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Research Article

Socioeconomic Determinants of Mangrove Exploitation and Seagrass Degradation in Zanzibar: Implications for Sustainable Development

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The concept of "sustainability" has become the current answer to absolving the world of its environmental and economic crises in the 21st century. This paper analyses seven socioeconomic factors (age of household head, household average annual income, marital status of household head, gender of household head, household size, education level of household head, and period of residence of household head) influencing extreme degradation of seagrass and exploitation of mangrove resources in Zanzibar, Tanzania. To accomplish this, Participatory Rural Appraisal approaches and household questionnaire survey were used to obtain information on primary data. Multiple regression analysis and descriptive statistics were used to analyze quantitative data while content analysis was used to analyse qualitative data. The findings revealed that all the socioeconomic variables tested were statistically significant ($P<0.05$) and had an influence on the exploitation of mangrove and degradation of seagrass except gender of the household ($P=0.88$) and household annual average income ($P=0.655$), respectively. In addition, statistical analysis revealed that there was significant difference in the mangrove status between the sites ($p= 0.0001$, $\chi^2 =27.27$) with more exploitation at Charawe compared to Kibele village, whereas no significant differences were revealed in the status of seagrass between the two sites ($p= 0.2693$, $\chi^2 =1.2202$). On one hand, the findings revealed that at Kibele and Charawe 60% and 50% practice gleaning, 40% and 55% are engaged in seaweed farming, and 60% and 70% collect bait from seagrass meadows, respectively. All these activities had direct influence on seagrass status. On the other hand, the finding revealed that livelihood needs, population growth, level of education, and lack of alternative source of income are the key drivers to exploitation of coastal natural resources especially mangrove and seagrasses. To ensure sustainable exploitation of coastal resources alternative livelihood activities such as farmed fish, small/petty business, and agriculture activities that are profitable and easy to manage should be introduced to the local coastal community to enhance active participation in conserving resources and improving their livelihood.

1. Introduction

Seagrass meadows and mangrove forests are crucial not only as unique ecosystems with their own inherent qualities, but also for the support they provide to other biologically diverse ecosystems. The coastal marine vegetation are the vital components of the subsistence livelihood systems of the coastal community as they offer various social and economic values to the people [1–3]. Mangrove and seagrasses are currently recognized as hotspot in climate change mitigation because of their ability to sequester and bury substantial amount of anthropogenic carbon dioxide [4–8]. Seagrass alone contributes approximately 50–64% of the organic carbon sequestered annually [9] and stores large amount of carbon buried in the global ocean [10, 11]. In addition, mangrove and seagrass meadows provide a range of ecological and socioeconomic benefits for the well-being of coastal communities [12, 13]. Ecologically, they provide nursery for marine species, nutrient cycling, water purification, and coastal stabilization [14–16]. Important socioeconomic

benefits include provision of wood products, sustaining subsistence and commercial fisheries, and tourism support [10, 17]. Seagrass and mangroves provide substantial support in intertidal fisheries sector [18, 19]. It is projected that billions of people worldwide especially in developing countries depend on coastal and marine resources for their livelihood [18]. Cochrane et al. [20] estimated that fish provide 4.3 billion people with at least 20% of their average intake of animal protein. Similarly, in WIO region it was reported that coastal communities greatly depend on fisheries resources obtained from seagrass and mangrove ecosystems [21–23]. Several studies [22, 24–26] reported that anthropogenic pressure caused by human activities (e.g. seaweed farming) has negatively impacted the seagrass productivity in Chwaka Bay. In addition, gleaning and bait collection have also reported to have significant impact on the healthy status of seagrass as they involve trampling and uprooting of the seagrass [22]. Geere [26] reported that 70% of the respondents declared that decrease in seagrass resulted in the decrease in fish catch and 70% of respondents reported the use of dragnet, which contributed to seagrass change. Tano et al. [27] reported change in habitats from natural seagrass to nonnative farmed seaweeds.

