COMMUNITY PERCEPTION OF THE VALUE OF THE ECOSYSTEMS OF THE BONS SINAIS ESTUARY, MOZAMBIQUE, SOUTHERN AFRICA

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ABSTRACT: Understanding the community's perceptions of, and beliefs about, the value of ecosystems and natural resources is important for designing effective environmental education and awareness campaigns and for the adoption of sustainable natural resources management. The present paper examines the perceptions of the natural resource users in the Bons Sinais Estuary and gauges their willingness to contribute to mangrove ecosystem restoration and management. 169 natural resource users, including fishermen, farmers, and forest produce users, from five villages along the Estuary (Marrubune, Gazelas, Icidua, Chuabo Dembe and Inhangome), were interviewed. The interviewees assigned high value to the estuary as a source of fish, as agricultural land and as productive forest. They considered the estuary important for provision of clean water and air and for its potential for tourism development. There were strong similarities, across the region, with regard to the value of the estuary ecosystem ($0.6 < r < 0.8$; $p=0.000$) and on the perception of the ecological importance of mangroves ($r \geq 0.9$; $p \leq 0.009$). The community agreed to mangrove restoration and were willing to contribute to this in labour and in cash. They were aware of and complied with the management rules and regulations for fisheries and mangroves. The banning of small mesh fishing nets and mangrove cutting and introduction of a close season were popular measures. The people favoured the co-management governance system.

Keywords: Ecosystem services, natural resource management, livelihood activities, mangrove restoration, co-management.

RESUMO: *Compreender as percepções e crenças da comunidade, sobre o valor dos ecossistemas e recursos naturais, é importante para a planificação de campanhas eficazes de educação e conscientização ambiental e para a adoção da gestão sustentável dos recursos naturais. O presente artigo examina as percepções dos usuários de recursos naturais no estuário de Bons Sinais e avalia sua disposição em contribuir para a restauração e gestão de ecossistemas de mangal. Foram entrevistados 169 usuários de recursos naturais, incluindo pescadores, agricultores e usuários de produtos florestais, de cinco aldeias ao longo do estuário (Marrubune, Gazelas, Icidua, Chuabo Dembe e Inhangome). Os entrevistados atribuíram alto valor ao estuário como fonte de peixe, terra agrícola e floresta produtiva. Eles consideraram o estuário importante para o fornecimento de água e ar limpos e por seu potencial para o desenvolvimento do turismo. Houve fortes semelhanças, em toda a região, em relação ao valor do ecossistema do estuário (0,6 <r <0,8; p = 0,000) e na percepção da importância ecológica do mangal (r≥0,9; p≤0,009). A comunidade concordou em restaurar o mangal e estava disposta a contribuir, para o efeito, em trabalho e em dinheiro. Eles estavam cientes e cumpriram com as regras e regulamentos de maneio de pesca e de mangal. A proibição de uso de redes de pesca de malha pequena e do corte de mangal e a introdução de veda na pesca, foram medidas populares. As pessoas eram favoráveis ao sistema de governança de cogestão.*

Palavras-chave: *Serviços de ecossistemas, gestão de recursos naturais, atividades de subsistência, restauração de mangal, co-gestão.*

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1. INTRODUCTION

The ecosystem of the Bons Sinais Estuary consists mainly of mangroves, which dominate the lower and mid estuary, and freshwater swamps which are abundant in the upper estuary. These mangroves and swamps provide a wide variety of goods and services to the resident population (Unaite, 2017). The services derived from estuaries include food production, mainly fish, and building material and energy sources obtained from mangroves. The mangroves and wetlands also provide protection from flooding, through absorbing floods by sponge function (Acreman e Holden, 2013; Agbasi, 2014; Badola e Hussain, 2005; McLaughlin e Cohen, 2013; Moreno-Casasola *et al*., 2009) as well as carbon sequestration (Alongi, 2012; Estrada, 2015; Inoue, 2019).

Despite their socio-economic importance, estuaries are threatened by both human and anthropogenic pressures worldwide (Pagliosa *et al*., 2006; Rasolofoharinoro *et al*., 1998; Zapata *et al*., 2018). In the Bons Sinais Estuary human pressure is one of the major threats to the ecosystem, where mangroves are depleted for firewood and charcoal production and cleared for human settlements, and freshwater swamps are converted into settlements and agricultural land (Unaite, 2017).

The presence of different resource users, often with conflicting interests, the complexity of the human-environmental interactions and the linkages between different ecosystems` functions and services in the estuaries, call for an integrated management approach, in order to preserve the benefits provided by these ecosystems and sustain the livelihood of the people who depend on estuarine resources (Calvão *et al*., 2013; Carvalho e Fidélis, 2013; Lai *et al*., 2015; Nobre, 2011; Supriatna *et al*., 2017). Understanding the social and economic aspects of coastal communities, which include demography, economics, perceptions, attitudes, and values pertaining to estuarine ecosystems is crucial to management of estuaries as pointed out by many authors (Burger, 2003; Huppert *et al*., 2003). McAuliffe *et al*. (2014) pointed out that the degree of degradation of estuary ecosystems is related to the economic background of a community that uses its resources. Supriatna *et al*. (2017) argued that community behaviour can affect, directly or indirectly, the ecosystems. Further, Huppert *et al*. (2003) argued that ecosystem management involves local public perception and collaboration and Burger (2003) pointed out that understanding how people use estuarine resources and what they see as the most important processes are critical to their assessment and management. Furthermore, Rojas *et al*.

(2017) argued that analysis of perceptions of Ecosystem Service is of increased importance to maintain biodiversity, ecosystem functions, and assure the well-being of the people. Moreover, for an effective awareness and education programme, knowledge of the trainee's perceptions and beliefs on the matter has to be taken into consideration and built on for programs to be effective (Ajaps e McLellan, 2015). Therefore, the present paper examines the community demography and socio-economic structure, analyses perception of the value of the estuarine ecosystems and gauges willingness to contribute to the restoration and conservation of the mangrove ecosystems. It aims to contribute to an effective awareness of, and education programmes on, the conservation and sustainable use of this precious ecosystem. The survey was conducted in five villages distributed along the Estuary as follows (Figure 1): two villages (Marrubune and Gazelas) in the lower estuary dominated by fishermen, one village at mid estuary (Incidua), a suburb in Quelimane City, representing suburban conditions, and two villages at the upper estuary (Chuabo Dembe and Inhangome), dominated by farmers.

