

Community Livelihoods at the Crossroad of Mangrove Conservation in the Rufiji Delta, Tanzania

Gideon Zakayo,^{1,2} Dr. Norbert Ngowi¹, Dr. Elizabeth Genda¹,

^{1,2}Institute of Development Studies, Mzumbe University, Morogoro, P.O. Box 83 Mzumbe, Morogoro, Tanzania;

²Environment and Cleansing Department, Kibiti District Council, P.O. Box 33 Kibiti, Pwani, Tanzania.

Abstract:- This study investigated the crossroad between community livelihoods and mangroves conservation interventions in the Rufiji delta of eastern, Tanzania. One hundred and twenty heads of households were selected to provide information by filling closed ended questionnaires. This was supplemented with key informants interviews through Focus Group Discussions. Quantitative data collected were analysed through descriptive statistics IBM SPSS version 20. Qualitative data were analysed using content method. The main research findings indicate that: (1) for mangrove conservation strategies to increase vegetation cover in the Rufiji delta result show that in intervention villages 85% of respondents agrees in increase in vegetation cover while in control village 65% of respondents agree (2) about monthly earning per month result show that for the intervention villages show a mean of 184666.67Tsh and standard deviation of 59816.19Tsh. and in the control village show a mean value of 159166.67Tsh and standard deviation of 47162.29Tsh. The results implies that implementation of mangrove forest management strategies improve income of the local community with increase in vegetation cover. The study recommends that fish farming, ecotourism and awareness about cooperation in farming activities be emphasized to address poverty, mangrove degradation and conflict resolution among resource users. Finally the study recommend social science research should be conducted in terrestrial forest about contribution of various interventions to the livelihoods of the local community.

Keyword:- Biodiversity, Mangrove, Livelihood, Kibiti.

I. INTRODUCTION

Mangrove forest covers about 16 million hectares worldwide (Monga et al., 2018). They include Asia 40%, Africa 19%, South America 16%, North and Central America 15%, Australia 7%, Pacific Ocean 4% and the Middle East 0.4% (Friess et al., 2019). In Africa, mangrove forests cover about 3 million hectares and these are mostly found in West and Central Atlantic 51%, Western Africa 49%, East Africa 37% and Central Africa 14% (Ajonina et al., 2013). In Tanzania, mangrove covers about 158,000 hectares that amounts to 14 percent of the mangrove forest found in the East Africa. These are mostly found in Mafia,

Rufiji, Mkuranga, Kibiti in the coast Region, Lindi and Kilwa in Lindi Region, Ilala, Kinondoni, Kigamboni in Dar es salaam Region and Mtwara Mikindani in Mtwara Region (Japhet et al., 2019) Of these, the Rufiji delta in particular has the largest mangrove coverage about 58,000 hectares (Nyangoko et al., 2020).

Monga et al., (2018) reported that mangrove ecosystems are significant in fighting against climate change through carbon absorption, protection of the shoreline, wildlife habitat and provision of livelihood assets to the local community. On the other hand, Hlaing et al., (2017) show that the livelihoods of local communities of more than 1.5 billion people whose 70 percent of them live in rural areas depend on mangroves forest ecosystem for fisheries, biomass fuel, construction materials and medicine. Despite, of the importance of mangroves forest ecosystem in preventing coastal erosion, protecting breeding sites of marine fish species, and habitats for many biodiversity, mangrove forests are sharply declining thus putting the livelihoods of the adjacent community at risk (Monga et al., 2018).

To address the problem various interventions have been introduced to safeguard mangrove ecosystem in many places since 1991 (Monga et al., 2018). In Rufiji area for instance, Rufiji, Mafia, Kilwa (RUMAKI) was introduced from 2006 to 2012 under a seascape programme (Mshale et al., 2017), Mangrove tree planting campaign in 2017 (Monga et al., 2018) and Rufiji Environmental Management Project (REMP) of 1998 to 2003 (Duvail et al., 2006). However, little is known on the implication of these interventions on the livelihood of the people who have been involved in the implementations (Mshale et al., 2017). This study therefore, aims at understanding why the livelihoods of the people have not been improved despite of mangroves conservation interventions in the Rufiji delta. The result of this study can be used as basis of changing the policies of mangrove conservation strategies in Rufiji delta.

