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BASELINE REPORT

INRM Madagascar Nosy Manga Baseline Report

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Sound management of natural resources is central to long-term development and resilience. Faced with an urgent need to reduce environmental degradation while improving human well-being, solutions that effectively integrate investments in natural resource management with economic and social development are increasingly urgent. INRM promotes integrated programming across environment and non-environment sectors and across the Program Cycle. INRM supports USAID to amplify program impacts, strengthen gender equality and social inclusion, and identify best practices for integration.

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Acronyms

ARSSI	Ability to Recover from Shocks and Stresses Index
BV	Blue Venture
COBA	Community-Based Associations
CPUE	Catch Per Unit of Effort
FIES	Food Insecurity Experience Scale
HH	Household
INRM	Integrated Natural Resource Management
IP	Implementing Partner
LMMA	Locally Managed Marine Area
NRM	Natural Resource Management
OF	Ocean Farmers
USAID	United States Agency for International Development
VOI	Vondron'Olona Ifotony
VSLA	Village Savings and Loan Association
WCS	World Conservation Society
WWF	World Wildlife Fund

Executive Summary

INTRODUCTION

The purpose of the USAID/Madagascar Nosy Manga Baseline Survey and Report is to provide the United States Agency for International Development (USAID), USAID/Madagascar, and Nosy Manga implementing partners (IPs) with baseline estimates across a range of social indicators, as well as background information on target communities to aid IPs in implementation and participant selection. The Nosy Manga activity will focus on promoting sustainable seaweed and sea cucumber farming in the Menabe region and the MaMaBay seascape in the Sava region, including Makira protected areas, Masoala National Park, and Antongil Bay, with plans for expansion of the sea cucumber farms into Atsimo Andrefana and Anosy.

USAID/Madagascar is conducting this baseline through a buy-in to the USAID Integrated Natural Resource Management (INRM) contract. The survey team includes INRM, two in-country consultants, and the in-country data collection firm, CAETIC. The survey team carried out community surveys and household surveys in all 16 villages across Sava and Menabe, identified by Nosy Manga IPs to roll out sustainable seaweed and sea cucumber farming programs. The household surveys conducted are representative of the targeted villages but are not necessarily representative of the regions. Following this baseline study, the survey team will also develop a simplified social monitoring tool to hand over to the IPs as they roll out in other villages in the future.

The surveys include standard modules on household (HH) demographics, livelihood sources, HH assets, food security and resilience, savings and borrowing, and access to basic services. The surveys also include fishery and gleaning modules on fishing practices at fishing sites, fishery assets, group participation and governance, natural resource use, and participation and attitudes towards natural resource management (NRM) (See details in Annex A).

FINDINGS

DEMOGRAPHICS

The research team completed 312 household surveys across five villages in the Sava region, 262 surveys in the Morondava district of Menabe across six villages, and 210 surveys in the Manja district of Menabe across five villages, supplemented by three community surveys in each village. The households in Menabe are slightly larger than Sava by one-to-two people, are more likely to have more children over five years old, and are more likely to have more youth and more females of reproductive age. About 58 percent of HHs in both regions are headed by a male household head with a female spouse, and 21 percent are headed by a female household head alone with no spouse. Adults and household heads in the surveyed HHs tend to be more educated and literate in Sava than Menabe, with no difference between genders. Adults are 15 to 25 percent less likely to be literate in Menabe than in Sava.

POVERTY AND FOOD SECURITY

Poverty and food insecurity are much more prevalent in the study villages in Menabe than in Sava. On average, HHs in Menabe earn 82 percent of what is earned in Sava. The average HH monthly income without outliers in Sava is 233,108 Ariary (USD 53), and that in Menabe is 199,019 Ariary (USD 45). In Sava, only 12 percent of HHs fall under the USD 1.90 per day poverty line, whereas in Menabe, 44 percent of the HHs do. In Sava, 76 percent of HHs experience little or no food insecurity, compared to only 28 percent in Menabe. Electricity and water access is a huge issue, particularly in Menabe, where only 27 percent of HHs have access to electricity and only 18 percent of HHs have water available in their HHs. In Sava, the lack of access is less severe but also significant. About 60 percent of HHs in Sava and 44 percent of HHs in Menabe have savings. More than half of HHs in both regions that have savings mention saving for emergency cash, for food, and for health problems. For the HHs who do not currently have savings, 48 percent in Sava and 28 percent in Menabe would use the savings for emergency cash for health, while 36 percent in Sava and 52 percent in Menabe would use it to send kids to school, and 24 percent in Sava and 33 percent in Menabe would use it to buy a pirogue[1]. In Sava, building a business (31 percent) was also a commonly mentioned use for savings.

LIVELIHOOD ACTIVITIES

Fishing accounts for a major source of livelihood across the regions for 57 percent of the population, with 65 percent of HH incomes coming from fishing. Nearly all fishing HHs (90 percent) use part of their catch for food – on average about 19 percent of their catch. Around 12 percent of HHs undertake gleaning as a main source of livelihood. Gleaning is a type of fishing method that involved gathering and collecting catch in the shallow water or exposed land in marine areas. For these HHs, gleaning accounts for 55 percent of their HH income in Sava and 37 percent in Menabe. Seaweed farming currently only exists in program villages in Menabe, where 17 percent of HHs in Menabe are involved in seaweed farming, but only 13 percent do so as one of their main livelihoods. The HHs with seaweed farming as a main activity earn, on average, 27 percent of their HH income from seaweed farming (but three percent of HHs with seaweed farming as their primary activity earn 52 percent of their HH income from it).

FISHING

Most fishing households across the region indicate a decrease in catch over the last ten years due to increased fishing competition and climate change. However, the majority of HHs (73 percent in Sava and 87 percent in Menabe) perceive still having enough fish in the sea to provide enough food for everyone who lives in the community. The most common fishing method employed in both regions is net fishing, with 75 percent of fishing HHs in Sava and 87 percent of fishing HHs in Menabe employing net fishing. When eliminating outliers in catch size (larger than three standard deviations above the mean), the average catcher per unit effort (CPUE) in Sava is 20kg per person-day and the average CPUE in Menabe is 17kg per person-day.

[1] A pirogue is a traditional fishing canoe typically mad out of wood.

Most fishing HHs feel confident or very confident that they can continue to access their primary fishing sites, with a smaller percentage feeling so in Sava than in Menabe (68 percent compared to 83 percent). In Sava, 21 percent of fishing HHs report disputes accessing fishing sites, whereas in Menabe, only four percent of fishing households reported disputes. In Sava, the disputes, which were sometimes with groups in the villages and with NGOs, tend to be about fishing gear, area access rules, and rule compliance and enforcement. In Menabe, disputes are about not having sufficient areas and amounts of fish, mostly among groups in the village.

FISHERY MANAGEMENT

Locally Managed Marine Areas (LMMAs) govern the marine areas of all study villages in Sava, and gear restrictions, temporary closures, mangrove closures, and permanent closures are reported by 90 to 100 percent of HHs. In Menabe, LMMAs govern the marine areas for nine out of the 11 villages. The survey asked HHs about the presence of a variety of resource management rules in communes and about attitudes towards these rules. About 80 to 85 percent of HHs in Menabe report the presence of gear restrictions, temporary closures, and mangrove closures in their commune, while 46 percent of HHs report having permanent closures. Sixty percent of HHs in Sava and 50 percent in Menabe would like the number of rules regarding marine and mangrove use to stay the same. More than 90 percent of HHs do not currently have aquaculture closures in their communes, and 64 percent in Sava and 82 percent in Menabe indicate that they would not like to have such a rule.

PERCEPTION OF SEAWEED AND SEA CUCUMBER FARMING

Seventy-five percent of HHs in Sava and 92 percent of HHs in Menabe think that seaweed and sea cucumber farming are good for the village. Commonly mentioned positive aspects of aquaculture are jobs and income provision, with some mentioning opportunities, particularly for women. HHs who think aquaculture is bad for the village see the curbing of fishing activities as the primary harm brought by aquaculture. In both regions, the loss of fishing livelihoods was the most mentioned reason among respondents who view aquaculture negatively, mentioned by 92 percent of negative respondents in Menabe and 76 percent of respondents in Sava. In Sava, 64 percent of respondents that think negatively of aquaculture also mention aquaculture bringing social conflict to the village regarding marine area use. HHs who participate in seaweed farming or who have aquaculture closures in their commune tend to have more positive attitudes towards aquaculture, while HHs that are more dependent on fishing for household consumption tend to view it more negatively.

LAND CLEARING

A substantial 57 percent of surveyed HHs in Sava and 14 percent in Menabe indicate that they intend to clear land in the next 12 months, while only 15 percent of HHs in Sava and four percent in Menabe indicate that they have cleared land in the past year. In Sava, the majority (63 percent) of HHs who cleared land did so in forested land, and 34 percent in fallow agricultural land. The reasons given are mostly to grow more crops to sell (75 percent).

CONCLUSIONS

The proportion of HHs under the poverty line, facing moderate-to-severe food insecurity and lacking basic access to HH electricity and water is substantially higher in study villages in Menabe than in Sava. Further analysis at lower administrative levels, coupled with community leader responses, can be used to provide a clearer picture of the concentration of poverty, public service access, and profiles of most vulnerable HHs within regions.

Land clearing and the intention of land clearing, mostly in forested land, widely exists in Sava, motivated mainly by commercial agriculture. The practice and intention also exist in Menabe, but they are less frequent.

Overall, in both regions, NGOs are mentioned as the most prominent actors in marine management. LMMAs are more prevalent in Sava, but marine resource decision-making seems to be more decentralized to involve local leaders at the village, *fokontany*, and commune level in Menabe than in Sava. However, group decisions other than natural resource use, such as decisions on village social life or government assistance/ material resource distribution, seem to be more decentralized at the village-level in Sava than in Menabe.

There may be obstacles obtaining local buy-in on the Nosy Manga program in certain areas, especially in Sava. The survey results indicate that a quarter of HHs in Sava view aquaculture negatively (compared to only eight percent in Menabe) and may be unwilling to engage with aquaculture programs. The HH surveys indicate that **these HHs perceive aquaculture as in competition with fishing livelihoods, particularly for household consumption, which can create conflict on marine use.** The potential for aquaculture sites to be on their sacred land is another major reason of opposition to aquaculture gathered from qualitative data.

Nuanced findings indicate the need to develop context-specific strategies for participant recruitment and negotiation of marine sites for aquaculture and rules regarding site access for fishing. More detailed village-level and fishing site-level analysis can be used to identify whether these sentiments and disputes are concentrated in particular fishing sites and villages to tailor localized approaches.

On a more positive note, **HHs who currently participate in seaweed farming and those who currently have aquaculture closures in their community tend to view aquaculture more positively**, implying that the hurdle may exist largely in initial access.

Currently, only two percent of HHs overall connect aquaculture activities to marine and fish population protection, mostly viewing it as an economic opportunity not connected to or opposing fishing. However, there is local demand for conservation efforts, and there exists a perception of ecological degradation and threat among 50 to 60 percent of the population, attributing the threat mainly to climate change and some unsustainable fishing. There exists potential to use qualitative understanding of how local populations connect their environmental perception, demand for NRM rules, and HH economic motivations to fishing, to better align and frame the benefits of the Nosy Manga program with the local population's motivations.

Introduction

Madagascar is one of the world's highest-priority countries for biodiversity conservation.[2] Madagascar has more than 5,000km of coastline with more than 250 islands, some of the world's largest coral reef systems, and some of the most extensive mangrove areas in the western Indian Ocean.[3] The richness of Madagascar's marine ecosystems is of invaluable importance to the country, sustaining much of its food stocks and livelihood resources.

However, increasing ocean temperatures brought on by climate change present a number of threats to Madagascar's already-fragile marine environments. Some of these threats include the migration of marine organisms to more favorable temperatures, acidification, and bleaching of coral reefs. The effects of rising ocean temperatures are significantly exacerbated under stressors associated with overfishing, coastal development, sedimentation, and pollution.[4] A projected increase in the frequency and severity of extreme weather events, such as cyclones, are also of notable concern to cause further damage to coastal environments – especially reef surfaces.

Meanwhile, poverty rates in Madagascar are reaching new levels of severity, with an estimated 1.62 million Malagasy facing acute food insecurity in 2022.[5] Extreme poverty poses a significant challenge to Madagascar's development, while high birth rates and unsustainable resource management worsens existing pressures on natural resources, resulting in resource overexploitation. The Malagasy population is particularly dependent on marine ecosystems, with approximately 50 percent of Malagasy residing near the coast and relying on coastal ecosystems as a source of food and livelihood.[6] Madagascar's population is at risk of becoming poorer as natural resource stocks are further depleted, prompting a significant need for sustainable agriculture to support at-risk communities.

The USAID/Madagascar Mission is supporting the Nosy Manga activity to help address the above issues, operating under the Health, Ecosystems and Agriculture for Resilient, Thriving Societies (HEARTH) program, within the Sustainable Environment and Economic Development (SEED) Office. Nosy Manga is a five-year activity that will invest in sustainable aquaculture of seaweed and sea cucumber, targeting both biophysical and livelihood outcomes. The activity includes an alliance of two aquaculture companies: Ocean Farmers (OF) and Indian Ocean Trepang, their international conservation NGO partners (including the World Conservation Society [WCS], Blue Venture [BV], and World Wildlife Fund [WWF]), and the LMMA national network. Nosy Manga will scale up a business model that combines industrial and community-based farming, which was previously developed in the Atsimo-Andrefana region to new landscapes in Mamabay and Menabe. The activity anticipates biophysical

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2 *Ecosystem Profile: Madagascar and Indian Ocean Islands.* Final Version, December 2014.

3 *Treasure Island: New biodiversity on Madagascar (1999 - 2010)*

4 *Impacts of Climate Change on Coral Reefs and the Marine Environment | United Nations*

5 *Madagascar Overview: Development news, research, data | World Bank*

6 *Factsheet – An overview of the WCS Madagascar Marine Program*

impacts related to climate change and habitat protection, in addition to livelihood improvements for Malagasy communities within and around the program's geographical operating areas.