2. DESCRIPTION OF THE STUDY AREA

The Bons Sinais Estuary (Figure 1) is located in south-eastern coast of Africa, between latitudes 17º 52'S and 18º 04'S and longitudes 36º 48'E and 36º 58'E. The estuary hosts diverse and rich habitats ranging from freshwater swamps to mangroves, which sustain important fisheries resources and fertile agriculture lands that provide livelihoods to a large population. Along the estuary, at about 25 km upstream, on the northern margin of the estuary, lies the city of Quelimane, the capital of the Zambézia Province, the second-most populated province in Mozambique. There is a fishing and a commercial harbour. The city offers opportunity for jobs and career development and business, all of which are promising ways to alleviate poverty and unemployment. During the Mozambican civil war of 1977 to 1992, the city of Quelimane grew rapidly, when up to 3 million people were displaced from rural inland areas to the more urbanised coast, considered safe (Wilson, 1994). After the civil war, the city continued to grow, and the population increased from 150,116 in 1997, to 193,343 in 2007, and to 349,842 in 2017 (INE 2007; INE 2017; www.populationstat.com). The urbanisation of Quelimane, including population growth and the consequent demand on local natural resources, may contribute to the reshaping of the people's occupation and perceptions on the importance of the natural ecosystem in the ever-dynamic socio-economic settings.

3. RESEARCH METHODS

The method was based on a case study strategy involving communities living in five villages distributed along the estuary (Table 1), as described above. These communities were selected because it was expected that they would have different livelihood activities and different uses of the estuary and estuarine resources, and so, different perceptions of the value of the estuarine ecosystem. The study was conducted through face-to-face surveys to gather qualitative and quantitative data on the stakeholders' use and perceived value of the estuarine ecosystem, focusing on mangrove ecosystems, as well as their willingness to contribute to mangrove restoration and conservation. Data were collected via semi-structured interview questionnaires with 169 people (26% female) living in the surveyed villages, namely Marrubune (28), Gazelas (23), Icidua (37), Chuabo Dembe (39) and Inhangoma (42). People were selected randomly from the community in the villages and each interviewee represented a household.

The results from the survey were checked, entered onto a computer and statistically analysed using MINITAB statistical package. Pearson correlation (r), was used to gauge the strength of the similarities or differences between the villages with regard to their perception of the estuarine ecosystem function, use and value, focusing on mangroves.
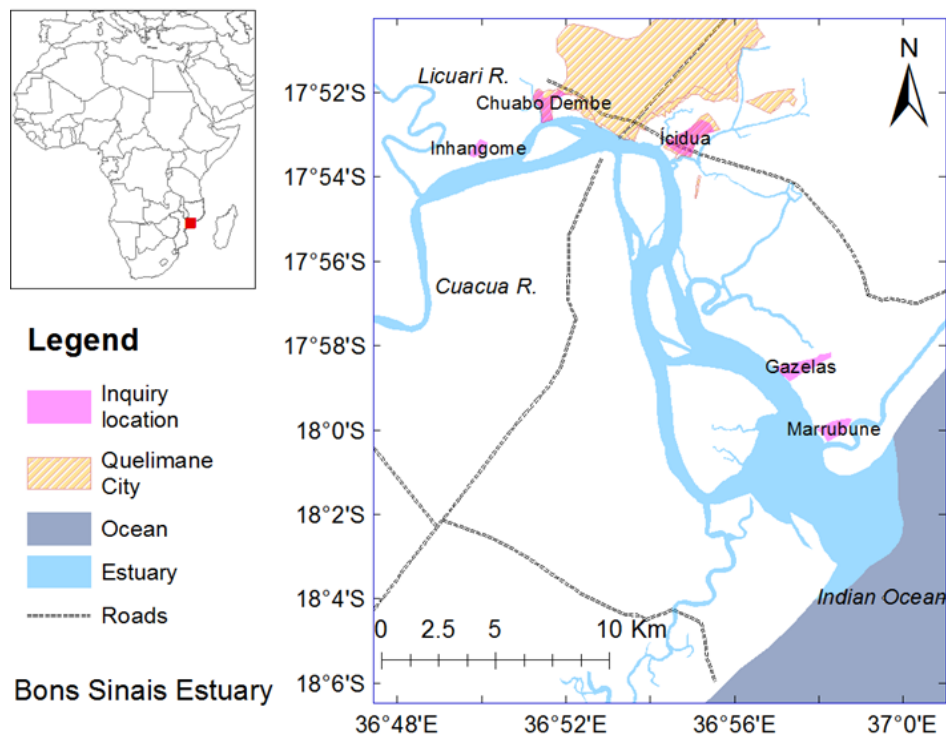

Figure 1. Location of the survey sites.

Table 1. Number of the interviewees.

Gender \ Villages	Marrubune	Gazelas	Icidua	Chuabo Dembe	Inhangome	Total
Male	25	14	29	20	37	**125**
Female	3	9	8	19	5	**44**
Total	**28**	**23**	**37**	**39**	**42**	169

4. RESULTS

4.1 Profile of the interviewees

Figure 2 presents the profile of the interviewees. A higher proportion of men, about 89%, was interviewed in Marrubune, at the mouth of the Estuary (Figure 2a). The proportion of men interviewed decreased up-estuary up to Chuabo Dembe, where men (51%) and women (49%) were in balance. The men took the lead again in Inhangome, further up-estuary. Regarding marital status, most of the interviewees were married (Figure 2b). There was a high proportion of married people in Marribune (96%) and Inhangome (95%). A higher proportion of singles was observed in Incidua (30%) and Chuabo Dembe (21%) and there were a number of widows (17%) in Gazelas. Overall, about 79% of the interviewees were married and about 13% were singles, 2% were divorced and 6% were widows. Most of the interviewees were young to middle age (Figure 2c), with age range 16-25 (30%), 26-35 (33%) and 36-45 (21%). Elder people, with age range 46-55 were 11% and with age above 55 were 6%. Christianity and Islam were the dominant religions of the interviewees (Figure 2d). Islam was dominant near the coast, in Marribune (~86%), followed by Icidua (24%). Christianity was the most dominant religion, with the highest proportion of Christians farthest up the estuary, in Inhangome (~86%), followed by Chuabo Dembe (80%), Gazelas (74%) and Icidua (~49%). Illiteracy (Figure 2e) was higher near the mouth of the Estuary at Marrubune and Gazelas. The proportion of interviewees with no primary School certificate was 61% in Marrubune and 70% in Gazelas. The proportion of illiteracy diminished up-estuary. In Icidua the proportion of interviewees that completed High School was about 22% and in Inhangome the proportion of interviewees that attended High School but did not complete was about 26%. In Icidua and Chuabo Dembe there were interviewees that attended College (3-8%). Overall, about 45% of the interviewees did not complete Primary School, but about 25% had completed Primary School. 12% attended High School, but only 8% completed High School and 2% attended college. The main occupations of the interviewees (Figure 2f) were fishing, followed by agriculture, forest products and small business. A higher proportion of fishermen was observed in Marribune (82%), followed by Icidua (62%), Inhangome (50%) and Gazelas (48%). The highest proportion of farmers was observed in Gazelas (44%) followed by Chuabo Dembe (26%) and Inhangome (19%). Forest product dealers were recorded in the upper estuary, in Chuabo Dembe (25%) and Inhangome (~5%). Small business dealers were observed across the region, except in Gazelas, with the proportion ranging from 10% and 13.5%. Chuabo Dembe presented a small proportion of fishermen but displayed a wide range of occupations. Other occupations included civil servants and employees were significant in Chuabo Dembe (25.6%).