II. THEORETICAL ASPECTS

This study is governed by sustainable livelihood framework (Williams & Hussein, 2019). The framework recognizes natural, financial, physical, social and human capital assets. It provides the direction in understanding the livelihoods of the people in the Rufiji delta while at the

same time conserving the mangrove forest ecosystem. According to Chinangwa *et al.*, (2016) livelihoods assets help to get the knowledge about people's resilience and provide a proper way of changing livelihoods results from negative to positive. As a result, in order to acquire a good livelihood outcome, there is a need of combining the five-capital assets which include financial, human, social, natural and physical. According to Chinangwa *et al.*, (2016) the livelihoods capital assets recognized are; Natural Capital; This asset includes land and produce, water river flow and aquatic resources, mangrove forest product, wildlife such as animals and birds, wild foods and fibres, biodiversity and environmental services. Financial Capital; This asset includes services such as credits, savings, debt, remittances, pensions and wages. Physical Capital; This type of asset comprises infrastructure such as transport, roads and means of transport, shelter and buildings, water supply and

sanitation and energy and communication. Social Capital; Includes network and connections, relations of trust and mutual understanding, formal and informal groups, shared values and norms, a mechanism for participation in decisions making and leadership in the community. Human Capital; This category includes health, nutrition, education, knowledge, skills and capacity to work for any changes in the community.

The current study analyzes community livelihoods at the crossroad of mangrove conservation in Rufiji Delta, Tanzania. The variables investigated in this study were; Housing materials used in the construction of house, Number of meals consumed per day, woman groups, status of vegetation cover in mangrove forest ecosystem and Earnings per month per person per household.

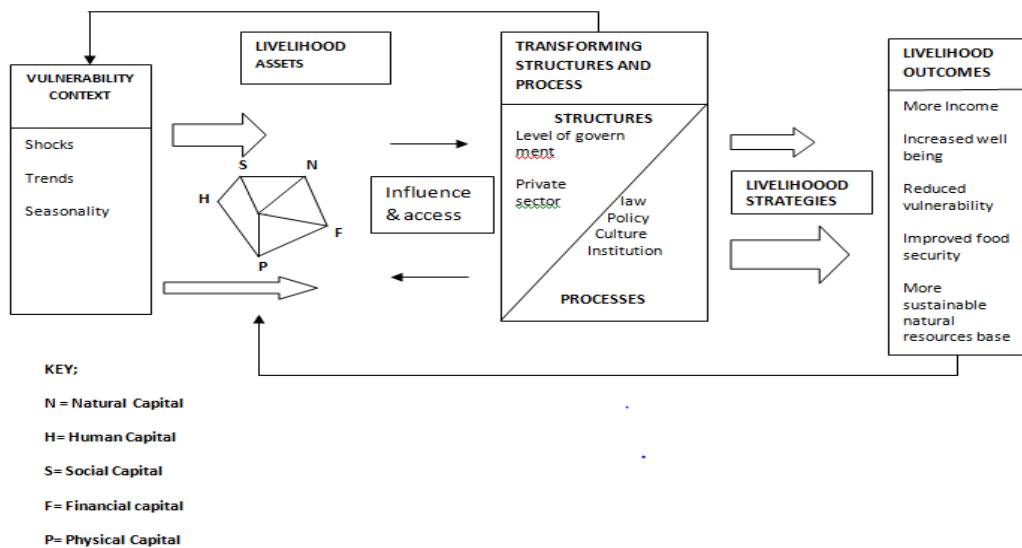


Fig 1 Show Modified from DFID Framework (Ahmed *Et Al.*, 2008).

III. METHODS

A. Study Area

This study conducted in the Rufiji Delta in Kibiti District in the Coastal region of Tanzania. The study area is located between latitudes 8° 20' 00", 7 35' 00" S and longitudes of 39° 10'00", 39° 20' 00" E (Japhet *et al.*, 2019). Five villages involved in this study were four villages namely Kikale, Nyamisati, Mchungu and Mfisini selected from intervention area and one Mbuchi as a control Village. Rufiji delta was chosen because it has the highest concentration of mangrove forest ecosystem in Eastern Africa with the concentration of human activities (Monga *et al.*, 2018). On the other hand, Nyangoko *et al.*, (2020) reported that more than 49,000 of people in 3 major ethnic groups of Wandengereko, Wamatumbi and Wamakonde are living in Rufiji delta with growth rate of 1.9 per year. There are 8 species of mangroves with local names in brackets found in the study area. These are - *Avicennia marina* (mchu), *Sonneratia alba*(mpira), *Ceriops tagal* (mkandaa), *Lumnitzera racemosa* (mkandaa dume), *Bruguiera gymnorrhiza* (msinzi), *Rhizophora mucronata* (mkoko), *Xylocarpus granatum* (mkomafi) and *Heritiera littoralis*

(msikundazi), Other biodiversity of the area include monkeys, oysters, crustaceans, fish, reptiles, migratory marine mammals and birds (Monga *et al.*, 2018).