Nosy Manga

Nosy Manga is a five-year activity that will invest in sustainable aquaculture of seaweed and sea cucumber, targeting both biophysical and livelihood outcomes. The activity includes an alliance of two aquaculture companies: Ocean Farmers (OF) and Indian Ocean Trepang, their international conservation NGO partners (including WCS, BV, and WWF), and the LMMA national network. Nosy Manga will scale up a business model that combines industrial and community-based farming, which was previously developed in the Atsimo-Andrefana region to new landscapes in Mamabay and Menabe. The main Strategic Approach includes the following:

- **SA #1:** Strengthening and expanding sustainable industrial sea cucumber enterprises;
- **SA #2:** Expansion and strengthening of sea cucumber and seaweed community-based farming as sustainable alternative livelihoods;
- **SA #3:** Empowerment and engagement of civil society and communities for local governance and management of areas surrounding community farms; and
- **SA #4:** Enhance research and information available for sustainable aquaculture practices.

The supporting Strategic Approach includes the following:

- **SA #5:** Improved harmonization, coordination, and access to information and data for decision-making;
- **SA #6:** Strengthened national governance and legal framework for sustainable aquaculture; and
- **SA #7:** Provide supporting services (health care, education, mobile money) for communities for greater buy-in for sustainable aquaculture enterprises.

The activity anticipates biophysical impacts related to climate change, in addition to livelihood improvements for Malagasy communities within and around the program's geographical operating areas.

The primary goals for Nosy Manga under HEARTH are to:

1. Reduce the pressure on coastal and marine resources through a sustainable market-based aquaculture model that is scaled up with the coastal communities;
2. Alleviate poverty of targeted coastal communities through new income-generating opportunities; and
3. Support the community-based sustainable management of marine resources in targeted areas.

Baseline Design and Methodology

OBJECTIVES

The USAID/Madagascar Nosy Manga baseline survey was designed to provide baseline measurements for activity indicators, and to provide baseline information on communities' well-being, fishing practices, and marine area use and management that will inform activity implementation surrounding each SA outlined above. The Nosy Manga baseline social survey may be followed by midline and endline surveys, at the discretion of USAID/Madagascar and OF.

OF will begin participant selection only after program start-up and on a rolling basis each year. Therefore, INRM, along with OF and USAID, decided to conduct the baseline survey with a random sample of households in each targeted village (since activity participants had not yet been identified). This survey provides important context about the community, supplemented through surveys with community leaders, and information to inform Nosy Manga targeting and implementation. INRM will create a condensed version of the surveys to serve as a monitoring tool for OF as they roll out the program in other locations, which can be used with project beneficiaries as they are identified.

GEOGRAPHIC FOCUS

The geographic focus on the Nosy Manga baseline survey data collection covers the Menabe region on the west coast, and MaMaBay in the Sava region of the east coast of Madagascar. The whole activity will focus on promoting sustainable seaweed and sea cucumber farming in the Menabe and MaMaBay seascapes, including the Makira protected areas, Masoala National Park, and Antongil Bay, with plans for expansion of sea cucumber farms in other villages. The baseline survey will only cover Menabe and Sava since target villages have not yet been identified in the Atsimo Andrefana and Anosy regions. INRM will develop a simplified social monitoring tool to hand over to OF for use in their roll-out in those regions in the future. Figure 1 shows the two focus seascapes that encompass critical coastal zones, including southern regions of Madagascar most affected by prolonged drought and food insecurity,[7] as well as high-priority conservation areas for marine biodiversity in the northeast. Table 1 lists the region, districts, and commune names of the study villages.

[7] Drought in Madagascar (nasa.gov)

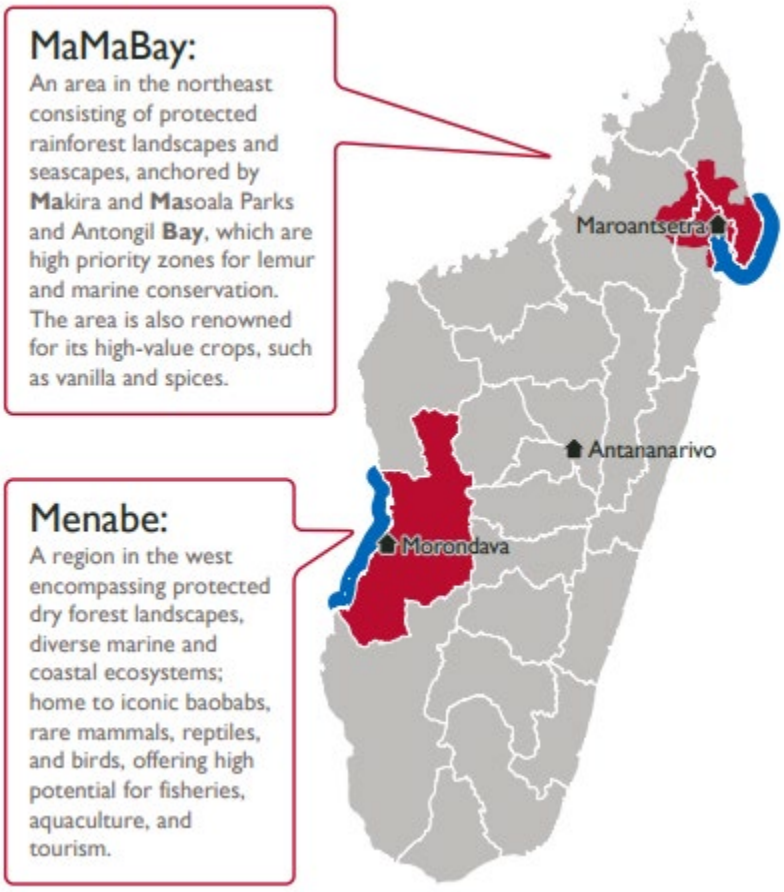


Figure 1: *Map of Nosy Manga program areas (Source: USAID MIKAJY Factsheet, 2019)*

SAMPLING DESIGN

The Nosy Baseline survey was conducted among a representative, random sample of the entire population of HHs of each study village in the Menabe and Sava regions where Nosy Manga activities will take place, amounting to 16 villages in total.[8] The survey team conducted a HH listing of each village, from which the study team intended to randomly select 50 households in each village (the first 42 are sampled households with the remaining eight as replacements). The team chose to not sample through the official government listing of HHs due to concerns of excluding minority ethnic groups. OF experience suggests that the official listings often exclude certain disadvantaged groups that OF views as part of the village and would like to target as potential program participants and indirect beneficiaries. As Table 1 shows, the total study population includes six villages in the Sava region, Antalaha district, and 11 villages in the Menabe region, Morondava, and Manja districts.

[8] This number of villages and associated Fokontany is slightly different than the information listed in the inception report. During fieldwork, upon clarification with local authorities as well as local NGO partners, we found that there was one duplicate village in the original list of villages. There were also some villages that were listed under the incorrect Fokontany. This revised list reflects the corrected information of the study villages after ground-truthing.

Table 1: *Number of villages in planned study population in each region*

Region	District	Commune	Fokontany	Number of program villages	Number of completed surveys per village
SAVA	Antalaha	Vinanivao	Anovandrano	1	54
		Vinanivao	Vinanivao	2	18; 78
		Vinanivao	Beankora	1	0
		Vinanivao	Masoala	2	90
MENABE	Morondava	Belo sur mer	Belo sur Mer	3	42; 42; 42
		Belo sur mer	Marovitike	1	39
		Bemanonga	Lovobe	1	55
		Belo sur mer	Ankilifolo	1	42
	Manja	Andranopasy	Ankoba	2	47; 32
		Andranopasy	Andranompasy I	1	42; 47
		Andranopasy	Andranompasy II	2	42

During fieldwork, the field teams were unable to access two villages in Commune Vinanivao due to refusal of the local population to partake in the study (See section Fieldwork for more detail). The study team adjusted their sampling strategy accordingly to preserve the sample size of 294 HHs in Sava and 462 HHs in Menabe to reach a total sample size of around 750 HHs overall. The research team also had limited information on the size of the program villages prior to fieldwork. During HH listing, CAETIC found that certain villages had less than the target number of HHs to be sampled. In these cases, CAETIC attempted to survey the whole village. Where the target number was not met, CAETIC added the remaining surveys to the target sample number of a nearby larger village. In the analysis, the research team applied sampling weights at the village level accordingly, so the statistics reflect the general population of study villages per region adjusted for the different proportion of populations sampled in each village.

For the community survey, CAETIC field teams were instructed to survey the authority most knowledgeable about local marine governance to complete the long community survey. In most villages, this person is the local Vondron'Olona Ifotony (VOI, or COBA, meaning community-based associations) or fishery group president. The CAETIC field teams were then instructed to identify two leaders of different local ethnic groups to complete the short community leader survey.

SAMPLE SIZE AND POWER CALCULATION

The aim of the Nosy Manga baseline survey is to produce estimates of indicators, including their standard errors and confidence intervals, and to enable a statistical test of differences to detect changes in indicators over time. Power calculations based on relevant outcome indicators are presented below, based on a target sample size of 750 HHs.

For the power calculations, the team used total HH daily expenditure (in USD) as a rough proxy for income from seaweed and sea cucumber (as discussed). OF provided a rough estimate, based on an expected 20 percent increase in income over the life of the activity. Thus, the INRM team estimated the power of the sample to detect a 10 percentage point (pp), 15pp, and 20pp anticipated change in daily HH expenditures with an alpha level of 0.95. Using data of HH expenditure in coastal regions of Madagascar as a proxy,[9] mean baseline expenditure is assumed to be 1.63 with a standard deviation of 1.80.

The study team estimated the power of the sample of 750 HHs per wave to detect anticipated changes with a two-sided test, using the "sampsi" command in Stata. The team also assumed that 15 percent of the variance will be explained by other predictors. With these assumptions, the estimates of the power to detect a 20pp, 15pp, and 10pp change are 94 percent, 75 percent and 42 percent, respectively, where the standard acceptable statistical power level is 80 percent. This result means that the sample size has enough power to detect a change in outcome of less than a 20pp, consistent with OF expectations.

SURVEY CONTENT

INRM developed six major documents associated with the survey: (1) the long community survey instrument, (2) the short community survey instrument, (3) the HH survey instrument, (4) the Interviewer's Manual, (5) the Supervisor's Manual, and (6) the Field Staff Training Manual. A short version of the surveys will also be developed for OF to serve as a monitoring tool as they expand to more program areas.

The survey instruments were developed based on existing, validated tools wherever possible, including the USAID HEARTH Global Monitoring Toolkit.[10] Many of the modules are also adapted from BV's social baseline survey tool, which they shared with the study team. BV uses these tools in coastal villages in the MaMaBay landscape, including questions related to HH wealth indicators, fishery assets, gendered livelihood practices and relevant local associations, natural resource use and NRM attitudes. The study team also included standard Poverty Probability Index (PPI), food security, and resilience indicators that are comparable to the TSIRO Alliance HEARTH activity in Madagascar, drawing from the HEARTH monitoring toolkit and FTF indicators.

[9] We used the 2015 Baseline Study of Food for Peace Development Food Assistance Projects in Madagascar to obtain this statistic. We only use the coastal regions for the mean and standard deviation assumptions of the power calculation. However, these estimates are more than five years old and are not direct estimates from the Nosy Manga implementation area.

[10] Source: https://www.climatelinks.org/sites/default/files/asset/document/2022-07/USAID%20HEARTH%20Monitoring%20and%20Evaluation%20Toolkit%202022-4.pdf

The Nosy Manga Baseline Survey Instrument includes the following survey modules. (Please see Appendix A for a detailed list of information captured under each module, and Appendix C for the full survey modules.)

Long and Short Community Leader Survey:

- Module 1: Respondent details (In short survey)
- Module 2: Village infrastructure
- Module 3: Village livelihoods and marine access rights (in short survey)
- Module 4: Governance of marine areas:
- Module 5: Local conservation initiatives:
- Module 6: Perception of natural resource management (in short survey)
- Module 7: Ethnic Relations (in short survey)

Household Survey:

- Module 1: Respondent details
- Module 2: HH Roster
- Module 3: HH assets
- Module 4: Livelihood
- Module 5: Fishery
- Module 6: Gleaning
- Module 7: Seaweed and sea cucumber farming
- Module 8: Savings, lending, and borrowing
- Module 9: Food security and coping strategies
- Module 10: Participation in groups and associations
- Module 11: Participation and attitudes towards resource management
- Module 12: Energy use, mangrove use, and land clearing

Fieldwork

TRAINING AND PILOTING

CAETIC hosted a six-day training workshop between October 10 –15, 2022 at its training center in Ambatolampy Tsimahafotsy, followed by a pilot in the coastal district Vatomandry, a day trip away from Antananarivo. The training consisted of four supervisors and 23 enumerator trainees, of which 16 were selected for the pilot, and 12 were selected from the fieldwork based on their familiarity with the survey post training, and performance at the pilot. The training, conducted with guidance and oversight from INRM remotely as well as the INRM's in-country Aquaculture Expert (Mamy Andriantsoa) and Data Quality Specialist (Aurélia Frédérich Andriambololoniainjanahary) covered the following material: introduction to the survey, conducting the interview, questionnaire content, fieldwork procedures, entering and managing data on the tablet, and completing survey modules. One day of training was dedicated also to household listing procedures. Hands-on training and practice sessions covered the use of all technical equipment required for survey implementation, including tablet computers with applications for data entry.

At the conclusion of training, pilot surveys were carried out for both the HH and community surveys in the coastal district Vatomandry in Fokontany Maintinandry, a day trip away from Antananarivo. The area purported to have similar characteristics to the Nosy Manga baseline survey population, with a large population reliant on fisheries for their livelihoods.

The pilot survey took place from October 18th –22nd, 2022 for 27 individuals, including: 16 enumerators, four field supervisors, two CAETIC staff, including the field manager, as well as the INRM Aquaculture Expert and Data Quality Specialist. A total of 80 HH pilot surveys and four community leader long surveys were completed. The team also piloted HHs listing, accompaniments, co-enumeration, and back-checks. The team refined the survey questions and translations according to feedback from the pilot.

