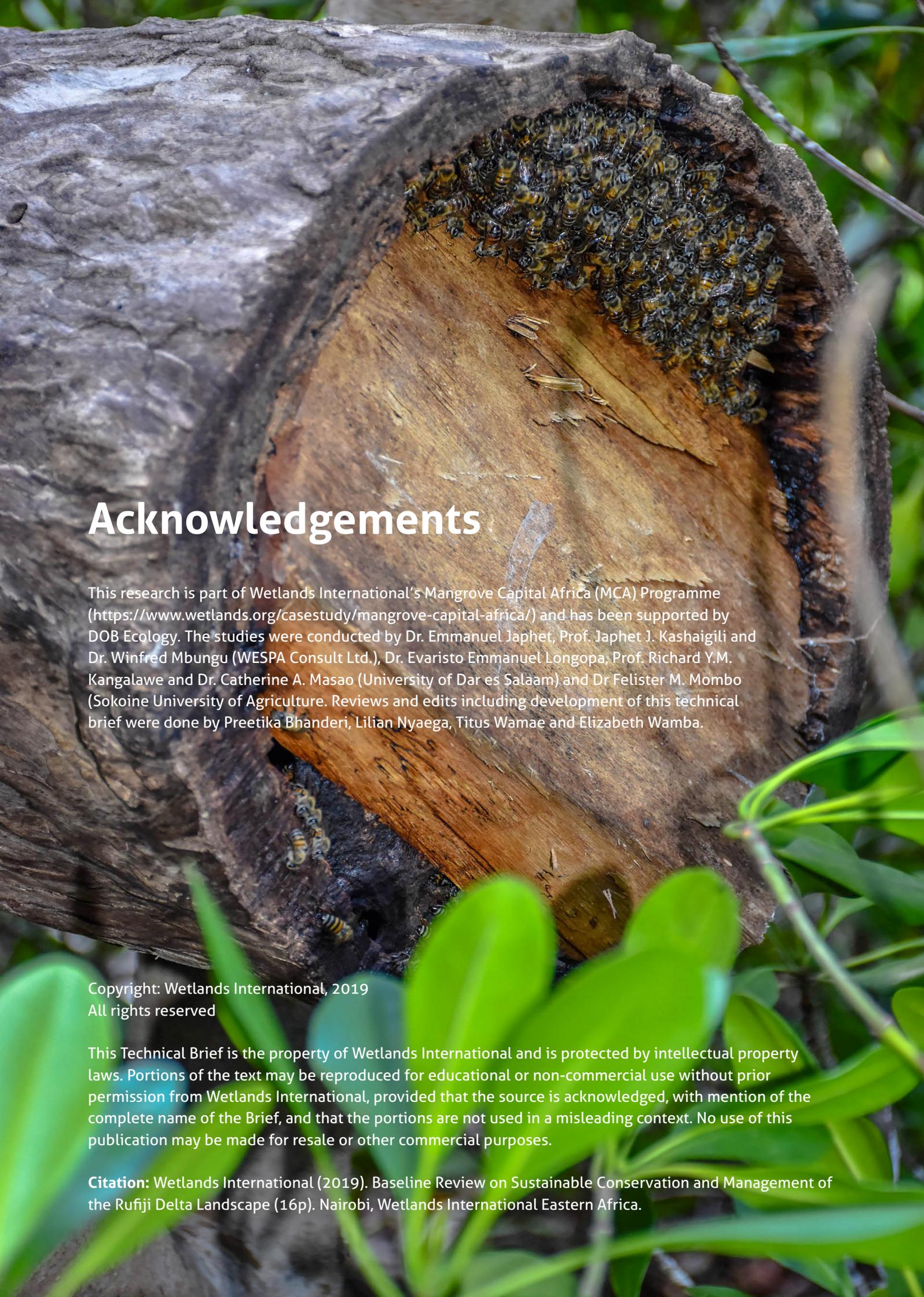


BASELINE REVIEW ON SUSTAINABLE CONSERVATION AND MANAGEMENT OF THE RUFJI DELTA LANDSCAPE

TECHNICAL BRIEF





Acknowledgements

This research is part of Wetlands International's Mangrove Capital Africa (MCA) Programme (<https://www.wetlands.org/casestudy/mangrove-capital-africa/>) and has been supported by DOB Ecology. The studies were conducted by Dr. Emmanuel Japhet, Prof. Japhet J. Kashaigili and Dr. Winfred Mbungu (WESPA Consult Ltd.), Dr. Evaristo Emmanuel Longopa, Prof. Richard Y.M. Kangalawe and Dr. Catherine A. Masao (University of Dar es Salaam) and Dr Felister M. Mombo (Sokoine University of Agriculture. Reviews and edits including development of this technical brief were done by Preetika Bhandari, Lilian Nyaega, Titus Wamae and Elizabeth Wamba.