There were significant similarities (r=0.7; p≤0.005) in the profiles of the interviewees across all the five villages surveyed. Strong similarities (r≈0.8, p≤0.001) were observed in all the villages with the exception of Marrubune. Similarities were observed in gender, which was dominated by men throughout, with Marrubune presenting an extreme case (89% men); in occupation, dominated by fishing with the exception of Chuabo Dembe where there was a whole spectrum of occupations with fishing being a small proportion and Gazela where agriculture and fishing were almost in equal proportion. Most people were illiterate and married. The religion was predominantly Christian, with the exception of Marrubune, which was Muslim dominated. In overall, the main occupation was fishing (51.6%), followed by agriculture (19.3%), small business (10.6%) and other activities including civil servants and paid jobs (11.2%).

4.2 Perceptions of the interviewees on the importance of the estuarine ecosystems on provision of goods and services

The importance of the estuary ecosystem on the provision of goods and services was assessed with regard to provision of forest products (mainly mangrove), fish and fish habitat, agricultural land, wildlife, clean water, clear air and favourable conditions for tourism development. The result is presented in Figure 3.

With regard to the role of the estuary to provide forest products (Figure 3a), in Marrubune 50% of the interviewees considered important, 39.3% considered very important and 10.7% said it was not important. In Gazelas, 56.5% considered important and 30.4% considered not important. In Icidua, 38.9% considered important and 49.7% very important. In Cuabo Dembe, 16.2% considered important and 83.8% very important. In Inhangome, 42.9% considered important and 35.7% very important. On average, 39.2% considered important and 43.4% considered very important.

On the role of the estuary to provide fish and fish habitats (Figure 3b), in Marrubune, 17.9% considered important and 75% very important. In Gazelas, 78.3% considered important and 8.7% very important. In Icidua, 44.4% considered important and 47.2% very important. In Chuabo Dembe, 16.2% considered important and 83.8% very important. In Inhangome, 33.3% considered important and 52.4% very important. On average, 35.5% considered important and 56% considered very important.
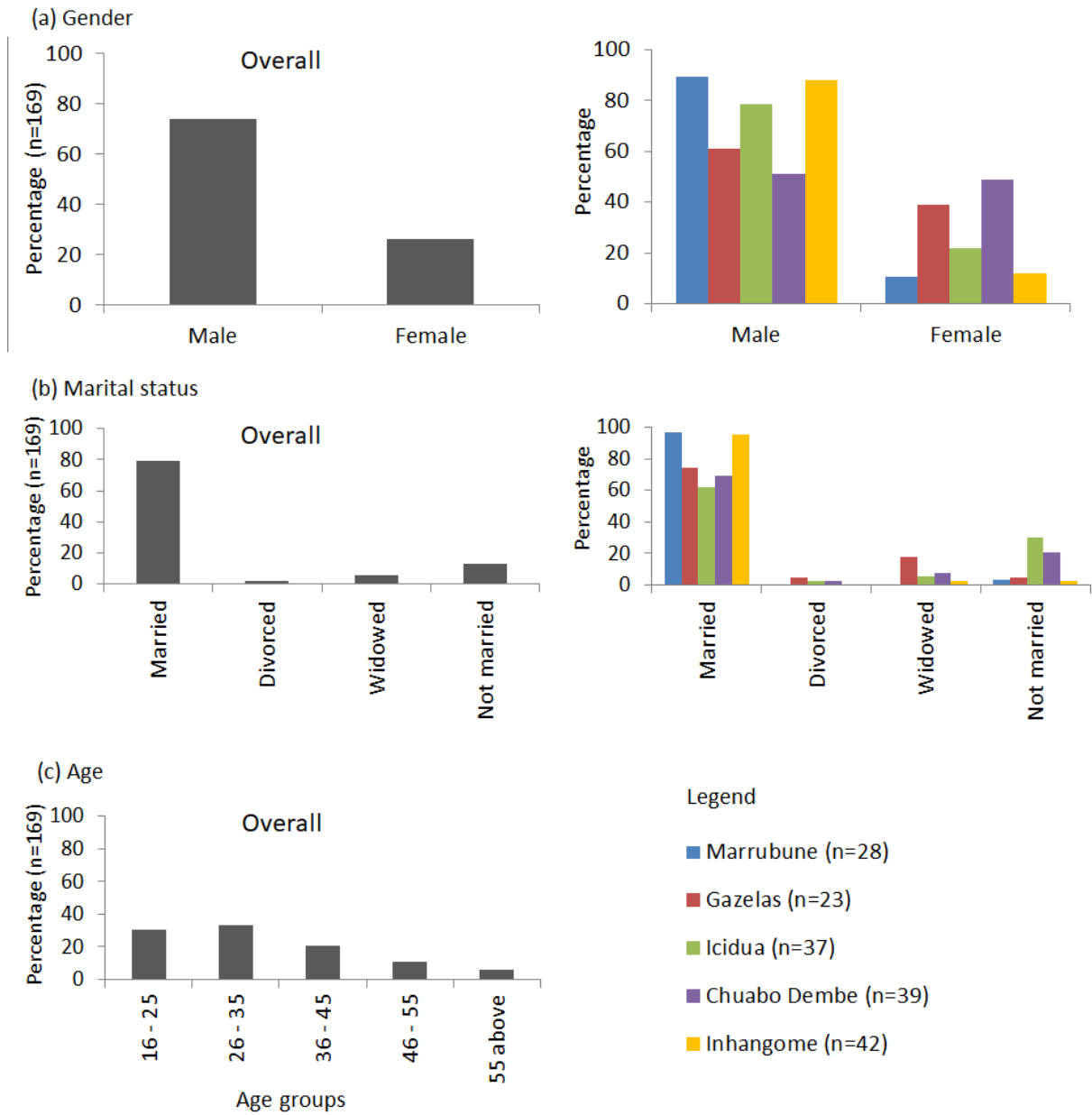
Figure 2. Profile of the interviewees.