DATA COLLECTION

Four field teams of enumerators and field supervisors as well as CAETIC management were deployed to the field from October 26th – December 2nd, 2022, for a total of 36 days of field work. The timing was decided based on considerations of OF's rollout timeline in Q1 2023, as well as travel conditions, as influenced by the rainy season. Upon arrival in each commune, CAETIC conducted courtesy visits with each mayor before beginning interviews in the selected *fokontany*. Representatives from the local office of OF and local NGOs in each region were also contacted at the beginning of fieldwork to ensure that they were aware of the expected dates of data collection in each commune, and to assist with the introduction and access to villages as needed. The INRM Data Quality Specialist also conducted supervisory visits to each of the field teams and carried out additional back-check surveys in the first three weeks of field collection.

Upon arrival at each fokontany, CAETIC conducted a courtesy visit to the local chief to explain the purpose of the survey. This was also an opportunity to inquire about information related to the survey, such as the name of hamlets in the fokontany, lodging for field teams, and any local considerations to keep in mind. The support given by the local authorities (fokontany chiefs, elders, and those responsible for local security) was essential to identifying the correct respondents listed in the sample. Based on information received from these visits, CAETIC was able to correct the location of two villages in Sava and identify a duplicate.

Table 2: *Surveys completed by district*

Region	District	Villages listed and surveyed	# Survey attempts	# Surveys completed	# of surveys targeted	% of target achieved	# refusals/ non-response
Sava	Antalaha	5 out of 6*	574	312	294	106	30
Menabe	Morondava	6 out of 6	333	262	252	104	29
	Manja	5 out of 5	229	210	210	100	7
Total			**1136**	**784**	**756**	**104**	**66**

*HHs in two villages refused to be surveyed, but one village of the two was listed.

HH listings as well as community and HH interviews were carried out using tablets and SurveyCTO.

Across the three districts included in the survey, a total of 784 interviews were fully completed out of the 756 targeted. There were no incomplete surveys. In a couple of cases, the field teams followed up with the same HHs that were unable to complete the survey on another day to complete it. In many villages, the field team intentionally scheduled and re-visited the HHs according to village event and farming activity schedules. The 66 HHs that declined to participate or were unable to be located were replaced using the replacement HH list in the random sample for each village. In all villages where HH listing was completed (all except one), one long community leader survey and two short community leader surveys were completed.

Two villages in Antalaha refused the field team entry due to negative perceptions of existing aquaculture projects reducing fishing areas, as well as rumors of the Nosy Manga project. With the negotiation of the local VOI president and WCS representative, the field team were ultimately able to complete the HH listing for one of the two villages and surveyed 18 non-randomly selected HHs identified by the VOI to be supportive of aquaculture thus willing to be surveyed by the field team. These Hhs are excluded from this analysis due to their non-random selection. This resulted in 312 surveys completed in Antalaha district, more than the targeted 294. The 10 extra surveys in Morondava district were in a village where local OF technician indicated the possibility of extending the intervention zone into two hamlets instead of one. Thus, INRM decided to expand the sample size in this area to randomly sample both hamlets. The full sample in this village is included in the analysis.

Throughout data collection, field supervisors performed quality control in the form of accompaniment, co-enumeration, and back-checks. A total of 72 of the surveys received an accompaniment, while 30 HHs were co-enumerated by the interviewer and supervisor, and 79 of the surveyed HHs were contacted for a short back-check survey to verify key responses. Each team organized a daily debriefing to discuss the work progress, to review any challenges faced, clarify questions related to the survey protocol, and solve any problems encountered.

Results

The Nosy Manga baseline survey findings are organized into the following categories: 1)demographics and background characteristics; 2) dwelling characteristics, assets, and land ownership; 3) food security and resilience; 4) livelihoods, access to basic services and savings and borrowing behavior; 5) group membership; 6) agriculture, livestock, and land clearing practices; fishery and gleaning practices 7) perception of fishery and environmental change; 8) aquaculture practices and attitudes towards aquaculture; 9) marine resource management decision-making and participation; and 10) attitudes towards NRM rules.

The study team focuses on the result from the HH surveys and presents inferences made regarding the population of study villages at the regional level. In each of the subsections, the team presents results from key HH-level indicators as well as statistical tests of differences across the region and other relevant disaggregation, such as gender and ethnic categories. Appendix B contains additional tables with summary statistics of indicators described for key outcome areas. To account for the different proportions of populations sampled in each village, the team applied village-level sample weights, so the statistics are representative of the study areas at each regional level.

DEMOGRAPHICS & BACKGROUND CHARACTERISTICS

HOUSEHOLD SIZE AND COMPOSITION

Table 3 presents the summary statistics on size and composition of the HHs. Across the regions, the average HH has between four to five members, with HHs in Menabe having about one to two more members than Sava. The mean number of adults (HH members over 18 years of age) per household is 2.14, with roughly equal number of adult females and adult males. There is about one female of reproductive age (female HH members between age 15 and 49) and one youth (HH members between 15 and 29) in each HH. The mean number of children over five years of age is 1.156 and the mean number of children under five years of age is 0.71 per HH. The HHs in Menabe are slightly larger than Sava, with a mean of 4.61 compared to 3.44. An average HH in Menabe have more female adults (1.12 compared to 0.92), more females of reproductive age (0.95 compared to 0.74), more youth (1.08 compared to 0.74) and more children over five years of age (1.70 compared to 0.89).

Table 3: *Summary statistics of household demographics by region*

	All		Sava		Menabe			
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
Household size	764	4.40 (2.80)	294	3.44 (1.67)	470	4.61 (2.95)	-1.17	0.0
Number of adults (>18)	764	2.14 (1.28)	294	1.83 (0.65)	470	2.21 (1.37)	-0.38	0.0
Number of adult males (>18)	764	1.06 (1.03)	294	0.91 (0.50)	470	1.09 (1.11)	-0.18	0.1
Number of adult females (>18)	764	1.08 (0.64)	294	0.92 (0.51)	470	1.12 (0.66)	-0.20	0
Number of females of reproductive age (15-49)	764	0.91 (0.81)	294	0.74 (0.61)	470	0.95 (0.84)	-0.21	0.01
Number of youth (15-29)	764	1.02 (1.10)	294	0.74 (0.76)	470	1.08 (1.15)	-0.34	0.00
Number of children over five years of age	764	1.56 (1.77)	294	0.89 (1.13)	470	1.70 (1.85)	-0.81	0.00
Number of children under five years of age	764	0.71 (0.81)	294	0.72 (0.76)	470	0.70 (0.81)	0.02	0.78

GENDERED HOUSEHOLD TYPE

Table 4 presents the percentage of households that fall within each gendered household type across the regions. Across the regions, 58 percent of the households are headed by a married male adult, 21 percent are headed by a single male adult, and an equal 21 percent are headed by a single female adult. There were no statistically significant differences in HH head type across the regions.

Table 4: *Gendered household type by region*

	All		Sava		Menabe			
	N	Percentage	N	Percentage	N	Percentage	Diff.	p-val
Female HHH, no spouse	764.00	20.78	294.00	18.58	470.00	21.26	-0.03	0.54
Male HHH, no spouse	764.00	20.99	294.00	17.18	470.00	21.81	-0.05	0.27
Male HHH, w/ spouse	764	58.23	294	64.25	470	56.92	0.07	0.15

EDUCATION, LITERACY, AND CHILDREN'S SCHOOL ATTENDANCE

Table 5 reports the education and literacy of the HH heads across regions. There are no statistically significant differences between the education level of female and male HH heads overall and within regions; thus, those statistics are not reported. However, across the regions, male HH head and male adult education is lower in Menabe than in Sava. An average male HH head in Sava has completed primary school education and 79 percent are literate, whereas an average male HH head in Menabe has an education level of between preschool completion and primary school completion, with only 53 percent being literate. An average female HH head across regions is between preschool completion and primary school completion, with about 64 percent being literate.

When looking at all adults in the population, both the average male adult and female adult have a higher education in Sava than Menabe. In Sava, an average female has an education of between preschool completion primary school completion with 75 percent being literate. In Menabe, the average female also has an education of between preschool completion and primary school completion but with more females only completing preschool, and with only 52 percent of adult females being literate. Similarly for male adults, in Sava, an average male adult has an education of between primary school completion and secondary school first cycle completion with 79 percent being literate. In Menabe, the average male also has an education of between preschool completion primary school completion like female adults in Menabe, and with only 53 percent of adult females being literate.

Table 5: *Summary statistics of HH education and literacy by region*

	Sava		Menabe		
	N	Mean	N	Mean	p-val.
HHH education (All)	293.00	2.04	457.00	1.59	0.00
HHH education (Female)	47.00	1.81	59.00	1.80	0.98
HHH education (Male)	246.00	2.09	398.00	1.53	0.00

	Sava		Menabe		
	N	Mean	N	Mean	p-val.
HHH literacy (All)	294.00	0.79	468.00	0.55	0.00
HHH literacy (Female)	47.00	0.77	59.00	0.62	0.16
HHH literacy (Male)	247.00	0.79	409.00	0.53	0.00
Average female adult education	231.00	1.90	344.00	1.48	0.00
Average male adult education	252.00	2.13	406.00	1.62	0.00
Average female adult literacy	231.00	0.75	351.00	0.52	0.00
Average male adult literacy	253.00	0.79	416.00	0.53	0.00

Tables 6 and 7 report school attendance of school-aged children (between five and 18 years old) across gender at the village and household levels. An average study village contains about 34 girls and 38 boys. School attendance is more prevalent in Sava (66 percent of the villages' school aged children attend school) compared to Menabe (only 43 percent). The team found no statistically significant difference in school attendance between boys and girls.

The reasons given by respondents for lack of school attendance include access (distance to school and money for tuition), provision (no teachers in schools), children wanting or needing to work, children being sick, and marriage or pregnancy for girls. In Sava, the most mentioned reason for non-attendance was lack of money for tuition. In Menabe, the most frequently mentioned reason was distance to school. Having no money for tuition and no teachers in schools were also prevalent reasons mentioned.

Table 6: *Percentage of school-aged boys and girls in school per village by region*

	All		Sava		Menabe		
	N	Percentage	N	Percentage	N	Percentage	Diff.
Percentage of village school-aged boys in school	15	47.07	7	66.23	11	42.93	23.30
Percentage of village school-aged girls in school	15	50.83	7	70.29	11	46.63	23.66
Percentage of village school-aged children in the village in school	15	49.46	7	68.59	11	45.32	23.27

Table 7: *Percentage of school-aged children in school per HH by region*

	# of HHs with children	Percent of girls in school	Percent of boys in school	p-val.
Percentage of HH school-aged children in school (All)	199.00	34.21	45.86	0.07
Percentage of HH School-aged children in school (Sava)	44.00	65.90	73.80	0.25
Percentage of HH School-aged children in school (Menabe)	155.00	30.95	42.99	0.09

ETHNICITY

Table 8 presents the respondent ethnicity breakdown across the two regions. The ethnic composition of each region is widely different. A total of 84.4 percent of HHs in Sava are Betsimisaraka, whereas Antaimoro, Merina, and Betsileo mainly compose the other minority groups. In Menabe, Vezo compose the majority (70.6 percent) of HHs, with Sakalava being the second largest group (24.9 percent), with Betsileo, Mahafaly, and Antandroy mainly composing the other minority groups. For subsequent analysis of ethnic group comparisons, the team created five categories of Betsimisaraka, Sava minority groups, Vezo, Sakalava and other Menabe minority groups.

Table 8: *Ethnicity composition by region*

Ethnicity	Region		
	Sava (percentage)	Menabe (percentage)	Total (percentage)
Bara	0.0	0.2	0.1
Mahafaly	0.0	0.9	0.5
Antandroy	0.3	0.9	0.7
Vezo	0.7	70.6	43.7
Sihanaka	0.3	0.2	0.3
Sakalava	0.0	24.9	15.3
Antaifasy	0.7	0.0	0.3
Antambahoaka	0.7	0.0	0.3
Antaimoro	4.8	0.0	1.8

Ethnicity	Region		
	Sava (percentage)	Menabe (percentage)	Total (percentage)
Antanosy	0.7	0.4	0.5
Betsimisaraka	84.4	0.0	32.5
Merina	2.4	0.4	1.2
Tsimihety	1.0	0.0	0.4
Tanala	0.0	0.2	0.1
Betsileo	2.7	1.3	1.8
Foreigner	0.7	0.0	0.3
Other	**0.7**	**0.0**	**0.3**
Total	**100.0**	**100.0**	**100.0**
N	**294**	**470**	**764**
Pearson chi2(16)= 724.833			
p-value= 0.000			

MIGRATION

Figure 2 presents the percentage of HHs in which the respondent was born in the village, as well as reasons for migration, if they are not native to the village. The team assumes that the migration status of the respondent reflects that of the HH. Across the regions, about 54 percent of HHs are native to the village, with no significant differences across regions. Out of the non-native HHs, 73.5 percent migrated for economic reasons across the regions. In Menabe, 15.4 percent of HHs migrated because of conflict, whereas only 2.6 percent in Sava migrated because of conflict. In Sava, 17 percent of HHs migrated because of marriage, whereas only 6.2 percent in Menabe migrated for marriage. Very few HHs across the regions (zero to one percent) attribute climate change as their reason for migration.