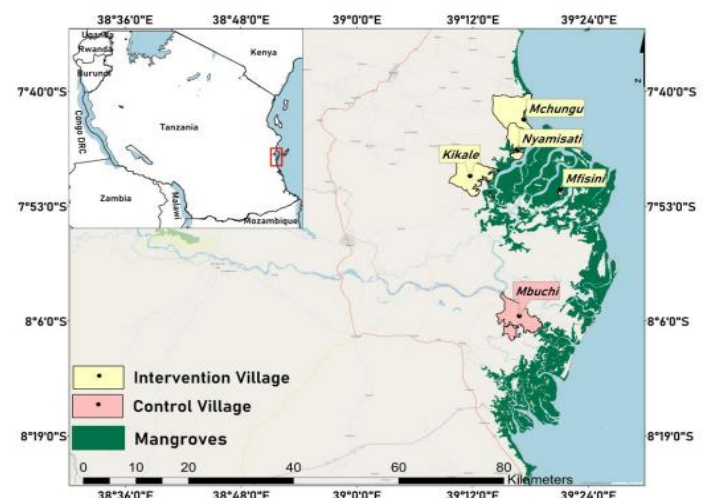


Fig 2 Map of Rufiji Delta Shows Location of Study Villages

Sources: Field Survey, 2022

B. Participants

These sample size for questionnaires (n=90) for the intervention villages were obtained using the probability formula $n = \frac{N}{1 + N(e)^2}$ (Ngowi & Mwakaje, 2020). The sample of n=90 for the household survey in the intervention villages - Mfisini (2014), Mchungu (1645), Nyamisati (2776) and Kikale (2025) making a total population of (N=8,460) (Namangaya & Mushi, 2019). Also, the sample size (n=30) for comparison was selected from Mbuchi Village as a control group. An in-depth interview of 10 key informants and 20 respondents through Focus Group Discussions were used to supplement quantitative data. Key informants and Focus Group Discussion members were selected according to their experience, exposure and expertise in Rufiji delta. The group discussion involved members 4-6 of mixed gender and age to allow effective discussion. The researcher personal observation supplements the information obtained in the field.

C. Data Collection.

In this study, both qualitative as well as quantitative data were collected (Ricci *et al.*, 2019). Secondary data were collected through the review of the published data from the literature- journal, books and progress reports on mangrove forest. Primary data were collected later using questionnaires and interviews. Questionnaires were distributed to respondents to collect quantitative data about socio economic activities of the study area, mangrove management strategies and contribution to the well-being of the people of the area. To supplement quantitative data interviews conducted with 10 key informants and 20 respondents through Focus Group Discussion (FGD). These respondents were selected based on their experience of the Rufiji delta, exposure and expertise in mangrove conservation.

D. Data Analysis

Two main sources of data analysis were used: (1) content analysis method to analyse narrative data. The method undertook different procedures such as data management, reduction and coding that was preceded through transcription of audio data. The data analysed through content analysis was mangrove forest ecosystem strategies attempted, contribution of strategies to the livelihoods assets and proposed model about futures strategies to conserve mangrove ecosystem in the study area. (2) Descriptive Statistics analysing quantitative data of a

sample population by using IBM SPSS statistics software. These tools were used to analyse categorical data from questionnaires. The data analysed through this tools were socio- demographic features, mangrove forest strategies and it is contribution to the livelihood assets of the local community in the study area. The livelihood assets analysed in this study were; In physical assets; housing material used in the construction of house. In human capital assets; number of meals consumed per day. In social assets were farming group formulation. In natural capital; increase in vegetation cover. In financial assets show a mean and standard deviation on monthly earning on various activities.