(d) Religion

(e) Education

(f) Occupation

Legend

■ Marrubune (n=28)   ■ Gazelas (n=23)
■ Icidua (n=37)   ■ Chuabo Dembe (n=39)
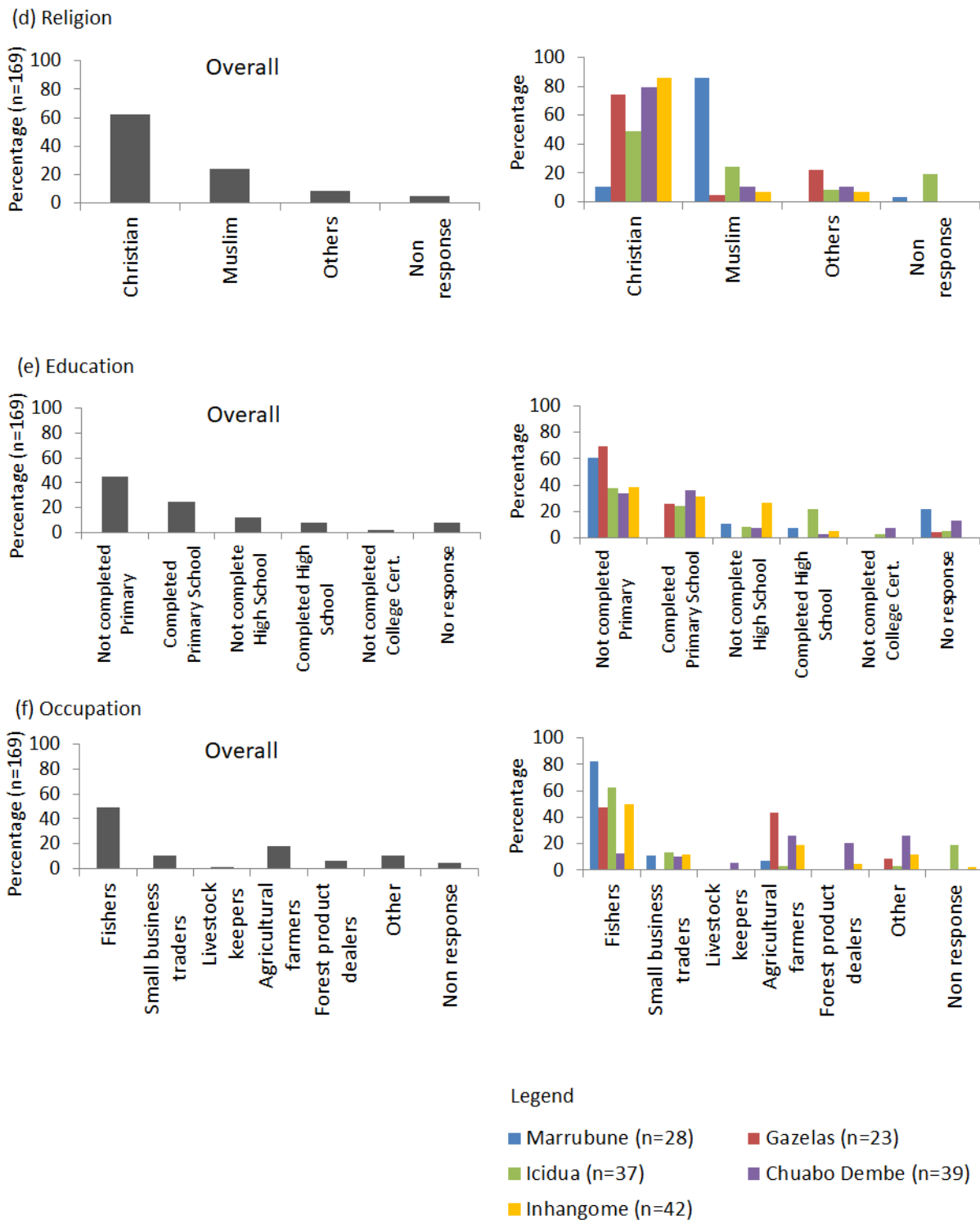■ Inhangome (n=42)

Figure 2. (Continued) Profile of the interviewees.

Concerning the role of the estuary in providing agricultural land (Figure 3c), in Marrubune 25% considered important and 71.4% very important. In Gazelas, 78.3% considered important and 8.7% very important. In Icidua, 16.7% considered important and 75% very important. In Chuabo Dembe, 10.8% considered important, 32.4% very important, 18.9% considered not important, 10.8% least important, and 21.6% confessed not knowing. In Inhangome, 16.7% considered important and 61.9% very important. On average, 25.3% considered important and 53.4% very important.

With regard to the function of the estuary to provide wild life (Figure 3d), in Marrubune, 57.1% considered important, 28.6% very important, and 14.3% considered not important. In Gazelas, 17.4% considered important and a large proportion of the interviewees (69.6%) considered not important. In Icidua, 61.1% considered important and 11.1% considered very important. In Chuabo Dembe, 29.7% considered important, 32.4% very important, 13.5% considered not important and 16.2% considered least important. In Inhangome, 40.5% considered important, 16.7% very important, and 14.3% declared not important. On average, 42.2% considered important, 19.3% very important, and 18.7% considered not important.

With respect to the role of the estuary in providing clean air (Figure 3e), in Marrumube, 17.9% considered important and 35.7% very important, and 28.6% said it was not important. In Gazelas opinions were divided, with 43.5% considering the provision of clean water to be important and an equal proportion considering it not important. In Icidua, 27.8% of the interviewees considered it important and 72.3% considered it even very important. In Chuabo Dembe, 18.9% and 13.5% considered it important and very important and a considerable proportion (35.9%) considered it not important while 21.6% admitted to not knowing. In Inhangome, 38.1% of the interviewees considered the provision of clean water important, 31.0% considered it very important, and 16.7% said it was not important. On average, 28.9% considered this factor to be important and 32.5% very important, and 22.9% considered it not important.

With regard to the function of the estuary to provide clean air (Figure 3f), 21.4% of the interviewees in Marrubune considered this important, 28.6% said it was very important, 32.2% said it was not important and 14.3% said they did not know. In Gazelas, 73.9% considered it important, 21.7% considered it not important and 4.3% said they did not know. In Icidua, 66.7% said it was important and 33.3% considered it very important. In Chuabo Dembe, 29.7% considered it important, 21.6% very

important, 37.8% said it was not important and 8.1% said not knowing. In Inhangome, 38.1% considered important, 35.7% considered very important, 19% said it was not important and 4.8% said not knowing. On average, 44.6% considered important, 25.9% considered very important, and 21.7% said it was not important.

With regard to the estuaries offering opportunity for tourism development (Figure 3g), in Marrubune, 57.1% considered important and 39.3% very important. In Gazelas, 60.9% considered important and 21.7% considered not important. In Icidua, 47.2% considered important, 13.9% very important, and 16.7% declared not important. In Chuabo Dembe, 24.3% considered important, 18.9% considered not important, 21.6% least important, and 29.7% admitted not knowing. In Inhangome, 21.4% said it was important, 40.5% affirmed not important and 23.8% said not knowing. On average, 39.2% considered important, 11.4% very important, 21.1% considered not important and 15.7% admitted not knowing.

There were strong similarities (0.7<r<0.8; p=0.000) in the answers from Marrubune, Icidua and Inhangome, and significant similarities (r=0.6; p=0.000) between Chuabo Dembe and these three villages. The similarities were in opinions about the role of the estuary as a provider of fish and fish habitats, forest products and agricultural land. In Icidua, a large proportion (60.9%) of the interviewees considered important the role of the estuary for tourism. In Gazelas, a large proportion (~70%) of the interviewees considered the provision of wildlife not important and neglected the role of estuary for tourism. In Chuabo Dembe, a large proportion of the interviewees (83.8%) ranked the role of the estuary in providing forest products and fish and fish habitats very high.