According to Mtwana Nordlund [13] and de la Torre-Castro et al. [23] majority of coastal communities are resource dependent as they rely on marine natural resource (seagrass and mangrove) for their livelihood. However, being resource dependent is risky due to reliance on particular resources for income and employment [28]. Depletion of these resources or changes in management policy pose serious threats to the resource-dependent communities both socially and economically [29]. Overexploitation of the coastal natural resources especially mangrove is common in coastal communities including that of Unguja Island [30–33]. Several studies [13, 19, 23, 34] in Zanzibar have reported on coastal and marine resource exploitation; however, the linkage between socioeconomic factors and rate of coastal and marine resources exploitation is not well captured. This paper therefore aims at analyzing the socioeconomic factors influencing exploitation of mangrove and degradation of seagrass resources in Unguja Island. The findings from this study will provide good insight for policy makers, researchers, and local communities into the sustainable management of coastal resources, especially seagrass meadows and mangrove forests. Hence, in order to promote sustainable conservation of these resources, there is a need to identify both positive and negative socioeconomic factors influencing resources utilization in a given society.

2. Materials and Methods

2.1. Description of the Study Area. The study was conducted in two coastal communities in Unguja Island, Zanzibar, Tanzania. The sites were chosen based on the extent of mangrove and seagrass coverage, which are located in different major bays in Unguja Island. These were Kibele and Charawe (Chwaka Bay) (Figure 1). These sites offer prime opportunities for studying socioeconomic issues regarding mangroves and seagrass resources, because the presence of both mangroves and seagrass resources acts as the main source of income to the majority of community members in the area.

Kibele is a coastal village within the '*Shehia*' of Tunguu located in the Central District (6°13′S, 39°19′E). Tunguu '*Shehia*' is located about 16 km from Zanzibar Town, and, according to '*Shehia*' population census of 2013, it has a population of 3246 [35]. The main economic activities conducted in this area include fishing, gleaning of bivalves, small-scale agriculture, and other low-scale businesses.

Charawe '*Shehia*' is located in the Central District (6°11′S, 39°26′E) and has a population of 954 [35] (Tanzania National Bureau of Statistics, 2013). The main livelihood and economic activities conducted in this area are fishing, tourism, harvesting of mangroves, other forest products, and other low-scale businesses.

2.2. Design. Participatory Rural Appraisal approach was applied to solicit information on general community knowledge and perception on coastal resource exploitation and the impacts of resource exploitation. Based on the identified indicators semistructured and open interviews were instituted to a gender balanced set of respondents randomly selected in the study areas; in each village 30 respondents were interviewed. Qualitative content analysis was employed to determine the interrelationship between coastal resources and community activities (social- ecological system). This approach helps us to identify drivers for exploitation, exploitation pressure, coastal resource status, impact, and response to exploitation [36, 37]. Three focus group discussions (local mangrove management committee, local fisheries management committee, and coastal/marine resource users, e.g., bait collectors, seaweed farmers, and gleaners) were conducted in each study site. Focused group discussions were used to triangulate information collected through interviews with a view to produce generalizations that represent the coastal resource conservation knowledge existing in the community.

Timeline analysis was carried out during focus group discussion to solicit information on the status of mangroves and seagrass over time and the reasons for the changes. Moreover, wealth-ranking exercise was carried out to correlate the wealth status of community members with the level of resource utilization in the study areas. From the collected data, frequencies and descriptive statistics were carried out. Moreover, Chi-square (χ^2) test was performed to investigate the relationship between the status of mangrove and seagrass resources and the study area. In addition, multiple regression analysis [38] was carried out to determine the effect of socioeconomic factors (independent variables) influencing exploitation of mangroves and seagrass resources (fixed factors) in the study sites.

The explicit form of the model is presented as $Yi=\alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots . \beta_7 X_7 + e_i$

where

Yi= dependent variables (number of extracted resources from mangrove forest and seagrass bed)

Table 1: Socioeconomic characteristics of households in the study sites (n = 60).