IV. RESULTS AND DISCUSSION

A. Housing Materials Used In The Construction Of House

The findings for intervention villages in terms of the materials used in the construction of house used by local communities in Rufiji in Table 4.1 show that 54 respondents (60%) selected mud walls with grass thatches, 18 respondents (20%) selected mud walls with corrugated iron sheets, 9 or 10 per cent selected brick walls with the corrugated iron sheet and 2 respondents (2%) selected stone walls with corrugated iron sheets. Furthermore, 2 respondents (2%) selected stone walls with thatched grass while 5 respondents selected others. Moreover, for the control group, the results show that 28 (93.3%) live in houses with mud walls and grass thatches, and 2 respondents (6.7%) selected mud walls with corrugated iron sheets. Further, for the control group, the findings reveal that none of the respondents selected brick walls with corrugated iron sheets, stone walls with corrugated iron sheets and stone walls with thatched grass. The findings imply that the majority of the respondents live in mud walls with grass thatched houses. In comparison, the houses for the intervention group are significantly much better compared to the control group (i.e. Mbuchi village with no intervention). These findings are similar to the findings in a study by Chinangwa *et al.*, (2016) on livelihoods and welfare impacts of forest co-management. Their findings showed that the implemented forest management strategies had no impact on the livelihoods and welfare of the local communities in Zomba and Ntchisi Districts in Malawi. Also, the presence of this type of house indicates that the raw construction materials are obtained in the mangrove forest which contributes to deforestation (Japhet *et al.*, 2019).

Table 1 Major Housing Materials in the Study Area

The material used to construct the house	Intervention Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
Mud walls with grass-thatched	54	60	28	93.3
Mud walls with corrugated iron sheet	18	20	2	6.7
Brick walls with corrugated iron sheet	9	10	0	0
Stone walls with corrugated iron sheet	2	2	0	0
Stone walls with thatched grass	2	2	0	0
Others	5	6	0	0
TOTAL	90	100	30	100

Source: Field Survey, 2022



Fig 3 Mud Walls with Grass-Thatched Houses
Source: Field Survey, 2022

B. Number Of Meals Consumed Per Day

The findings show that 75 respondents (83%) selected twice, 9 respondents (10%) selected once, 4 respondents (5%) selected thrice and 2 respondents (2%) selected four times a day as shown in Figure 4.2. Moreover, the findings from villages without intervention show that 15 per cent selected once; 80 per cent selected twice, 5 per cent selected thrice and none selected four meals per day in the control group. The findings show that the majority of respondents in the study area consume two meals per day but the intervention villages have more access to meals per day compared to the villages with no intervention. This implies that community members living at Rufiji Delta are living in poverty while there is strategies introduced in the conservation of mangroves. These findings relate to the findings in a study on Poverty and institutional management stand-off in Rufiji delta: A restoration and conservation dilemma for mangrove forests of Tanzania (Mangora, 2011) revealing that poverty condition in Rufiji delta is a source of mangrove forest degradation. And the mangrove conservation and the livelihoods improvement cannot move simultaneously (Sunderlin *et al.*, 2005).