4.3 Perceptions of the interviewees on the ecological importance of mangroves

Figure 4 presents the perception of the interviewees of the overall usefulness of the mangrove ecosystem. In Marrubune, 57.1% of the interviewees considered the maintenance of biodiversity and environmental protection as the main ecological function of mangroves, 21.4% of the interviewees considered the maintenance of biodiversity, environmental protection and soil fertility improvement as the main ecological function of mangroves and 10.7% considered biodiversity only as the main ecological function of mangroves. In Gazela, 47.8% of the interviewees considered the maintenance of biodiversity and environmental protection and 21.7% of the interviewees considered the maintenance of biodiversity, environmental protection and soil
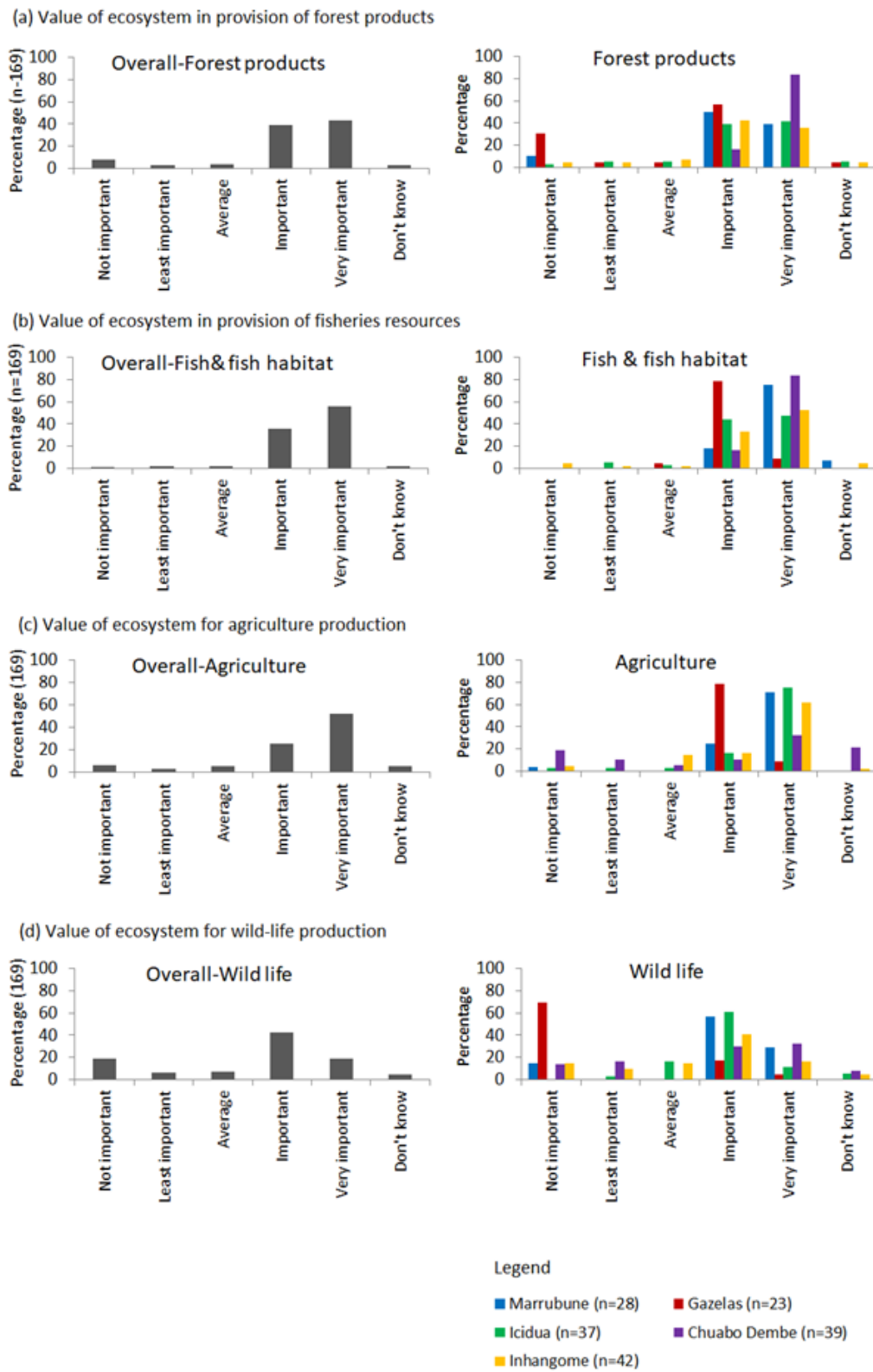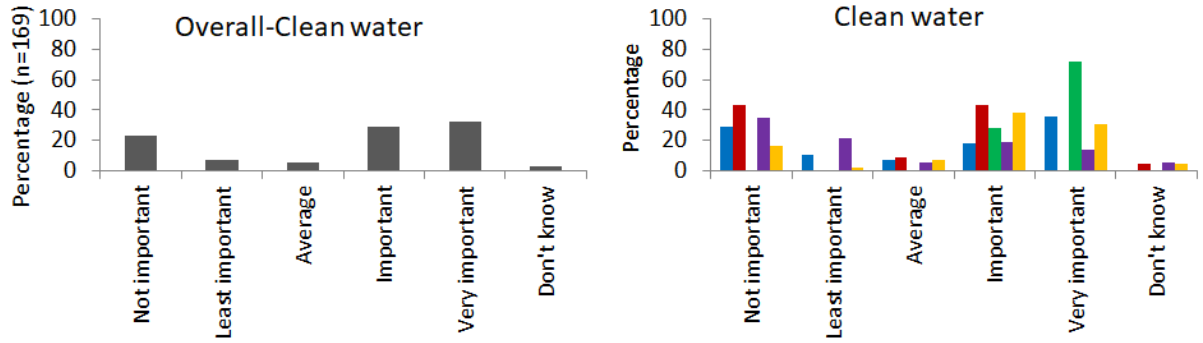
(a) Value of ecosystem in provision of forest products

(b) Value of ecosystem in provision of fisheries resources

(c) Value of ecosystem for agriculture production

(d) Value of ecosystem for wild-life production

Legend

- Marrubune (n=28)
- Gazelas (n=23)
- Icidua (n=37)
- Chuabo Dembe (n=39)
- Inhangome (n=42)