Copyright: Wetlands International, 2019
All rights reserved

This Technical Brief is the property of Wetlands International and is protected by intellectual property laws. Portions of the text may be reproduced for educational or non-commercial use without prior permission from Wetlands International, provided that the source is acknowledged, with mention of the complete name of the Brief, and that the portions are not used in a misleading context. No use of this publication may be made for resale or other commercial purposes.

Citation: Wetlands International (2019). Baseline Review on Sustainable Conservation and Management of the Rufiji Delta Landscape (16p). Nairobi, Wetlands International Eastern Africa.

1. Introduction

Mangroves inhabit the boundaries of terrestrial, marine and freshwater ecosystems of tropical and sub-tropical coastlines of 123 countries around the world (Spalding et al., 2010). They form one of the most ecologically and economically valuable ecosystems of the world (Nagelkerken et al., 2014). They are unique and remarkable ecosystems that thrive in harsh conditions of high salinity, turbulent and dynamic coastal environment and erratic soil conditions. These spectacular ecosystems are characterised by high primary production and carbon storage that exceed the levels of most of other tropical or temperate forests (Donato et al., 2011). Of the 152,000 km² coverage of mangrove ecosystems worldwide, 28,000 km² occur in Africa, which represents 18% of the global mangrove cover.

Over the past decade, concern has grown over degradation and subsequent loss of mangrove ecosystems of the world (Abuodha & Kairo, 2001; Alongi, 2002). They are being lost at a rate of 2% to 8% per year (Polidoro et al., 2010). The main causes of such loss include conversion to aquaculture and agriculture, unsustainable harvesting and climate change. To alleviate the impacts of such threats, the adoption of an innovative approach that is based on scientific, economic, social and traditional knowledge is required (Datta et al., 2012).

Mangrove Capital Africa (MCA) Programme, led by Wetlands International, is a 10-year (2017 – 2027) initiative that focuses on healthy mangroves, biodiversity and improvement of the livelihoods of millions of people and strengthening their resilience to the impacts of climate change. The Programme works to raise awareness on the values of mangroves as well as provide the knowledge and tools necessary for their improved management. Essentially, the MCA programme helps to safeguard and restore the mangrove capital in East and West Africa for nature and people. With initial targets of the Saloum delta in Senegal and Rufiji delta in Tanzania, it will expand to cover sites in Kenya, Madagascar, Mozambique, Cameroon, Guinea, Guinea-Bissau, Nigeria and Sierra Leone.



Simbaulanga shoreline that is increasingly vulnerable to sea level rise and erosion



Rufiji delta is a habitat rich in biodiversity

RUFJI DELTA: GEM UNDER SIEGE

Rufiji delta is the largest single mangrove forest in Eastern Africa and has a coverage of about 500 km² (Wang et al., 2003). In recent decades, the delta has been severely affected by a complex set of factors including anthropogenic pressures and climate change (Wagner & Sallema-Mtui, 2016). Further, the area is experiencing a range of management challenges such as ecosystem encroachment; pollution and salinisation of soils, estuaries and aquifers; degradation of resources; shoreline erosion and conflicts of interest among stakeholders giving rise to increased concern. Climate change is aggravating this situation due to sea level rise and frequent erratic and extreme weather. Other potential threats to the Rufiji delta are upstream damming and pollution from agricultural land (Mwalyosi, 2018). With that, pressure on the mangrove ecosystem of Rufiji delta is likely to continue and worsen in the near future unless stringent measures are taken to protect these unique forests.

This Technical Brief discusses the status, opportunities and challenges of mangrove conservation and management in the Rufiji delta. These have been drawn from studies conducted in the framework of the MCA Programme on the ecological and hydrological conditions as well as the socio-economic and management regimes in the landscape. These help to create a sound knowledge base on the existing conditions that are necessary to determine the type and magnitude of interventions to be implemented.

The overriding conclusion is that there is increasing degradation and inadequate responses and interventions to either the long-standing pressures or the rapidly escalating threats that have emerged in recent years. Recommendations for implementation by different actors have also been provided.