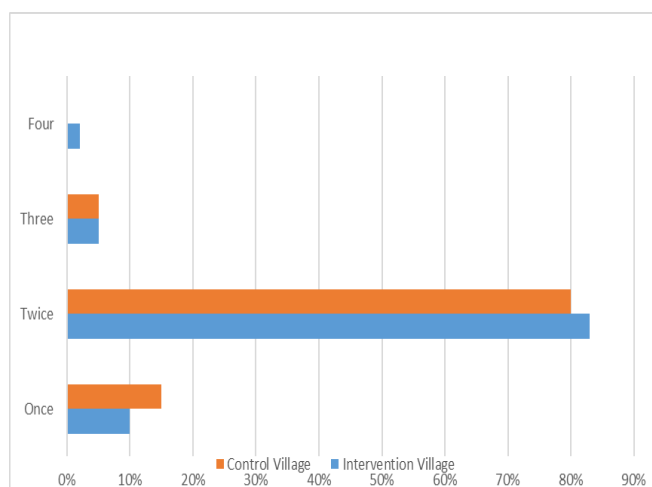


Fig 4 Number of Meals Consumed Per Day
Source: Field Survey, 2022

C. Women Farming Groups

In social contribution, the study wanted to find out the number of farming groups formed in the community along gender lines. The findings in Table 4.3 present the status of the farming groups among two groups of villages. For intervention villages, the results indicate that 36(40%) of the respondents admitted, 45(50%) refuted and 9 10 per cent reported not knowing the number of farming groups formed in the community along gender lines. Further the results of the control village indicate that 9(30%) admitted belonging to the farming group, 18(60%) refuted belonging to the farming group and 3(10%) indicated not knowing the answer. The findings imply that the majority of intervention villages belong to the farming group as opposed to the control villages. These findings are in line with the findings in a study by Mshale *et al.*, (2017) on the unique challenges of managing Tanzania's coastal forests. The study revealed that 16 farming group was established in 2011 having 250 members registered in 4 villages and given a permit by Tanzania Forest Service Agency for rice farming in the Rufiji delta, but this programme was not sustainable. The reason for the failure of this programme to deliver to the local community is that it was too short a period to favour agriculture activities. According to Wu *et al.*, (2022), the promotion of rural farming facilitates rural development. To assist the livelihoods of the local community in the Rufiji delta rural farming should be enhanced.

Participants in the focus group discussion especially members of Group 3 revealed that the farming group was established in some of the villages but failed to develop due to a lack of knowledge about the cooperation group.

This was also observed during interviews with Village Officials of Nyamisati Village among them was Participant 7 who said, “There are 16 farming groups established in the village but failed to develop due to lack of awareness among community members.”

This situation implies that farming groups are established in intervention village and control villages but failed to develop due to a lack of awareness about cooperative groups.



Fig 5 Women Participating in Group Farming
Sources: Field Survey, 2022

Table 2 Formulation of Women Farming Groups

Farming groups	Intervention Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
Yes	36	40	9	30
No	45	50	18	60
I don't know	9	10	3	10
Total	90	100	30	100

Source: Field Survey, 2022

D. Increased Vegetation Cover In Mangrove Forest Ecosystem

The study required to find out if mangrove conservation strategies increase vegetation cover in the Rufiji delta. Finding of intervention exposed that 85% said “yes” while 10% said “no”. Likewise, for control group 65% said “yes” while 20% said “no. This implies that, both group intervention and control village indicate that the majority of respondents agreed that mangrove conservation strategies increase vegetation cover in the Rufiji delta. These findings are lie with the findings in a study by Monga *et al.*, (2018) on mangrove cover change detection in the Rufiji delta which reveal that there is an increase in vegetation cover of mangrove forests between 2010 to 2015 due to afforestation and natural regeneration. And the human activities like paddy farming and illegal cutting of poles which causes destruction of mangroves in Rufiji delta had been reduced after conservation strategies introduced in 1990 (Ntibona *et al.*, 2022).

Participants of the focus group discussion especially members of Group 2 revealed that since various strategies were adopted in the Rufiji delta vegetation cover and wildlife have been increasing.

A similar observation was made during the interviews with Village Officers among them was Participant 5 and elder from Mchungu village who said, “The mangrove forest ecosystem has been increasing since conservation strategies started in 1990 and these trees are well protected through government and non-government organisation and other stakeholders” “Kiazi Kitamu.”

This situation implies that strategies adopted in the Rufiji delta succeeded to increase the vegetation cover in both intervention and control villages.