Figure 3. The interviewees' perception of the value of the estuary ecosystem.
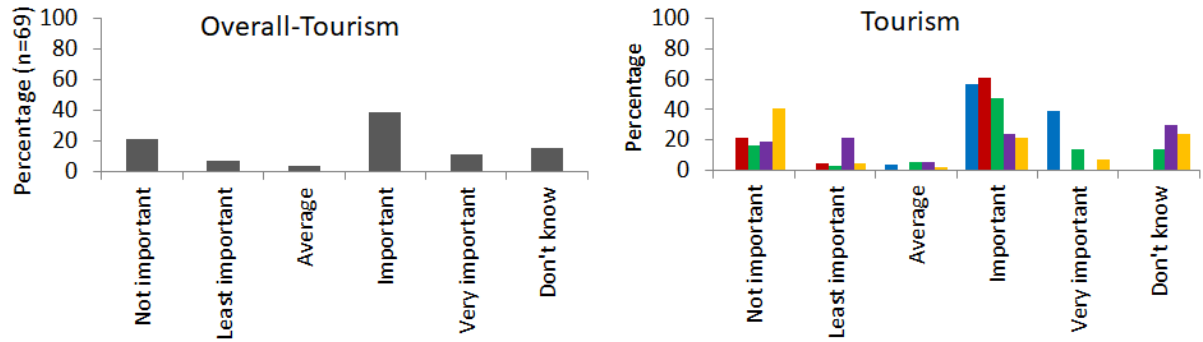
(e) Value of ecosystem in provision of clean water

(f) Value of ecosystem in provision of clean air
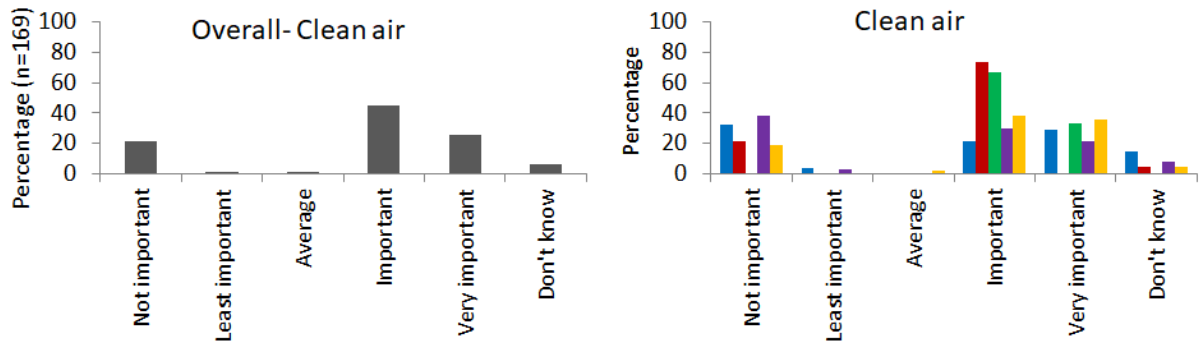
(g) Value of ecosystem for tourism development

Legend

- Marrubune (n=28)
- Gazelas (n=23)
- Icidua (n=37)
- Chuabo Dembe (n=39)
- Inhangome (n=42)

Figure 3. (Continued) The interviewees' perception on the value of the estuary ecosystem.

fertility improvement as the main ecological function of mangroves. In Icidua, 47.2% of the interviewees considered the maintenance of biodiversity and environmental protection, 21.7% considered the maintenance of biodiversity, environmental protection and soil fertility and 19.4% considered environmental protection alone as the main ecological functions of mangrove. In Chuabo Dembe 86.5% of the interviewees considered the maintenance of biodiversity and environmental protection as the main ecological functions of mangroves. In Inhangome, 21.4% of the interviewees considered the maintenance of biodiversity and environmental protection as the main ecological function of mangroves and the same proportion considered the maintenance of biodiversity, environmental protection and soil fertility improvement as most important. 16.7% considered environmental protection alone as the main ecological function of mangroves. 7.1% chose combined environmental protection and soil fertility and 9.5% soil fertility alone.

There were strong similarities (r≥0.9; p≤0.009) in the perception of the interviewees across the five the villages surveyed, with ecological importance placed on maintenance of biodiversity, environmental protection and soil fertility improvement.

4.4 Willingness to contribute to mangrove rehabilitation and conservation

All the people interviewed agreed on the need to restore and conserve mangroves. 131 interviewees, representing about 77.5% preferred to contribute in labour for restoration of mangroves and the remaining 38, representing 22.5% of the total interviewed said they would contribute in cash. Figure 5 shows the contribution by village. Most of the interviewees that chose to contribute in labour for restoration of the mangroves were willing to offer 2-6 hours a week (Figure 5a). In Marrubune about 80% and in Chuabo Dembe about 64% of those interviewed were willing to offer 2-6 hours per week. In Gazelas, about 38% of the interviewees were willing to offer 20-22 hours per week and in Icidua, about 41% of the interviewees were willing to offer 35-40 hours per week. On average, 44% of the interviewees in the five regions were willing to offer 2-6 hours a week for rehabilitation of mangroves, about 12% were willing to offer 20-24 hours and about 17% were willing to offer 35-40 hours.

Commitment to contributing monetary value for restoration of mangroves was in the range 0.5-5 US$ per month (Figure 5b). In the villages where there was a significant proportion of interviewees that preferred contributing monetary value, most of the interviewees, Marrubune (72.7%), Chuabo Dembe (72.7%), Inhangome (66.7%), Icidua and Marrubune, each 50%, committed to contribute 0.5-2 US$ per month. In all, 57.9% of the interviewees across the five villages were willing to commit 0.5-2 US$ per month for restoration of mangroves.