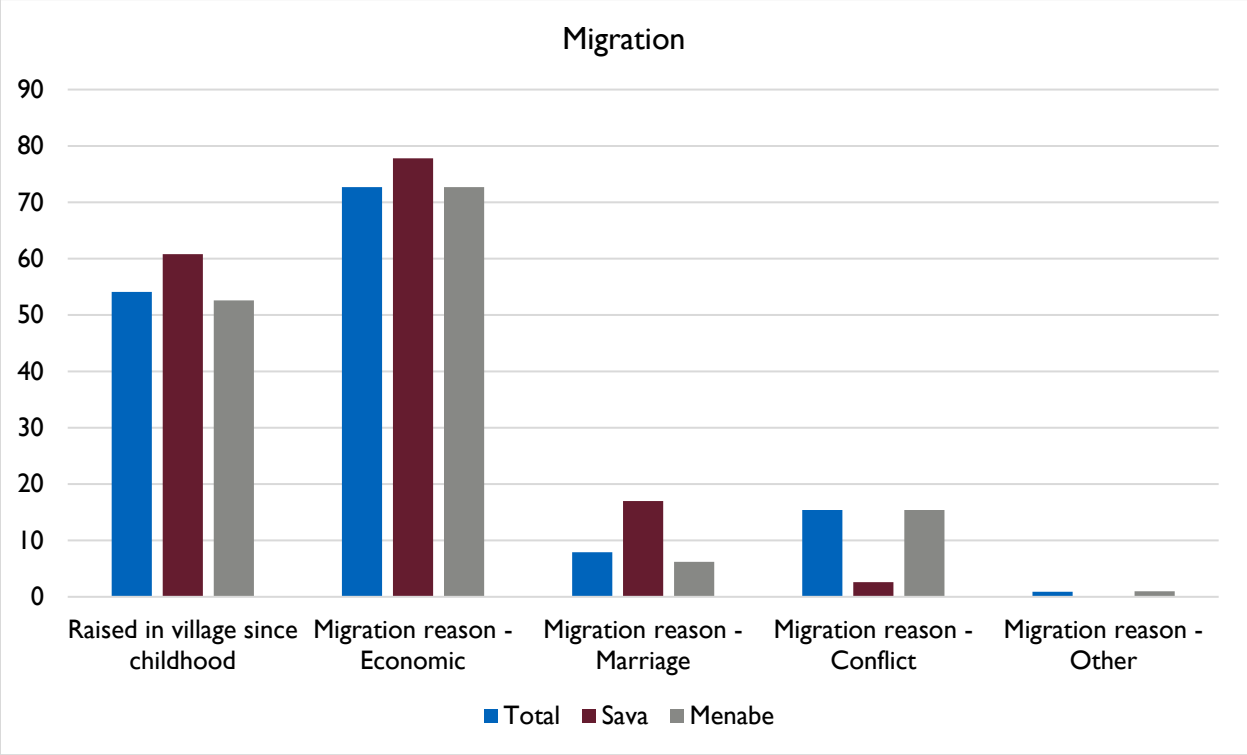


Figure 2: *Migration responses by region*

DWELLING CHARACTERISTICS, ASSETS AND LAND OWNERSHIP

DWELLING CHARACTERISTICS

Figure 3 describes the dwelling characteristics across regions. The main wall materials are similar across the regions, with 62 percent of households using cement and 31 percent using thatch/palm/leaves. The main material of the roof is also similar across regions, with 72 percent of HHs using thatch/palm/leaves and 27 using sheet metal. The main material of the floor differs substantially between regions. In Sava, 30 percent of HHs use wooden boards and 30 percent use palm/bamboo/tree trunks. In Menabe, 54 percent of HHs use woven mats, and 11 percent have bare ground.

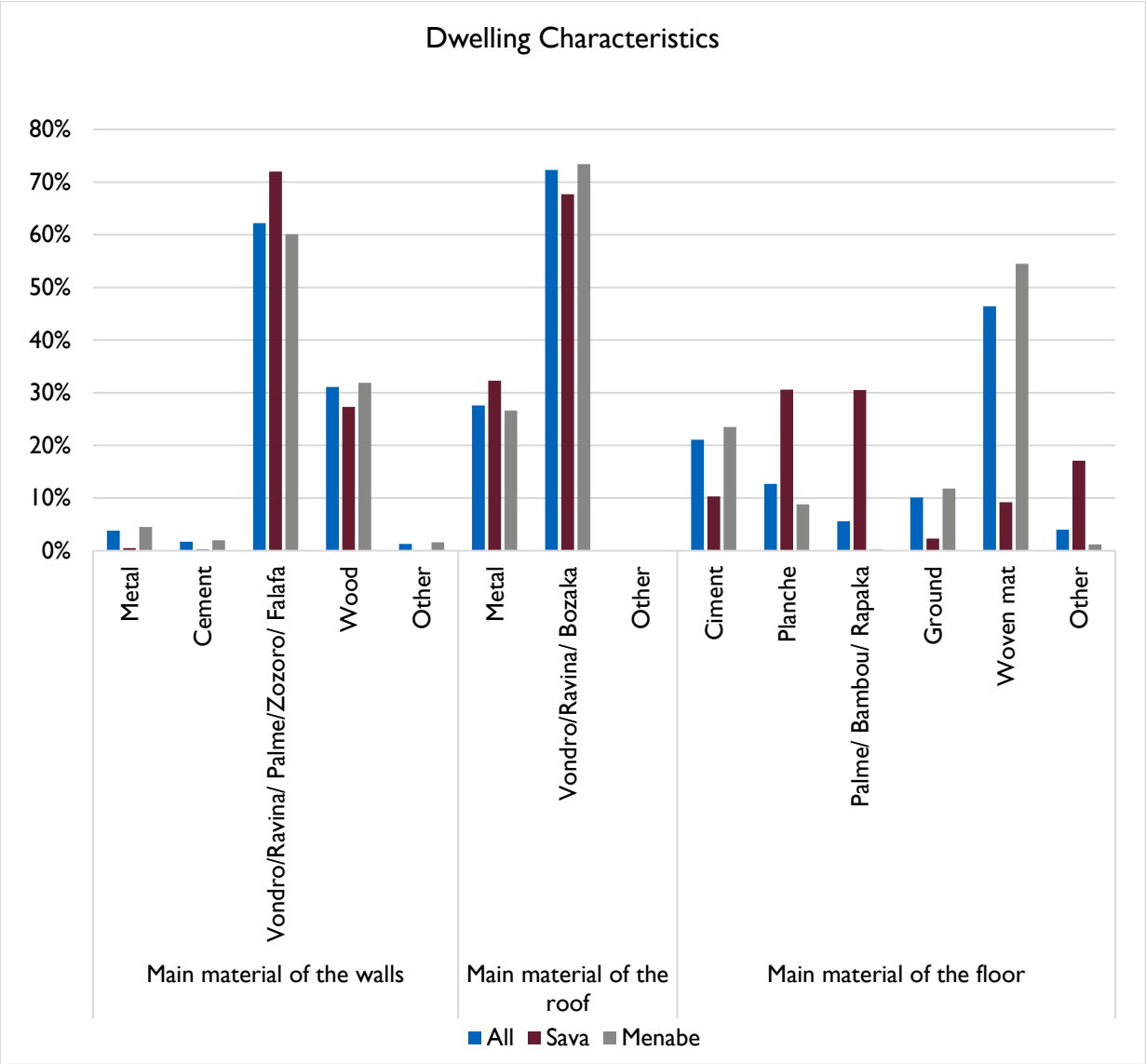


Figure 3: *Dwelling characteristics by region*

HOUSEHOLD TRANSPORTATION ASSETS

In both regions, 99 percent of HHs do not own any land-based motorized vehicles, including motorcycles/scooters, tractors, and cars. Only 1.4 percent of HHs own a bicycle. However, the majority of HHs in both regions (69 percent in Sava and 83 percent in Menabe) own at least one pirogue. HHs own on average 0.8 pirogues in Sava and 1.1 pirogues in Menabe.

Figure 4 presents characteristics of the pirogues that HHs own in the sample. All of the pirogues that the sampled HHs own are wood. While the majority have no motor, five percent of pirogues in Sava and one percent in Menabe have a motor. The average carrying capacity of the pirogue is four people, but ranges from one person to 30 people. The average age of the pirogues is two years old in Sava and

one year on in Menabe, ranging from zero to ten years. A total of 64 percent of the pirogues in Menabe have a sail, compared to 19 percent in Sava.

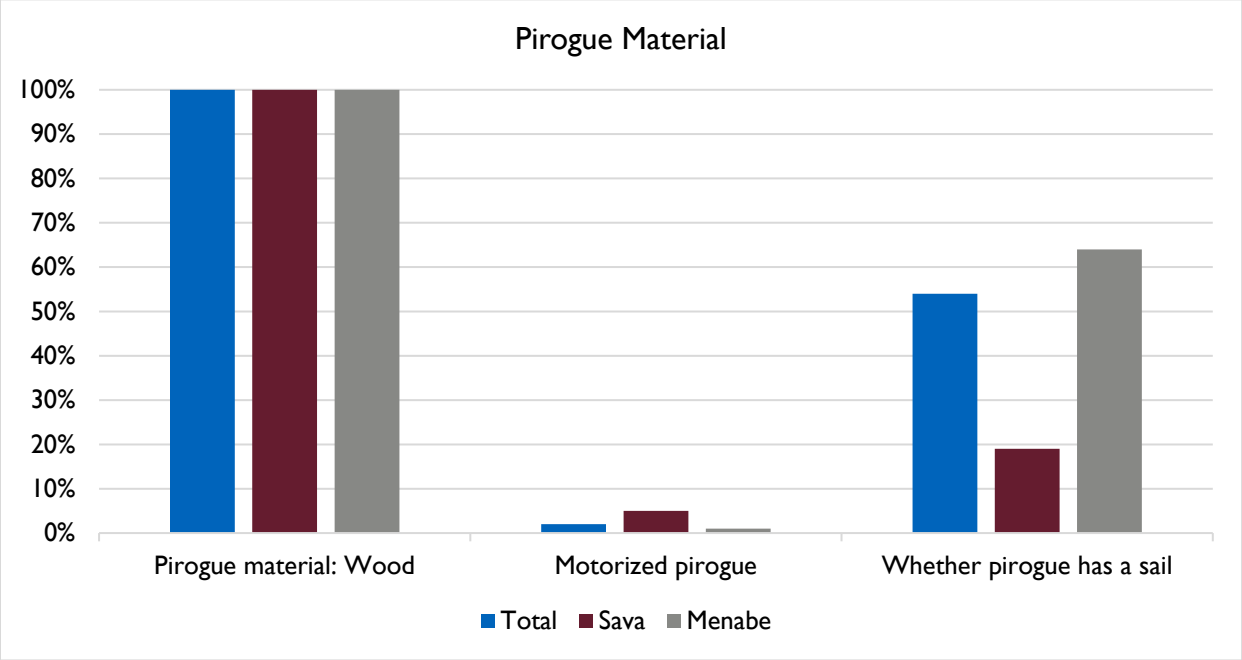


Figure 4: *Pirogue materials of HHs that own at least one pirogue, by region*

LAND OWNERSHIP

Most (85 percent) of the HHs in both regions own their house, and 68 percent of HHs in Sava and 84 percent of HHs in Menabe own the land on which the HHs live. Of the HHs that own their land, 45.2 percent are not recognized by the state (formal land title deed from the office of Service Foncier Domanial et Topographique) nor by the head of the fokontany (customary recognition). In Sava, 11 percent are recognized by both the state and fokontany, 21 percent recognized only by the state and 25 percent only recognized by the fokontany. In Menabe, 45.5 percent of the land ownership is recognized by the state only, nine percent by the fokontany only, and none are reported to be recognized by both. Independent of house ownership, 51 percent of HHs across the region own land elsewhere for building a house.

GROUP MEMBERSHIP

Respondents were asked whether eight types of groups or associations existed in their community. Figure 5 shows the percentage of HHs in each region that indicated that the group type exists in their community, and Figure 3 shows the percentage of HHs of only the villages where at least one HH indicated that the group type exists in each region, that also have at least one HH member who participates in the group.

The most prevalent groups in both regions are agriculture/livestock/fisheries producer groups (95 percent in Sava and 83 percent in Menabe), local government (100 percent in both regions), and

religious groups (98 percent in Sava and 85 percent in Menabe). In Sava, credit or microfinance groups are also prevalent, with 83 percent of HHs reporting having one in their community. In Menabe, only 36 percent of HHs reported having a credit or microfinance group, with one village having no HHs that reported having a microfinance group in their community.

To understand the prevalence of group participation, the study team looked at the percentage of HHs that indicate that they have HH members who participate in the group type. In the calculation of percentages for each group type, the team excluded villages where no HHs indicate the group type exists in their community. The groups that have the most participation across the regions are religious groups. About 64 percent of HHs in both regions participate in a religious group. The second most prevalent participation is in agriculture/ livestock/ fisheries producer groups, where 55 percent of HHs in Sava and 32 percent in Menabe have HH members that participate. In Sava, where microfinance groups are more prevalent than in Menabe, 44 percent of HHs participate in a microfinance group, whereas in Menabe only 14 percent of HHs participate.

While local government exists across the villages, only about three percent of HHs across the regions reported having HH members who participate in it. Only 2.4 percent of HHs reported having civic groups in their community, and no HHs in Sava and only one HH in Menabe in our sample participated in it.

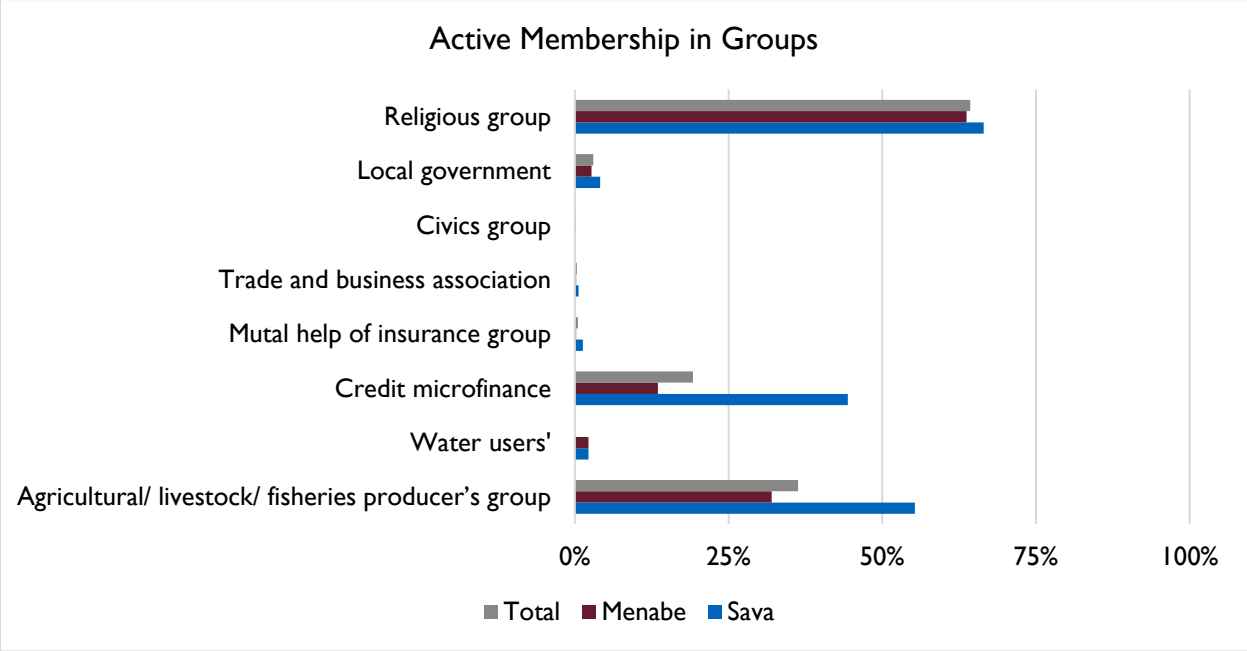


Figure 5: *Percentage of HHs that participate in each group, by region*

FOOD SECURITY AND RESILIENCE

The study used the Food Insecurity Experience Scale (FIES) to measure food security, and the Ability to Recover from Shocks and Stresses Index (ARSSI) to capture the ability to recover from shocks. The team modified the standard ARSSI module that asks about shock experience on 16 types of shocks to condense it to general shock and modified the shock-exposure correction procedure accordingly. The social capital indicator is a Feed the Future (FTF) standard indicator.