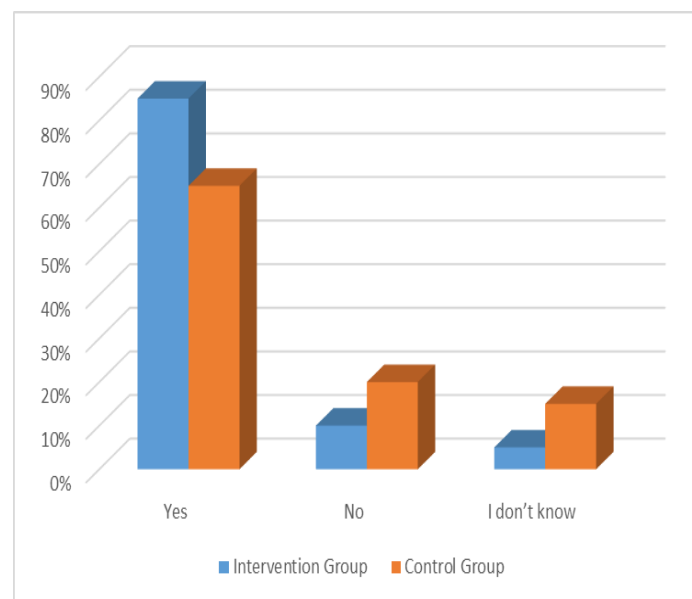


Fig 6 Increased Vegetation Cover in Mangrove Forest Ecosystem

Source: Field Survey, 2022

E. Earnings Per Month Per Person Per Household

In the case of monthly earning through various activities in the Rufiji delta result for the intervention group show a mean of 184666.67Tsh and standard deviation of 59816.19Tsh. Moreover, in the control group, the results show a mean value of 159166.67Tsh and standard deviation of 47162.29Tsh (see Table 4.5). The findings indicate further that intervention villages earn more per month than control villages.

Findings of t-test for Equality of Means indicate that group means are statistically significantly different because the value in the "Sig. (2-tailed)" row is less than 0.05 (0.036<0.05). This study found that income for control group had statistically significantly lower income (159166.67 ± 47162.29) compared to income for intervention village (184666.67 ± 59816.19), t(118)=2.123, p=0.036 as displayed in Table 4.6. The fluctuation of income in the Rufiji delta is due to the fishing season. Fishing is the source of income in the Rufiji delta a part of mangrove poles and rice farming (Nyangoko *et al.*, 2022).

Table 3 Group Statistics

	Group variable	N	Mean	Std. Deviation	Std. Error Mean
What amount did you receive being involved in these the strategies per month?	Control Group	30	159166.6667	47162.29012	8610.61672
	Intervention	90	184666.6667	59816.19787	6305.18088

Source: Field Survey, 2022

Table 4 Independent Samples Test

T-Test for Equality of Means						
T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
-2.123	118	.036	-25500.00000	12009.79146	-49282.65676	-1717.34324
-2.389	62.575	.020	-25500.00000	10672.30182	-46829.72756	-4170.27244

Source: Field Survey, 2022

V. CONCLUSION AND RECOMMENDATIONS

This paper investigated community livelihoods at the crossroad of mangrove conservation in Rufiji Delta, Tanzania. The main results were; majority of respondents their houses constructed with mud walls with grass thatches, consume two meals per day, agree on increase of vegetation cover, presence of women farming group and monthly earning through various activities show a mean of 184666.67Tsh and standard deviation of 59816.19Tsh. in intervention villages while control village, show a mean value of 159166.67Tsh and standard deviation of 47162.29Tsh. These findings reveal that mangrove strategies conducted in Rufiji delta contribute increase in vegetation cover while community members living in the Rufiji delta are living in poverty condition. Based on this study, we recommend that fish farming, ecotourism and land use planning be emphasized to address poverty, mangrove degradation and conflict resolution among resource user.

REFERENCES

- Ahmed, N., Allison, E. H., & Muir, J. F. (2008). Using the Sustainable Livelihoods Framework to Identify Constraints and Opportunities to the Development of Freshwater Prawn Farming in Southwest Bangladesh. *Journal of the World Aquaculture Society*, 39(5), 598–611. <https://doi.org/10.1111/j.1749-7345.2008.00198.x>
- Ajonina, G., Diamé, A., & Kairo, J. (2013). Current Status and Conservation of Mangroves in Africa: An overview. *Journal of Chemical Information and Modeling*, 53(9).
- Chinangwa, L., Pullin, A. S., & Hockley, N. (2016). Livelihoods and Welfare Impacts of Forest Comanagement. *International Journal of Forestry Research*, 2016. <https://doi.org/10.1155/2016/5847068>
- Duvail, S., Hamerlynck, O., Nandi, R. X., Mwambeso, P., & Elibariki, R. (2006). Participatory Mapping for Local Management of Natural Resources in Villages of the Rufiji District (Tanzania). *The Electronic Journal of Information Systems in Developing Countries*, 25(1), 1–6. <https://doi.org/10.1002/j.1681-4835.2006.tb00167.x>
- Friess, D. A., Rogers, K., Lovelock, C. E., Krauss, K. W., Hamilton, S. E., Lee, S. Y., Lucas, R., Primavera, J., Rajkaran, A., & Shi, S. (2019). The State of the World's Mangrove Forests: Past, Present, and Future. *Annual Review of Environment and Resources*, 44(1), 89–115. <https://doi.org/10.1146/annurev-environ-101718-033302>
- Hlaing, Z. C., Kamiyama, C., & Saito, O. (2017). Interaction between Rural People's Basic Needs and Forest Products: A Case Study of the Katha District of Myanmar. *International Journal of Forestry Research*, 2017, 1–18. <https://doi.org/10.1155/2017/2105012>
- Japhet, E., Mangora, M. M., Trettin, C. C., & Okello, J. A. (2019). Natural Recovery of Mangroves in Abandoned Rice Farming Areas of the Rufiji Delta, Tanzania. *Western Indian Ocean Journal of Marine Science*, 18(2), 25–36. <https://doi.org/10.4314/wiojms.v18i2.3>
- Mangora, M. M. (2011). Poverty and Institutional Management Stand-off: A Restoration and Conservation Dilemma for Mangrove Forests of Tanzania. *Wetlands Ecology and Management*, 19(6), 533–543. <https://doi.org/10.1007/s11273-011-9234-2>
- Monga, E., Mangora, M. M., & Mayunga, J. S. (2018). Mangrove Cover Change Detection in the Rufiji Delta in Tanzania. *Western Indian Ocean Journal of Marine Science*, 17(2), 1. <https://doi.org/10.4314/wiojms.v17i2.1>

