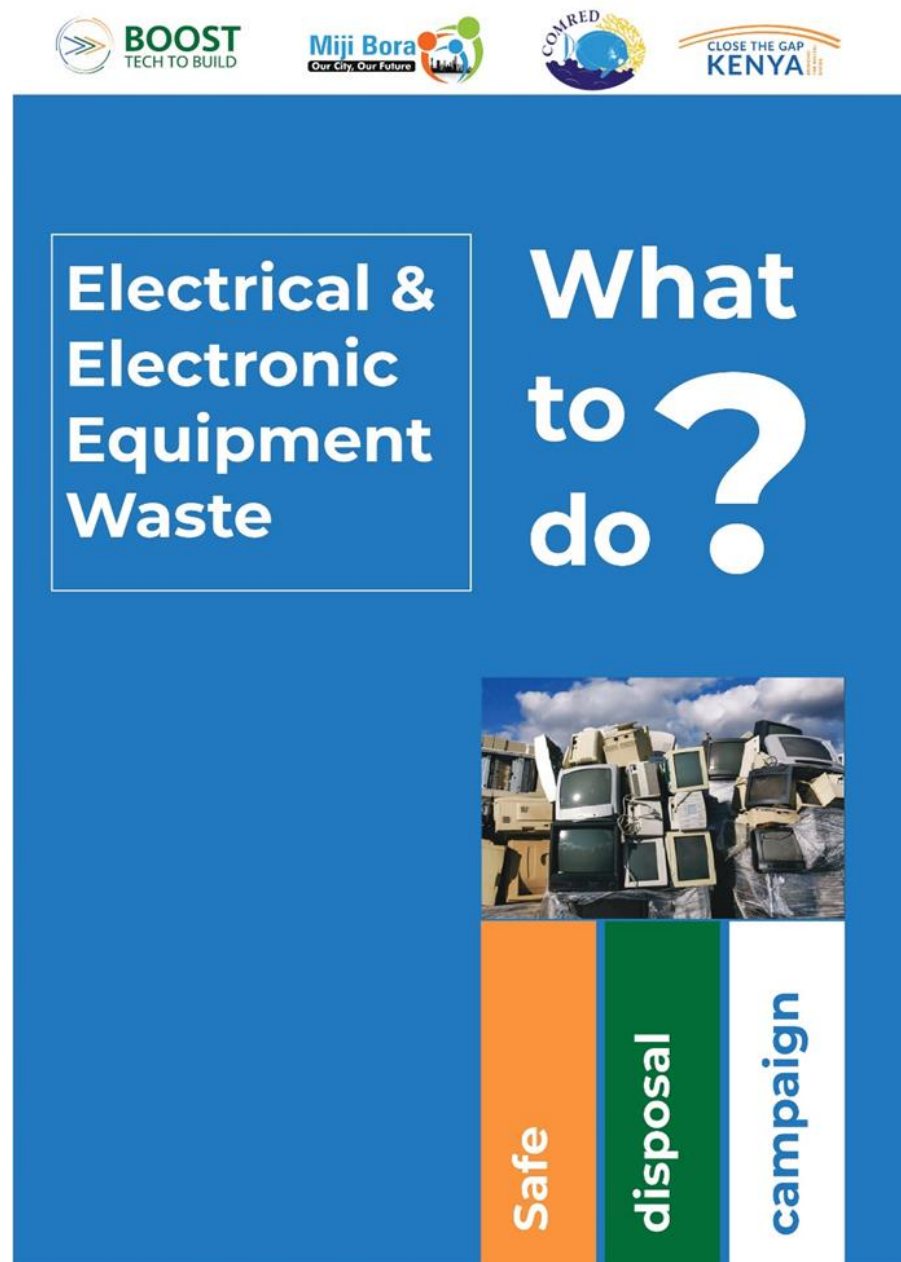
Venue: Close the Gap Hub Mombasa.

8:00am-9:00am	Registration and Reception
9:00am-9:30am	Opening Prayers Welcoming Remarks

9:30am-10:00am	Guests Introductions Partners Introduction
10:00am-10:10am	Overview of Previous Sessions Overview of today's session
10:10am-12:00pm	Pitching
12:00pm-12:30pm	Judges Deliberations Tea Break
12:30pm-1:00pm	Keynote Address (Dr Nato)
1:00pm-1:45pm	Award Ceremony Closing Remarks & Next Steps
1:45pm-3:00pm	Group Photo Lunch & Networking

Hackathon 2- Climate Change Challenge: See [link](#) to the concept

TWG Activity- E-Waste campaign



The poster features a blue background. At the top, there are four logos: BOOST TECH TO BUILD, Miji Bora Our City, Our Future, COMRED, and CLOSE THE GAP KENYA. The main text on the left is 'Electrical & Electronic Equipment Waste' in white, enclosed in a white box. To the right of this box is the text 'What to do?' in large white font, with a large question mark. Below this text is a photograph of a pile of discarded electronic equipment, including monitors and keyboards. At the bottom of the poster, there are three vertical bars: an orange bar with the word 'Safe', a green bar with the word 'disposal', and a white bar with the word 'campaign'.

TWG Activity- Mombasa Climate change policy dialogue

TWG Activity- Transformative River survey: see [the link](#) to the report