FOOD INSECURITY

FIES captures the level of food insecurity that a HH experiences during the 12 months prior to data collection. The module asks whether the HH experienced eight dimensions of food security in the past 12 months. Based on their response, each HH is assigned to a category of food insecurity severity (little or no, moderate, or severe insecurity). Consistent with the PPI, households in Sava are a lot more food secure than HHs in Menabe. In Sava, 76 percent of HHs experience little or no food insecurity, 23 percent experience moderate food insecurity, and only one percent experience severe insecurity. In Menabe, only 28 percent of HHs experience little or no food insecurity, while 56 percent of HHs experience moderate insecurity, and 16 percent experience severe food insecurity.

RESILIENCE - ABILITY TO RECOVER FROM SHOCKS

The ARSSI is an indicator that measures the ability to recover from shocks by asking about a HH's ability to currently meet food needs and future needs after experiencing a major shock in the past 12 months. These questions result in an index that ranges from two-to-six, where higher values indicate more resiliency. The response to ability to meet food needs is then corrected with the level of shock experience, where the ability to recover is adjusted downward if a HH's level of shock exposure is below the mean of the population, and adjusted upward if a HH's level of shock exposure is above the mean of the population.

Around 29 percent of HHs in Sava and 37 percent of HHs in Menabe self-reported having experienced difficult times in the past 12 months. These shocks seriously impacted the HH's economic situation. After adjusting for level of shock exposure, of the households that experienced shocks, the overall ARSSI score is 3.38 on a scale of two-to-six. The score is not statistically different between the two regions.

RESILIENCE - SOCIAL CAPITAL

Another dimension of HH resilience is social capital. This indicator measures the ability of HHs to rely on and support people within their own community (bonding social capital) and on HHs outside of their own community (bridging social capital) "during difficult times." The definition of community is interpreted by the respondent. Each indicator ranges from zero to four. Overall, Sava has slightly stronger social capital than Menabe (3.14 compared to 2.81), and in both regions, bonding capital is stronger than bridging social capital. The study villages in Sava scored 3.48 out of four for bonding social capital and 2.81 out of four for bridging social capital. In Menabe, the study villages scored 3.25 out of four for bonding social capital and 2.37 out of four for bridging social capital.

LIVELIHOODS

This section presents an overview of the livelihoods of HHs across villages in both regions. The team first describes the main livelihood activities of households in each region, as well as average income and percentage of income from the main livelihoods. Then, using the PII created for the TSIRO baseline survey (TSIRO Baseline Survey, 2021), the team predict whether a HH falls below the USD 1.90 per day poverty line based on a series of HH consumption/expenditure and composition indicators. Due to the choice to use FIES and exclude the food consumption module in the survey, the team adjusted the TSIRO PII index and categorization accordingly. The team also describes access to electricity and water, borrowing, lending and mobile money use, and savings in each region.

MAIN LIVELIHOOD ACTIVITIES AND HOUSEHOLD MONTHLY INCOME

The study asked each respondent, "What is the most important, the second most important, and third most important activity your household relies on to meet food and income needs?". Table 9 presents the percentage of HHs that reported each livelihood type as one of their top three main livelihoods. Figure 6 presents this information in graph form for the main livelihoods of each region as well as fishery or aquaculture livelihoods of interest.

Table 9: *Percentage of HHs with activity as one of their top three livelihood sources, by region*

	Sava (percentage)	Menabe (percentage)	Total (percentage)	Signif. of difference between regions
Crop farmer	86.3	24.3	35.3	***
Animal farmer	15.3	11.1	11.8	
Forest exploitation	0.7	2.9	2.5	
Seaweed farmer	0.0	12.9	10.6	**
Sea cucumber farmer	0.2	0.8	0.7	
Fisher	51.3	58.0	56.8	
Diver	0.9	5.1	4.4	**
Gleaner	9.2	12.9	12.3	
Teacher	3.4	5.4	5.0	
Seasonal labor	17.0	14.8	15.2	
Non-fish retailer	21.9	26.1	25.3	
Fish retailor	4.5	1.4	1.9	
Other: unskilled	3.5	8.2	7.4	*

	Sava (percentage)	Menabe (percentage)	Total (percentage)	Signif. of difference between regions
Other: skilled	6.5	9.0	8.5	

Fishing, crop farming, and non-fish retail are the main livelihoods in both regions, with crop farming being much more important in Sava than Menabe. In Sava, 86 percent of HHs rely on crop farming, 51 percent of HHs rely on fishing, and 22 percent of HHs rely on non-fish retail, while 17 percent also rely on seasonal labor and 15 percent on animal farming. In Menabe, 58 percent of HHs rely on fishing, 26 percent on non-fish retail, 24 percent on crop farming, while 15 percent rely on seasonal labor, 13 percent on gleaning, and 13 percent on seaweed farming. There are no seaweed farmers in the sample of HHs in Sava (although community leader surveys indicate that there are seaweed farmers in Sava. More details are included in the seaweed farming and Learning Questions section). Across both regions, only two HHs reported relying on sea cucumber harvesting as one of their main livelihoods, although the none of the community leaders reported any sea cucumber farming activities in their villages.

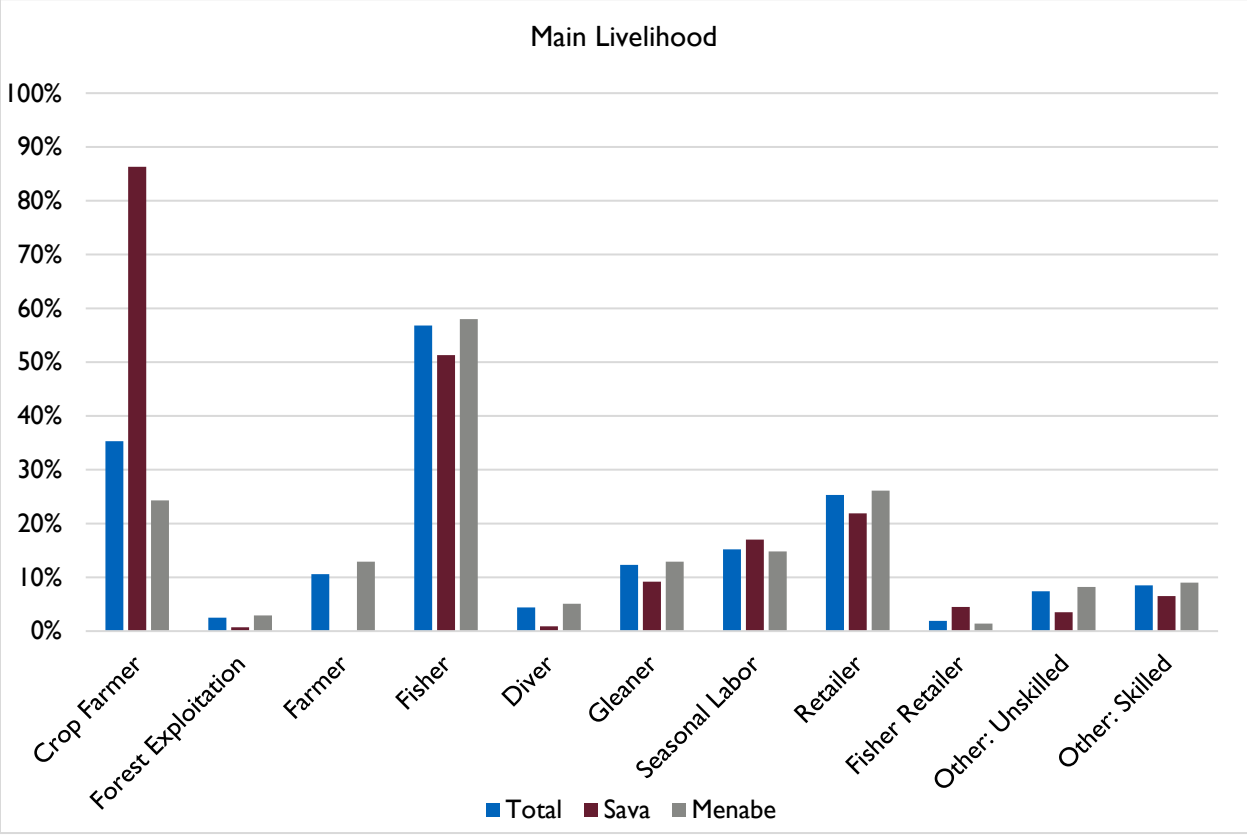


Figure 6: *Main livelihoods by region*

The study also broke down main livelihoods by gendered HH types and HH ethnicity. However, these statistics should be interpreted with caution, as the sampling design does not allow sufficient statistical power to make claims regarding sub-group populations, especially for the less common livelihood types where the sample is scarce.

Table 10 presents the livelihood breakdown by gendered HH types. The reliance of most livelihoods does not differ between HH types, except for forest exploitation, fishing, and non-fish retail. Forest exploitation is almost only reported by single male-headed HHs. Single female-headed HHs rely on fishing less than others (only 23 percent of single female-headed HH), whereas the majority of married male-headed HHs (71 percent) and the majority of single male-headed HHs (53 percent) rely on fishing. The most popular livelihood of single female-headed HHs is non-fish retail (45 percent), whereas a smaller percentage of married male-headed HHs and single male-headed HHs rely on non-fish retail (21 percent and 18 percent, respectively).

Table 10: *Percentage of HHs with activity as one of their top three livelihood sources, by gendered household type*

	Single male headed households (percentage)	Married male headed households (percentage)	Single female headed households (percentage)	Total (percentage)	Signif. Of difference between household types
Crop farmer	44.0	36.4	23.6	35.3	
Animal farmer	7.4	13.4	12.0	11.8	
Forest exploitation	11.6	0.1	0.0	2.5	***
Seaweed farmer	5.1	10.7	15.6	10.6	
Sea cucumber farmer	0.0	0.1	3.3	0.7	
Fisher	52.4	70.5	22.9	56.8	***
Diver	3.9	6.1	0.0	4.4	
Gleaner	10.6	14.0	9.1	12.3	
Teacher	6.9	4.9	3.3	5.0	
Seasonal labor	16.6	13.9	17.4	15.2	
Non-fish retailer	17.6	21.1	45.0	25.3	**
Fish retailor	4.8	1.1	1.2	1.9	
Other: unskilled	10.2	5.9	8.6	7.4	
Other: skilled	6.5	10.3	5.5	8.5	

Table 11 presents the livelihood breakdown by the major ethnic categories in each region. There are statistically significant differences in main livelihoods between ethnic categories in Menabe in crop farming, forest exploitation, seaweed farming, and other skilled activities. HHs of the Sakalava ethnic group rely more on crop farming (65 percent of Sakalava households) than Veza and other numerical minority ethnic groups (18 percent and one percent, respectively). Forest exploitation is also mainly

undertaken by Sakalava HHs, with no other ethnic categories being reliant on forest exploitation. Both HHs of the Sakalava and Veza ethnic groups rely more on fishing (60 and 62 percent), seaweed farming (15 and 10 percent), and gleaning (13 and 18 percent) than HHs of other ethnic groups. HHs of other ethnic groups in Menabe rely mainly on fishing (32 percent), but also on animal farming (24 percent) and teaching (22 percent), seasonal labor (23 percent), and other skilled activities (25 percent). HHs of the Betsimisaraka ethnic group and other numerical minority groups rely on mostly the same livelihoods, except more HHs of minority ethnic groups rely on other skilled activities (15 percent) than Betsimisaraka HHs (five percent).

Table 11: *Percentage of HHs with activity as one of their top three livelihood sources, by ethnic category*

	Menabe-Veza (percentage)	Menabe-Sakalava (percentage)	Menabe-Other (percentage)	Sava-Betsimisaraka (percentage)	Sava- Other (percentage)	Signif. of difference between ethnic categories
Crop farmer	17.6	64.7	1.2	85.6	91.0	***
Animal farmer	8.7	15.6	23.8	14.6	19.2	
Forest exploitation	0.0	16.7	0.0	0.9	0.0	***
Seaweed farmer	14.6	10.3	2.6	0.0	0.0	***
Sea cucumber farmer	1.1	0.0	0.0	0.3	0.0	
Fisher	59.9	61.7	32.3	50.7	55.4	
Diver	6.8	0.4	0.0	1.0	0.0	
Gleaner	13.2	17.5	0.6	9.3	8.8	
Teacher	3.7	4.9	21.8	3.3	4.0	
Seasonal labor	14.6	12.0	23.0	17.1	16.2	
Non-fish retailer	28.3	21.4	16.0	21.7	22.8	
Fish retailor	1.8	0.0	0.0	4.5	4.2	
Other: unskilled	8.0	12.5	1.3	3.8	1.7	
Other: skilled	9.0	1.6	24.7	5.1	15.4	*

HH MONTHLY INCOME AND INCOME FROM MAIN LIVELIHOODS AND AQUACULTURE

The average HH monthly income is 420,928 Ariary (USD 95.72), with similar income across regions. Since the distribution of HH monthly income is heavily right skewed, to better represent the average HH, the team also calculated population statistics excluding outliers, defined as greater than three standard deviations from the mean. Excluding outliers (HHs that earn much higher incomes than the rest), the average HH monthly income is 207,465 Ariary (USD 47.18) across the regions. Table 12 presents the HH income by region, including and excluding outliers. On average, HHs in Menabe earn slightly less income than HHs in Sava (82 percent that of Sava). Table 12 presents the average monthly

HH income by region with and without outliers. The average HH monthly income without outliers in Sava is 233,108 Ariary (USD 53), and that in Menabe is 199,019 Ariary (USD 45.26).