- [10]. Mshale, B., Senga, M., & Mwangi, E. (2017). Governing Mangroves: Unique Challenges for Managing Tanzania's Coastal Forests. In *Governing Mangroves: Unique Challenges for Managing Tanzania's Coastal Forests*. Center for International Forestry Research (CIFOR). <https://doi.org/10.17528/cifor/006596>
- [11]. Namangaya, A. H., & Mushi, D. M. (2019). Actors' Influences on Land Use Planning Decisions in Small Towns: The Case of Geita, Gairo and Kibiti Towns in Tanzania. *Open Journal of Social Sciences*, 07(07), 172–190. <https://doi.org/10.4236/jss.2019.77016>
- [12]. Ngowi, N. J., & Mwakaje, A. G. (2020). Implementation Effects of Incentive Policies on Tanzanian Wetland Ecosystems. *Kasetsart Journal of Social Sciences*, 41(1), 83–90. <https://doi.org/10.1016/j.kjss.2018.05.016>
- [13]. Ntibona, L. N., Shalli, M. S., & Mangora, M. M. (2022). Incentives and Disincentives of Mangrove Conservation on Local Livelihoods in the Rufiji Delta, Tanzania. *Trees, Forests and People*, 10, 100326. <https://doi.org/10.1016/j.tfp.2022.100326>
- [14]. Nyangoko, B. P., Berg, H., Mangora, M. M., Gullström, M., & Shalli, M. S. (2020). *Community Perceptions of Mangrove Ecosystem Services and Their Determinants in the Rufiji Delta, Tanzania*. <https://doi.org/10.3390/su1301>
- [15]. Nyangoko, B. P., Berg, H., Mangora, M. M., Shalli, M. S., & Gullström, M. (2022). Local perceptions of changes in mangrove ecosystem services and their implications for livelihoods and management in the Rufiji Delta, Tanzania. *Ocean & Coastal Management*, 219, 106065.
- [16]. Ricci, L., Lanfranchi, J.-B., Lemetayer, F., Rotonda, C., Guillemin, F., Coste, J., & Spitz, E. (2019). Qualitative Methods Used to Generate Questionnaire Items: A Systematic Review. *Qualitative Health Research*, 29(1), 149–156. <https://doi.org/10.1177/1049732318783186>
- [17]. Sunderlin, W. D., Angelsen, A., Belcher, B., Burgers, P., Nasi, R., Santoso, L., & Countries: An Overview. *World Development*, 33(9), 1383–1402. <https://doi.org/10.1016/j.worlddev.2004.10.004>
- [18]. Williams, A. A., & Hussein, S. (2019). Impact of IPSAS Adoption on Transparency and Accountability in Managing Public Funds in Developing Countries: Evidence from Liberia. *Journal of Accounting and Taxation*, 11(6), 99–110. <https://doi.org/10.5897/JAT2019.0345>
- [19]. Wu, Z., Zeng, T., & Huang, J. (2022). Sustainable Livelihood Security in the Poyang Lake Eco-economic Zone: Ecologically Secure, Economically Efficient or Socially Equitable? *Journal of Resources and Ecology*, 13(3), 442–457. <https://doi.org/10.5814/j.issn.1674-764x.2022.03.009>