Particulars	Category	Charawe (%)	Kibele (%)	Average (%)
Gender of household head	Males	67	83	75
	Females	33	17	25
Marital status	Married	82	57	70
	Divorced	12	25	19
	Widowed	6	18	12
Age	5-25 (years)	12	6	9
	26-30 (years)	50	70	60
	31- 45 (years)	85	90	88
	46-50 (years)	30	50	40
	51-60 (years)	25	30	28
	>61 (years)	3	4	4
Education	No education	23	13	18
	Informal education	13	16	15
	Incomplete primary	17	26	21
	Complete primary	30	40	35
	Incomplete secondary	14	40	27
	Complete secondary	10	2	6
	Tertiary level	16	6	11
Occupation	Civil servants	13	10	12
	Small businesses	13	20	17
	Farming	4	17	10
	Mangrove harvesting	64	0	32
	Fishing	6	17	11
	Seaweed farming	55	40	48
	Casual labor	0	17	8
	Gleaning	50	60	55
	Bait collection	70	60	65
Household size	4-6 persons	30	23	26
	7-9 persons	47	45	46
	10-12 persons	23	32	28
Monthly income	< 232USD	33	33	33
	(232- 465) USD	53	50	52
	> 2,325 USD	17	13	15

X_1 to X_n = independent variables, which were seven as follows:

X_1 = age of household head

X_2 = household average income

X_3 = marital status of household head

X_4 = gender of household head

X_5 = household size

X_6 = education level of household head

X_7 = period of residence of the household head.

α_0 is the Y-intercept while $\beta_1\beta_2 \ldots\ldots\beta_7$ are the regression coefficients that were estimated while e_i is the error term.

3. Results

3.1. Socioeconomic Characteristics of the Households. Socioeconomic characteristics are an economic and sociological combination of total measure of a person and economic and social position relative to others, based on their gender of household head, marital status, household size, education level, household monthly income, age, and period of residence. These characteristics are presented in Table 1. Overall results show that majority (75%) of the household heads were males and only 25% of the household heads were female in the study sites. In case of marital status, majority (70%) of household heads were married. The distribution of their household size revealed that 26% of the respondents had family size of 4-6 persons, 46% had family size of 7-9 persons, and 28% had family size of more than 10 persons. The average household size was estimated to be nine, an indication of a relatively larger household size. On their education level, majority (21%) of the household heads had not completed primary education and 18% had no education level at all, only 11% of the household heads had attained tertiary level of education, and 15% had informal level of education. Furthermore, the

Table 2: Timeline analysis of mangrove forest status at Charawe and Kibele (key informant: village leader and elders).

Period	Status of mangrove forest in Kibele	Status of mangrove forest in Charawe	Reasons for Kibele	Reasons for Charawe	Source
1964-1972	Dense mangrove forest cover, tall mangrove trees species present. Status was very good	Dense mangrove forest cover, tall mangrove trees of species present and status was very good	Demand for mangrove was small, small population size, only men were involved in mangrove activities and conservation management by government officials	Demand for mangrove was small, population size was small, only men were involved in mangrove activities, conservation was under government officials and use of traditional rules	Key informant
1990-1995	Decrease in mangrove forest cover bad status	Decrease in mangrove forest cover at slow rate bad status	Increase in population size, increase in mangrove demand, only men were involved in mangrove harvesting and breaching the government laws	Increase in population size, increase in mangrove demand, only men were involved in mangrove activities, breaching of government laws and neglecting the traditional rules.	Key informant
1996-2000	Decrease in mangrove forest at fast rate hence very bad status	Decrease in mangrove forest cover hence bad status	Introduction of charcoal making, dye production, building poles, firewood, women and youth were involved in mangrove harvesting and use of chain saw	Increase in mangrove demand, women and youth were involved in mangrove harvesting and use of chain saw.	Key informant
2000-to date	Good status	Very bad status	Introduction of local community mangrove management committee, replanting of mangrove forest, burnt use of saw machine, burnt charcoal making, availability of creditable livelihood/forest	Rapid increase in population size, lack of alternative creditable livelihood, poor transport network system, community engage in mangrove charcoal making activities.	Present study

results indicate that majority (52%) of the households had an average annual income ranging from 465 to 2,325 USD, while few (15%) households earned an average annual income above 2,325 USD and most of them (17%) were found in Charawe village. The age distribution of the household heads shows that respondents with age between 26-30 (60%), 31-45 (88%), and 46-50 (40%) years constituted majority of respondents. This implies that majority of respondents were young and within the economically active age. Those with age above 61 years constituted only 4%, an indication of old and less economic active age who are dependent (Table 1).