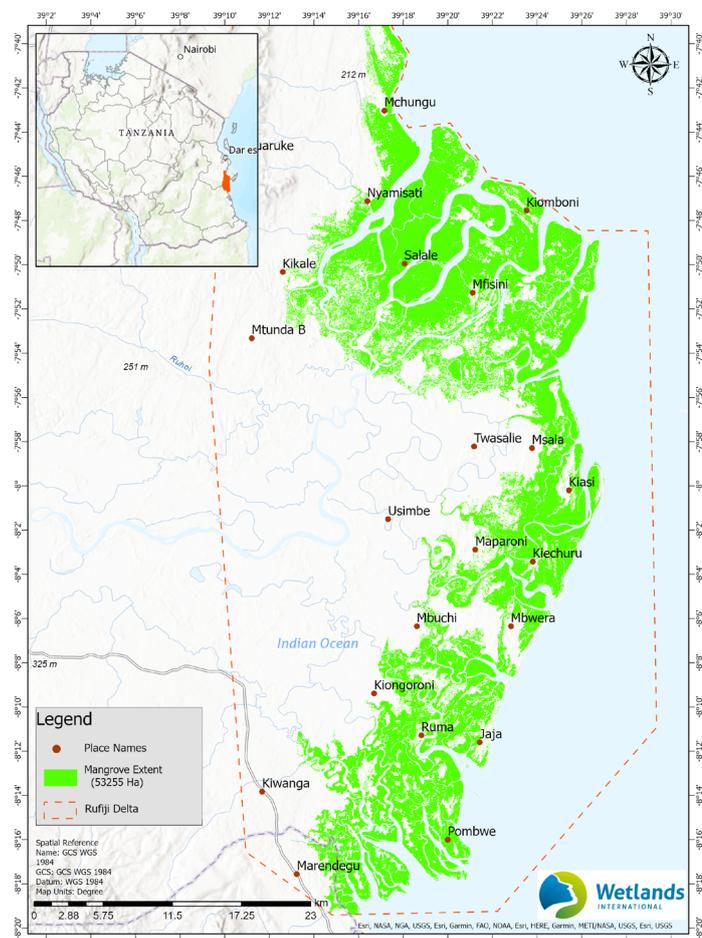


Figure 1: Rufiji delta mangrove extent

2. A Case for Rufiji Delta's Mangroves

KEY MESSAGES

The major pressures on the ecological resources of the Rufiji delta are on the mangrove forest. Hydrology is by far the most important ecological driver in wetland dynamics as it is the primary determinant of wetland type. Nonetheless, hydrology has often not been taken into account mainly because it is very variable and dynamic, making it difficult to quantify and get representative observations. The success of restoration projects requires an understanding of, among other things, both the biotic and abiotic factors. The differences in structure and function of mangroves are reflected in differences in their environmental setting, including their hydrological regime and soil characteristics.

Proposed upstream developments such as the Julius Nyerere Hydropower Station (formerly Stiegler's Gorge dam) will have an immense impact on the Rufiji delta mangroves. All related information and knowledge need to be considered to advocate for the protection of the Rufiji delta mangroves.

Communities in the Rufiji delta have a livelihood base that is dependent on natural resources such as mangroves and fisheries. Therefore, diversification of income sources is imperative to enhance the revenue levels and thereby improve local livelihoods in the delta. In this light, it is recommended that non-destructive and effective income-generating activities such as beekeeping and sustainable fisheries are widely implemented and earnestly supported.

The sustainability of the Rufiji delta mangrove ecosystem needs to be prioritised while enhancing livelihoods. For example, a quota needs to be allocated for livestock numbers that recognise the carrying capacity; while sustainable mangrove harvesting with strict issuance of permits needs to be implemented. In all the processes, the local community needs to be involved as decision makers to enhance ownership and adherence. These interventions should also address the problem of high poverty levels in Rufiji delta.

Restricted use of mangroves is leading to illegal logging. Policies focused on sustainable harvesting that are backed by scientific knowledge are needed. Logging permits based on season and species are required, with close monitoring. This has to go hand in hand with the implementation of sustainable mangrove restoration approaches.

There is a critical need to mainstream mangrove forests management through the inclusion of specific provisions in policies and legislation related to mangrove management and governance. This will in turn raise interest and permit allocation of national resources and technical knowledge to improve mangrove forests conservation.



Communities in Rufiji rely on natural resources like mangroves for their livelihoods and wellbeing

3. Approach

Conducted between 2018 and 2019, the baseline studies analysed the ecology, hydrology, socio-economic and policy and legislative factors concerning the conservation and management of mangroves in the Rufiji delta.

Using an analysis of available literature, biological surveys (flora and fauna), spatial data (land cover changes, mangrove species mapping) and socio-ecological assessments (key informant interviews, focus group discussions and questionnaire interviews) compiled through extensive surveys, it was possible to obtain a detailed description of the Rufiji delta.