There were no statistically significant similarities across the villages. The best found were between Incidua and Inhangome (r=0.5; p=0.026) for the labour contribution and between Chuambo Dembe and Inhangome (r=0.5; p=0.121) for the monetary contribution.
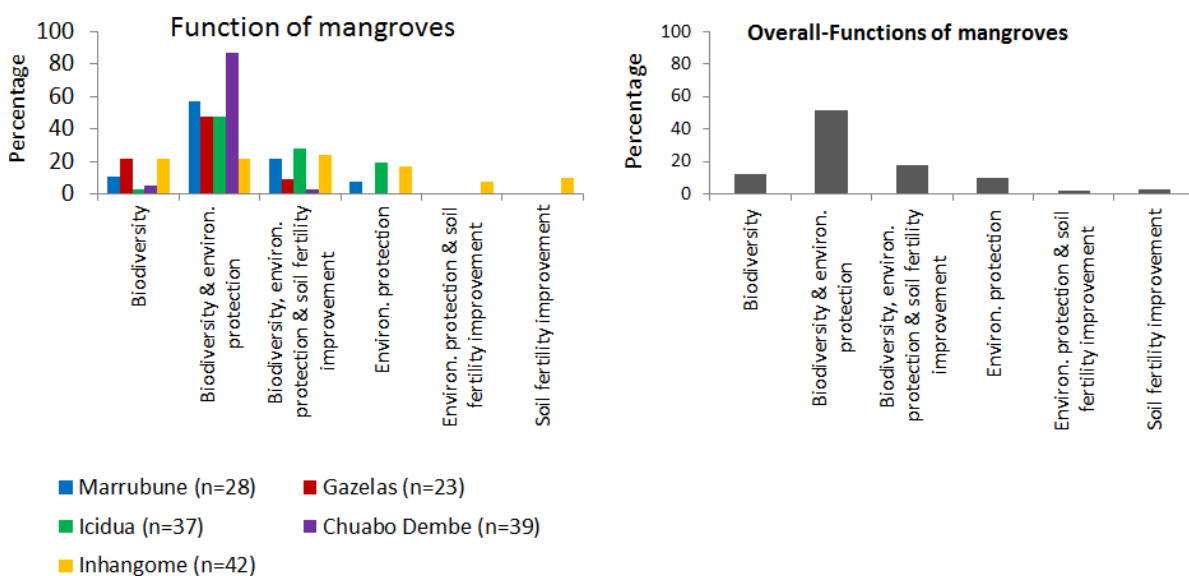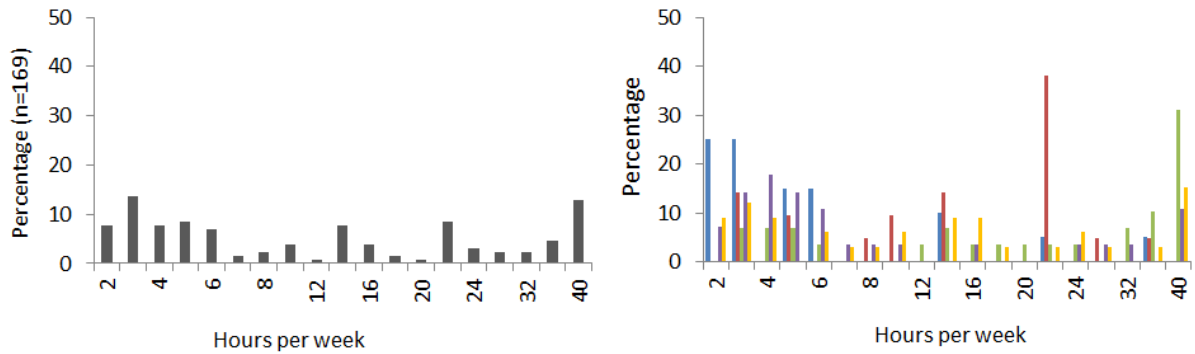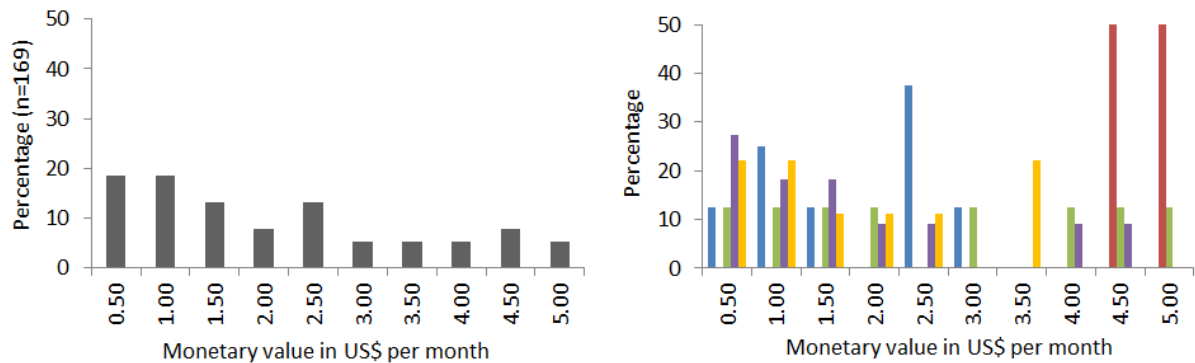

Figure 4. Perception of the interviewees on the overall ecosystem function of mangroves.

(a) Willingness to contribute in labour for mangrove restoration

(b) Willingness to contrubute monetary value for mangrove restoration

Legend

- Marrubune (n=20)
- Gazelas (n=21)
- Icidua (n=29)
- Chuabo Dembe (n=28)
- Inhangome (n=33)

Figure 5. Willingness to contribute to mangrove restoration.

4.5 Awareness of the management measures and rules governing estuarine resources

Table 2 presents the awareness of the interviewees of the major management measures and rules governing estuarine resources. Most of the interviewees were aware of the prohibition of the use of small mesh fishing nets (63.5%) and the fishing close season (35%). It should be mentioned that almost all the interviewees, including fishermen and non-fishermen were aware of those measures. As regards conservation management measures and rules for mangroves, 81.8% said they were aware of the prohibition of cutting mangroves and 18.2% of the prohibition of cutting small trees. Regarding the traditional rules, two measures, namely, no cutting mangroves, which was known by 19% of the interviewees and prohibition of the use of small mesh fishing nets, a measure also established and enforced by the government, known by 63.2% of the interviewees. The pure traditional measures, which were prohibition to make firewood out of some species of mangrove and prohibition to defecate in the river bed, were known by a small proportion (2.9%) of the interviewees. A significant proportion (11.8%) of the interviewees was not aware of the traditional measures and rules to govern estuarine natural resources.

Table 2. Management measures and rules of the estuarine resources in the Bons Sinais Estuary.

Resources	Measure	Proportion of the interviewees who knew about the rules
Fisheries management	Fishing close season	35.0
	Ban to small mesh nets	63.5
Mangrove management	No cutting of mangroves	81.8
	No cutting of small trees	18.2
Traditional rules on Fisheries management	No use of small mesh net	63.2
	Did not know	11.8
Traditional rules on mangrove management	No cutting mangroves	19.1
	Not allowed to make firewood out of some species of mangroves	2.9
	Did not know	11.8
General	Not allowed to defecate in river bed	2.9

5. DISCUSSION

5.1 Profile of the interviewees

A high proportion of males was interviewed in Marrubune and Inhangome where the majority of interviewees were fishermen. A significant proportion of women was observed in the villages where agriculture and dealing in forest products were practiced by a significant proportion of interviewees, namely Icidua and Chuabo Dembe. A significant proportion of forest product dealers was observed in Chuabo Dembe, where charcoal production is practised mostly by women. The suburbs, near Quelimane city, such as Icidua and Chuabo Dembe exhibited a significant proportion of interviewees whose occupation was small business and other jobs, which included civil servants and employees. The highest rates of literacy among interviewees were in Icidua and Chuabo Dembe, the nearest villages to Quelimane. The highest proportion of least educated people was observed at the remote area, at the mouth of the Estuary, dominated by fishermen. Regarding the age profile of the interviewees, it was dominated by young people and people under the age of 45. This reflects the population age structure of Quelimane given in the demography statistics of 2017 (INE, 2017), which stated that 28% of the population were aged below 10 years, 44% were between 20 and 30 years, 19% between the ages 30 and 50 years and 7% above 50 years.

