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Incorporating poverty and gender considerations in Marine Spatial Planning: Pilot baseline study of the Sofia and Boeny Regions, Madagascar

Technical Report

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PREFACE AND ACKNOWLEDGEMENTS

This study was undertaken with the support of the Swedish Agency for Marine and Water Management (SwAM) and the Food and Agricultural Organisation (FAO). It forms part of two projects, a SwAM project on incorporating poverty and gender dimensions in Marine Spatial Planning (MSP) which involves case studies in Kenya, Tanzania and Madagascar, and an FAO project focusing on providing a better understanding of artisanal and small-scale fishing activities in the MSP process. This study was carried out by the South African centre of the Environment for Development Initiative at the University of Cape Town (UCT), in collaboration with FAO Madagascar and the Madagascan Ministry of Fishing and the Blue Economy.

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1 Introduction

Marine Spatial Planning (MSP) is a strategic process for spatial planning of the use of the sea designed to bring about sustainable development of the "blue economy" through ecosystem-based management[1] and sustainable ocean governance (Douvere, 2008; Ehler & Douvere, 2009; Agardy, 2010, Schaefer & Barale 2011). A recurring critique of MSP is that it tends to be sector focused and fails to take all the complex social issues around space into account, such as the value of certain areas for marginalised groups (Flannery, Healy & Luna, 2018). MSP decisions are often accused of being centrally driven, favouring stakeholders that are resource strong and influential (International Monetary Fund, 2007; Jones, Lieberknecht & Qiu, 2016a; Flannery *et al.*, 2018; Tafon, 2019; Saunders *et al.*, 2020). MSP can thus have negative impacts on vulnerable social groups that largely depend on marine resources for their food security and livelihoods.

The Swedish Agency for Marine and Water Management (SwAM) is supporting the implementation of MSP in the Western Indian Ocean (WIO) region and aims to have a regional approach in its MSP work. SwAM has recognised the potential risk that MSP fails to address the needs of society as a whole. With support from SwAM, Turpie *et al.* (2022) have developed a framework for incorporating poverty and gender perspectives in MSP. This involves incorporation of a Social Sustainability Framework into the overall approach, and the use of metrics and indices of relative poverty/prosperity and gender equality that are based on Sida's multidimensional poverty framework.

If following international guidelines for MSP, such as IOC-UNESCO's step-by-step approach, it can be a lengthy process (Ehler & Douvere, 2009). The approach involves a preparatory phase in which baseline data are collected, followed by an analytical phase in which alternative planning scenarios are evaluated. The next phases involve the development of spatial and management plans, the monitoring and evaluation of their impacts and adaptation of the plans as necessary. This report provides a pilot case of baseline data collection to better understand local communities' dependence on marine resources and other livelihood activities, with emphasis on understanding the role of marine spatial zonation and resource management on poverty and gender equality, and developing replicable methods to quantify these.

This case study is one of three studies undertaken in selected coastal areas of Kenya, Tanzania, and Madagascar. A total of 490 households were surveyed by a group of trained enumerators in the vicinity of three large coastal bays in Sofia and Boeny in Madagascar during December 2021. This information was supplemented by 14 focus group discussions and key informant interviews. The methodology for this study and the overall analysis of poverty and gender metrics is provided in an accompanying report by Turpie *et al.* (2022). This report provides the detailed results of the baseline survey undertaken in Boeny and Sofia, Madagascar.

[1] This entails adherence to the Malawi Principles. http://www.fao.org/3/y4773e/y4773e0e.htm

2 Study site description

In Madagascar, the study areas comprised three coastal bays in the north-western regions of Boeny and Sofia, namely Bombetoka, Mahajamba and Sahamalaza Bays (Figure 1). The study was confined to these bays because the remainder of the coasts of these two regions is largely inaccessible, and most of the population is concentrated here.

Bombetoka, Mahajamba and Sahamalaza Bays are characterised by highly diverse marine ecosystems and contain mangrove forests, coral reefs, and seagrass beds. In fact, this stretch of coast, has some of the highest diversity of corals in the WIO region (>300 species) (Obura, Church & Gabrié, 2012). The area around Sahamalaza is also home to some of Madagascar's largest mangrove forests. Bombetoka and Mahajamba Bay also have extensive mangrove forests, 19,800 ha and 47,800 ha respectively – more than 10% of the total area of mangroves in the country. The bays are also zones of high coastal fishing activity with the main targeted species being coastal shrimp, sea cucumber, crab, demersal and pelagic fish. A little further off the coast one can find island systems which are volcanic, karst, and coral.

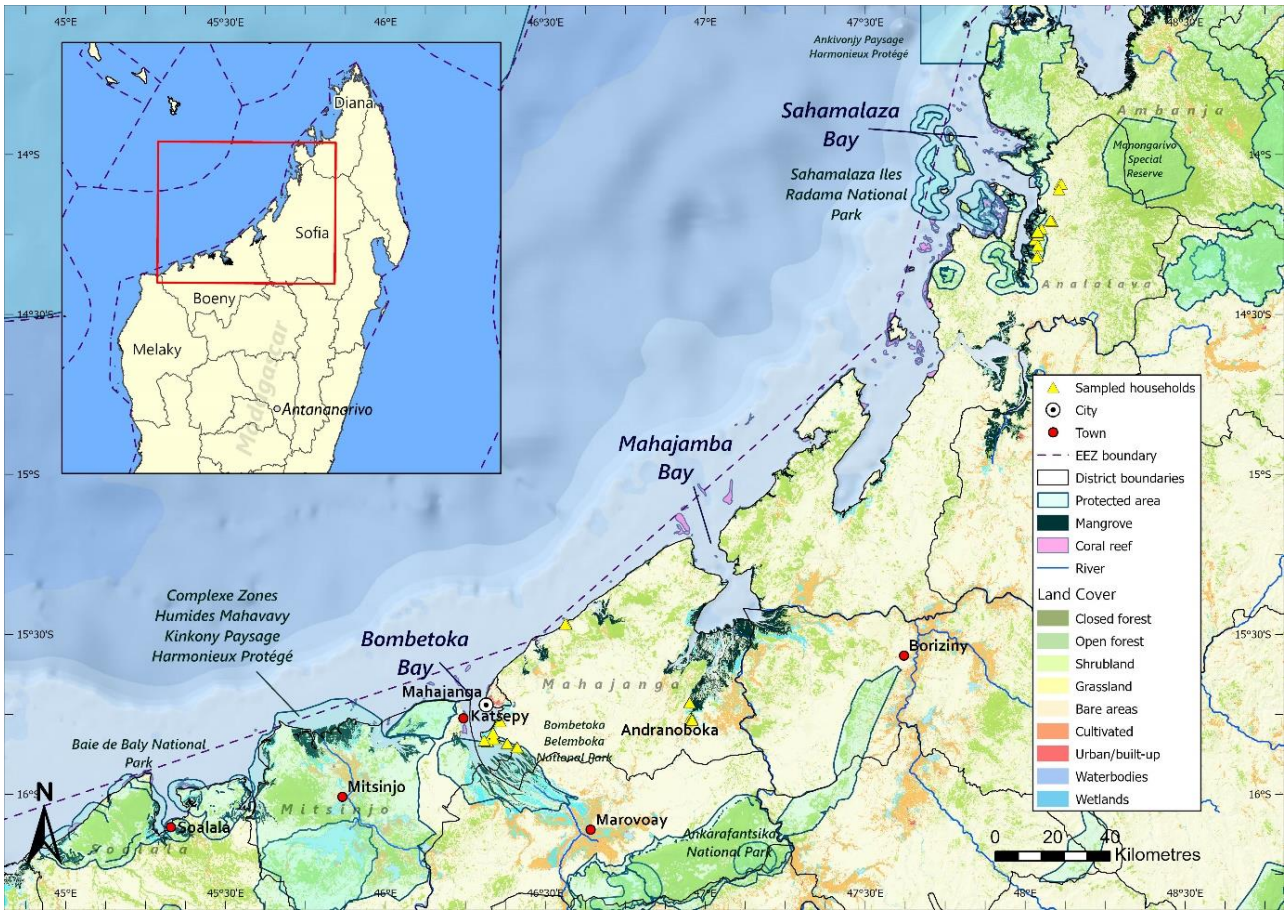


Figure 1. The three bays of Bombetoka, Mahajamba and Sahamalaza in the Boeny and Sofia region of Madagascar. Land cover, location of mangrove forests, coral reefs and marine protected areas are also shown, including the location of the sampled households.

The region's marine ecosystems are vital for downstream reefs and for reef recovery in case of unexpected disturbances. Overexploitation of marine resources has had negative effects on species populations and ecosystem health – primarily driven by traditional and industrial fisheries. Coral reefs are threatened by sea cucumber, octopus, and shrimp fishers. The region's shark population has also been severely reduced. The area between Mahajanga and Sahamalaza Bays is home to the dugong, potentially the only area left in Madagascar where dugongs are still found. Their populations in Madagascar have been reduced

significantly due to fishing practices, including mesh gill and seine netting, and seagrass bed destruction. (Obura *et al.*, 2012)

Environmental issues in the region have been increasing due to continuous degradation of mangroves which are used for construction and firewood due to stagnant economic development and strong demographic growth (especially migratory flows). Increased erosion and siltation of the coastal areas has also been contributing to the destruction of mangrove forests. Mangrove forests decreased in area by 21% between 1990 and 2010 (Jones *et al.*, 2016b).

The most important economic sectors for the local economy are fishing, agriculture, and livestock. There is no industry, such as oil, gas, offshore energy, or shipping, in the region; only maritime transport contributes some income to the local economy. Most fishing is small-scale and done traditionally (68% of total fish production) and men make up the majority of fishers (Nairobi Convention, 2011). Small-scale fishing is vital for household food and income security. Small-scale fisheries are also important on a national level – local fishermen from the Bombetoka and Mahajamba Bays access high quality fish products with high market values and are the lead suppliers of seafood on the national market (Radonirina Ioniarilala, pers. comm.). However, increasing demand for crabs and changes in human settlements has had strong negative impacts on fish stocks and mangroves (Long *et al.*, 2021). Economic progress had already been slow in recent years before the COVID-19 pandemic. However, COVID-19 slowed down the trade and travel between communities and stalled economic development (World Bank, 2020).

Comparing the regions Boeny and Sofia to their neighbouring coastal regions Diana (to the north) and Melaky (to the south) shows that agricultural land ownership differs across regions (Table 1). Boeny and Sofia are study areas while Melaky and Diana were solely added as reference points for comparisons. Percentage of agricultural land ownership is very high across Madagascar (71.7%). While slightly more households in Sofia own agricultural land than the national average, the proportion in Boeny is much lower (52.1%).

Most households are male-headed, but there are slightly more female headed households in Sofia and Diana than the Madagascar average (Table 1). Households in Sofia also tend to have more children than households in Boeny or the average Madagascan household. Very few households have internet at home, with more in Boeny (16.1%) than Sofia (8.5%) (Table 1).

Table 1. Overview of household characteristics in Boeny and Sofia (study areas) and the neighbouring regions of Melaky and Diana (added here as comparisons), and the Madagascar average (data source: Madagascar Multiple Indicator Cluster Survey (MICS) 2018)

	Melaky	Boeny	Sofia	Diana	Madagascar average
hh head female	23.1% (3.1%)	24.3% (1.8%)	26.2% (1.3%)	28.8% (1.6%)	22.2% (0.3%)
hh head age	40.6 (1.1)	42.0 (0.6)	42.6 (0.5)	41.32 (0.5)	42.5 (0.1)
Household size	4.7 (0.2)	4.2 (0.1)	4.3 (0.1)	3.7 (0.8)	4.5 (0.0)
No. of children (age 5 to 17)	1.7 (0.1)	1.4 (0.1)	1.6 (0.1)	1.2 (0.1)	1.6 (0.0)
Internet at home	3.6% (1.4%)	16.1% (1.5%)	8.5% (0.8%)	22.5% (1.5%)	13.3% (0.2%)
Owning agricultural land	82.2% (2.8%)	52.1% (2.1%)	76.9% (1.3%)	45.2% (1.8%)	71.7% (0.3%)

Note: The Madagascar Multiple Indicator Cluster Survey (MICS) was carried out in 2018 by INSTAT as part of the global MICS programme which is run by the World Bank.

3 Data collection

The study targeted households living within 10 km of the coast to capture those communities that could potentially be affected by changes in access to marine resources. Data were collected through focus group discussions, key informant interviews and household surveys. The data collection was carried out by staff of the Ministry of Fishing and the Blue Economy in the Boeny and Sofia regions. For each region, there was one supervisor and six enumerators who were trained by the authors over two days. The supervisors were responsible for quality control and for holding the focus group discussions and key informant interviews.

3.1 Focus group discussions and key informant interviews

Thematic Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were conducted in selected villages to collect information on different aspects of people's livelihoods and their poverty and gender dimensions. Focus group discussions were held on fishery-related livelihoods (including fishers, aquaculture producers, fish processors and traders), forestry (particularly mangrove) related livelihoods, and with women on their opportunities and roles in the community and at home. Key informant interviews were held on farming, tourism and marine conservation, industrial fishing, and the local economy. This allowed the research team to collect information of a general nature to avoid unnecessarily lengthy household questionnaires, such as resource descriptions, rules of access, equipment, seasonality, returns to effort, changes in availability, prices and inputs, and who is involved. Discussions took up to an hour and were semi-structured, following a discussion guideline which was developed in advance. Participants were reminded to speak on behalf of the entire community.

3.2 Household surveys

A total of 490 households were interviewed (Table 2Table 1). Household sampling effort per village was guided by information on village populations from census data (INSTAT Madagascar, 2020). At the village level, households were randomly selected with the help of village headmen and given unique serial identifiers. Global Positioning System (GPS) coordinates were collected for each of the households surveyed. Enumerators interviewed one or more household members (male or female) who were the household's main decision-maker (and above the age of eighteen). In-person interviews were conducted in people's homes. Each interview took about an hour to complete.

Table 2. Number of households interviewed in the three bay areas

	N	Percent
Sahamalaza	203	41.4
Mahajamba	94	19.2
Bombetoka	193	39.4
Total	490	100.0

The household surveys were programmed in Kobo Toolbox software[2] and executed face-to-face using smartphones or tablets (this could be done while offline). Using data collection software rather than paper questionnaires allowed for a faster interview process and reduced the likelihood of errors, overall resulting in more accurate data. The questionnaires were in French and were undertaken in the local vernacular by the enumerators. Completed questionnaires were checked by the supervisors before final submission to the online platform. The questionnaire design, programming and operation was tested through role play

[2] Kobo Toolbox is a free open-source software which was developed by the Harvard Humanitarian Initiative for data collection in very challenging environments.

exercises during the enumerator training, in a pre-testing of the survey in the field. After the pre-test, final adjustments were made to the household survey and updated on the enumerators' devices.