4. Status, Values and Challenges

4.1 ECOLOGICAL RESOURCES

Of the 9 species of mangroves found in the Rufiji delta, 8 were recorded in this assessment. These are *Avicennia marina*, *Bruguiera gymnorrhiza*, *Ceriops tagal*, *Heritiera littoralis*, *Lumnitzera racemosa*, *Rhizophora mucronata*, *Sonneratia alba* and *Xylocarpus granatum*. *Ceriops tagal* has the highest percentage of species cover (38%) in the delta, followed by *Avicennia marina*, *Rhizophora mucronata* and *Xylocarpus granatum*. However, the three blocks of the study (north, central and south) have different species diversity, attributed to the varying river water flow and sedimentation. *Avicennia marina* is the most abundant tree species in the north and central block while *Ceriops tagal* is the most abundant in the south block. The diameter size distribution revealed that the mangrove forest is undergoing normal recruitment and recovering naturally from anthropogenic disturbances. A startling observation was made in the south block where *Bruiguieta gymnorrhiza* and *Heritiera littoralis* were reported to have disappeared. This was attributed to an increase in salinity likely due to reduced freshwater flow from River Rufiji.

Firewood was ranked as the most beneficial mangrove ecosystem good whereas its use as a fishing ground is seen as one of the most valued ecosystem service. Interestingly, the delta's mangrove ecosystem is considered to provide services related to shoreline stabilisation and climate change mitigation. Similar to other mangrove ecosystems, prawns were also observed in large numbers in the Rufiji mangroves, and several species of fish too. However, a decline of prawn numbers was recorded and this was higher than several fish species. The study recorded an incredible 93 species of birds, 5 species of mammals and 4 species of reptiles.



Mangrove poles awaiting transportation along the delta

Respondents indicated that the mangrove forests of Rufiji delta are affected by various pressures. Most respondents (61.3%) ranked unsustainable harvesting of mangroves as the main cause. This was followed by clearing of mangrove forests for rice farming (40.5%) and fishing camps (24.3%). Most of the harvested trees were in the north block at 747 stems per hectare. This was followed by the south block at 606 stems per hectare while the central block stood at 563 stems per hectare. In all blocks, the species which were most harvested are *Ceriops tagal* and *Rhizophora mucronata*.

Rice farming affected mostly two mangrove species, *Heritiera littoralis* and *Bruguiera gymnorrhiza*. This is because the rice farming activities have been conducted in the preferred habitat for these species.

Dismally, most of these rice farms are abandoned after approximately five farming seasons and new farms are opened. Change detection analysis shows that cultivated land covered 138,731 hectares. Of this, approximately 7,000 hectares were cleared from the mangrove forest since 1991 to pave way for rice farming. Fishing is common amongst the communities in the Rufiji delta. Though most are artisanal, there is also occurrence of commercial fishing. Fishermen clear mangroves to set fishing camps. After a single fishing season, fishermen move to other areas and establish new fishing camps, thus continuously clearing mangroves.

A fairly unique pressure was also observed in the Rufiji mangrove forest, and that is the liana invasion. The long-stemmed woody vines are climbers that suppress the healthy growth of mangrove trees and affect natural regeneration of degraded mangrove areas.

Moreover, prospective harbour development poses an emerging threat to the mangroves in form of increased human population in the Rufiji delta, harbour-associated oil spills and sediment changes.

4.2 HYDROLOGY AND WATER RESOURCES

Local patterns of hydrology such as tidal wave effects, riverine influences, groundwater inputs and surface drainage from uplands may affect the chemical and physical characteristics of the soil in mangrove habitats and the appearance of the mangrove forest. Out of the many factors, runoff in form of flooding as a result of rainfall, dry periods, increasing temperature, water levels and sediments deposition have great impacts on the hydrology of the mangrove forests in the Rufiji delta. Inventory of data for hydrometry, climate, water quality, groundwater, sediments and water level revealed the absence of required data whilst the available data is characterised by significant periods of missing data.

Available stream flow data show that the Rufiji delta being at the mouth of the Indian Ocean receives what is being discharged in the upstream catchments. Analysis of these data shows that the annual discharge of the Rufiji River at Julius Nyerere Hydropower Station can be estimated at 800 m³/s. However, the stream flow in the catchments and in the Lower Rufiji where the delta is located show high variability due to seasons. Rainfall data show a significant decreasing trend of rainfall in the area. The Rufiji delta is dominated by saline soils



which make it a good environment for the mangroves. However, human activities such as illegal logging, conversion of flooded areas to paddy fields and dams are a threat to the survival of the mangrove forests.

Measurements carried out in-situ and in the lab from different sites show that the pH of water from sites close to paddy fields had a mean of 7.35 ± 1.6 , while water from sites close to *Rhizophora mucronata* had a mean pH of 7.31 ± 0.08 and water from sites close to *Avicennia marina* had a mean pH of 7.5 ± 1.6 . Results further show that the pH was variable for sites in the paddy fields due to changing conditions and was less variable in the mangrove forests, especially in the *Rhizophora mucronata*.