Table 12: *Average income by region, with outliers and excluding outliers (greater than three standard deviations from mean) of total sample.*

	Mean	Std. Err.	95 percent Conf.	Interval
HH monthly income (Ariary)				
Sava	459,246	29,357	401,614	516,878
Menabe	412,648	49,873	314,742	510,555
HH monthly income, excluding outliers (Ariary)				
Sava	243,260	10,344	222,948	263,572
Menabe	200,162	13,365	173,918	226,407

The study also disaggregated HH monthly income by gendered HH type as well as seaweed farming and non-seaweed farming HHs (Table 13). The income of seaweed farming and non-seaweed farming HHs are not statistically significantly different from each other. HHs headed by a single female earn less than HHs with a married male HH head. Single male and single female-headed HH income, as well as single and married male-headed HH income, are not significantly different from each other.

Table 13: *Average income by seaweed farming and non-seaweed farming households (Menabe only), as well as gendered household head types, excluding outliers of total sample.*

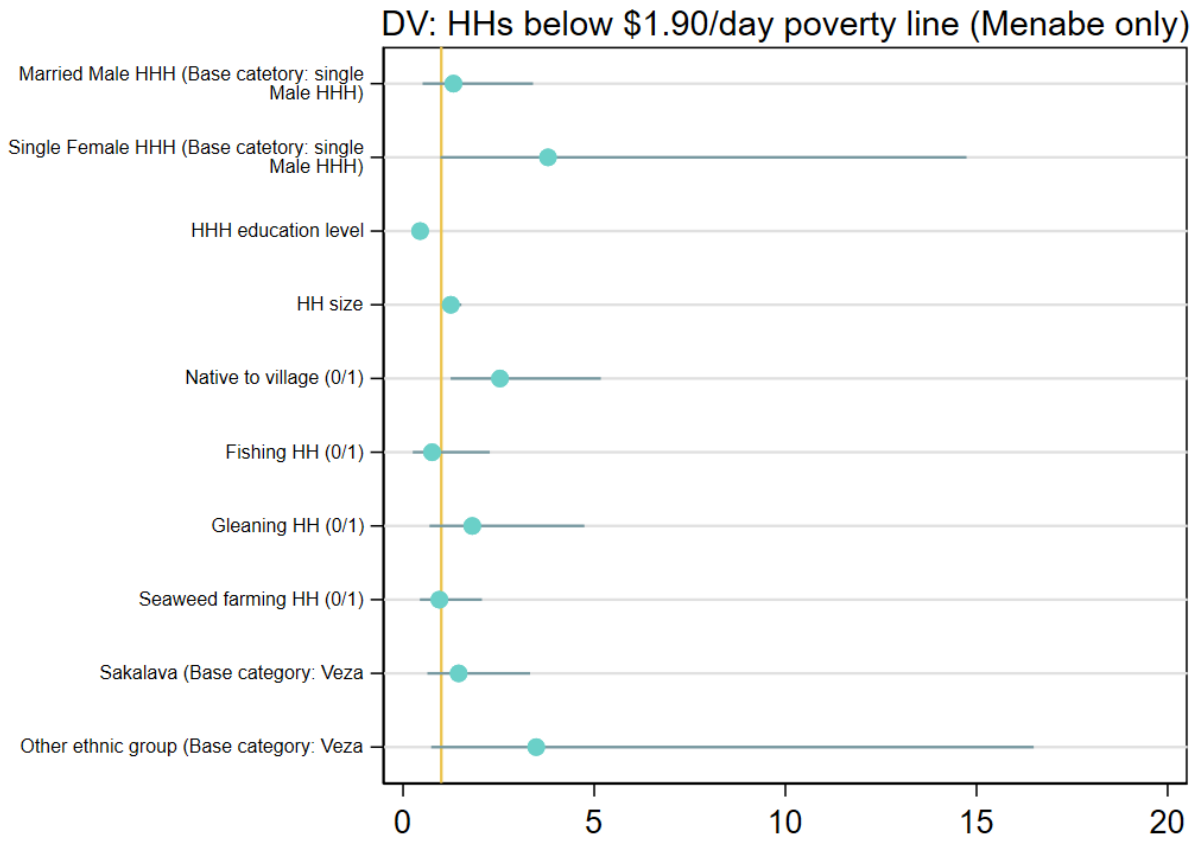
	Mean	Std. Err.	95 percent Conf.	Interval
HH monthly income, excluding outliers (Ariary), Menabe only				
Non-seaweed farming HHs	212,726	17,449	178,430	247,023
Seaweed farming HHs	233,170	23,245	187,481	278,860
HH monthly income, excluding outliers (Ariary)				
Female HHH, no spouse	107,746	16,285	75,766	139,725
Male HHH, no spouse	185,048	26,167	133,664	236,433
Male HHH, w/ spouse	258,662	12,176	234,752	282,572

Table 14 presents the average HH monthly income from livelihood activities, excluding the income outliers. The study only presents the statistics for the more common livelihood activities (crop farming,

fishing, non-fish retail, and in Menabe, seaweed farming), as there are not enough observations of income from less common livelihood sources to make claims for the population of HHs in each region that rely on those livelihoods. In Sava, a HH with crop farming as one of their main livelihoods makes about 71,557 Ariary (USD 16.27) from crop farming, whereas in Menabe HHs that crop farm make only 31,612 Ariary (USD 7.19) from crop farming. For fishing, HHs that fish as one of their main livelihoods make about 165,322 Ariary (USD 37.59) in Sava and 95,413 Ariary (USD 21.70) in Menabe. Likewise, for non-fish retail, HHs that engage in non-fish retail as one of their main livelihoods make about 165,322 Ariary (USD 37.59) in Sava and 95,413 Ariary (USD 21.70) in Menabe, with no statistically significant difference between the regions. HHs that depend on seaweed farming as one of their main livelihoods (only in Menabe) make on average 45,064 Ariary (USD 10.25) from seaweed farming.

Table 14: *Average income by region, with outliers and excluding outliers of total sample.*

Average monthly income from each main livelihood activity (Ariary)			
Region	**Mean**	**95 percent Conf.**	**Interval**
Crop farmer			
Sava	245,758	222,933	268,583
Menabe	161,450	125,590	197,310
Fisher			
Sava	299,236	271,710	326,763
Menabe	238,311	210,447	266,175
Non-fish retailer			
Sava	282,163	233,080	331,246
Menabe	204,503	154,818	254,187
Seaweed farmer			
Menabe	181,933	160,892	202,975



RELIANCE AND INCOME DIVERSIFICATION

The study presents the percentage of HH income from each major livelihood activity to demonstrate the level of reliance of HHs on each major livelihood. Figure 7 shows the percentage of HH income from fishing, gleaning, crop farming, and non-fish retail among the HHs that rely on the activity as one of their main livelihood activities. Fishing composes an average of 65 percent of HH incomes across both regions, with fishing as one of the top three livelihood activities. (HHs that rely on fishing as their primary livelihood earn 76 percent of their HH income from fishing.) The average percentage of HH income from gleaning among HHs with gleaning as a main activity is 55 percent in Sava and 37 percent in Menabe. The average percentage of HH income from crop farming among HHs with crop farming as a main activity is 34 percent in Sava and 22 percent in Menabe. The average percentage of HH income from non-fish retail among HHs with it as a main activity is 57 percent in Sava and 51 percent in Menabe.

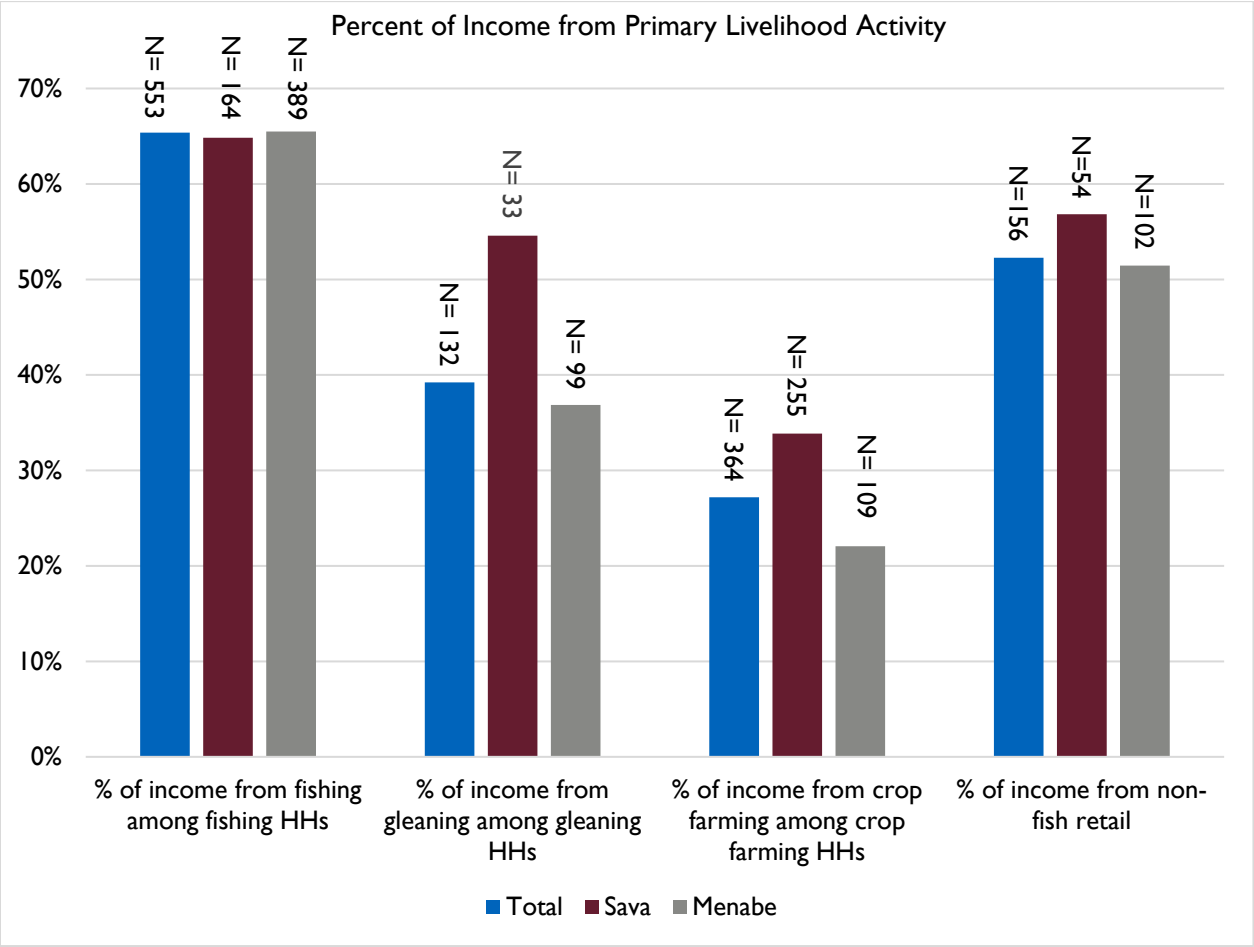


Figure 7: *Percent of income from main livelihoods by region*

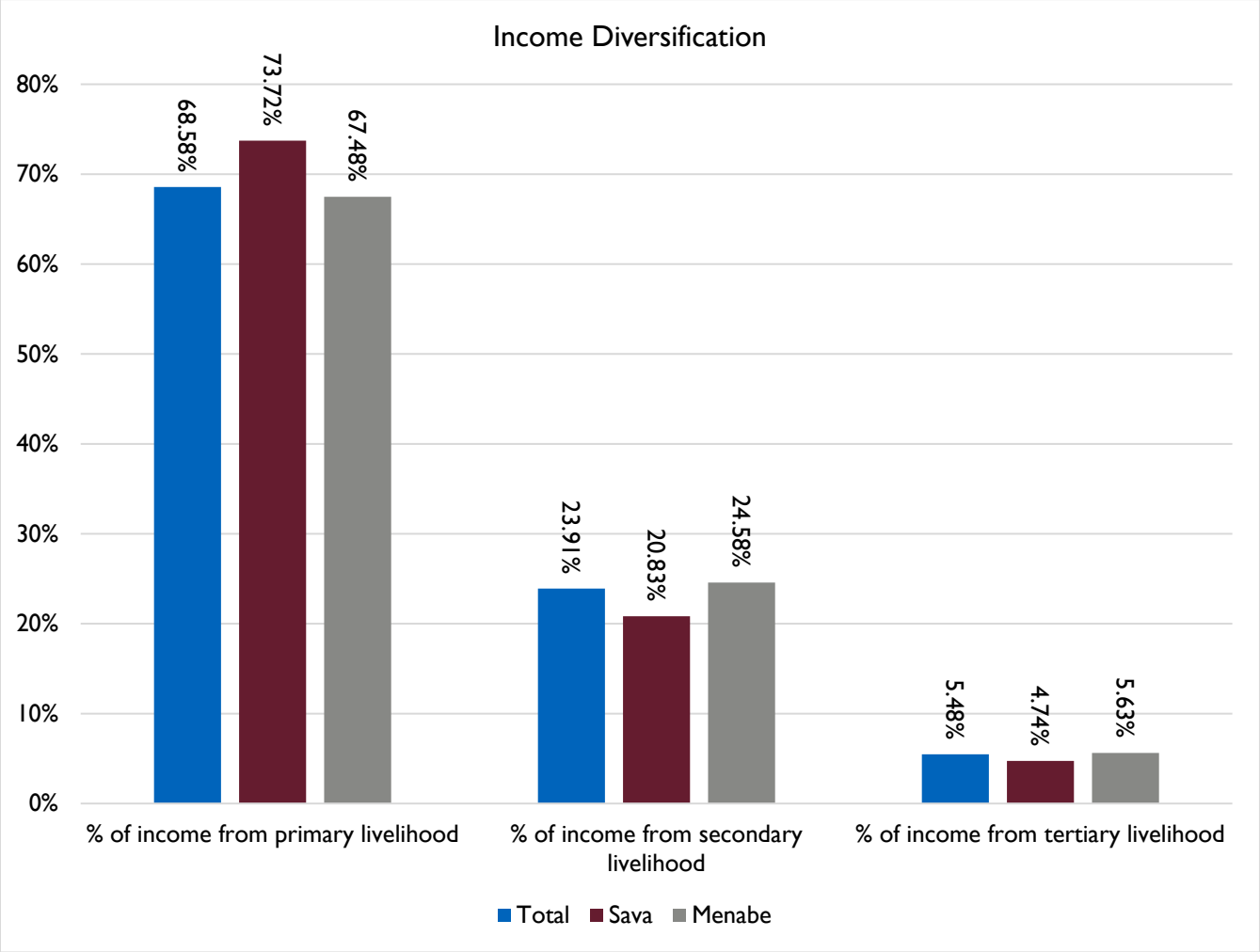


Figure 8: *Income diversification. Percentage of income from primary, secondary and tertiary livelihood sources, by region*