5.2 Main livelihood activities

The main livelihood activities found in this study were fishing, forest product dealing, agriculture and small business, with fishing being the main livelihood activity in the estuary. This is in agreement with the study by Unaite (2017), who found that about 64% of the 84 people he interviewed in Icidua, Chuabo Dembe and Marizane, all villages surrounding Quelimane, were fishermen.

5.3 Valuing the estuarine resources

All the interviewees agreed that the estuary provides livelihood and income generating opportunities. People place the value of the ecosystem in the uses and benefits they get from it (Stone et al., 2008; Williams et al., 2018). From the interviews it was clear that the community uses the Bons Sinais estuary for fishing, mangrove wood harvesting and farming. This may explain why the value of the estuary in providing fish and fish habitat and agriculture was most valued (Figures 3b and 3c). The interviewees were also aware of the ecological value of mangroves (Figure 4). The few people who questioned the value of the estuary as a forest product provider, and ranked it not important (Figure 3a), may have been influenced by the fact that cutting mangroves is discouraged. The value of the estuary in providing wildlife was also doubted by some; this may be explained by the fact that in the Bons Sinais estuary there are no stands of mangroves developed to sustain valuable wildlife. Further, there were a number of interviewees who ranked the value of the estuary in providing clean water as unimportant. This may be explained by the fact that people are not using water from the estuary for drinking, nor for irrigation, as it is salty. They obtain water from wells and boreholes and use rainwater for agriculture. Similarly, there were a few people who did not understand the value of the estuary in providing clean air, and hence they ranked it as unimportant. The few people who ranked the role of the estuary in attracting tourism as unimportant may have been influenced by the fact that tourism in the Bons Sinais Estuary is not developed, and so, people are not benefitting from it.

5.4 Contribution to restoration and management of mangroves

All the interviewees agreed on the need to contribute to the restoration and maintenance of mangroves. The massive willingness to contribute to rehabilitation of mangroves may be a result of awareness campaigns undertaken by government officials and extension workers and NGOs. Indeed, the community in Icidua and Marizane, suburbs of Quelimane have participated

in projects of mangrove rehabilitation. Further, the perception of the ecological and economic value of mangroves to the community as shown in Figures 3 and 4 may be a strong reason for their willingness to contribute to mangrove rehabilitation. This argument is accordance with Stone *et al*. (2008), who on investigating the community willingness to contribute toward mangrove restoration among different user groups, fishermen and agriculture, in India, found that each user group was willing to make substantial contribution of labour and/or cash based on the economic value of perceived benefits of mangroves. For instance, their study showed that fishermen were strongly motivated by the perception that mangroves contribute to fish nurseries and that mangroves serve as an alternative source of income. This argument was further supported by Hai *et al*. (2020) who stated that some of the key community motivations for the development of mangrove restoration programs included perception of the ecosystem and economic benefits provided from mangroves. However, most of the interviewees preferred to contribute in labour, which may reflect the low income of most of the families in Quelimane.

The offers of labour and money committed for restoration varied a lot across the villages which may be an indication of the differences in wages and expenses of each household. The preference in contributing labour could be explained by the fact that most of the interviewees have low income; and according to Rezende *et al*. (2015) labour is the preferable contribution to mangrove rehabilitation among the low-income households. So, the few (22.5%) that preferred to contribute money may be people engaged in activities that give them a relatively high income, or employees whose nature of work does not spare them time to contribute in labour. In fact, in the occupation profile of the interviewees (Figure 2f), the combined small business and others makes up about 21.8% of the occupational profile of the interviewees, which is close to the proportion of those that preferred to offer money for rehabilitation of mangroves.

5.5 Management measures and rules of the estuarine ecosystems

People interviewed were well aware of the management and rules on fisheries and mangroves. This may be due to awareness campaigns undertaken by the government, academia and NGO's. In the early 90's the government shifted from centralized planning and decision making to market economy and participatory decision making. In the fisheries sector a co-management of fisheries and local governance institutions, or the community councils of fisheries (CCPs), involving the community and fishermen, was

created along the coast (Blythe *et al*., 2013; Menezes *et al*. 2009). Co-management had massive support from the communities for various reasons. It targeted the poorest groups (Menezes *et al*., 2011); under this system, the government initiated a massive programme of developing coastal fisheries, enhancing economic productivity and placing an increasing emphasis on poverty alleviation. It proved to be an effective mechanism for conflict resolution; the outcome of the co-management arrangements in terms of natural resource stewardship, management system resilience, equity and efficiency was evident to all the stakeholders (Sverdrup-Jensen e Raakjær-Nielsen, 1998). Further, the co-management system allowed the stakeholders (fishermen and community) to work together and support each other, as well as working with the government, which gave them additional benefits including building consensus and resilience to cope better with the impacts of adverse socio-economic stresses (Menezes *et al*., 2011). In addition, the various regulations that included a ban on small mesh nets, establishment of a close season and a closed area were also supported by local communities because, apart from being well formulated and relevant as noted by Darkey e Turatsinze (2014), they were well-advertised and the communities soon noticed their benefits (McClanahan *et al*., 2013; Wilson, 2012), though compliance was a challenge (Darkey e Turatsinze, 2014).

Regarding mangrove management, the interviewees were aware of the rules against cutting mangroves which were laid down in a set of laws and regulations. The Forestry and Wildlife Law (Decree 12/2002 of 6 June), declares mangrove species to be protected, and hence no cutting of mangroves is allowed. The General Regulations for Aquaculture (Decree 35/2001, of 13 November), prohibit the transformation of mangrove lands for the installation of aquaculture facilities; or obliges compensation by replacement in another area. The Law of Territorial Planning (Law 18/1997, of 18 July), establishes the needs of the community and the protection of fragile ecosystems, such as mangrove forests, coastal areas and the seafront. The wide awareness of these laws by the community may be due to the awareness campaigns undertaken by Government officials and technicians, academia and NGO's. In Icidua, a suburb of Quelimane, several activities of mangrove reforestation were undertaken with the involvement of community.

It was not surprising that only an insignificant portion of the interviewees were aware of the traditional rules. The guardians of traditional rules are usually older people, and often regarded as mystics, and so the young people and urbanized society may not be aware of these rules.

6. CONCLUSIONS

The result of the present study has re-emphasized the role of the estuary in providing goods and services that sustain a large proportion of the people living on it. People valued the estuarine ecosystem for the use and benefit they get from it. Hence, high value was placed on fisheries, agriculture and forest products. There was a significant proportion of people that placed no value on the estuary for providing clean water, clean air, wildlife and tourism, probably because they were not yet benefitting from these uses. The community was aware of the ecological importance of mangroves to the extent of committing time in labour and cash for their restoration. The prohibition of small mesh nets and a close season were the most common management measures for fishers, whereas for forest product users the no mangrove cutting was the major management measures of concern. Co-management was the governance system widely known, supported by the interviewees and applied.

ACKNOWLEDGEMENTS

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