3.2. Mangrove Status in the Study Area. Mangrove exploitation showed significant difference between the two studied villages Kibele and Charawe (p= 0.0001, χ^2 =27.27). At Charawe, 49.2% of respondents revealed high mangrove exploitation as compared to the situation that existed 10 years ago due to the persisting illegal and unsustainable mangrove harvesting (Figures 2(a) and 2(b)), hence making the current status of this resource very bad (Figure 3). On the contrary, many respondents (56%) at Kibele revealed that the status of mangroves is better as compared to the situation that existed 10 years back. Generally, the results showed that mangroves of Charawe have been significantly impacted by anthropogenic activities as compared to Kibele (Figure 3). Timeline analysis revealed significant reduction in mangrove from 1965 to date (Table 2) due to unmanageable clearing for source of energy (charcoal and firewood) (Figure 2(a)), timber (Figure 2(b)), and making fishing trap/crab cages (Figure 2(c)).

3.3. Status of Seagrass Beds. Statistical analysis revealed no significant difference on the status of seagrass between the two sites (p= 0.2693, χ^2 =1.2202). Eighty-seven percent and ninety-one percent of the respondents at Charawe and Kibele, respectively, stated that status of seagrass was good (Figure 4). Timeline analysis for seagrass (Table 3) is inconsistent from 1962 to date; the observed inconsistence could be due to either failure of the key informant to notice the disappearances of seagrass since it is under water or the loss that sometimes occurs without human conscious. However, direct observation depicted gleaning, seaweed farming, and uprooting of long seagrass (*Enhalus acoroides* and *Thalassodendron ciliatum*) for assisting in burning the mangroves logs during charcoal making at Charawe village (Figure 2(d)) had great contribution to seagrass loss.

Table 3: Timeline analysis of seagrass status in Charawe and Kibele village since 1962 to date.

Period	Status of seagrass bed in Kibele	Status of seagrass bed in Charawe	Reasons for Kibele	Reasons for Charawe	Source
1964-1972	Very good	Very good	Small population size, few fishermen, fishing using traps by old people and conservation management by government officials	Small population size, few fishermen, only old people fished in seagrass beds, use of traps and conservation by government officials	Key informant
1990-1995	Bad	Bad	Introduction of improved vessels, deep water fishing, drag net fishing, youth and old people involved and breaching the government laws	Introduction of improved vessels, deep water fishing, drag net fishing, youth and old people involved and breaching the government laws	Key informant
1996-2000	Good	Good	Lack of money value of the resource to the community, burnt use of drag nets and introduction of management committee	Lack of money value of the resource to the community, burnt use of drag nets and introduction of management committee	Key informant
2000-to date	Good	Good	Controlling harvesting of bivalves and availability of creditable livelihood Gleaning and bait collection activity heavily conducted	Lack of valuable resources on seagrass beds and community concentrate with mangrove extraction Gleaning, bait collection, and seaweed farming	Key informant

Table 4: Multiple regression analysis of socioeconomic factors influencing extraction of mangrove and seagrass resources in the study areas. *Mangrove (n= 60, R^2 =0.614) and seagrass R^2 =0.562, ∗=statistically significant at 0.05 level of significance.*

	Mangrove			
Variables	β	Standard error	t	P-value
Age of household head	0.236	0.214	3.738	0.001∗
Household average annual income	0.564	0.000	10.62	0.001∗
Marital status of household head	-0.213	0.175	-3.18	0.002∗
Gender of household head	-0.010	0.418	-0.149	0.882
Household size	-0.217	0.056	-3.937	0.001∗
Education level of household head	-0.229	0.079	-4.002	0.001∗
Period of residence of household head	-0.511	0.009	-7.971	0.001∗
	Seagrass			
Age of household head	0.168	0.229	2.502	0.013∗
Household average annual income	0.026	0.148	0.447	0.655
Marital status of household head	0.166	0.188	2.327	0.021∗
Gender of household head	0.404	0.449	5.695	0.001∗
Household size	-0.206	0.268	-3.533	0.001∗
Education level of household head	0.118	0.085	1.920	0.057
Period of residence of household head	0.387	0.010	5.633	0.001∗