To illustrate the extent of livelihood diversification, irrespective of livelihood source, the study looked at the percentage of HH income from HHs' primary livelihoods, secondary livelihoods, and tertiary livelihoods, respectively, in Figure 8. It shows that the majority of HHs rely on their primary livelihood for about 67 percent of their income, with secondary livelihoods earning them about 25 percent and tertiary livelihoods five percent, with little difference across the regions.

Next, the study looked at the role of seaweed farming in livelihood diversification in Menabe. Figure 9 shows the percentage of income from seaweed farming among all HHs that undertake any seaweed farming activity (even if not as one of their top three livelihoods), as well as those that rely on it as their primary, secondary, and tertiary livelihoods, respectively. The three percent of HHs in Menabe that undertake it as their primary activity earn 52 percent of their HH income from it. Those that rely on it as a secondary activity (seven percent of all HHs in Menabe) earn on average 26 percent of their HH income from it, and those that rely on it as a tertiary activity (three percent of all HHs in Menabe) earn about seven percent of their HH incomes from seaweed farming. HHs that have at least one HH

member involved in seaweed farming, regardless of it being their main source of livelihood or not (35 percent of HHs in Menabe), earn on average 20 percent of their HH income from seaweed farming.

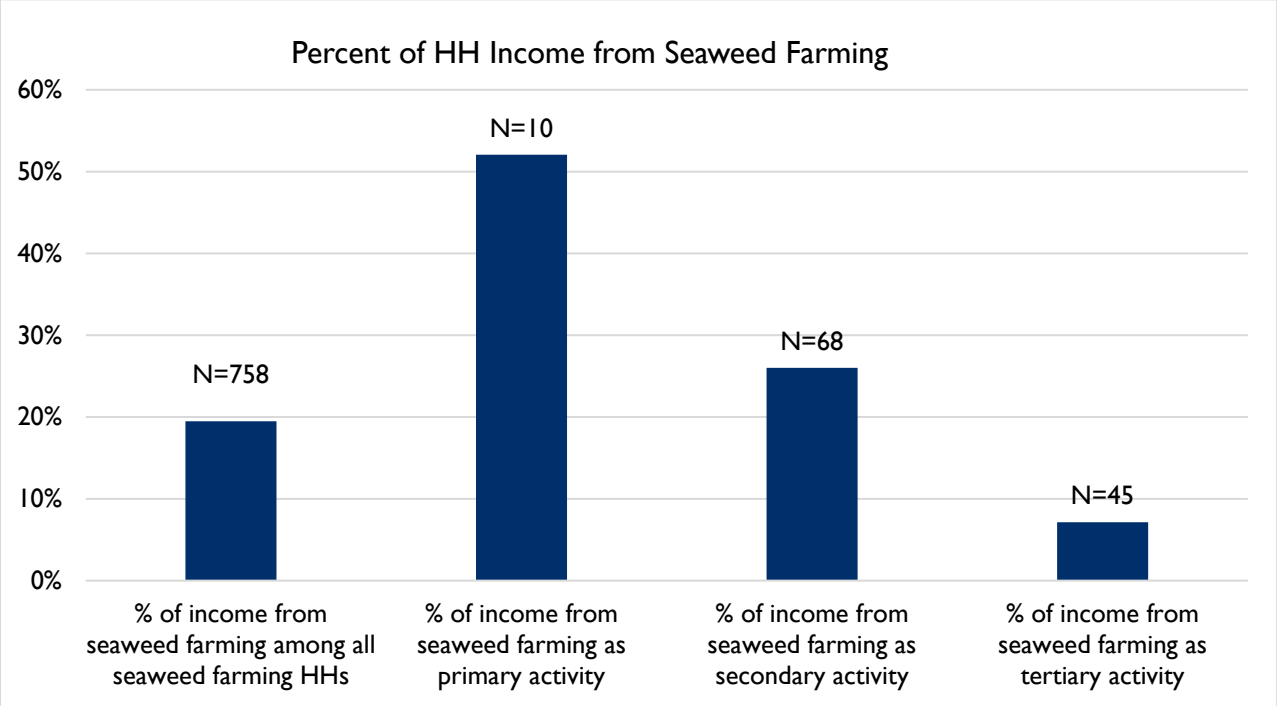


Figure 9: *Percent of HH income from seaweed farming*

PREVALENCE OF POVERTY

Figure 10 shows the distribution of HHs below the poverty line across regions. On average, 38 percent of HHs fall below the USD 1.90 per day poverty line, but the percentage differs significantly across the two regions. Only 12 percent of HHs in Sava, compared to a substantial 44 percent of HHs in Menabe fall below the poverty line.

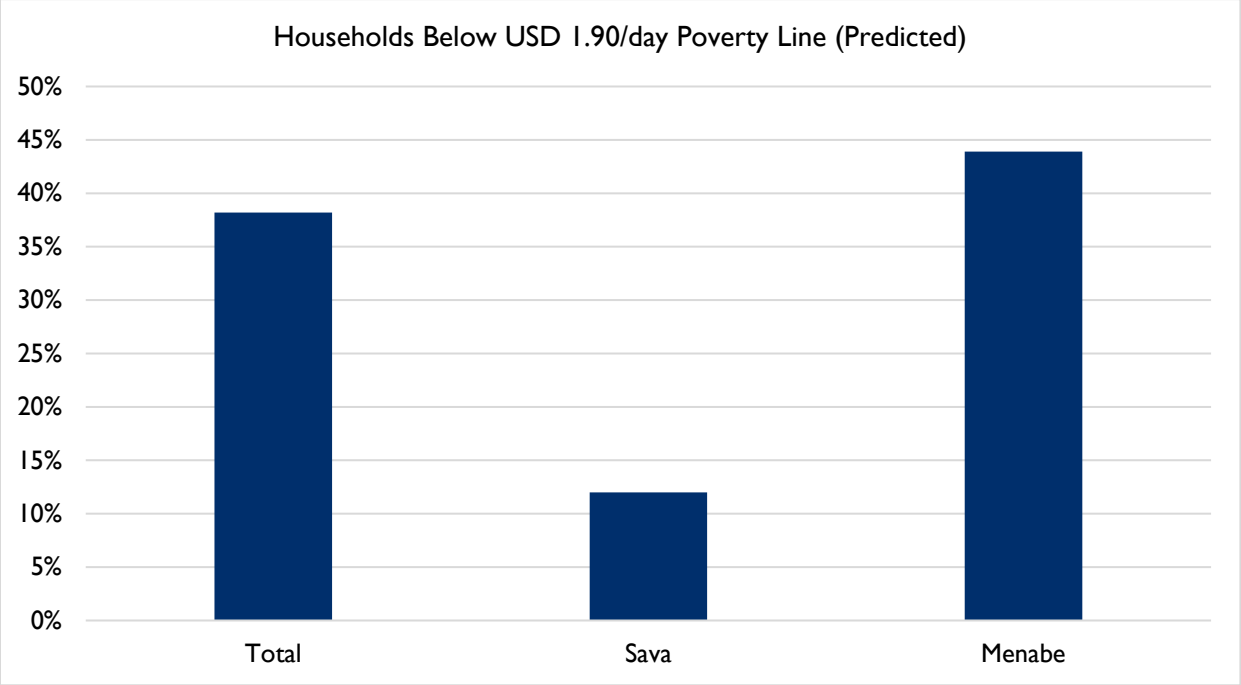


Figure 10: *Percentage of HHs below the poverty line, by region*

To look at the HH characteristics that are associated with poverty, Table 15 presents the multivariate logistic regression results comparing the association between poverty status and a range of socio-demographic and livelihood characteristics, and Figure 11 plots out the coefficients with confidence intervals. The study first tested the association of HH characteristics with poverty while controlling for regional effects.[11] To test the association of regional ethnic groups with poverty, the study also conducted subpopulation analysis using only the sample in each region and added the ethnic categories relevant to each region as an explanatory variable. The result table is presented in odds ratios.

Unsurprisingly, lower educated HHHs and larger HHs are more likely to fall below the poverty line. Model 1 results show that with each increase in education level of the HH head (for example from preschool education completion to primary school education completion), the household is 54 percent less likely to be under the poverty line. The subpopulation analysis indicates that other characteristics associated with poverty may be different in each region. A HH that is larger and native to the village is more likely to be under the poverty line in Menabe, with those who are native 2.54 times more likely, and the addition of a HH member 1.25 more likely to fall under the poverty line. In Sava, being a HH with at least one HH member who fishes decreases the odds of being under the poverty line by 61 percent. Controlling for these HH characteristics, ethnic group categories are not associated with poverty.

[11] We used regional-level fixed effects. Doing so eliminates any regional differences that might influence a household's poverty status, including ethnic groups which have distinct regional dynamics.

Table 15: *Logistical regression result of socio-demographic and livelihood characteristics on poverty (odds-ratio)*

	Model 1: All (HHs below $1.90/day poverty line) Coefficient (SE)	**Model 2: Sava (HHs below $1.90/day poverty line) Coefficient (SE)**	**Model 3: Menabe (HHs below $1.90/day poverty line) Coefficient (SE)**
MHHH w/ spouse	1.17 (0.36)	0.52 (-1.35)	1.32 (0.57)
FHHH only	2.66 (1.71)	0.75 (-0.46)	3.79 (1.93)
HHH education (category)	0.46*** (-5.39)	0.45*** (-4.01)	0.45*** (-5.23)
How many people are in your household? (include you, and babies/children)	1.21* (2.19)	1.04 (0.31)	1.25* (2.17)
Were you raised in this village since childhood?	1.93* (1.97)	0.56 (-1.41)	2.54* (2.56)
Fishing HH	0.65 (-0.94)	0.39* (-2.18)	0.76 (-0.50)
Gleaning HH	1.46 (0.88)	1.14 (0.24)	1.81 (1.21)
Seaweed farming HH	0.98 (-0.05)		0.95 (-0.13)
Menabe	4.87*** (4.73)		
Sava - other		0.33 (-1.66)	
Menabe - Sakalava			1.45 (0.89)
Menabe - other			3.48 (1.58)
N	750	293	457

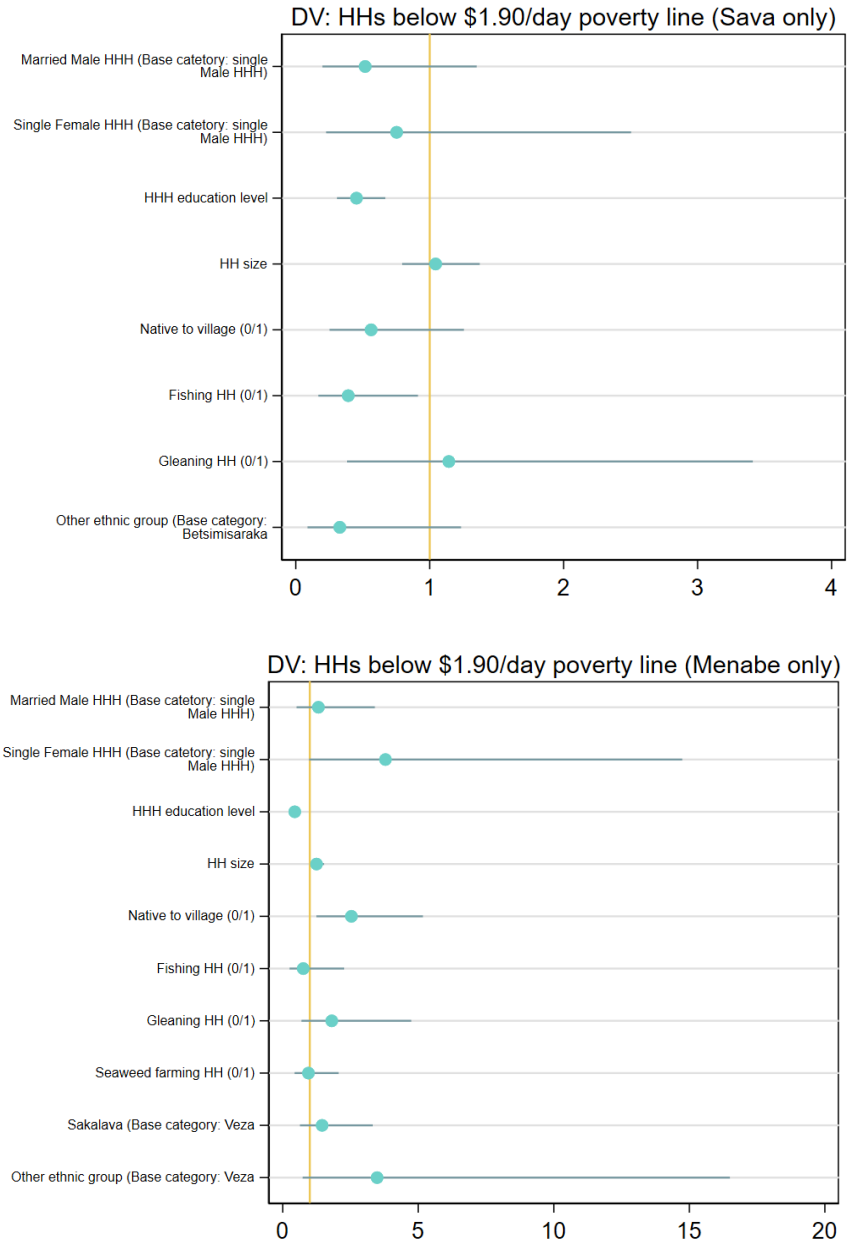


Figure 11: *Coefficient plots of logistical regression result of socio-demographic and livelihood characteristics on poverty, by region (odds-ratio), 95 percent confidence interval*

ACCESS TO ELECTRICITY, COOKING FUEL AND WATER

Figure 12 shows the level and method of HH access to electricity, cooking fuel, and water across the region. Electricity access differs substantially and significantly across the two regions, though sources of electricity are similar. In Sava, 76 percent of HHs have electricity access, whereas in Menabe, only 27 percent do. Out of the HHs that have access to electricity, 90 percent use solar panels as their main

source of electricity, eight percent use batteries as their main source, and two percent use the electrical grid.