Results further show that most mangrove species flourish in high salinity areas as zones with low electrical conductivity (EC) concentrations were associated with paddy fields which had an average EC concentration of $88 \pm 16.0 \mu\text{S}$. High turbidity values of up to 968 NTU were recorded in the area, signifying the presence of colloidal matters and suspended sediments within the water column. The lowest value of turbidity recorded was 20.5 NTU. These findings suggest that water and soil pH and salinity are some of the important factors governing the zonal distribution of mangroves.

4.3 SOCIO-ECONOMIC CHARACTERISTICS

Traditionally, although communities in the Rufiji delta were dependent on mangrove ecosystems for income generation, the current status shows that the primary sources of income are agriculture and fishing. The agricultural sector is regarded as key to the economy of the Kibiti District whereby 95% of its residents are engaged in growing crops like cashew nuts, cassava and rice. Fishing in Rufiji delta is mainly a male-dominated activity while women fish small shrimps only. As reported by villagers, fishing is constrained by declining fish availability as most of the fish have migrated to the deep seas where the traditional fishing gears cannot be used. Absence of reliable storage facilities also contributes to making fishing a difficult endeavour.

Other economic activities in the Rufiji delta include mangrove businesses like selling poles for construction, livestock keeping, salt production, beekeeping, employment and small-scale business. For the majority of respondents (67% - 70%), income from the various economic activities is less than Tanzania Shillings 100,000 (USD 43.50) per month. These economic activities increase mangrove degradation mainly associated with harvesting of mangrove products, especially for commercial use, that directly causes biodiversity loss in the Rufiji delta. Livestock grazing is rampant in many parts of the delta and these incursions exceed the vegetation resources' carrying capacity. Salt production has impacts on the mangrove ecosystem as mangrove forests are cleared and replaced with a series of solar evaporation pans.



Mangroves are cleared to pave way for rice cultivation in Rufiji delta



Fishing is a primary source of livelihood for the local communities

In the surveyed villages, respondents asserted that they depended on mangroves as a source of fuelwood during salt production processes. In addition, rice farming in the mangroves causes more clearance of mangroves to allow the opening of new farms because many people prefer farming in the mangrove areas to avoid weeding.

Current government restrictions on harvesting mangroves, fishing and farming have largely impacted income generation at a local level. As a result, communities indicated a narrowed and constrained livelihood diversification option, which largely affects the general sustenance capacity of the communities. The findings further showed that in terms of livelihood diversification, the south and central delta zones are more diversified in terms of agricultural production, with coconuts as the prominent cash crop. The form of livelihood diversification provide an opportunity for adaptation to both climatic and non-climatic stressors.

Climate change and variability are yet another barrier to livelihood sustainability in the Rufiji delta as it affects the mangrove, fishing and agriculture activities. Although most of the villagers in the northern delta zone did not perceive climate change and variability as among issues constraining their livelihood, discussions with villagers in the southern and central zones revealed that they have experienced climate variability i.e. changes in rainfall (patterns and amounts), increasing temperatures and wind. This was considered to significantly affect their livelihood activities especially the fisheries-based livelihoods. It was noted that rainfall was becoming uncertain, with delayed onset and early cessation, a condition that is affecting both agricultural and fisheries activities. In addition, seasonal floods were mentioned to often cause disasters and shocks in the delta. These impacts are likely to reinforce the cycle of poverty in the area, creating severe social and economic costs.

Tanzania has no specific policy on mangrove forests. The 1991 National Mangrove Management Plan developed by the then Forestry Division was the first attempt at halting mangrove conversion alongside monitoring and regulating their use. However, although the management plan addresses livelihoods and

socio-economic issues, alternative livelihoods are not adequately articulated. The studies have found that despite the high value of mangrove products and the availability of fisheries resources, harvesting is at a small scale but a large part of the community is still poor. Also, there was a feeling among communities that they had been left out in the management of the mangroves, posing a threat to the mangroves as they are not motivated to report any illegal harvesting. Discussions with local communities as well as literature indicated that there has been frequent illegal mangrove cutting and use of illegal fishing gears such as small mesh-sized nets that have often been unchecked. The reported increase in incidences of improper resource use and limited trust between communities, government bodies and the village authorities jeopardises the future of Rufiji delta resources.

The five capitals considered in the Sustainable Livelihoods Analysis (SLA) framework - human, social, physical, natural and financial - are among the strengths in the Rufiji delta. The human capital considered here include demography, the supply of skills and technical training in favour of households and communities dependent on mangrove ecosystems, and the improvement of access to health care and education. The social capital includes mediation systems, community institutions and their training record, while physical capital encompasses access to markets, social facilities and drinking water, supply of tools and equipment for subsistence activities. The natural capital considered here comprises natural resources (soils, water) for livelihoods linked to mangrove ecosystems. The financial capital is access to financial resources involving both flows and stocks. Some of the surveyed villages have more access to physical capital like drinking water, health facilities and services, road transport, among others, while others are not. Similar variability in accessibility prevails for all other capitals. Inadequate social services (health and education) and poor infrastructural development (water supply and transport) appeared as the first locally perceived barrier.