3.3 Household questionnaire design

The household questionnaire was divided into several sections: Sections A and B covered the demographics and socio-economic background, and the residence and neighbourhood characteristics, and included questions on sources of energy and water, household assets and distances to services and markets. Section C covered employment and income for each member of the household, including economic sector of formal or informal employment. Here, broad information on dependence on household production activities, pensions, and welfare was also collected.

Section D then covered livelihood activities in more detail, fishing (boat-based and shore-based), other ocean related livelihood activities (mining for sand and coral, salt production, mariculture, and tourism), agriculture (crop production, poultry, and livestock), mangrove and other forest-related activities (timber, charcoal, and firewood), plant related activities (wild foods and medicines), and hunting. For each of these, respondents were asked to describe their participation, production, sales, and gender roles. For livelihood activities, households were first asked to estimate production or income in the last month and were then asked to provide an estimate for the past 12 months. Questions about marine activities included some details on location and status of resources as applicable.

Section E covered security and voice. This included levels of agreement on several statements about community and household harmony, questions on membership of organisations and questions on the extent of involvement of women in decision making.

Section F went into more detail on the status of marine resources and their use and management in the respondent's local area. These sought to understand household perceptions on the health of marine ecosystems and resource stocks, what they thought about existing regulations and their enforcement, and what they thought about different commercial activities in the area.

Section G comprised a choice experiment which is described and analysed in a separate report (Turpie *et al.*, 2022), while section H comprised questions on the impact of the pandemic on household income and activities. Finally, at the end of the interview, enumerators recorded the GPS location, their own details, details of who was present at the interview, whether the female(s) present seemed able to express themselves freely, the overall quality of the interview in terms of likely reliability of the information given, and whether the choice question was properly understood.

4 Household demographics and living conditions

Most household heads were male (82.2%) with an average age of 39 years, and commonly had either primary or secondary education (Table 3). Most household heads in Bombetoka and Mahajamba were married. The average household size was around five people and households had on average lived in the area for 21.5 years. Households generally did not own many assets: from a list of 16 assets, the average number owned was only about three (Table 3).

Table 3. Household demographics summary statistics across bays. For figures summarised as means, the standard deviation is given in parenthesis.

	Sahamalaza	Mahajamba	Bombetoka	Overall
Sample size	203	94	193	490
Male household head	76.2%	81.9%	88.6%	82.2%
Average age	36.8 (11.2)	42.1 (12.7)	40.2 (12.3)	39.2 (12.1)
Married	25%	62.8%	67.4%	48.8%
Level of education:				
None	16.3%	23.4%	17.6%	18.2%
Primary	33.0%	43.6%	40.4%	38.0%
Secondary	41.4%	12.8%	22.8%	28.6%
Higher education	1.5%	0.0%	0.5%	0.8%
Some but not completed	7.9%	20.2%%	18.7%	14.5%
Household size	5.3 (2.8)	5.6 (2.8)	5.1 (1.9)	5.3 (2.5)
Number of children (age 0-12)	1.5 (1.5)	1.6 (1.5)	1.3 (1.3)	1.4 (1.4)
Number of youth (age 13-17)	0.9 (1.0)	1.1 (1.2)	1.0 (1.1)	1.0 (1.1)
Number of years in the village	21.7 (15.2)	22.8 (13.3)	20.6 (12.1)	21.5 (13.7)
Average number of assets/16	3.5 (1.6)	2.6 (1.5)	2.7 (1.5)	3.0 (1.6)

The most owned assets were houses, radios and mobile phones (Table 4). Farmland ownership was most common in Sahamalaza and Mahajamba. Dhow ownership was most prevalent in Bombetoka while canoe ownership was more common in Mahajamba. Motorised transport ownership was uncommon; only a few households owned motorbikes. A third of the surveyed households in Sahamalaza owned bicycles.

Table 4. Percentage distribution of households by assets owned, across bays and across the entire sample

	Sahamalaza	Mahajamba	Bombetoka	Overall
House	74.9%	62.8%	66.8%	69.4%
Radio	51.7%	41.5%	65.3%	55.1%
Mobile phone	69.0%	38.3%	45.6%	53.9%
Dhow*	30.5%	34.0%	42.5%	35.9%
Farmland	47.3%	40.4%	11.9%	32.0%
Canoe	21.7%	30.9%	21.2%	23.3%
Bicycle	33.5%	5.3%	5.7%	17.1%
TV	10.3%	6.4%	10.4%	9.6%
Phone	5.9%	3.2%	0.0%	3.1%
Motorbike	3.9%	0.0%	1.6%	2.2%
Motorboat	0.0%	0.0%	0.5%	0.2%

Note: car, fridge, tuktuk, minibus, and truck was removed from the list because no household chose any of these items.

* A dhow is a traditional sailing boat, which commonly has one mast in this region.

The main source of energy for cooking was firewood (66.1%) or charcoal (31.1%; Figure 2). Charcoal was more commonly used for cooking amongst households in Bombetoka. For lighting, most households either used solar panels (41%) or torches (26.1%). Households in Bombetoka commonly used torches or solar

panels while households in Mahajamba used oil, paraffin, or kerosene and those in Sahamalaza mainly used solar panels.

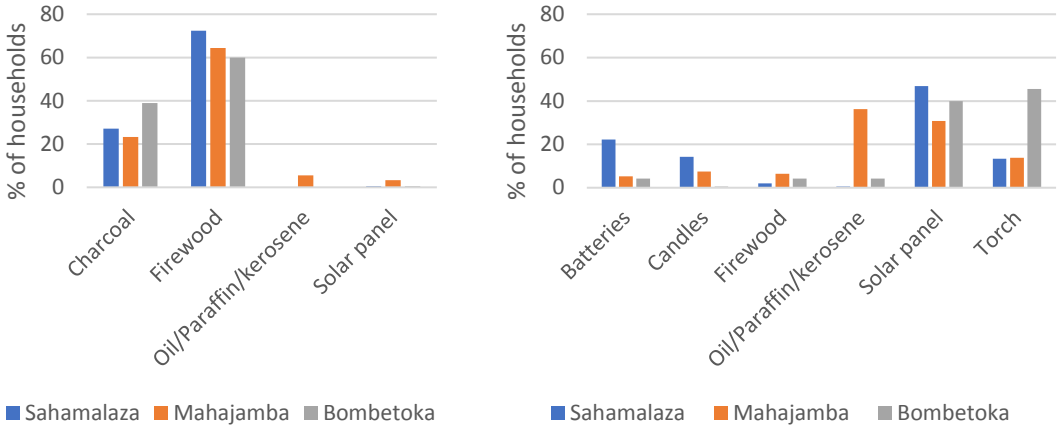


Figure 2. Percentage distribution of main sources of energy used for cooking (left) and lighting (right) across bays

Most households used a well or borehole for their water supply (83.1%) (Figure 3). However, there were large differences in the water supply source among the bays. Sixteen percent of households depended on rivers for their water in Mahajamba, compared with 31% in Sahamalaza and none in Bombetoka. Only few households were connected to the public water supply system.

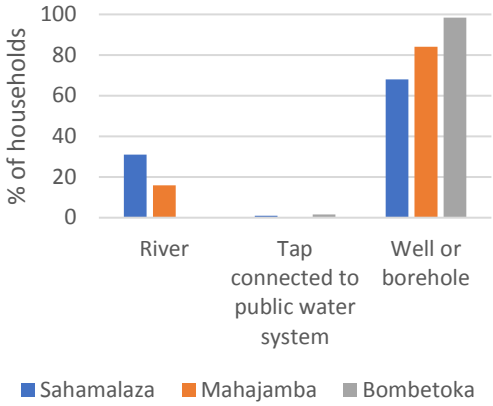


Figure 3. Percentage distribution of main sources of water across bays

Households in Mahajamba had to travel further to schools, markets, and clinics. Households in Sahamalaza had easy access to schools but were relatively far away from the nearest market and clinic (Figure 4). In Bombetoka, the most common answer for distance to school or market was “31 minutes or longer” and “21-30 minutes” to get to a clinic by motorised transport (Figure 4).

Overall, households were very unsatisfied with the level of government services in their area (Table 5). Government services included the quality of public roads and recreational spaces, water, electricity and sewage, educational facilities, and public health services. More than half of the sample rated the level of government services as either very poor or poor. 84% of the sampled households rated the government service level as below average, poor, or very poor.

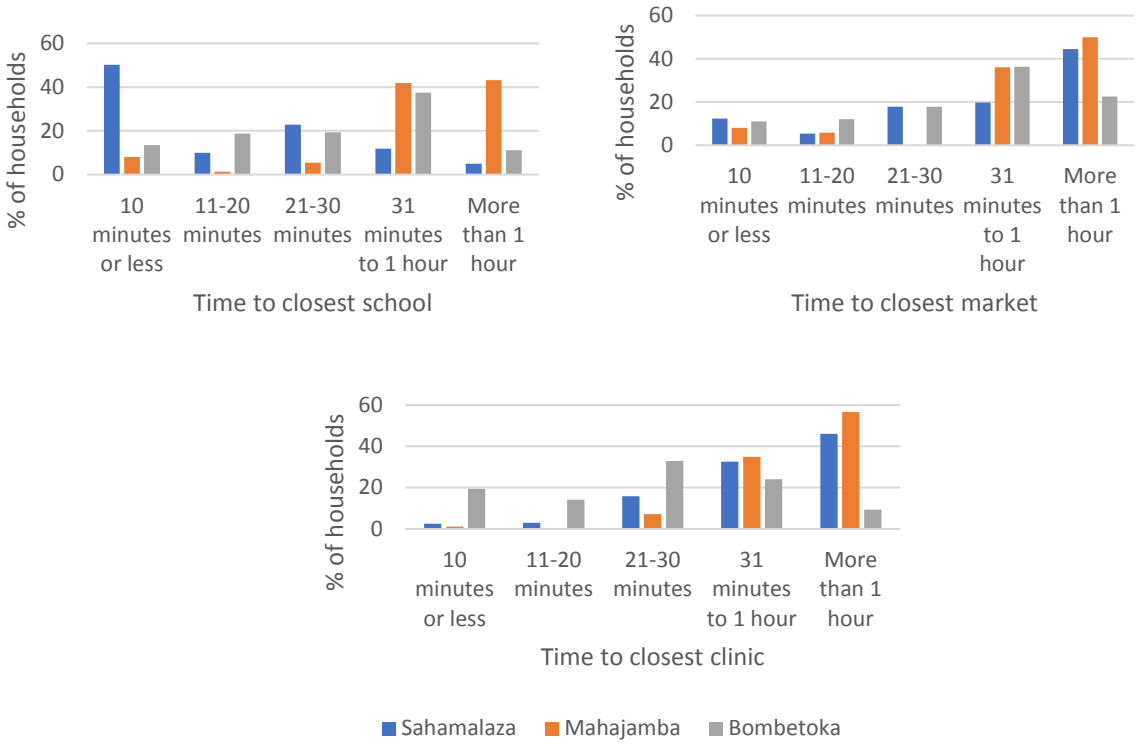


Figure 4. Percentage distribution of time that it takes households to get to the closest school, market, and clinic across bays

Table 5. Level of satisfaction with government services on a scale of 1 to 7 (where 1 is very poor and 7 is excellent; 4 is average) across bays

	N	mean	sd	median
Sahamalaza	193	2.5	1.3	3
Mahajamba	94	2.4	1.2	2
Bombetoka	203	2.4	1.1	2

Respondents were also asked to rate their agreement with statements about their community. Households across all three bays tended to agree that life in their community is harmonious and peaceful (Table 6). They generally did not seem to have conflicts over access to resources. Households in Sahamalaza tended to agree more that local government officials are trustworthy and that their community life is harmonious.

Table 6. Mean score for the level of agreement with statements about the state of the community across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
Community is harmonious	5.6	4.4	4.6
Life in this area is peaceful	4.7	4.3	4.9
There is conflict over access to resources in this area	4.0	3.7	3.7
Local government officials are trustworthy	4.5	3.6	3.7

5 Resources and Income

5.1 Employment and sectoral breakdown

Few households in Mahajamba and Sahamalaza earned an income from paid employment compared to Bombetoka (Table 7**Error! Reference source not found.**). Household members with employment were predominantly male and were mostly employed in the fishing sector (Figure 5).

Table 7. Percentage distribution of household members with employment and male household members with employment across bays

	% of hh with employment	Employed hh member is male (%)
Sahamalaza	20.2	63.2
Mahajamba	17.0	100.0
Bombetoka	47.2	81.3

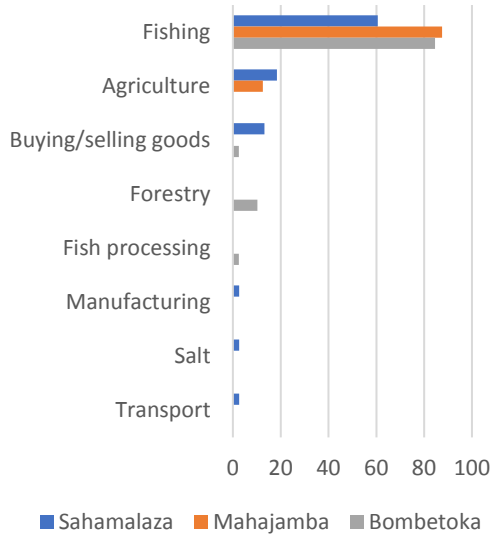


Figure 5. Sectoral contribution to employment across bays

Madagascar's industrial fisheries have focused on shrimp catches since the 1960s (Le Manach *et al.*, 2012). According to the focus group discussions, industrial fishing in Boeny focuses on shrimp which is available year-round except during the closed season from December to February. According to a key informant from the local fishing industry, shrimp catch sizes vary seasonally and most of the catches are exported to the European market.

Local fishermen also reported that industrial shrimp trawlers held formal licenses and exploitation rights. The public administration (Direction de la Pêche/Directorate of Fisheries) reportedly obliges shipowners to declare their catches and systematically controls their gear through Le Centre de Surveillance des Pêches (CSP) de Madagascar (The Fisheries Monitoring Centre of Madagascar). There are no local extraction fees applied at the community level but taxes for fishing resources are applied at the national level.