3.4. Socioeconomic Factors Influencing Extraction of Mangrove and Seagrass Resources. The present findings revealed that all socioeconomic variables (Table 4) tested were statistically significant (P<0.05) and had an influence on the exploitation of mangrove and degradation of seagrass except gender of the household (P=0.88) for mangroves, household annual average income (P=0.655), and education of household head (0.057) for seagrass (Table 4). For example, the age of the household and household income had a significant influence on exploitation of mangrove forest with positive regression coefficients (β) = 0.236 and 0.564, respectively. Moreover, change in marital status, household size, change in education level, and period of residence of the household had a significant influence on exploitation of mangrove forest with negative regression coefficients (β) = -0.213, -0.217, -0.229, and -0.511, respectively, while gender of the household had no significant influence on the mangrove forest exploitation (P=0.882). For the case of seagrass degradation

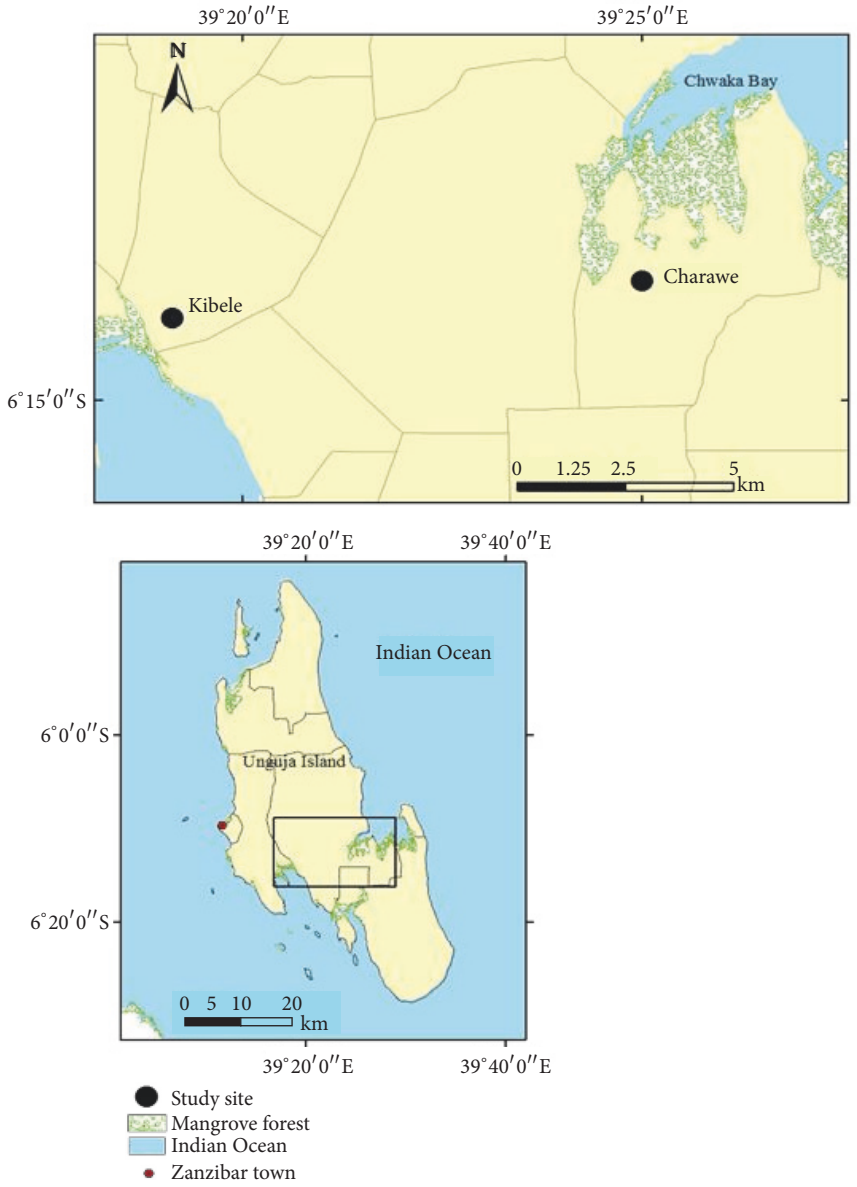

Figure 1: Unguja map showing the study sites (Source IMS Database).

all socioeconomic variables, including age of the household, marital status, gender of the household, education level, and period of residence of household, had significant impact on the degradation of seagrass with positive regression coefficients except household size with negative regression (β) = - 0.206. Household annual average income (P= 0.655) had no significant influence on the degradation of seagrass (Table 4).