Livestock incursions are rampant in some parts of Rufiji's mangrove forest

4.4 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORKS

Mangroves in Tanzania occupy a relatively marginal role with few policies or regulations tailored to their unique conservation needs within the forest sector. There is no specific policy and legal framework for mangrove ecosystem management. The most relevant policies are the National Environment Policy and National Forest Policy which provide for integrated forest management plans that accommodate all other ecosystems within the forest reserve. These policies also call for participation of local communities in the forest management processes particularly before making decisions that affect people's livelihoods.



Heavily eroded riverbank in the southern Rufiji delta

Mangrove forests are managed under the Forests Act, 2002 which provides for community participation in forest management and the distribution of the benefits of forest conservation and management. Although the implementation of the Forest Act is the responsibility of the Tanzania Forest Service (TFS), experience with participatory forest management in Tanzania remains limited. Community members have preferred the Joint Forest Management (JFM) system as it provides broader rights and benefits to participating communities compared to the other two mechanisms. Through this approach, communities can negotiate their rights (although ownership remains with the State) so that their actions (for example harvesting timber, poles, charcoal, firewood, and other products) are no longer criminalised as they have been for decades.

From a gender perspective, although women in the Rufiji delta use mangroves extensively, their participation is not reflected in their role in mangrove management and group leadership. Village regulations require that women comprise 40% of resource committee members, but cultural and religious norms often counter the legal requirements. Women are generally keen to participate in mangrove monitoring and patrolling, which are paid activities, yet efforts are still needed to increase their active engagement in management.

Despite a positive legal framework for forest management and the recognition of community rights, there have been additional institutional challenges in mangrove management. Lack of coordination between forestry and marine conservation agencies results in ineffective mangrove management. For instance, forestry agents cannot pursue illegal mangrove loggers transporting mangrove logs and poles on the high seas. Overlapping jurisdictions between forest management authorities and marine and coastal resource management authorities have often led to conflict. Mangrove management is also challenged by a mismatch of rules between the mainland and the semi-autonomous status of Zanzibar. For example, while mainland Tanzania has banned charcoal exports, the Zanzibar Government allows its export. As a result, loopholes exist and charcoal produced (legally and illegally) from mangrove forests on the mainland is often transported to Zanzibar before being exported.

The fragmentation of responsibilities across agencies such as forests, fisheries, environment and wildlife contributes to a high level of segmentation and jurisdictional ambiguity. Therefore, frameworks and mechanisms for enabling multi-sectoral coordination across agencies and governance levels are not clear.

5. Solutions and Hopes

RECOMMENDATIONS

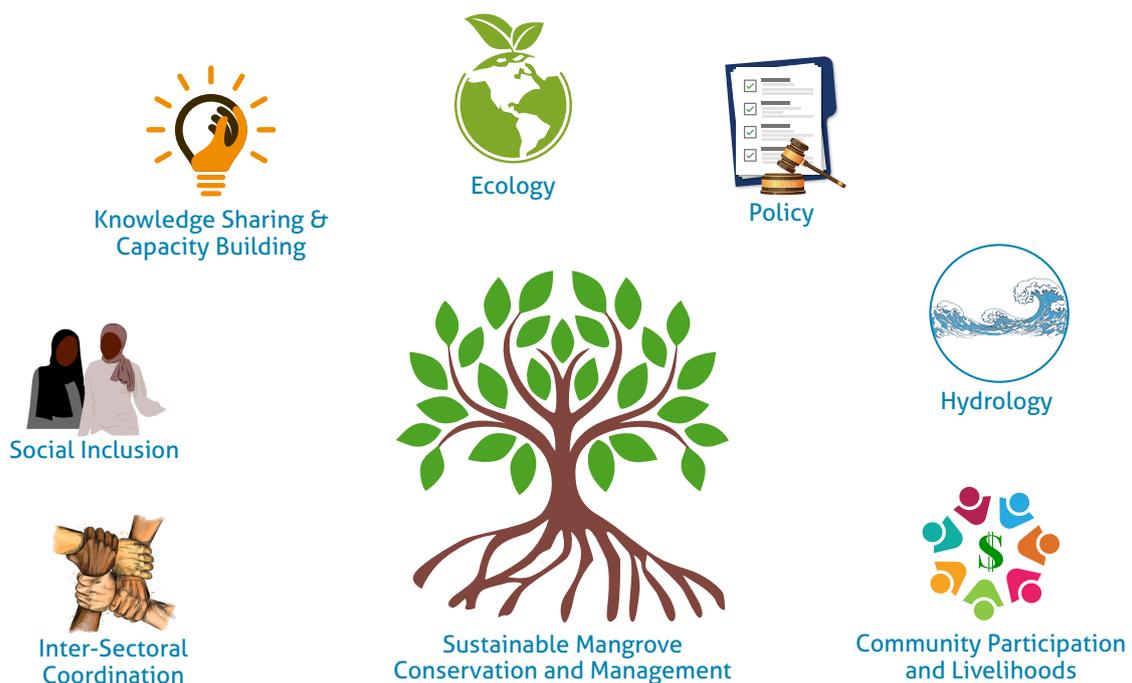
The protection status of the mangroves of Rufiji delta needs to be implemented and elevated. Particular focus should be on the implementation of the revised Rufiji Mangrove Management Plan (2021). Unsustainable harvesting of mangrove trees has led to mangrove loss and degradation. It is necessary to have policies in place to regulate this to achieve a healthy mangrove forest. These policies should include harvesting quotas which vary based on the season and species.