On a community level, households across all bays indicated that the most important income source for their community was fishing (Table 8). This was followed by farming and trading crops which was the second most important income source in Sahamalaza and Mahajamba. Households in Mahajamba and Sahamalaza were also relying more on processing fish and trading dried and fresh fish than households in Bombetoka. Mahajamba seemed to be the only bay where charcoal making was a considerable source of

income. Households in Sahamalaza also indicated that they make liquid sugar out of sugar cane. Households in Bombetoka indicated that some of them are employed in reforestation and found casual employment in temporary project work.

Table 8. Percentage frequency with which respondents identified different activities as a main source of income for the community (multiple answers per household were allowed)

Source:	Sahamalaza	Mahajamba	Bombetoka
Fishing	99.5%	95.7%	95.3%
Farming and trading crops	40.4%	26.6%	8.3%
Trading dried fish	16.3%	29.8%	19.2%
Trading fresh fish	22.7%	19.2%	13.5%
Processing fish	20.2%	16.0%	8.8%
Informal trade	9.9%	1.1%	1.0%
Charcoal making /trade	0.0%	10.6%	0.0%
Formal business (Grocery, etc)	1.0%	1.1%	2.1%
Farming and trading livestock	0.0%	1.1%	1.0%
Carpentry	1.0%	1.1%	0.0%
Fish farming	1.0%	0.0%	0.0%
Transport	0.0%	0.0%	0.5%
Petty trading of goods or services	0.5%	0.0%	0.0%
Firewood collection/trade	0.5%	0.0%	0.0%
Construction	0.5%	0.0%	0.0%
Brick making	0.0%	0.0%	0.0%

Households were also asked which marine sectors were a key source of formal employment. Marine fisheries were by far the most important source of formal employment (Table 9). Given the very low rate of formal employment, a lot of households responded with “Don’t know”. Most households thought that their community is not fairly represented in the blue sector formal jobs (Figure 6).

Table 9. Percentage of households identifying a certain marine sector as a key source of formal employment across bays

	Sahamalaza	Mahajamba	Bombetoka
Marine fisheries	97.5	64.9	87.1
Fish processing	0.5	12.8	2.1
Don't know	1.0	20.2	8.3

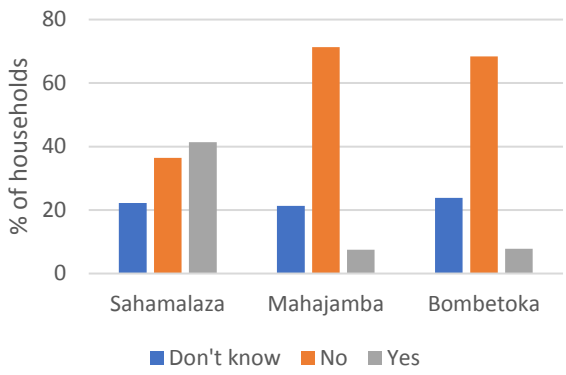


Figure 6. Percentage of households that agree / disagree that they are represented in the blue economy

The focus group discussion findings across all bays suggested that women generally did not have the same economic opportunities as men. During the household survey, households were asked to rate the differences in opportunities in the marine sector perceived by gender (men, women, youth) on a 7-point Likert scale, where 1 meant strongly disagree and 7 strongly agree (Table 10). Survey responses indicated that marine economy jobs were mostly available for men and not for the youth or women. A representative from the industrial fishing industry suggested that the industrial fishing industry only provided opportunities for men and only hired male crew members.

Table 10. Mean score for the level of opportunities in the marine sector for men, women, and youth across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
Men	5.1	4.0	4.3
Women	2.7	3.2	3.3
Youth	3.1	3.4	3.7

5.2 Participation in different livelihood activities

The most common livelihood activity across the three bays was inshore fishing, followed by offshore fishing (Table 11). Poultry farming and firewood farming were also common livelihood activities. Poultry farming was most prevalent in Sahamalaza while households in Mahajamba engaged more in firewood collection.

Table 11. Percentage distribution of households engaging in various livelihood activities across bays, and across the study area sample as a whole.

% hh	Sahamalaza	Mahajamba	Bombetoka	Overall
Inshore fishing	77.3	93.6	82.9	82.7
Offshore fishing	36.0	79.8	78.8	61.2
Poultry	70.9	55.9	38.0	55.3
Firewood	17.9	54.3	33.2	30.9
Fish trading	52.7	8.8	5.3	25.9
Crops	21.7	18.1	31.6	24.9
Livestock	27.1	25.5	21.5	24.6
Timber & poles	4.5	52.1	17.5	18.8
Mariculture	15.8	0.0	0.0	15.8
Petty trade	13.8	4.3	1.1	7.0
Wild plant raw materials	1.5	18.1	6.8	6.8
Charcoal	1.0	21.3	2.6	5.5
Wild plant foods	3.5	16.0	1.0	4.9
Salt making	4.4	10.8	0.0	3.9
Hunting	0.5	13.8	0.5	3.1
Tourism	0.0	1.1	0.5	0.4
Mining	0.0	0.0	0.0	0.0

5.3 Fishing and fish trading

Small scale fishing is highly important for food security, livelihoods and income in Madagascar (Barnes-Mauthe, Oleson & Zafindrasilivonona, 2013; Gardner *et al.*, 2017). Along the west coast, 87% of adults are small-scale fishers, 82% of household income comes from fishing and fish is the most prevalent protein source (99%). Despite the importance of fisheries, there have been very few studies aiming to quantify the economic value of fishing in Madagascar (Barnes-Mauthe *et al.*, 2013). Given the strong dependence of

fishing for livelihoods along the Madagascan coast, sustainable management of fish stocks is essential for the future of the local communities.

Offshore fishing

Households in the Boeny and Sofia region heavily depended on fishing for household income and subsistence. Offshore fishing was more prevalent in Bombetoka and Mahajamba where 76% and 78% of households had at least one male member of their household going out to sea (compared to only 35% in Sahamalaza; Table 12).

Offshore fishing was less common among female household members. In Bombetoka, only 21% of households had at least one woman going out to sea, compared to 38% in Mahajamba and 3% in Sahamalaza. Fishing was very male dominated: men carry out the fishing and women commonly contribute to the processing of the products (drying and wrapping of fish).

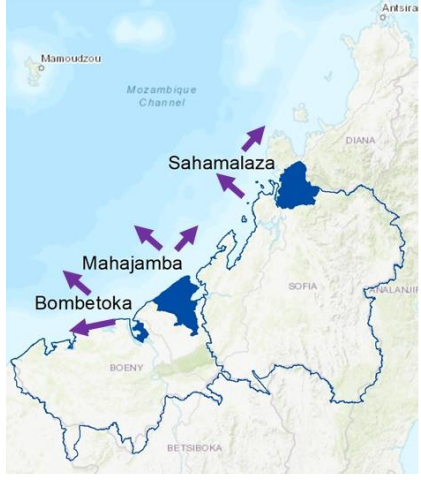
Table 12. Percentage of households that have at least one member, man or woman fishing offshore by bay

	At least 1 member	At least 1 man	At least 1 woman
Sahamalaza	36.0%	35.5%	3.0%
Mahajamba	79.8%	77.7%	38.3%
Bombetoka	78.8%	76.2%	21.2%
Overall	61.2%	59.6%	16.9%

Most offshore fishing took place just off the coast from where the household lived, particularly in Sahamalaza (96%) (Table 13). A large number of households in Sahamalaza also went fishing further to the south and north from their homes (see diagramme). Households in Bombetoka were also travelling further south for fishing. Households in Mahajamba also tended to travel further north to find fish stocks (Table 13). The area around Sahamalaza National Park which is located in the rural commune of Maromandia and Ambolobozo is classified as marine protected area where fishing is prohibited. The marine protected areas are governed under the Code des Aires Protégés (COAP) (Code of Protected Areas).

Table 13. Percentage of households fishing north, south or around their homes, across bays

	Sahamalaza	Mahajamba	Bombetoka
Offshore around here	95.9%	64.0%	65.8%
Further north	24.7%	36.0%	2.6%
Further south	37.0%	2.7%	23.7%



Sahamalaza focused on offshore reef fishing while Mahajamba and Bombetoka were focused on open sea fishing (Figure 7). 17% of households in Bombetoka that fished offshore indicated that they also fished around offshore islands. A small proportion (11%) of fishing households in Mahajamba fished on offshore reefs.

The most used boat types were canoes and dhows; less than 1% of fishing households indicated using a motorised boat for their offshore fishing activities (Figure 7). Canoes were mainly used in Mahajamba and Sahamalaza, while dhows were mostly used in Bombetoka. The majority of offshore fishers in Mahajamba and Sahamalaza owned their boat compared to households in Bombetoka (Figure 9). Shared boat ownership was less common in Sahamalaza compared to Bombetoka and Mahajamba.

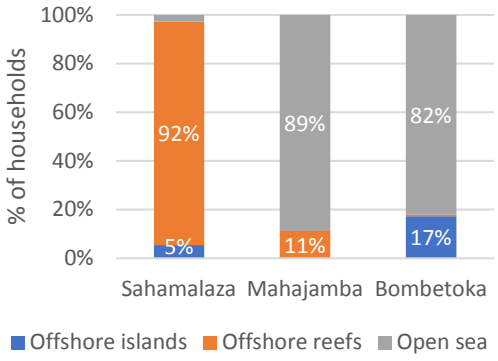


Figure 7. Most used fishing grounds

Figure 8. Most commonly used boat type

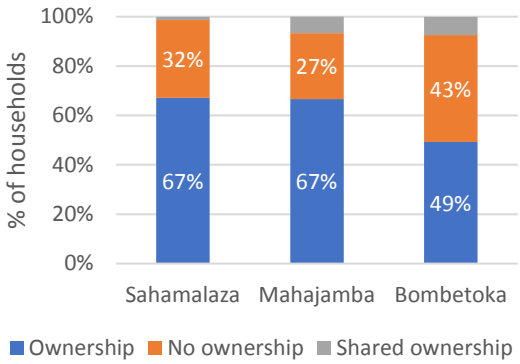


Figure 9. Boat ownership

The most important offshore species targeted by fishers were small pelagics and demersal fish (Table 14). Pelagics is a term for fish which live in open oceanic waters (= pelagic zone), while demersal fish live close to or on the ocean floor. Small pelagics include prey fish such as anchovies, sardines, herrings, and mackerels. Large pelagics include predatory fish such as tuna, king mackerel, and sharks. Smaller fish species are caught by local fishermen for subsistence and large pelagics are more commonly targeted by foreign fish fleets (Le Manach *et al.*, 2012).

Table 14. Frequency with which respondents identified different types of fish as their most important offshore catch (in percent), across bays

	Sahamalaza	Mahajamba	Bombetoka	Overall
Small pelagics	19.2	16.2	62.5	40.5
Demersal fish	57.5	24.3	19.1	29.8
Prawns	20.6	43.2	2.0	16.7
Large pelagics	2.7	4.1	12.5	8.0
Other	0.0	12.2	4.0	5.0
Total	100.0	100.0	100.0	100.0

Across the three bays, offshore fishing focuses on different fish species. According to respondents involved in offshore fishing, the main types of species targeted were small pelagics in Bombetoka, prawns in Mahajamba and demersal fish in Sahamalaza. According to the focus group discussions, some of the most

important species were capitaine (*Lethrinus nebulosus* / spangled emperor), merou (*Epinephelus coioides* / orange spotted grouper), trident (*Otolithes ruber* / tigertooth croaker), rouget (*Upeneus vittatus* / yellow striped goatfish), and madama tombé (*Lutjanus rivulatus* / blubberlip snapper). Shrimps, which are the main target of industrial fisheries and destined for overseas markets, were not targeted by artisanal fishers.

According to focus groups, catches were typically in the range of 3 to 8 kg per day per fisher, or 20 to 30 kg per week. This is fairly low compared to the south west of Madagascar where fishers caught approximately 13.6 kg of fish per day (Barnes-Mauthe *et al.*, 2013). Fishermen in this study reported that they sold almost all their caught fish (close to 100%). Barnes-Mauthe *et al*. (2013) found that 83% of catches were sold in the Velondriake region in south-west Madagascar.

The price of fish varied between 1500 and 3000 Ariary per kg depending on the size and quality of fish. According to the focus group discussions in Sahamalaza and Mahajamba, fish prices had been declining over the past five years. Fishers did not have to pay local extraction fees at any level. In Mahajanga, if a wholesaler bought fish to sell outside the district of Mahajanga II, the wholesaler paid a royalty fee ("ristourne") to the local community.

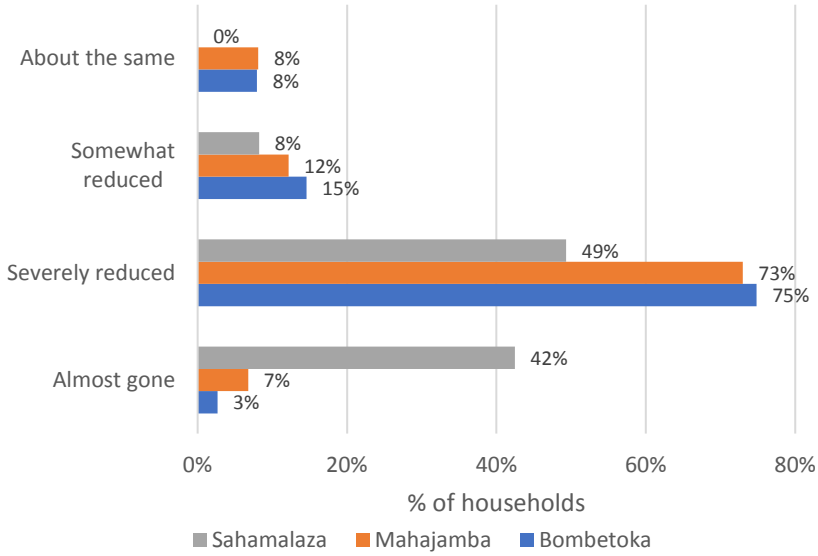


Figure 10. Percentage distribution of households' rating of abundance of offshore fish stock by bay

Fish yields in Madagascar have previously been reported to be unsustainable and fish stocks have been declining over the past decade (le Manach *et al.*, 2012). For example, small-scale fisheries in the Menabe region in western Madagascar have been overfished – most fish species are caught below optimal size (Gough *et al.*, 2020). Offshore fish stocks in Sahamalaza seemed to decline particularly strongly compared to fish stocks in the other bays: 42% of households in Sahamalaza, where most of the fishing was done on offshore reefs, indicated that they perceived the fish stocks to be almost gone (Figure 10). Households in Bombetoka and Mahajamba, where most offshore fishing was done in the open sea, mostly perceived fish stocks to be severely reduced (75% and 73% respectively). The decreasing levels of fish stock in some areas has led local fishermen to migrate into more remote parts of the Malagasy coast to secure their livelihoods (le Manach *et al.*, 2012).