4. Discussion

In all the study sites, the determinants of mangrove exploitation and seagrasses degradation were demographic change and socioeconomic characteristics. Increase in population growth has increased the demand for natural coastal resources from mangrove to seagrass. Good example is tremendous increase in demand for building poles, wood fuel, fish trap, and charcoal making (Figures 2(a), 2(b), and 2(c)) which specifically comes from mangroves [39]. Quinn et al. [37], Hussain [40], and Semesi [41] reported similar situations in three countries: Brazil, Vietnam, and Zanzibar. The findings also reveal that the increase in human activities, for example, bivalve collection, bait collection, and seaweed farming, at Kibele and Charawe village, with average percent of 55, 65, and 48 (Table 1), respectively, significantly increased pressure on seagrass degradation. Similarly, Nordlund et

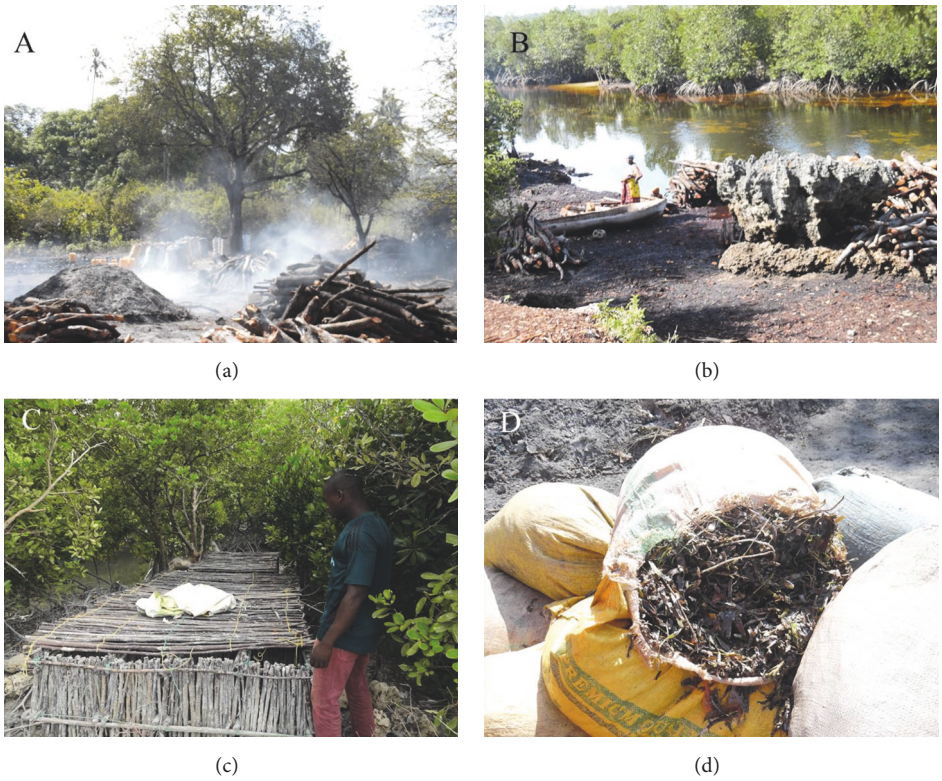

Figure 2: ((a) and (b)) mangrove clearing for charcoal making at Charawe village, (c) mangrove clearing for crab cage making at Kibele village, and (d) seagrass collected/parked for charcoal burning at Charawe village (photo by Amina Asiya Nchimbi).