Poor and incongruent management structures and systems significantly affect the ecological resources of the Rufiji delta. Collaboration of the various government agencies and non-government organisations is imperative. Policies can focus on outlining the specific roles of the various stakeholders and on harmonising efforts.

The management of mangrove forests is under the jurisdictional authority of the Government in Tanzania. Devolving tenure rights to the local communities who use and manage mangrove forests resources offers key benefits for the government and the local communities. Strengthening community-based mangrove management systems can ensure that mangroves will be protected and appropriately managed over the long-term. Lessons from these governance and tenure arrangements can also offer improvements in mangrove restoration and enhance coastal spatial planning processes.

Development of an inter-sectoral coordination mechanism and the review of the national mangrove management plan can pave way for identification and clarification of the roles and mandates of specific ministries and agencies, and the overall framework to manage mangroves across the nation's coastal landscape including Rufiji delta. This may result in recommending the necessity of a dedicated mangrove agency within a given ministry.

To address failures in restoration efforts, there is need to adopt approaches such as the Community-Based Ecological Mangrove Restoration (CBEMR) which is most effective and less resource-intensive. This approach involves addressing hydrological issues among other factors at the restoration sites. In the Rufiji





Salt produced traditionally at Jaja Village

delta, decline and loss of certain mangrove species are due to high salinity. In regards to this, basin-wide policy instruments are required so that the necessary fresh water flow is maintained. In addition, the hydrological data is sporadic and not updated. Non-operational gauging stations ought to be repaired and, where necessary, new stations established. Furthermore, policy is needed to ensure regular collection of data and harmonised data storage with a government body.

There must be in place clear terms on benefit-sharing mechanisms between institutions and communities in management of mangrove forest resources in Rufiji Delta. This will ensure that communities participate effectively

through Beach Management Units (BMUs) and Village Natural Resources Committees (VNRCs) in the management and protection of mangrove forests. Overfishing, particularly prawns, is a major issue in the Rufiji delta. Local fisheries by-laws can help address this by regulating the catch per season to allow the species to maintain a healthy and viable population.

Social inclusion is a missing element in mangrove conservation and management in Tanzania, both at the sub-national, national and legislative levels or within local governance institutions. Consideration of social inclusion including gender and the marginalised in mangrove management can support the design of tailored laws, policies and institutions to promote equity and inclusion.