To protect the dwindling fish stocks, the Ministry of Fisheries and the Blue Economy of Madagascar introduced restrictions on the use of certain fishing gear and equipment. For example, the use of mosquito nets or nets with a mesh size of less than 15mm was prohibited. Fishers also needed to carry a fishing card. Access to the various fishing grounds was free but fishers need to obey the restrictions which were enforced by fisheries surveillance agents or gendarmes. According to fishers in Sahamalaza, there was no

specific season for fishing and availability of fish. People fished all year round except in bad weather, such as during the cyclone season, or during closed season for crabs, shrimps, and lobsters.

Inshore fishing

Inshore fishing (fishing within the intertidal or shallow coastal areas) was more common in Mahajamba than in Bombetoka or Sahamalaza amongst men (Table 15). There were also more women fishing inshore in Mahajamba compared to Bombetoka and Sahamalaza.

Table 15. Percentage of households that have at least one member, man or woman fishing inshore by bay

	At least 1 hh member	At least 1 man	At least 1 woman
Sahamalaza	77.3%	71.2%	36.2%
Mahajamba	93.6%	89.0%	63.4%
Bombetoka	82.9%	72.5%	42.5%
Overall	82.7%	75.2%	43.9%

The most important fish species caught inshore by men and women were chevaquine (small shrimp), finfish, crabs, and prawns (Table 16). Subsistence fishing of finfish used to be very common along the western coast of Madagascar where finfish has in the past provided households' main source of protein (Barnes-Mauthe *et al.*, 2013). However, octopus, sea cucumber and sharks are now commonly caught and sold (Cripps & Gardner, 2016). Shark fins for the Chinese export market have become a lucrative business along the west coast of Madagascar (Cripps & Gardner, 2016). Cheap finfish, including mojarras (Gerreidae), damselfish (Pomacentridae), squirrelfish (Holocentridae), sweepers (Pempheridae), and herring, shads, sardines and menhadens (Clupeidae), has been the main catch (by weight) in the Velondriake region in the southwest of Madagascar (Barnes-Mauthe *et al.*, 2013). As these fish stocks have collapsed further in the south west of Madagascar, local communities have migrated north in search for high-value fish stocks (Cripps & Gardner, 2016).

According to focus group discussions, the fishing of chevaquine and anchovies was reserved for female household members. Crab fishing was indicated to be done by both men and women equally. Crabs were on average sold for 2500 Ariary per kg, shrimp for 3000 to 5000 Ariary per kg depending on size, and lobsters for 8000 Ariary per kg.

Table 16. Percentage frequency with which respondents identified different types of fish as their most important inshore catch, by bay

	Sahamalaza		Mahajamba		Bombetoka	
	Men	Women	Men	Women	Men	Women
Chevaquine (small shrimp)		61.8		65.0		89.0
Crabs	27.7	15.8	38.1	13.3	18.4	3.7
Finfish	60.1	13.2	48.8	8.3	79.4	2.4
Prawns	12.2	7.9	13.1	13.3	1.4	4.9
Shellfish	0.0	1.3	0.0	0.0	0.7	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Men and women used different areas for inshore fishing. Across all bays, men predominantly fished off the beach or in mangrove creeks (Figure 11). Fishing from the beach was particularly prevalent amongst inshore fishermen in Bombetoka. Inshore fishermen in Sahamalaza predominantly fished in mangrove creeks. Very little to no inshore fishing was done in seagrass areas or on reefs. Women on the other hand fished predominantly in sand or mudflat areas and in mangrove creeks (Figure 11). Inshore fishing in sand or mudflat areas was particularly prevalent amongst women in Bombetoka. No inshore fishing was done in

seagrass areas amongst women and very few women indicated that they fish on reefs. Barnes-Mauthe *et al.* (2013) find that 34% of the total fish catch (including fishing and gleaning) in the west of Madagascar is done in mangrove habitats.

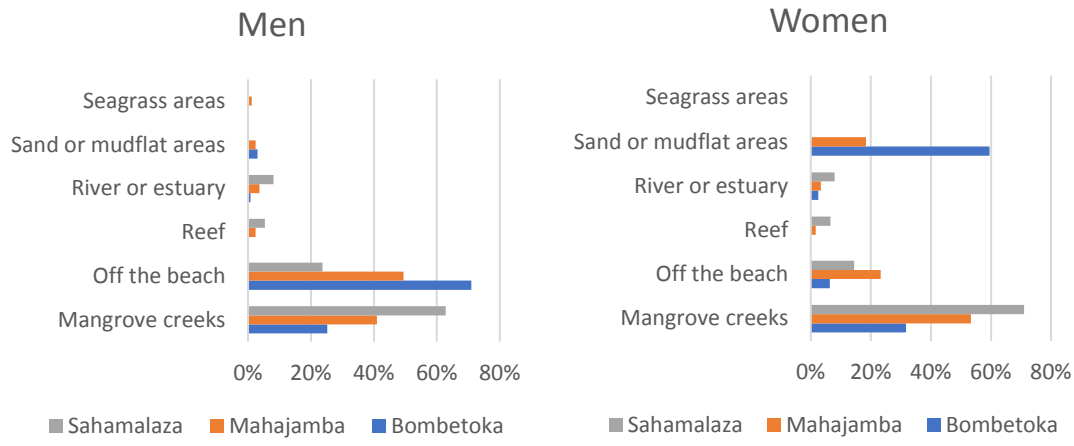


Figure 11. Percentage distribution with which men and women named different types of fishing areas as their primary inshore fishing areas.

Both men and women who fished inshore perceived fish stocks to be severely reduced (Figure 12). Very few households indicated that they did not see a change in the availability of inshore fish stocks. These findings are in line with other studies looking at the state of small-scale fisheries in Madagascar. Studies have reported decreasing catches, decreasing size of caught fish, and decreasing return on effort (Brenier, Ferraris & Mahafina, 2012; Lemahieu *et al.*, 2018). Fishers predominantly catch juvenile fish which means that fish have not been able to reproduce before being caught resulting in decreasing fish stock (Gough *et al.*, 2020).

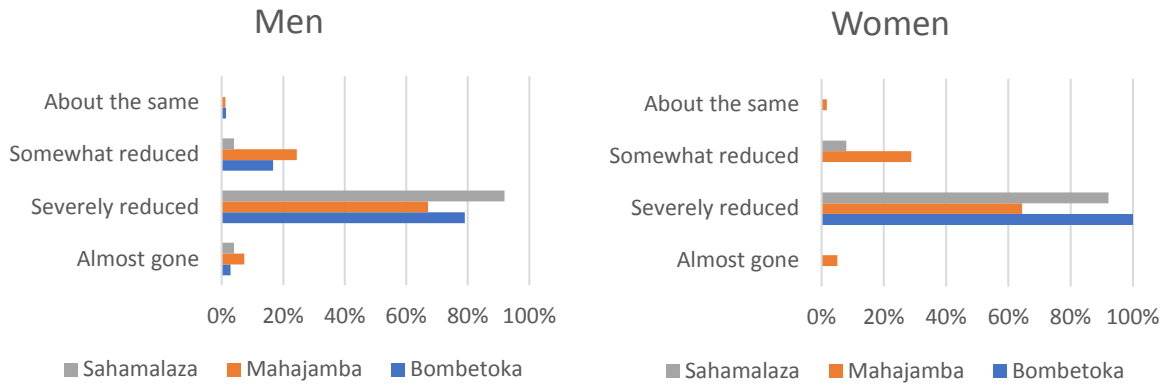


Figure 12. Percentage distribution of inshore fish stock abundance rated by men and women across bays

Most inshore fishermen sold their catches (about 81%) across all bays. Among female fishers, the percentage of catches that were sold rather than kept for own household consumption was slightly lower in Sahamalaza (71%) compared to Mahajamba (79%) and Bombetoka (83%).

Different fishing gear was used depending on the targeted species. Nylon nets (15mm, 20mm and 30mm mesh) were commonly deployed either from the beach or from a boat. Scoop nets and hand lines were also commonly used. Creels were used for lobster and crab fishing. Certain types of fishing gear were

prohibited such as beach seines and bottles for sea cucumber fishing. There were no restrictions regarding the quantity of catch, but it was forbidden to catch certain types of species such as sea turtles and dugong. There were closed seasons for catching crabs, shrimps, and lobsters.

Fish trading

There was almost no fish trading in Bombetoka and Mahajamba but many households traded fish in Sahamalaza (Table 17). The fish trading work was equally divided between men and women in Sahamalaza. While fish trading was much less prevalent in Bombetoka, most of the trading was done by female household members.

Table 17. Percentage of households engaging in fish trading and percentage of work done by female household members across bays

	Sahamalaza	Mahajamba	Bombetoka	Overall
Percentage of hh trading fish	52.7	8.8	5.3	25.9
Percentage of work done by women	51.5	40.7	90.0	53.9

5.4 Tourism

Only two households in the survey sample indicated that they provided tourism services – both indicating that the services were mostly provided by male household members.

There is very little tourism in Sofia. Tourists mainly travel in very small groups to Sahamalaza Park to see its fauna and flora and stayed in the park's camp, often for research purposes. Tourism was reported to be very seasonal with most visitors coming between July and September. Tourism did not provide an important income source for the region as tourists generally did not interact much with the locals. They paid an entrance fee to the park (20,000 to 50,000 Ariary per visitor) and additional fees to the park officials if they booked guided tours. According to focus group discussions in Sahamalaza, only national park officials worked in the tourism industry. During the COVID-19 pandemic, the number of tourists greatly reduced to only 4 to 6 tourists per year instead of 100 to 150 per year before the pandemic.

Tourism was also not an important income source in the Boeny region. According to a local tourism operator, tourism was the least developed sector in the region, especially in the Bombetoka area. However, given the presence of certain tourist sites in the Bay of Mahajamba (such as the rural commune of Mariarano and Katsepy, and the Anjohibe cave), tourism was expanding. Normally, tourists only come between May and October, but the COVID-19 pandemic strongly impacted the industry as all tourism related activities were halted.

5.5 Salt making and mariculture

10.8% of households in Mahajamba made salt and most of this work was done by women (Table 18). No households in Bombetoka made salt and only 4.4% of households in Sahamalaza engaged in salt making. There was no mariculture in Bombetoka and Mahajamba but 15.8% of households farmed fish and prawns in Sahamalaza with less than half of this work being done by women (Table 19). The average size of the mariculture area was 1.2 acres.

Table 18. Percentage of households engaging in mariculture and percentage of work done by female household members across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Salt making	4.4	10.8	0	3.9
Mariculture	15.8	0	0	15.8

Table 19. Percentage of households engaging in salt making and estimated percentage of work done by female household members across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Salt making	30.6	57.6	NA	44.8
Mariculture	27.4	NA	NA	27.4

5.6 Mangrove harvesting

Mangroves in Madagascar have been under threat due to timber and charcoal production and agricultural expansion. Mangrove forests are often cut down to increase rice and salt production in the area (Martin & Burgess, 2022). Growing maricultural activities have also put increasing pressures onto mangrove forests. In the Bay of Mahajamba, mangroves are particularly threatened by fuelwood, charcoal, and timber production (Martin & Burgess, 2022).

According to focus group discussions, households collect wood from mangroves and terrestrial wood (particularly tamarind and mango wood). The main mangrove species targeted is *Avicennia marina*. The household survey results also showed that mangroves were particularly used for firewood in Mahajamba. Mahajamba had the largest percentages of households reporting that they engage in timber and pole production, charcoal making, and firewood collection (Table 20). Small-scale harvesting of mangrove wood was less important in the bays of Sahamalaza and Bombetoka.

Table 20. Percentage of timber, poles, charcoal, and firewood production from mangroves by bay (median is shown in brackets)

	Sahamalaza	Mahajamba	Bombetoka	Average
Timber	36.8 (1.5)	27.0 (20.0)	22.6 (20.0)	26.5 (20.0)
Poles	18.4 (1.0)	16.0 (10.0)	12.4 (10.0)	14.7 (10.0)
Charcoal	NA	14.5 (12.5)	0.8 (0.0)	10.9 (4.0)
Firewood	22.7 (1.0)	57.8 (75.0)	39.1 (25.0)	41.1 (25.0)

A key informant expressed that wood resources were not well managed, and that extraction was largely unregulated. This was attributed to the lack of safeguard committees and local protection boards (Communauté de Base).

5.7 Agriculture (crops and livestock)

Most households in Sahamalaza and Mahajamba kept poultry compared to Bombetoka (Table 21**Error! Reference source not found.**). Crop farming was most common in Bombetoka, followed by Sahamalaza and Mahajamba. Livestock farming was less prevalent with around 25% of household farming livestock across all bays. Keeping livestock was more prevalent in Mahajamba and Sahamalaza than in Bombetoka (Table 21).

Table 21. Percentage of households engaging in farming activities across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Poultry	70.9	55.9	38.0	55.3
Crop farming	21.7	18.1	31.6	24.9
Livestock farming	27.1	25.5	21.5	24.6

The most commonly grown crops in the study area were fruit, followed by potatoes and cassava and rice (Table 22). Households in Sahamalaza produced a much greater variety of produce than households in the other two bays. Crop growing households in Sahamalaza particularly grew rice (89%) and maize (80%) which were much less commonly grown in Bombetoka and Mahajamba (Table 22). According to the focus group discussions, most households in Sahamalaza did not own the land they used for agriculture but used a sharecropping system. Households also commonly shared agricultural equipment, including axes, cutters, spades, and ploughs, particularly amongst households that had family ties. The harvest season for maize was between February and April while the harvest season for rice was between May and July.

Households in Mahajamba primarily grew potatoes and cassava, while those in Bombetoka focused on growing fruit. According to a key informant interview on agriculture in the Boeny region, most of the farming households in this area owned their land. Households shared their equipment. The most important pieces of equipment were ploughs, which cost between 200,000 and 250,000 Ariary and last two to three years, and spades, which cost 8000 - 12,000 Ariary and last one to two years. People in Bombetoka also did not rotate crops.

Rice was sold for 1600 to 1800 Ariary per kg on the community market. To sell their crops on the local market, households needed to pay a levy ticket.