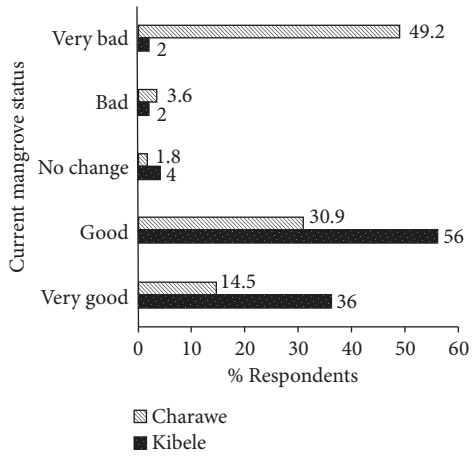

Figure 3: Perception on the current mangrove status in Charawe and Kibele as compared to the situation 10 years ago.

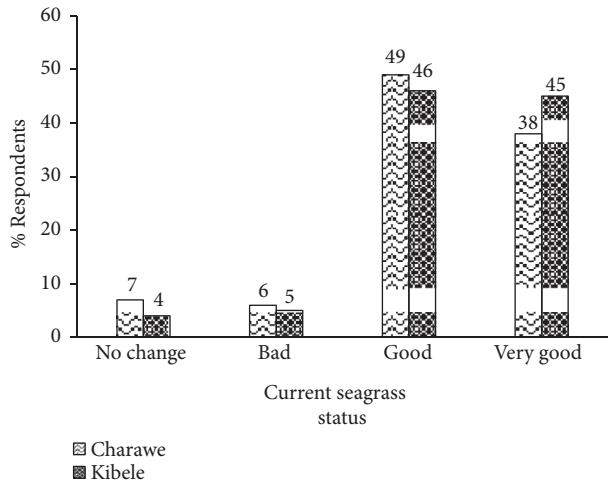

Figure 4: Perception on current status of seagrass beds in Charawe and Kibele as compared to the situation 10 years ago.

al. [19] reported the increase in gleaners, both women and children in seagrass ecosystem in Zanzibar. Moreover, assessment done by Watson et al. [42] revealed that the global catch of bivalves is approximately 121,000 tonnes per annum with a retail value of £5.5 billion. This increase comes with physical disturbance in seagrass meadows; for example, Garmendia et al. [43], Watson et al. [42], and Eckrich and Holmquist [44] reported the effect of trampling and digging during bait collection in *Zostera noltii* (Zosteraceae) and *Thalassia testudinum*.

The present study revealed that substantial numbers of respondents (48%) in all sites studied engage in seaweed farming, and they contribute unknowingly to seagrass degradation. The reports from several authors [22, 24–26] have confirmed seaweed farming in seagrass meadows having

negative effects on seagrass characteristics including plant height, biomass, and plant density. Mangroves exploitation and seagrass degradation in the Zanzibar coastal communities are influenced by various factors and each factor reflected the reality in terms of social livelihood of the coastal communities in the study sites. The findings reveal that age of household head had significant influence on the extraction of both mangrove and seagrass resources in the study sites. Mangrove resources extracted were used for charcoal making, boat making, building poles, and fuel wood [45]. Quinn et al. [37] reported similar findings in Brazil and Vietnam, whereas the resources extracted from seagrass included bivalve and bait collection [19, 43] and seaweed [22, 42] through seaweed farming and fish by using fishnets and traps. The resources obtained from both mangrove forest and seagrass meadows were collected by economically active ages ranging from 26 to 50 years old. The resources were for substance use or selling within and outside the villages. These findings are consistent with the findings reported by Branch et al. [46] who noted that productive ages are involved in many development activities which may also be associated with degradation of natural resources.

Moreover, the results show that marital status of the household head had a significant influence on the exploitation of the mangroves resources as well as seagrass degradation. It was observed from the focus group discussions and personal observation that married household heads extracted many resources from mangrove forest and seagrass meadows in order to meet the demands of their family members (wives and children). The involvement of the family members such as the elder sons in mangrove extraction, wives, elder daughters, and young children in seagrass resource extraction also increased the pressure on these resources. This was not the case in single household heads because this group has less demand when it came to seagrass and mangrove resources because they were living alone and had no family members of their own to take care of. Similarly, Nussbaum [47] and Shackleton et al. [48] reported that married individuals had significant influence on exploitation of natural resources in a given area.