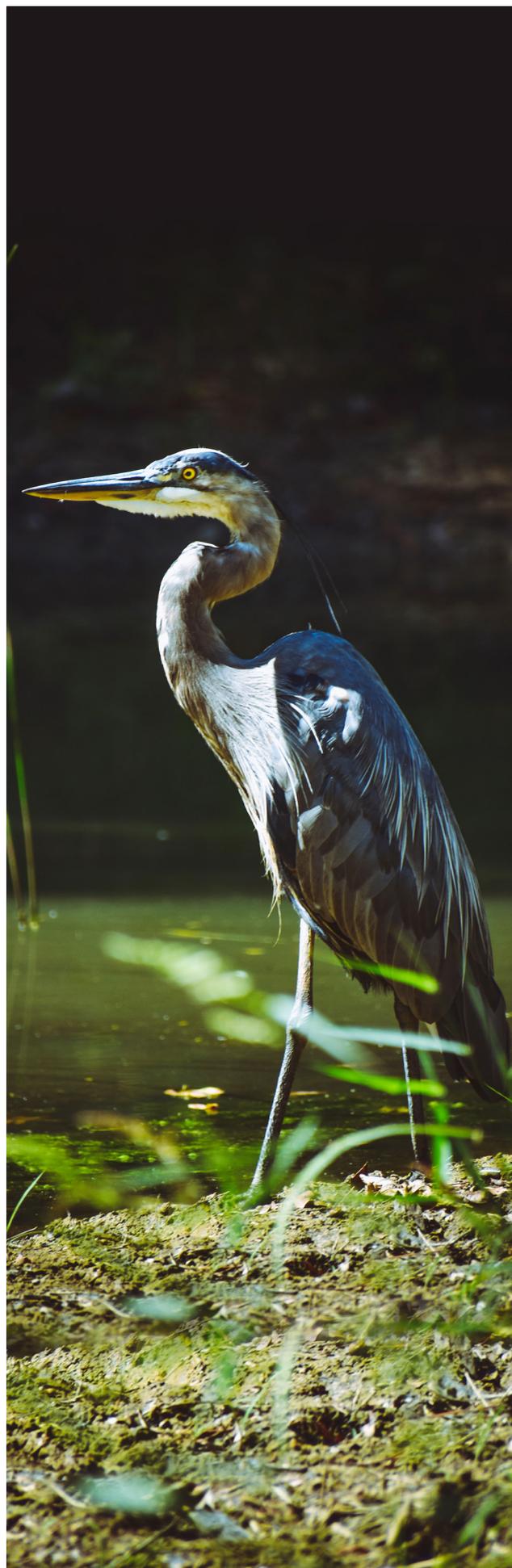
Traditionally produced salt at Jaja Village in southern Rufiji delta

REFERENCES

- Abuodha, P.A.W. and J.G. Kairo (2001).** Human induced stresses on mangrove swamps along the Kenya Coast. *Hydrobiology*, 45 (8): 255 – 265.
- Alongi, D.M. (2002).** Present and future of the world's mangrove forests. *Environmental conservation*, 29 (3): 331– 349.
- Datta, D., R. Chattopadhyay and P. Guha (2012).** Community based mangrove management: a review on status and sustainability. *Journal of environmental management* 107, 84-95.
- Donato, C.D., J.B. Kauffman, D. Murdiyarso, S. Kurnianto, M. Stidham and M. Kanninen (2011).** Mangroves among the most carbon-rich forests in the tropics. *Nature Geoscience*.
- Mwalyosi, R.B.B. (2018).** Management of the Rufiji Delta as a wetland.
- Nagelkerken, I., A.D. Olds, M. Dorenbosch, M.M. Igulu, M.G. Grol, P.J. Mumby, I.A. Kimirei, Y.D. Mgaya and A.R. Harborne (2014).** Meta-analysis reveals that utilization of mangrove and seagrass nursery habitats across the globe is related to tidal regime rather than biogeographic region. *PloS one*.
- Polidoro, B.A., K.E. Carpenter, L. Collins, N.C. Duke, A.M. Ellison, J.C. Ellison, E.J. Farnsworth, E.S. Fernando, K. Kathiresan, N.E. Koedam, S.R. Livingstone, T. Miyagi, G.E. Moore, V.N. Nam, J.E. Ong, J.H. Primavera, S.G. Salmo III, J.C. Sanciangco, S. Sukardjo, Y. Wang and J.W.H. Yong (2010).** The loss of species: Mangrove extinction risk and geographic areas of global concern. *PloS one* 5, e10095.
- Spalding, M., M. Kainuma and L. Collins (2010).** World atlas of mangroves. Earthscan, London, UK and Washington DC, USA.
- Wagner, G.M. and R. Sallema-Mtui (2016).** The Rufiji Estuary: Climate Change, Anthropogenic Pressures, Vulnerability Assessment and Adaptive Management Strategies. In: Diop, S., Scheren, P., Machiwa, J. (Eds.) *Estuaries: A Lifeline of Ecosystem Services in the Western Indian Ocean*. pp 183 - 207.
- Wang, Y., G. Bonyng, J. Nugranad, M. Traber, A. Ngusaru, J. Tobey, L. Hale, R. Bowen and V. Makota (2003).** Remote sensing of mangrove change along the Tanzania Coast. *Marine Geodesy*. 26, 35-48.

PHOTO CREDITS

Front cover - Michael Poliza/NG Image Collection
Back cover, pg 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, Acknowledgement - EWamba/Wetlands International, Pg 6: Dominic Wodehouse, Pg 9: IHama/Wetlands International, Pg 15: Chris F.



Wetlands International Eastern Africa
Woodland Court, Woodlands Road
Off Denis Pritt Road
PO Box 22475-00505 Ngong Road
Nairobi, Kenya
Tel: +254 707366395
info@wetlands-eafrica.org

Wetlands International Tanzania
Mikocheni B, Manyara Street, Dar es Salaam
Rufiji Delta, Nyamisati Village
Kibiti District
Tel: +255(0) 756558398



Wetlands
INTERNATIONAL

dwb ecology