Table 22. Percentage of various types of crops grown by households across bays

Type of crop	Sahamalaza	Mahajamba	Bombetoka
Fruit	68.2	41.2	46.7
Potatoes / cassava	54.6	58.8	25
Rice	88.6	29.4	0
Maize	79.6	29.4	6.7
Vegetables	18.2	0	0
Beans / legumes	6.8	0	5

Households in Sahamalaza had larger areas that they used for cultivating crops (median size of 25 acres compared to 15 in Mahajamba and 8 in Bombetoka). They also had on average more banana trees, coconut palms, and fruit and nut trees than households in Bombetoka and Mahajamba. Crops in Bombetoka and Mahajamba were predominantly grown for household consumption (around 60% of households indicated that they sold little to none of their crop production) while more of the crop production was sold in Sahamalaza.

In Mahajamba and Sahamalaza around half of the crop farming was done by female household members while farming activities seemed to be more male dominated in Bombetoka (Table 23). According to focus group discussions, men were usually responsible for ploughing the land, while women and children contributed to crop maintenance and harvesting.

Table 23. Percentage of farming activities done by women across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Percentage of the work done by women	48.9	50.0	34.4	41.8

To ensure more sustainable farming practices, people in Sahamalaza suggested using organic fertilizer (such as cow dung), seeds that are more appropriate for the climate of this region, and better farming equipment.

5.8 Upland resource harvesting

The most common livelihood activity besides fishing and farming was firewood collection. Firewood was collected across all bays: Mahajamba (54.26%), Bombetoka (33.16%), and Sahamalaza (17.91%). Most of the firewood collection was done by male household members and used for own consumption. Households in Sahamalaza sold the largest percentage of firewood across all bays – approximately 8.6% of the firewood they collected. However, officially the extraction of wood for profit in any form was prohibited. Households in Sahamalaza on average collected more headloads of firewood (mean = 23.1, sd = 16.5, median = 20.5) than households in Mahajamba (mean = 19.5 sd = 13.3, median = 20) and Bombetoka (mean = 10.7 sd = 8.6, median = 10).

Table 24. Percentage of households engaging in various upland resource harvesting activities across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Firewood collection	17.9	54.3	33.2	30.9
Timber making	4.5	52.1	17.5	18.8
Making products	13.8	4.3	1.1	7.0
Plant raw materials	1.5	18.1	6.8	6.8
Charcoal making	1.0	21.3	2.6	5.5
Wild food	3.5	16.0	1.0	4.9
Hunting	0.5	13.8	0.5	3.1

There was very little timber making in Sahamalaza (4.5%) compared to Bombetoka (17.5%) and Mahajamba (52.1%). Households in Mahajamba also engaged in more charcoal making (21.3%). Commonly, men cut down the wood and women process it into charcoal and firewood. Charcoal was sold for 6000 Ariary per bag. Over the last years, the price of charcoal had been increasing due increased scarcity in various wood types. More households in Mahajamba indicated that they collect wild food or plant raw material compared to households in the other two bays with most of this work done by male household members (Table 25). Mahajamba respondents reported the most hunting (13.8%), mostly of coastal and mangrove birds (53.9%) and forest animals and birds (38.5%) for household consumption (Table 24). 13.8% of households in Sahamalaza made products for sale (Table 24) with 40% of these indicating that this was done by women (Table 25). Products were mostly sold to locals, not tourists.

Table 25. Percentage of work done by women for selected livelihood activities across bays

	Sahamalaza	Mahajamba	Bombetoka	Average
Firewood collection	24%	49%	34%	37%
Making products	40%	63%	13%	41%
Plant raw materials	25%	17%	9%	15%
Wild food	50%	38%	25%	41%

6 Overall income

Households were asked to divide their monthly income into the various sources (employment, fishing, farming, pension and welfare, and remittances) (Figure 13). On a household level, across all bays, most households reported that most of their monthly income came from fishing (around 70%) followed by farming in Mahajamba (17.6%) and Sahamalaza (22.7%) and employment in Bombetoka (24.5%) (Figure 13).

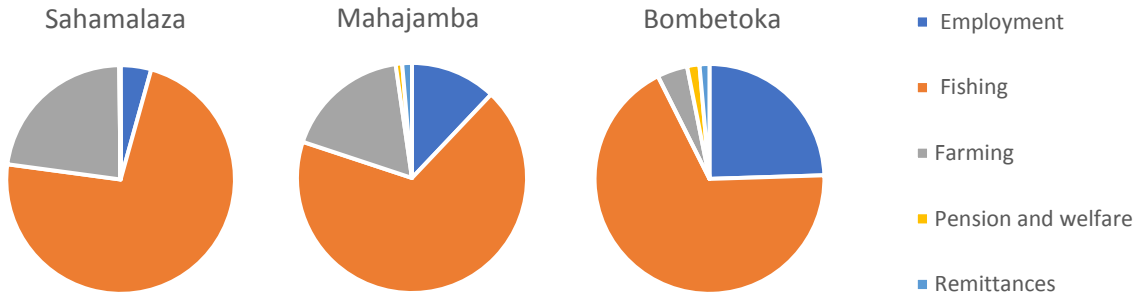


Figure 13. Household income sources across bays; indicated by respondents by dividing 20 beans to show how much the different sources contribute to their household's monetary income in a typical month

Few households in the Boeny / Sofia region received income from formal or informal employment in Mahajamba and Sahamalaza (17%-20%) (Table 26). Close to half of the households in Bombetoka received some income from formal / informal employment with a median earning of 2,880,000 Ariary per year, mostly in addition to other livelihood activities, predominantly fishing. Very little of the total earned income was made by female household members (Table 26).

Table 26. Annual household income from employment (in Ar '000s), by bay

	% of households receiving income from employment	% of this income made by female hh member	N	median	mean	sd
Sahamalaza	20.2	17.9	37	2 400	2 857	2 690
Mahajamba	17.0	0	16	840	4 103	11 731
Bombetoka	47.2	35.9	64	2 880	2 831	3 543

Income from livelihood activities included any income that households earned from fishing related activities (inshore / offshore fishing and fish trading), other ocean related activities (salt making, mariculture, tourism, and mangrove harvesting activities), non-mangrove wood related activities (timber, charcoal, or firewood production), the collection of wild food or hunting, and farming activities (cultivating crops and raising livestock and poultry). Median annual household income from fishing and farming activities was highest in Sahamalaza where households comm, only did not earn income from any kind of formal or informal employment (Table 27). Households in Mahajamba had the lowest median annual income from fishing across the three bays; however, their median annual income from farming related activities was higher than in Bombetoka (Table 27).

Table 27. Annual household income from livelihood activities (fishing, farming, other marine activities, and upland activities, in Ar '000s), by bay

	N	mean	sd	median
Fishing				
Sahamalaza	201	3 892	3 801	3 000
Mahajamba	93	2 938	2 312	2 000
Bombetoka	180	2 553	1 734	2 400
Farming				
Sahamalaza	151	493	922	240
Mahajamba	62	147	184	90
Bombetoka	116	149	404	20
Other marine activities				
Sahamalaza	68	1 528	2 494	60
Mahajamba	70	56	150	0
Bombetoka	81	158	1 422	0
Upland activities				
Sahamalaza	69	1 176	2 141	0
Mahajamba	72	127	378	0
Bombetoka	82	45	180	0

Households across all three bays made around 80% of their annual household income from fishing related activities (Figure 14). These calculations do not include subsistence production at market prices but only reflect households' cash-based income from livelihood activities. Other marine resources and upland resource harvesting did not create much income for most households (Figure 14). Farming related activities contributed the most to annual household income in Sahamalaza. Jobs contributed roughly 16% to total household income in Bombetoka. These study findings are corroborated by previous studies in rural coastal communities along the west coast in Madagascar. For example, Barnes-Mauthe *et al.* (2013) find that small-scale fisheries generate on average 82% of household income.

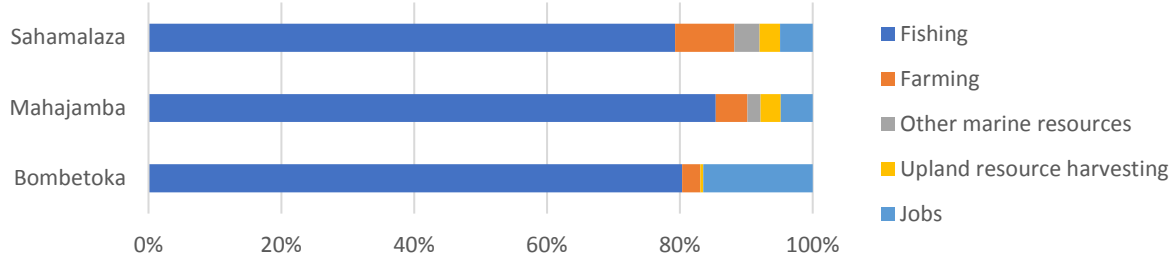


Figure 14. Percentage contribution of various income sources to household's total annual income, across bays

Most of the household income from various livelihood activities was earned by men (Table 28). Women generate very little of the monthly household income. Their contribution was largest in fishing-related activities.

Table 28. Percentage of household income from livelihood activities generated by women (average; median shown in brackets)

	Sahamalaza	Mahajamba	Bombetoka	Overall
Fishing	21% (12%)	15.7% (15%)	13% (0%)	18%
Farming	5% (0%)	2% (0%)	2% (0%)	4%
Other marine resources	14% (15%)	13% (0%)	0% (0%)	9%
Upland resource harvesting	40% (0%)	11% (0%)	1% (0%)	16%

Median annual income from all livelihood activities combined in Bombetoka was 2,414,000 Ariary compared to 3,660,000 Ariary in Sahamalaza (Table 29).

Table 29. Annual income from all livelihood activities (in Ar '000s), across bays

	N	mean	sd	median
Sahamalaza	203	5 136	5 471	3 660
Mahajamba	94	3 143	2 410	2 595
Bombetoka	188	2 557	1 837	2 414

Median total annual income (including income from all different sources) was highest in Sahamalaza followed by Bombetoka and Mahajamba (Table 30). On average, women earned only between 14% to 21% of the annual household income.

Table 30. Total annual income (in Ar '000s), by bay

	N	median	mean	sd	% earned by women
Sahamalaza	203	3 720	5 656	6 055	21% (14%)
Mahajamba	93	2 700	3 236	2 338	15% (14%)
Bombetoka	193	3 000	3 430	3 208	14% (0%)

Income per capita (median and mean) was also highest in Sahamalaza, followed by Bombetoka and Mahajamba (Table 31). Per capita income was highest in Sahamalaza for both fishing and farming activities.

Table 31. Annual total per capita income and per capita income from various sources (in Ar '000s), by bay

	N	median	mean	sd
Total				
Sahamalaza	203	810	1 380	1 917
Mahajamba	93	529	696	642
Bombetoka	193	550	747	811
Livelihood				
Sahamalaza	203	732	1 259	1 777
Mahajamba	94	500	678	651
Bombetoka	188	446	559	512

7 Gender roles and equality

7.1 Employment and livelihood activities of women

Most of the women in the communities predominantly took care of their household and children. Some women practiced fishing or contributed to other income-generating activities such as animal husbandry and arts and crafts. Women often contributed to the processing of harvested resources. For example, men harvested wood and women processed it into firewood.

Fishing activities were largely considered to be male occupations. Offshore fishing was not very common among female household members. In Sahamalaza, 3% of households had at least one woman fishing offshore. 21% of households in Bombetoka indicated that at least one woman in their household went offshore fishing. Offshore fishing was slightly more common amongst women in Mahajamba – 38% of households in Mahajamba indicated that at least one female household member went out to sea.

Inshore fishing was more common amongst women than offshore fishing. In Sahamalaza, 36% of households indicated that they had at least one woman fishing offshore. 43% had at least one woman fishing offshore in Bombetoka and 63% in Mahajamba. Women mainly caught chevaquine (small shrimp) and anchovies across the north-western coastline of Madagascar. Their main fishing grounds were sand or mudflat areas and mangrove creeks.

Farming was done by both genders in the community. Men in the communities ploughed the land, while women and children contributed to crop maintenance and harvesting. In Mahajamba and Sahamalaza more than half of the crop farming was done by female household members while farming activities seemed to be more male dominated in Bombetoka. Lack of means, equipment and materials prevented women from choosing different livelihood activities.

Fish trading was most common in Sahamalaza, and the trading work was done by both men and women. Sahamalaza was also the bay where most of the mariculture in this region takes place. However, most of this work was done by men. Salt making was mostly done in Mahajamba with most of the work done by female household members. Other livelihood activities, such as firewood collection or collecting plant raw materials or wild foods, were male dominated.

7.2 Decision-making power in households

During the focus groups, women stated that their husbands were responsible for the income earning activities of the household. Women reported that they commonly acted as advisors to the men on finding income generating activities. The survey responses corroborated the focus group discussion findings. Women were involved in deciding on how the household earned an income but tended to have less decision-making power when it came to their own occupations and activities (Table 32). During one of the focus group discussions, it was suggested that a woman's profession and activities were commonly proposed by their husbands and that a woman could look for opportunities along those suggestions.

Table 32. Mean score for the level of agreement with statements about women's decision-making power across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
Women's involvement in decisions on:			
...how household earns an income	5.5	4.1	4.5
…on household expenditure	4.5	4.8	4.9
…on where household lives	4.4	3.9	4.4
…on children's schooling	4.3	3.3	3.9
…on having children	4.1	3.8	4.0
…on their own occupations and activities	4.2	3.5	3.7

Men also seemed to have more decision-making power on having children and on where the children go to school (Table 32). Overall, women had most decision-making power on household expenditure.

7.3 Perceptions of household harmony

Households tended to agree that their lives were harmonious (Table 33). However, households in Mahajamba seemed to be less satisfied with their household harmony compared to households in Sahamalaza and Bombetoka.

Table 33. Mean score for the level of agreement with statements about household harmony across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
My family functions well for all members	5.9	4.5	5.5
My family's day-to-day interactions are peaceful	5.0	4.3	5.1
Family members accommodate each other	5.2	4.6	5.4

8 Household membership in community organisations

The most common membership organisations for men were fishing associations and co-operatives, especially in Sahamalaza where almost all household reported that they were a member of a fishing association (Table 34). Religious groups, including churches and mosques were also a common organisation that men belonged to, particularly in Sahamalaza (Table 34).