The results showed that household size had significant influence on the extraction of both seagrass resources and mangrove forests. Increase in household size increased the number of people who were engaged in the extraction of seagrass and mangrove resources in the study sites. This therefore led to the decrease in the resources obtained from the mangrove forest and seagrass meadows as a result of increase in demand for these resources. This was observed from personal observation where there was increase in the number of gleaners, net and trap fishers, seaweed farmers, charcoal making, and building poles collectors. This increase has led to the decrease in the resources obtained from seagrass and mangrove forest, respectively, through unsustainable harvesting. Related findings have been confirmed by Jiddawi and Öhman [49] and Mtwana Nordlund [13] who reported that household size with a lot of women is predominantly involved in the invertebrate harvesting, which is commonly conducted on rocky shores, in mangroves and seagrass meadows, in unsustainable manner due to lack of formal management.

Educational level of the household head had significant influence on the extraction of mangrove resources and seagrass resources. The negative regression coefficient on the mangrove resource extraction implied that increase in education level of the household head leads to decrease in the extraction of the mangrove resources. Thirty-five percent of the respondents have received at least primary education (Table 1) and this might have been attributed to development and engaging of community members to various livelihood activities such as owning small shops, food vending, and casual labor, therefore reducing pressure on the mangrove resource extraction. This study is in line with earlier findings of Nussbaum [47] and Shackleton et al. [48] who found out that the more education one attains helps one better in the management of natural resources. On the other hand, seagrass resource extraction has increased with the increase in the level of education. This might be due to the fact that since the majority of the coastal communities in the study site have attained only primary level education, it becomes very hard for this majority group to secure a white-collar job, hence ending up employing themselves in the small-scale fisheries (SSF) within the seagrass meadows, therefore promoting unsustainable extraction of seagrass resources.

The results also revealed that household average annual income had significant influence on the extraction of mangrove resources. The increasing standards of living and low level of education of the majority of the coastal communities in the study sites have limited them to secure government and private employment opportunities. This situation forces the local coastal community to rely on mangrove resources as an alternative source of income generation through selling of building poles, making charcoal, fuel wood, fish traps, and poles for boat making. Similar findings were also reported by Dahdouh-Guebas et al. [50] and Jin et al. [51] in Kenya and China, respectively. Despite the awareness on the importance of marine natural resources, particularly mangrove, their exploitation is still alarming due to economic dependency and lack of alternative source of energy for their daily use [52, 53] imposing significant pressure on the mangrove forest.

Households headed by males had significant influence on seagrass resource extraction. These household heads had the ability of conducting fishing activities within and outside the villages on seagrass meadows found in shallow waters and deep waters using traps and fishing nets, unlike their female-headed counterparts who engage themselves in bivalve collection and seaweed farming. This was noted from participant observation and focus group discussions conducted in the study sites. The different roles performed by different genders in exploitation of resources can in one way or another impact the conservation of a given resource. This finding is in connection with other studies conducted by Gadio and Rakowski [54], Crus-Torres [55], and Mtwana Nordlund [13] who noted that some roles of gender in the exploitation of natural resource may undermine ecosystem sustainability. The results further show that period of residence of the household head in a given village had significant contribution to the extraction rate of the mangroves and seagrass resources. The

less the time/period people stay in a given area, the less their families grow in size; thus less mangrove resources will be demanded from the mangrove forest, and vice versa. Similar observations were reported by Giliba et al. [56] and Kajembe [57] which indicated that people who stay longer in a given area with resource availability are more likely to exploit more of those resources than those who stay for a short duration. Timeline analysis revealed continued decrease in mangrove (Table 2) due to active interaction between the coastal ocean and community surrounding the ocean. The most important drivers for coastal resources (mangroves and seagrass) exploitation are the demographic characteristics of the coastal community including population growth, limited arable land, and development of tourism industry in Zanzibar. Despite the existence of laws and bylaws governing the mangrove conservation and sustainable exploitation, there is a need for enforcement of these laws to avoid unsustainable mangroves exploitation. Moreover, we suggest the establishment and introduction of laws and bylaws to govern seagrass conservation and utilization by the local management committees and local coastal communities.

To ensure sustainable exploitation of coastal resources alternative livelihood activities such as farmed fish, small/petty business, and agriculture activities that are profitable and easy to manage should be introduced to the coastal/marine resource dependents.

Data Availability

Research data are available when needed.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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