Table 34. Percentage of male household members being part of an organisation across bays and the entire study sample

	Sahamalaza	Mahajamba	Bombetoka	Overall
Fishing association or co-operative	98.0	25.5	44.6	63.1
Religious group	15.8	2.1	6.2	9.4
Environmental or conservation association	4.4	6.4	15.5	9.2
Neighbourhood security group	1.0	12.8	1.6	3.5
Farming association or co-operative	3.0	0	0	1.2
Political organisation	0.5	1.1	1.6	1.0
Educational, developmental or social welfare association	0.5	3.2	0	0.8
Business association or cooperative	1.0	0	0	0.4

According to local communities in the Bay of Mahajamba, the absence of fishing associations made it difficult to effectively manage fishing resources. Households suggested that fishers needed to be educated and sensitised more about existing regulations, particularly with regard to the type of gear, closed seasons, and minimum exploitable fish size, and why it is crucial to adhere to the restrictions. On the other hand, in the Bay of Bombetoka, the existence of associations and the support of NGOs, such as DELC Madagascar – Mizàna Maitso, facilitated a better management of the coastal and marine resources in collaboration with the local small-scale fishermen.

Similarly to men, women were also mostly part of fishing associations or co-operatives or part of local religious groups. However, overall fewer women were part of fishing associations (Table 35).

Table 35. Percentage of female household members being part of an organisation across bays and the entire study sample

	Sahamalaza	Mahajamba	Bombetoka	Overall
Fishing association or co-operative	75.9	7.5	20.2	40.8
Church, mosque or other local religious group	18.7	5.3	8.8	12.3
Environmental or conservation association	9.9	6.4	13.5	10.6
Educational, developmental or social welfare association	1.5	2.1	1.0	1.4
Farming association or co-operative	2.5	0	0	1.0
Political organisation	0.5	3.2	0	0.8
Business association or cooperative	1.0	1.1	0	0.6
Neighbourhood security group	0	1.1	0	0.2

9 Households' perceptions and preferences regarding marine ecosystem management

9.1 Households' perceptions on feeling heard on marine issues

Households in Sahamalaza tended to feel more that they could voice their concerns about coastal and marine management and that their concerns are heard than households in the other bays (Table 36). This might be because more households in Sahamalaza were part of fishing associations and co-operatives and therefore had more opportunities to make their voices heard. Households in Mahajamba felt less heard, which could be attributed to the lack of fishing organisations in the area.

Table 36. Mean score for the level of agreement with statements about coastal and marine management across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
Households are able to voice concerns about coastal and marine management.	4.8	3.9	4.4
Concerns about marine / coastal management are heard.	4.7	3.8	4.2

9.2 Households' perceptions on enforcement on rules

Despite most of the households noticing the large decrease in fish stocks over the last years, households in all bays suggested that the marine life in their area was healthy and tended to disagree that small-scale fishing harmed the marine life in Sahamalaza and Mahajamba. However, households tended to disagree that there was a good balance between protection and use (Table 37). Households generally did not seem to be concerned that there were too many fishing restrictions (closed areas, closed seasons, permits etc). Households in Sahamalaza tended to agree more that the fishing regulations in their area were well enforced while households in Mahajamba and Bombetoka were more in disagreement. During focus group discussions, households in Sahamalaza said that they had already noticed a decline in their catch rate and expected their fish stocks to be exhausted in the next five years if no stricter measures were implemented. They attributed the fish shortages to the increasing use of prohibited equipment and fishermen disrespecting the closing period. They suggested that to improve the availability of resources in Sahamalaza, it was necessary that the local communities took responsibility for illegal fishing, such as night fishing.

During focus group discussions, households suggested that they generally were not opposed to the expansion of Marine Protected Areas in the region if it resulted in an improvement in the longer-term availability of fish stocks. Most households supported marine wildlife conservation, particularly in Sahamalaza (Table 37). Tourism currently does not play an important role for local livelihoods in the region. However, households in Sahamalaza are more neutral about the importance of ecotourism as source of income in their region (Table 37).

Table 37. Mean score for the level of agreement with statements about marine resources across bays (from 1 = strongly disagree to 7 = strongly agree)

	Sahamalaza	Mahajamba	Bombetoka
The marine life is healthy	5.1	4.5	4.6
Fishing regulations are well enforced	4.7	3.7	3.8
Small-scale fishing is threatening the marine life here	3.1	3.1	4.4
Too many fishing restrictions	3.8	3.8	4.0
There is a good balance between protection and use	3.9	3.7	3.8
Industrial expansion will pose a risk to our marine life	4.1	4.5	4.7
Must ensure that inshore fishing areas are not impacted	5.3	4.2	4.2
Our household supports marine wildlife conservation	5.5	4.5	4.4
Ecotourism is an important source of income here	4.2	3.9	3.5
If government gets more taxes, it will deliver better services	4.7	3.6	3.4

Households in Mahajamba and Bombetoka were also afraid of changes in the availability of fishing resources and the depletion of stocks. According to focus group discussions, if fish stocks were severely depleted, households in Mahajamba would shift towards agriculture, livestock farming, and timber harvesting. The community of Mahajamba was particularly afraid of the depletion of timber stock and suggested creating protected areas mainly to conserve mangroves and to implement a community-based management system to better manage the remaining mangrove forests.

9.3 Household preferences for future coastal developments

As demonstrated in the previous chapter, households' livelihoods were strongly dependent on fishing and farming activities which was reflected in the household survey responses, the focus group discussions, and the key informant interviews. Commonly men were responsible for catching fish and women took part in preparing and selling fish. Other ocean related activities (including salt making, mariculture, and tourism) were less important for local livelihoods.

Households were asked if they would vote for a situation where job opportunities were increased if it had a negative impact on small scale fishing. The majority of households in Sahamalaza would be opposed to increased job opportunities in the region if these opportunities in more formal employment came at the expense of small scale fishing (54%) or inshore fishing (74%) (Figure 15)**Error! Reference source not found.**. Households in Bombetoka and Mahajamba were less clear on their decision as many households opted to answer "Don't know" (Figure 15)**Error! Reference source not found.**. In Bombetoka, 38% of households would vote for an increase in job opportunities at the expense of small-scale fishing. In Mahajamba, households seemed more opposed to increases in job opportunities if they came at the expense of offshore or inshore fishing. Households in Sahamalaza agreed that it was important that inshore fishing areas are not impacted by economic developments while households in Mahajamba tended to be more neutral (Table 37).

Households in Bombetoka were more used to informal / formal employment compared to households in the other two bays as many households already earned income from employment activities potentially making them less opposed to opportunities in formal employment. However, households were generally concerned that an increase in industrial activities along the coast could increase the risk to their marine life (particularly households in Bombetoka) (Table 37).

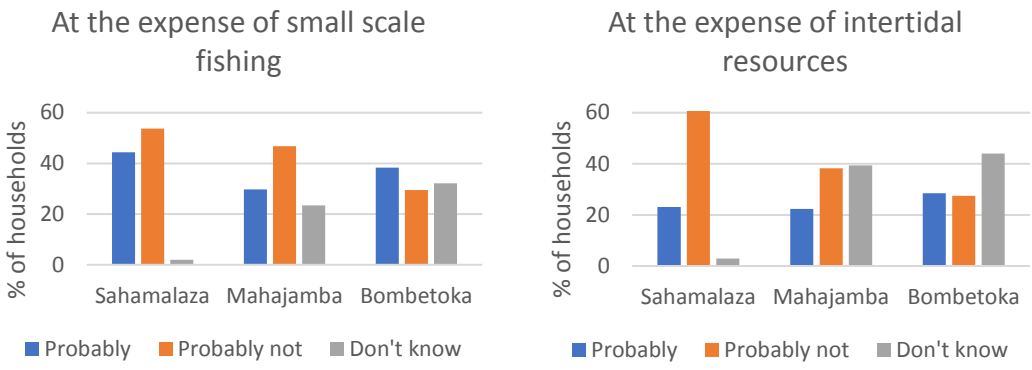


Figure 15. Percentage distribution of households' interest in employment opportunities at the expense of small-scale fishing and intertidal resources across bays

Households were asked which types of development would provide their household with the best income opportunities. Across all bays, households would like to see more economic developments in marine fisheries and fish processing (Table 38). Households in Bombetoka seemed to be particularly interested in coastal protection. Households in Mahajamba were interested to have more economic opportunities in aquaculture and transport (Table 38). The household surveys indicated that currently mariculture was only prevalent in Sahamalaza. Households in Sahamalaza were interested in expanding their mariculture activities but would also like to see more opportunities in coastal tourism and transport (Table 38).

Table 38. Percentage of households interested in different types of developments across bays

Sahamalaza		Mahajamba		Bombetoka	
Development 1st choice					
Marine fisheries	89.7	Marine fisheries	78.7	Marine fisheries	92.2
Fish processing	5.4	Fish processing	9.6	Fish processing	3.6
Coastal tourism	2.5	Aquaculture	3.2	Coastal protection	2.1
Development 2nd choice					
Fish processing	51.2	Fish processing	35.1	Fish processing	55.4
Aquaculture	25.1	Transport	26.6	Coastal protection	14.5
Transport	9.4	Marine fisheries	12.8	Transport	8.3

10 Conclusions and discussion

Households in the Sofia and Boeny regions in the north / north-west of Madagascar have been experiencing the impacts of dwindling fish stocks and were worried that fish stocks will completely disappear in a few years if no actions are taken. Overall, households therefore saw the need for improved MSP in the area. However, fishing was by far households' main income source – both for livelihood activities and for the few households that had some type of paid employment. In Mahajamba and Bombetoka close to 80% of households engaged in offshore fishing. Restricting access to fishing grounds would likely have very large impacts on households' monthly incomes as their incomes were rather undiversified.

Our findings for coastal communities in the Sofia / Boeny regions were in line with previous studies which found gender-specific roles and marine use preferences. Men are commonly more involved in offshore fishing and women usually collect marine resources closer to the shore (Schwerdtner Máñez & Pauwelussen, 2016; de la Torre-Castro *et al.*, 2017). In the Sofia and Boeny regions, very few women went fishing offshore. Inshore fishing was also more common amongst men; however, on average around 44% of households had at least one female household members engaging in inshore fishing activities. Women were mostly involved in the processing and packaging of fish.

Households indicated that they would move into agriculture and timber production if marine resource access was restricted in their area. Agriculture was most prevalent in Sahamalaza in the most northern stretch of coast where approximately 9% of household income came from farming activities. Most households farm poultry (55%). According to focus group discussions, timber stocks in the area were already overexploited. On average around 31% of household collect firewood for their own use; firewood collection was most prevalent in Mahajamba where 54% of households engaged in this activity. Timber making was also the most prevalent in Mahajamba with 52% of households engaging in this activity. Future marine spatial plans would need to consider potential adverse impacts that a change in marine zonation could have on other natural resources in the area. If changes in marine spatial zonation led to increased agricultural production, local communities would need to be supported with the necessary skills and information to ensure sustainable agricultural practices. This would, for example, include providing climate resilient crops and informing households about the best practices for crop rotation.

Increasing jobs in the marine sector would likely have very little impact on women's financial security in the region. Women and men occupied traditional gender roles: men were the main household income earner and decision-maker while women took care of the household and children. Employment, which was most prevalent in the Bay of Bombetoka, was mostly held by male household members and household survey responses indicated that new employment opportunities would most likely benefit men (as opposed to the youth or women).

This study was strongly dependent on getting access to very rural and remote coastal areas in Madagascar. Great efforts were made to interview households in very remote areas; however, time and resource constraints did not allow the research team to interview households in the most remote parts of the north / north-western coast of Madagascar. Households living along the shore in extremely remote villages would be expected to be more reliant on fishing for their livelihoods.

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12 Appendix: Household Questionnaire

A: INTRODUCTION AND INFORMED CONSENT

Greetings. My name is XXXX. We are doing a survey on behalf of the government to inform the future management of marine and coastal resources in this area through a process called Marine Spatial Planning. We would like to ask you about how your household derives its income and the way in which you benefit from coastal activities, and we would like your opinion on how future developments might affect your household. We need about 45 minutes of your time. Our questions relate to the whole household, so we need to talk to at least one senior decision maker in the household, but it will be even better if we could jointly interview both a man and a woman of the household. Your answers are confidential. and our report will not identify individuals. Would your household consent to being interviewed?

☐ Yes ☐ No

B: DEMOGRAPHIC AND SOCIO-ECONOMIC BACKGROUND

1. Please could you give the following details about the household head:
    a. What gender is the household head?: ☐ Male ☐ Female ☐ Other ☐ Don't know / Prefer not to say
    b. What age is the household head? _____
    c. Marital status: ☐ Never married ☐ Married ☐ Divorced ☐ Other ☐ Don't know
    d. Level of education completed: ☐ None ☐ Some schooling but no level completed ☐ Primary ☐ Secondary ☐ Higher education ☐ Don't know

2. How many members are there in this household in the following age groups?
   Adults (age 60 +) ____ Adults (age 18-59) ____ Youth (age 13-17) _____

   Children (0-12) _____

3. To which religious group does this household belong? ☐ None/Atheist or Agnostic ☐ Roman Catholic Christianity ☐ Islam ☐ Zionist ☐ Protestant Christianity ☐ Traditional ☐ Other ☐ Don't know
4. How long have you been resident in this village / area (in years)? _____
5. [if < 4 years] Where did you move here from?
    a. ☐ Another village in this county
    b. ☐ Another county
    c. ☐ Another country

C: RESIDENCE AND NEIGHBOURHOOD CHARACTERISTICS

6. What are the main house's walls made of?

   ☐ Mud ☐ Thatch/leaf/reed/palm/ bamboo ☐ Cement blocks ☐ Mud bricks – local/homemade ☐ Commercial bricks ☐ Other ☐ Don't know
7. What is the roof made of? ☐ Thatch/leaf/reed/palm/ bamboo ☐ Corrugated iron ☐ Mud ☐ Cement/concrete ☐ Other ☐ Don't know
8. What is the household's main source of energy for cooking? ☐ Firewood ☐ Charcoal ☐ Solar panel ☐ Public electricity grid ☐ Oil/Paraffin/kerosene ☐ Candles ☐ Other ☐ Don't know
9. What is the household's main source of energy for lighting? ☐ Firewood ☐ Charcoal ☐ Solar panel ☐ Public electricity grid ☐ Oil/Paraffin/kerosene ☐ Candles ☐ Batteries ☐ Other ☐ Don't know
10. What is the household's main source of water? ☐ River ☐ Well or borehole ☐ Tap connected to public water system ☐ Rainwater storage ☐ Other ☐ Don't know
11. Does this household own any of the following? ☐ Bicycle ☐ Motorbike ☐ Car ☐ Phone ☐ Radio ☐ TV ☐ Fridge ☐ Mobile phone ☐ Canoe or rowing boat ☐ Dhow (sailing boat) ☐ Motorboat ☐ Tuktuk ☐ Minibus ☐ Truck ☐ House ☐ Farmland ☐ Don't know
12. About how long would it take to get from your home to the nearest school if you walked? ☐ 10 minutes or less ☐ 11-20 minutes ☐ 21-30 minutes ☐ 31 minutes to 1 hour ☐ More than 1 hour ☐ Don't know
13. About how long would it take to get from your home to the nearest market if you walked? ☐ 10 minutes or less ☐ 11-20 minutes ☐ 21-30 minutes ☐ 31 minutes to 1 hour ☐ More than 1 hour ☐ Don't know
14. About how long would it take to get from your home to the nearest clinic by motorized transport? ☐ 10 minutes or less ☐ 11-20 minutes ☐ 21-30 minutes ☐ 31 minutes to 1 hour ☐ More than 1 hour ☐ Don't know

X. ASSETS FOR FOOD PRODUCTION AND FOOD AVAILABILITY

15. How many meals do you have per day?
16. How often do you eat fish, meat, eggs, dairy or beans? ☐ Daily ☐ Once or a few times per week ☐ Less than once a week
17. How often do you eat fish or shellfish? ☐ Daily ☐ Once or a few times per week ☐ Less than once a week
18. In the last year - how often has someone in the household gone hungry because there is not enough to eat? ☐ Never ☐ Occasionally/only during a certain period of the year ☐ 1-2 times per month ☐ 1-2 times per week Daily
19. How does the household source food? ☐ Harvest from the wild ☐ Farm ☐ Buy from others ☐ Donation ☐ Exchange ☐ Other
20. Do you store food for the household to have long term? ☐ Yes ☐ No
21. Approximately how long does the food that you store last? ☐ 1 day ☐ 1 week ☐ 1 month ☐ 3 months ☐ 6 months ☐ Nearly 1 year ☐ More than a year

Compared to previous 2 years, do you think that the time that food lasts has increased or decreased? ☐ Decreased ☐ Increased ☐ No change

D. EMPLOYMENT AND INCOME

22. Has anyone in this household earned income from formal or casual employment here in this area in the last 3 years? ☐ Yes ☐ No ☐ Don't know
23. Please give details for each of these household members:
    a. Gender: ☐ Male ☐ Female ☐ Other
    b. Type of occupation: ☐ Self-employed/ informal trade ☐ Formally registered business ☐ Employed in community ☐ Employed outside of community
    c. Economic sector related to main occupation: ☐ None ☐ Farming livestock ☐ Farming crops ☐ Aquaculture ☐ Fishing ☐ Fish processing ☐ Forest extraction ☐ Oil / gas ☐ Salt ☐ Mineral extraction ☐ Construction ☐ Manufacturing ☐ Transport ☐ Tourism ☐ Buying/selling goods ☐ Service industry ☐ Health and education ☐ Other
24. When was their last month of paid employment (year and month)?
    a. Year: ☐ 2021 ☐ 2020 ☐ 2019 ☐ 2018 ☐ before 2018
    b. Month: ☐ January ☐ February ☐ March ☐ April ☐ May ☐ June ☐ July ☐ August ☐ September ☐ October ☐ November ☐ December
25. What is or was their monthly income (before tax)? (Don't know 999)
26. Please divide these 20 beans to show how much the following contribute to your household's monetary income in a typical month (Don't know 999)
    - Employment (where you get paid a salary)
    - Own fishing or other livelihood activities involving coastal and marine resources or coastal tourists
    - Own farming or livelihood activities involving upland resources
    - Pensions and welfare
    - Remittances

E: LIVELIHOOD ACTIVITIES AND INCOME

27. What are the main sources of income in your community? Farming and trading crops ☐ Farming and trading livestock ☐ Fishing ☐ Processing fish ☐ Fish farming ☐ Trading fresh fish ☐ Trading dried fish ☐ Informal trade ☐ Formal business (Grocery, etc) ☐ Petty trading of goods or services ☐ Brick making ☐ Firewood collection/trade ☐ Charcoal making /trade ☐ Carpentry ☐ Construction ☐ Transport ☐ Other

Fishing by boat

28. I am going to ask separately about fishing by boat and fishing on the shore. Let's start with boat-based fishing. How many men in this household have regularly gone fishing out to sea (by motorised boat, dhow or canoe) in the last 12 months? (Don't know 999)
29. And how many women? (Don't know 999)
30. Where off the coast did most of this fishing take place?
    ☐ Offshore from around here
    ☐ Further to the north of here
    ☐ Further to the south of here

☐ Don’t know

31. Where do you/they do most of this fishing? ☐ Offshore islands ☐ Offshore reefs ☐ Open sea ☐ Don’t know
32. What type of boat is used for this?
    - ☐ Dhow
    - ☐ Motorised boat
    - ☐ Canoe
    - ☐ Other
    - ☐ Don’t know
33. Does this household own the boat?
    - ☐ Yes
    - ☐ No
    - ☐ Shared ownership
    - ☐ Don’t know
34. What are the main types of species caught (up to 3)?
    - ☐ Demersal fish
    - ☐ Small pelagics
    - ☐ Large pelagics
    - ☐ Turtles
    - ☐ Dolphins or whales
    - ☐ Prawns
    - ☐ Lobster
    - ☐ Sharks and rays
    - ☐ Other
    - ☐ Don’t know
35. Was this fishing mainly for household consumption or for sale?
    - ☐ Household consumption
    - ☐ Sale
    - ☐ Don’t know
36. Approximately what percentage of the catch was sold? (Don’t know 999)
37. Approximately how much income (in Ar) was earned from offshore fishing in the last month? (Don’t know 999)
38. Approximately how much income (in Ar) was earned from offshore fishing in the last 12 months? (Don’t know 999)
39. How do you rate the abundance of these fishery stocks relative to their historical levels?
    ☐ Almost gone ☐ Severely reduced ☐ Somewhat reduced ☐ About the same ☐ More abundant ☐ Don’t know

Men inshore fishing

40. How many men in the household have regularly gone fishing from the shore (in tidal or shallow areas) in the last 12 months? (Don't know 999) If number > 0:
    a. What were the 3 main types of species caught or collected at the shore, in order of importance?
        - ☐ Finfish
        - ☐ Prawns
        - ☐ Lobster
        - ☐ Sharks and rays
        - ☐ Crabs
        - ☐ Octopus
        - ☐ Squid
        - ☐ Turtles
        - ☐ Sea Cucumber
        - ☐ Shellfish
        - ☐ Seaweed or sea grass
        - ☐ Other
        - ☐ Don't know
    b. Where do you do most of this fishing? ☐ River or estuary ☐ Reef ☐ Mangrove creeks ☐ Seagrass areas ☐ Sand or mudflat areas ☐ Off the beach ☐ Don't know
    c. How do you rate the abundance of these fishery stocks relative to their historical levels? Almost gone ☐ Severely reduced ☐ Somewhat reduced ☐ About the same ☐ More abundant ☐ Don't know
    d. Approximately what percentage of these catches were sold? (Don't know 999)
    e. Approximately how much income (in Ar) did this earn in the last month? (Don't know 999)
    f. Approximately how much income (in Ar) did this earn in the last 12 months? (Don't know 999)

Women inshore fishing

41. How many women in the household have regularly gone fishing at the shore in the last 12 months? (Don't know 999)
    a. What were the 3 main types of species caught or collected at the shore, in order of importance?
        - ☐ Chevaquine
        - ☐ Finfish
        - ☐ Prawns
        - ☐ Lobster
        - ☐ Sharks and rays
        - ☐ Crabs
        - ☐ Octopus

- ☐ Squid
- ☐ Turtles
- ☐ Sea Cucumber
- ☐ Shellfish
- ☐ Seaweed or sea grass
- ☐ Other
- ☐ Don't know

b. Where do you do most of this fishing? ☐ River or estuary ☐ Reef ☐ Mangrove creeks ☐ Seagrass areas ☐ Sand or mudflat areas ☐ Off the beach ☐ Don't know

c. How do you rate the abundance of these fishery stocks relative to their historical levels? Almost gone ☐ Severely reduced ☐ Somewhat reduced ☐ About the same ☐ More abundant ☐ Don't know

d. Approximately what percentage of these catches were sold? (Don't know 999)

e. Approximately how much income (in Ar) did this earn in the last month? (Don't know 999)

f. Approximately how much income (in Ar) did this earn in the last 12 months? (Don't know 999)

Fish processing and trading

42. Have any members of the household been regularly involved in buying fish or other sealife from fishers to process and sell, or just to sell? ☐ Yes ☐ No ☐ Don't know

    a. How much of this work was by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know

    b. Approximately how much income (in Ar) did this earn in the last month? (Don't know 999)

    c. Approximately how much income (in Ar) did this earn in the last 12 months? (Don't know 999)

Salt

43. Has anyone in this household been regularly involved in salt making in the past 12 months? ☐ Yes ☐ No ☐ Don't know

    a. How much of this work was by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know

    b. How much income (in Ar) did your household earn from this in the last month? (Don't know 999)

    c. And approximately how much income (in Ar) was earned in the last year? (Don't know 999)

Mariculture

44. Does this household undertake any mariculture (farming fish, prawns or seaweed) as a business? ☐ Yes ☐ No ☐ Don't know

45. What type of mariculture?
    - ☐ Fish
    - ☐ Prawns
    - ☐ Seaweed
    - ☐ Don't know
    a. What size area do you have for mariculture (acres)? (Don't know 999)
    b. How much of the mariculture work is done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    c. How much income (in Ar) did your household earn from this in the last month? (Don't know 999)
    d. And approximately how much income (in Ar) was earned in the last year? (Don't know 999)

Tourism

46. Has anyone in this household have regularly provided guiding or other services to tourists in the last 3 years? ☐ Yes ☐ No ☐ Don't know
    a. How much income (in Ar) was earned from this in the last month? (Don't know 999)
    b. And in the last 12 months (in Ar)? (Don't know 999)
    c. How much of this was earned by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    d. How much would have been earned in a year before the pandemic? (Don't know 999)

Timber and poles

47. Has anyone in this household regularly cut timber or poles from mangroves or other forests in the last year? ☐ Yes ☐ No ☐ Don't know
    a. Approximately how many logs were cut for timber in the last two months? (Don't know 999)
    b. Approximately how many of these were from mangroves (in percent)?
    c. How much income (in Ar) was earned from timber in the last two months? (Don't know 999)
    d. And approximately how much in the last year (in Ar)? (Don't know 999)
    e. Approximately how many scores of poles were harvested in the last two months? (Don't know 999)
    f. Approximately how many of these were from mangroves (in percent)?
    g. How much income (in Ar) was earned from poles in the last two months? (Don't know 999)
    h. And approximately how much in the last year (in Ar)? (Don't know 999)

Charcoal

48. Has anyone in this household regularly made charcoal from mangroves or other forests in the last year? ☐ Yes ☐ No ☐ Don't know
    a. Approximately how many bags of charcoal were produced in the last two months? (Don't know 999)
    b. Approximately how many of these were from mangroves (percent)?

c. How much income (in Ar) was earned from selling charcoal in the last two months? (Don't know 999)
d. And approximately how much in the last year (in Ar)? (Don't know 999)

Firewood

49. Does this household regularly collect firewood? ☐ Yes ☐ No ☐ Don't know
    a. How much of the firewood collecting is done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    b. How many headloads were collected in the last month? (Don't know 999)
    c. How much of the firewood collected comes from mangroves? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    d. What percentage of firewood collected is sold? (Don't know 999)
    e. How much was earned from this in the last month (in Ar)?
    f. Approximately how much was earned from this in the last year (in Ar)?

Wild food and medicines

50. Has anyone in the household regularly collected wild vegetables, fruits or medicines in the past year? ☐ Yes ☐ No ☐ Don't know
    a. How much of this work was done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    b. What proportion of the food collected was sold? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    c. How much was earned from this in the last month (in Ar)? (Don't know 999)
    d. Approximately how much was earned from this in the last year (in Ar)? (Don't know 999)

Hunting

51. Has anyone in the household regularly hunted for bush meat or wild honey in the past year? ☐ Yes ☐ No ☐ Don't know
    a. Which of these do they hunt for the most? (top 3)
        - Mangrove honey
        - Forest honey
        - Forest animals and birds
        - Coastal and mangrove birds
        - Don't know
    b. What proportion of this was sold? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    c. How much was earned from this in the last month (in Ar)? (Don't know 999)
    d. Approximately how much was earned from this in the last year (in Ar)? (Don't know 999)

Plant raw materials

52. Has anyone in the household harvested reeds, sedges, grasses or palm leaves in the last year? ☐ Yes ☐ No ☐ Don't know

a. How much of this work was done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
b. What proportion of the amount collected was sold? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
c. How much was earned from this in the last month (in Ar)? (Don't know 999)
d. Approximately how much was earned in the last year (in Ar)? (Don't know 999)

Mining

53. Has anyone in the household regularly mined for sand or minerals in the last year? ☐ Yes ☐ No ☐ Don't know
    a. How much of this work was done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    b. What proportion of the amount collected was sold? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    c. How much was earned from this in the last month (in Ar)? (Don't know 999)
    d. Approximately how much was earned in the last year (in Ar)? (Don't know 999)

Making products for sale

54. Has anyone in the household regularly prepared food, drinks or handicrafts for sale in the past 12 months? ☐ Yes ☐ No ☐ Don't know
    a. Approximately how much was earned from this in the last month (in Ar)? (Don't know 999)
    b. Approximately how much was earned in the last year (in Ar)? (Don't know 999)
    c. How much of this income was generated by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
    d. Approximately what proportion of this income was from sales to tourists? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know

Crops

55. Does this household engage in growing crops, fruits, nuts or coconuts? ☐ Yes ☐ No ☐ Don't know
    a. How many banana plants do you have? (Don't know 999)
    b. How many coconut palms? (Don't know 999)
    c. How many fruit and nut trees? (Don't know 999)
    d. What area of land do you cultivate (acres)? (Don't know 999)
    e. What are the main crops grown?
        ☐ Rice
        ☐ Maize
        ☐ Potatoes or cassava
        ☐ Fruit
        ☐ Beans or other legumes
        ☐ Vegetables
        ☐ Other
        ☐ Don't know

f. Approximately what proportion of this work was done by female members of the household? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
g. What proportion of your production was sold? ☐ Most or all ☐ More than half ☐ Less than half ☐ Little or none ☐ Don't know
h. How much income was generated in the last year (in Ar)? (Don't know 999)

Livestock

56. Do you keep poultry? ☐ Yes ☐ No ☐ Don't know
57. Does this household have any other livestock? ☐ Yes ☐ No ☐ Don't know
    a. (If yes) How many pigs do you have?
    b. How many goats or sheep do you have?
    c. How many cattle do you have?
    d. How many horses or donkeys do you have?
58. How much income was generated from poultry and livestock in the last month (in Ar)? (Don't know 999)
59. And in the last year (in Ar)? (Don't know 999)
60. Does your household use the livestock / poultry that you raise? (Rank in order of importance) ☐ Eat ☐ Sell ☐ Give Away ☐ Other

T: TRAINING RECEIVED

61. Has anyone in your household received any advice, support or training related to fishing? ☐ Yes ☐ No ☐ Don't know
62. When was the training conducted? ☐ In the last year ☐ 2-5 years ago ☐ 5-10 years ago ☐ Don't know
63. Who provided the training advice?

    What topics were addressed during the training? ☐ Business management ☐ Fish farming ☐ Fish processing ☐ Fishing methods ☐ Fishing laws and regulations ☐ Co-management of fisheries ☐ Protection or restoration of areas where fish live and breed ☐ Other

R: FISHING RESTRICTIONS

64. Do you know of any restrictions to fishing in your community area? ☐ Yes ☐ No
65. What kind of restrictions are there? ☐ Closed area ☐ Closed season ☐ Restrictions to fishing gear or methods ☐ Restrictions to boat or engine size ☐ Restrictions to catching certain species ☐ Restrictions to catching certain sizes ☐ Other
66. Do you approve of this restriction "${selected_kind_restriction}"?
67. Why do you approve?
68. What type of fishing gear or method is not allowed? ☐ Fish traps ☐ Longlines ☐ Handlines ☐ Surface gillnets ☐ Bottom gillnet ☐ Trawlers ☐ Beach saines ☐ Purse seines ☐ Harpoon ☐ Collect (intertidal activities) ☐ Mosquito net ☐ Others
69. Do you approve of this ban "${selected_disallowed_fishing_gear}"? ☐ Yes ☐ No
70. Why do you approve it?

71. To your knowledge do most people comply with the fishing restrictions? ☐ Yes ☐ No
72. Why do they comply?
    - ☐ Yes, because the community actively enforce the restrictions
    - ☐ Yes, because the local authorities enforce the restrictions
    - ☐ Yes, because of local traditions, customs or beliefs
    - ☐ Yes, because they agree with the restrictions
73. Why do they not comply?
    - ☐ No, they don't comply because they don't know about the restrictions
    - ☐ No, they don't comply because there is no risk of getting caught
    - ☐ No, they don't comply because the punishment if you get caught is not so high
    - ☐ No, they don't comply because they need food
    - ☐ No, they don't comply because they need money
    - ☐ No, they don't comply because they are not from the community
    - ☐ No, they don't comply because of other reason
74. Who decided about the fishing restrictions?
    - ☐ Central government
    - ☐ Local authorities
    - ☐ Local Community Fishing Council
    - ☐ Other local fishing organisation
    - ☐ Others
75. How did you find out about the fishing restrictions?
    - ☐ Radio/TV
    - ☐ Newspaper
    - ☐ Internet/mobile phone
    - ☐ Meeting
    - ☐ Poster/sign
    - ☐ Local Authority
    - ☐ Local Community Fishing Council
    - ☐ Fishing cooperative or organisation
    - ☐ Local fish market
    - ☐ Friend, neighbour (word by mouth)
    - ☐ Other:
76. In your view, are there any problems affecting catches of fish or seafood in your community negatively? ☐ Yes ☐ No
77. What kind of problems affect catches of fish or seafood in your community negatively?
    - ☐ Too many people in the community fishing too much (overfishing)
    - ☐ People from outside the community fishing too much
    - ☐ People using bad fishing methods or gears
    - ☐ Pollution from sewage or industry
    - ☐ People destroying places where fish live and breed

- ☐ Climate Changes
- ☐ Others

78. Specify what method / gear ☐ Fish traps ☐ Longlines ☐ Handlines ☐ Surface gillnets ☐ Bottom gillnet ☐ Trawlers ☐ Beach saines ☐ Purse seines ☐ Harpoon ☐ Collect (intertidal activities) ☐ Mosquito nets ☐ Others
79. Specify how "People destroying places where fish live and breed"
80. Specify what other kind of problems
81. Do you think more fishing restrictions should be introduced? ☐ Yes ☐ No
82. Which fishing restrictions should be introduced? ☐ Closed area ☐ Closed season ☐ Restrictions to fishing gear or methods ☐ Restrictions to boat or engine size ☐ Restrictions to catching certain species ☐ Restrictions to catching certain sizes ☐ Other
83. What additional fishing restrictions should be introduced?

F: SECURITY AND VOICE

84. Please rate the following on a scale from 1 = strongly disagree to 7 = strongly agree:
    - My family functions well for all members.
    - My family's day to day interactions are peaceful.
    - Family members accommodate each other.
85. Please rate the following on a scale from 1 = strongly disagree to 7 = strongly agree
    - Our community is harmonious.
    - Life in this area is very peaceful.
    - There is conflict over access to resources in this area.
    - Local government officials are trustworthy.
    - Households are able to voice their concerns about the use and management of our coastal and marine areas through organisational structures.
    - I feel that our concerns about marine and coastal management are heard.
86. Are any men in the household part of any community organisations? Please select:
    - ☐ Church, mosque or other local religious group
    - ☐ Fishing association or co-operative
    - ☐ Farming association or co-operative
    - ☐ Business association or cooperative
    - ☐ Political organisation
    - ☐ Neighbourhood security group
    - ☐ Environmental or conservation association
    - ☐ Educational, developmental or social welfare association
    - ☐ Don't know
87. Are any women in the household part of any community organisations? Please select:
    - ☐ Church, mosque or other local religious group
    - ☐ Fishing association or co-operative
    - ☐ Farming association or co-operative
    - ☐ Business association or cooperative
    - ☐ Political organisation
    - ☐ Neighbourhood security group
    - ☐ Environmental or conservation association
    - ☐ Educational, developmental or social welfare association

☐ Don't know

88. To what extent are women involved in decision-making in the house, on: (Seldom or not at all, Sometimes, Often, Mostly or always)?
    - How the household earns an income
    - How the household spends its money
    - Where the household lives
    - Children's schooling
    - Having children
    - Women's occupations and activities

G: HOUSEHOLD PERSPECTIVES ON LOCAL CONDITIONS AND DEVELOPMENT

89. Please say how much you agree with the following, based on a scale from 1 = strongly disagree to 7 = strongly agree:
    - The coastal and marine life around here is healthy, diverse and productive.
    - It is important to ensure that inshore fishing areas are not impacted by other developments.
    - There are too many restrictions on fishing in this area, like closed areas, closed seasons or permits.
    - Fishing regulations in this area are well enforced.
    - Anyone should be able to fish or harvest resources in this area.
    - Ecotourism is an important source of income in this area.
    - Small-scale fishing is threatening the marine life in the area.
    - An increase in industrial activities along this cost will increase the risk to our marine life.
    - Our household supports marine wildlife conservation.
    - There is a good balance between protection and use of marine resources in this area.
    - If the government gets more taxes from big business, it will deliver better services in our area.
90. How do you rate the overall level of government services in your local area, including the quality of public roads and recreational spaces? ☐ Very poor ☐ Poor ☐ Below average ☐ Average ☐ Good ☐ Very good ☐ Excellent ☐ Don't know
91. Which of these marine sectors is a key source of formal employment in your community?

    ☐ Coastal tourism ☐ Oil and gas ☐ Fish processing ☐ Shipbuilding ☐ Marine fisheries ☐ Ports ☐ Aquaculture ☐ Transport ☐ Marine Renewables ☐ Desalination ☐ Coastal protection ☐ Marine biotechnology ☐ Don't know
92. How would you rate the general availability of marine sector formal jobs for men, women and youth in your community? (on a scale of 1 (not available) to 7 (abundant))

    ☐ For men

    ☐ For women

    ☐ For youth
93. Which types of marine sector development in this area would provide <u>this household</u> with the best opportunities for income? (top 3)

    ☐ Coastal tourism ☐ Oil and gas ☐ Fish processing ☐ Shipbuilding ☐ Marine fisheries ☐ Ports ☐ Aquaculture ☐ Transport ☐ Marine Renewables ☐ Desalination ☐ Coastal protection ☐ Marine biotechnology
94. Would you say that your community is fairly represented in blue sector formal jobs in this area? ☐ Yes ☐ No ☐ Don't know

95. Would you vote for a situation where job opportunities are increased if it meant loss of access to small scale fishing? ☐ Probably ☐ Probably not ☐ Don't know
96. And if it only meant loss of access to the marine resources that are collected from the shore at low tide? ☐ Probably ☐ Probably not ☐ Don't know

CC: CLIMATE CHANGE ADAPTATION

97. What hazards or disasters commonly affect your community?
    - ☐ None
    - ☐ Drought
    - ☐ Floods
    - ☐ Heavy storms (wind and rain)
    - ☐ Dry spells
    - ☐ Whirlwind
    - ☐ Bushfires
    - ☐ Others
    - ☐ Don't know
98. How often does this hazard occur?
    - ☐ Every year (recurring)
    - ☐ Once in a year (once off)
    - ☐ Multiple times in every year
    - ☐ Once in every 3 years
    - ☐ Once in every 5 years
    - ☐ Others
    - ☐ Don't know
99. How long does the hazard persist?
    - ☐ hours
    - ☐ days
    - ☐ weeks
    - ☐ Others
    - ☐ Don't know
100. Are there any changes in terms of frequency, duration, and severity of the hazard for the past 5 years? ☐ Yes ☐ No
101. What is the tendency in terms of frequency, duration, and severity of the hazard for the past 5 years? ☐ Increase ☐ Decrease ☐ Don't know
102. Has the hazard impacted the household? ☐ No significant impact ☐ Yes
103. How?
    - ☐ Destruction or damage to Health of household member
    - ☐ Destruction or damage to House
    - ☐ Destruction or damage to Electricity
    - ☐ Destruction or damage to Water or sewage

- ☐ Destruction or damage to Agriculture equipment
- ☐ Destruction or damage to Fishing equipment or boats
- ☐ Destruction or damage to Crops
- ☐ Destruction or damage to Livestock
- ☐ Destruction or damage to Fish catches
- ☐ Destruction or damage to Other – specify

104. Please specify how hazards impacted the HH

105. Time required to recover from "${selected_hazard_impact}" to original status?

- ☐ Less than a week
- ☐ 1 week-1month
- ☐ 1-6 months
- ☐ 6-12 months
- ☐ More than a year
- ☐ Not yet recovered

106. How did you cope with and recover from the hazard?

- ☐ Temporary Job
- ☐ Took a loan
- ☐ Borrowed
- ☐ Used savings
- ☐ Sold Livestock
- ☐ Sold agriculture equipment
- ☐ Sold fisheries equipment/boat/engine
- ☐ Sold other assets
- ☐ Support from family or friends
- ☐ Support from community organisation
- ☐ Support from government authorities
- ☐ Took other action – specify:
- ☐ Got other support – specify:
- ☐ Don’t know
- ☐ None of the above

H: CHOICE EXPERIMENT

Now I would like to ask you about how you feel about potential future development decisions regarding the use of the coastal and marine areas in this county. The government of Tanzania is embarking on the process of Marine Spatial Planning. One of the outcomes of this process will be decisions on the zonation of the coastal and ocean areas for different types of uses, and whether and how this might change from what we have today. Decisions will need to be made about what areas to set aside for protection and tourism, for different types of fishing or aquaculture, for ports and shipping, or for oil and gas exploitation, or other activities. The government will also need to decide how to find a balance between high value activities that generate jobs and taxes to pay for

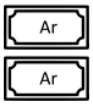
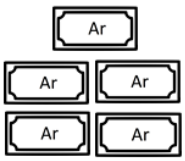
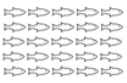
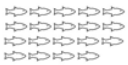
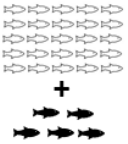
government services, and the status of natural resources from which households derive material and non-material benefits.

Depending on how different types of developments or activities are prioritized for this area, it might affect your household in the following ways. Firstly, **household income from formal or casual employment** could change. It might go up if the area undergoes development in different sectors, or it could even go down if some activities are moved away from this area. Secondly, it might affect the **amount of marine resources** that you would have access to **in inshore and inshore areas**. This could change as a result of changing the area available for fishing and/or the impacts from other sectors. Thirdly, it will also affect the level of **protection of coastal and marine ecosystems and wildlife,** and the capacity of these systems to generate benefits such as recreation or protection from storms, or helping to reduce climate change. This would be determined by how much area is set aside in reserves, as well as how ecosystems might be impacted by other types of developments.

In this exercise I am going to show you the potential outcomes of three possible marine spatial planning scenarios, and then I am going to ask you to choose which one you would vote for if you had the choice. We'll do this four times.

Before we start, I need to mention the COVID pandemic. We realise that the world has changed a lot during the COVID pandemic. We'd like you to consider the situation before the pandemic, as being the business as usual situation that we expect to return to in the near future. We are comparing everything against this baseline.

Choice Task 1:

Attribute	Business as usual	Option 1	Option 2
Household income from employment 	Same as 2019 	90,000 Ar more 	400,000 Ar more 
Boat-based fishing stocks that households have access to 	Same as 2019 	25% less 	20% more 
Onshore fishing stocks that households have access to 	Same as 2019 	Same as 2019 	50% less 
Level of coastal and marine ecosystems protection 	Same as 2019 	50% more 	20% more 

Please choose your preferred option:

- ☐ Business as usual
- ☐ Option 1
- ☐ Option 2

107. Do you believe that the potential increases in household income shown in this question could be achieved as a result of better coastal planning? ☐ Yes ☐ Not sure ☐ No

I: COVID IMPACT

108. To what extent was this household's income negatively affected by the COVID pandemic? ☐ Very little ☐ Moderately ☐ Greatly ☐ Don't know
109. Did your use of any of the following increase as a result? ☐ Boat based fishing ☐ Marine resources harvested at the shore ☐ Mangrove wood ☐ Sand, salt or other mining ☐ Bush and forest resources ☐ Don't know

That is the end of the interview. Thank you for your time.

Please complete the final part of the form after leaving the interview.

J: INTERVIEW DETAILS

Note: Date, start and end time will be automatically recorded by the programme

Take the GPS location at the house then fill in the details away from the house.

Enumerator:	Supervisor:
Ward:	Village:

Who was present (tick one or both)

- ☐ Adult male
- ☐ Adult female

Was the female able to express herself freely?

- ☐ No
- ☐ Somewhat
- ☐ Yes

Overall quality of the interview (reliability of information given)

- ☐ Poor
- ☐ OK
- ☐ Good

Understanding of the choice question

- ☐ Poor
- ☐ Good

Any other comments, observations or information to take note of? _____

END