With regards to cooking fuel, across regions, 64 percent of HHs use a wood stove only, 21 percent of HHs use a charcoal stove only, and 15 percent of HHs use both wood and charcoal. No HHs in the sample reported using a kerosene or clean energy stove.

Very few HHs have their main source of drinking water within the HH; 85 percent of HHs across the regions rely on village wells as their primary source of drinking water. About 10 percent of HHs have their own well in the HH. For HHs where enumerators were able to observe the place where HH members most often wash their hands, 40 percent in Sava and 82 percent in Menabe did not have water available, and 72 percent in Sava and 98 percent in Menabe did not have soap.

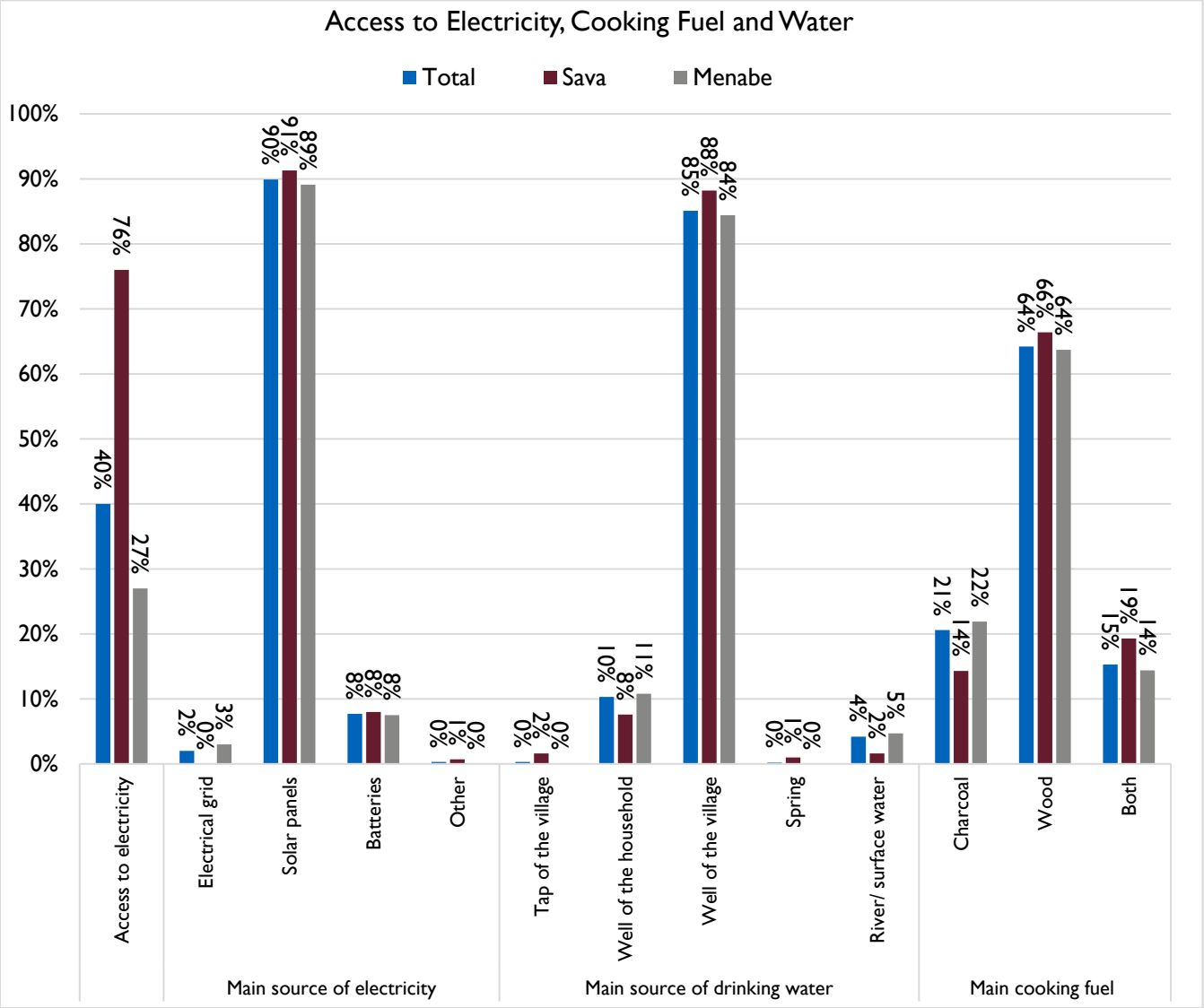


Figure 12: *Access to electricity, cooking fuel, and water by region*

BORROWING & LENDING AND MOBILE MONEY USE

Across the regions, 61 percent of HHs did not borrow any money from others in the past year, and 36 percent borrowed once or twice. Of those that borrowed money once or more, about 91 percent of HHs only borrow from one source: 56 percent borrowed from family, and 38 from a local business-person or shop owner (23 in Sava and 40 in Menabe). No HHs in Sava and only 0.2 percent in Menabe borrowed from NGOs, but 14 percent of HHs across regions borrowed from other entities, including local Village Savings and Loan Associations (VSLAs), friends in the community, and mobile money advances. About 52 percent of HHs across the regions were not asked to lend money in the past year, while 25 percent of HHs were asked by one-to-two people, and 17 percent of HHs were asked by three-to-five people.

Figure 13 presents mobile money services usage prevalence and scope by region. A total of 32 percent of HHs use mobile money, of which, 93 percent report being able to withdraw all their money from their mobile devices, and 93 percent also report being able to use their money on their mobile devices to trade or send to individuals. Only nine percent of those that use mobile money services report being able to trade with shops using mobile devices.

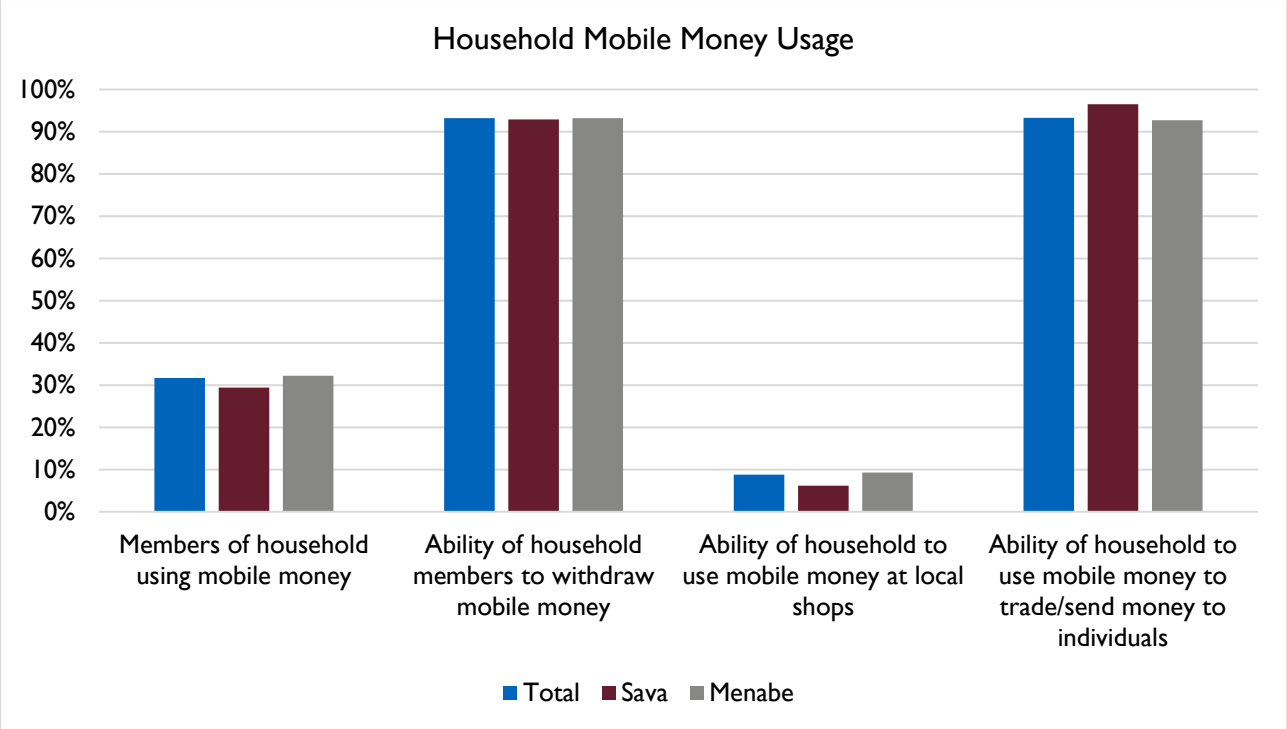


Figure 13: *Household mobile money usage prevalence and scope by region*

SAVING

With regards to saving practices, 60 percent of HHs in Sava and 47 percent in Menabe have savings. The main reasons HHs reported saving money are for emergency cash for food (61 percent) and emergency cash for health problems (49 percent). Other reasons mentioned in both regions include for funeral costs (23 percent), to build a retail business (19 percent), and for clothes (11 percent). In Sava, house building (29 percent) and children's schooling (19 percent) were also mentioned as major reasons for saving. In Menabe, HHs also mentioned buying fishing equipment for HH use (13 percent) and buying a pirogue (12 percent) as reasons for saving. Other reasons respondents frequently mentioned in Sava are buying farmland and paying land labor for crop farming.

AGRICULTURE, LIVESTOCK AND LAND CLEARING PRACTICES

This section summarizes agricultural land tenure, livestock ownership, and land clearing practices across the sampled villages in both regions.

AGRICULTURAL LAND TENURE

HHs were asked whether any members of their HH farmland and the size of the farm that they cultivate. HHs that farmland were then asked what percent of their farmed land they also own. If HHs do not own any of the land they farm, they were asked about the contractual arrangement to farm the land. HHs that do not farmland were asked whether they own land that is farmed by someone else.

In Sava, 92 percent of the HHs engage in crop farming, whereas in Menabe only 27 percent do. Out of the farming HHs, the area of land farmed by HHs in Sava is statistically significantly larger than in Menabe. Farming HHs in Sava farm on average 176 ares (1.76 hectares) of land compared to 123 ares (1.23 hectares) in Menabe. In both regions, around 84 percent of the HHs farm own their land, and each HH owns on average 95 percent of the land on which they farm.

Aside from owning farmland, in Sava, 23 percent of HH who farm use common land, and around eight percent rent private land. In Menabe, 25 percent of HHs who farm rent private land to do so, and almost no HHs use common land.

In both regions, about 19 percent of HHs own farmland that is not farmed by HH members, of which 35 percent of HHs have other relatives (not from their HH) who farm the land. About 60 percent of HHs own farmland that is fallowed, with some citing reasons for its lack of use as drought and waiting to use it as children's inheritance.

LIVESTOCK OWNERSHIP

About 75 percent of HHs in Sava and 53 percent in Menabe own livestock. In Sava, the predominant livestock is poultry (72 percent of HHs) with 14 percent of HHs also owning zebus. Out of the HHs who own livestock, each HH owns an average of 10 poultry and 0.56 zebu in Sava. In Menabe, 42 percent of HHs own poultry, 13 percent own pigs, 10 percent own goats, and only 5 percent of HHs

own zebus. Out of the HHs who own livestock, each HH owns an average of six poultry, three goats, one pig, and one zebu.[12]

LAND CLEARING PRACTICES

The study asked respondents whether anyone in the HH cleared land to allow more cultivation or livestock rearing in the past year, as well as if they intend to clear land in the next 12 months. Figures 14 and 15 show the responses by region. Fifteen percent of HHs in Sava and four percent of HHs in Menabe indicate that they have cleared land in the past year, and a substantial 57 percent in Sava and 14 percent in Menabe indicate that they intend to clear land in the next 12 months. In Sava, the majority (63 percent) of HHs who cleared land did so in forested land, and 34 percent in fallow agricultural land. In Menabe, the majority (70 percent) of HHs who cleared land did so in fallow agricultural land, and only two percent cleared forested land. A few HHs also mentioned clearing land in rice fields.

The HHs who intend to clear land were asked to list all the reasons for the intention. The most frequently mentioned reason (mentioned by 75 percent of HHs who intend to clear land) is to grow more crops to sell. Fifty percent of HHs also mentioned growing crops for HH consumption, and 47 percent mentioned the reason being to grow different crop types. In Sava, 22 percent of HHs also mentioned acquiring their own land or more land as other reasons they cleared land.

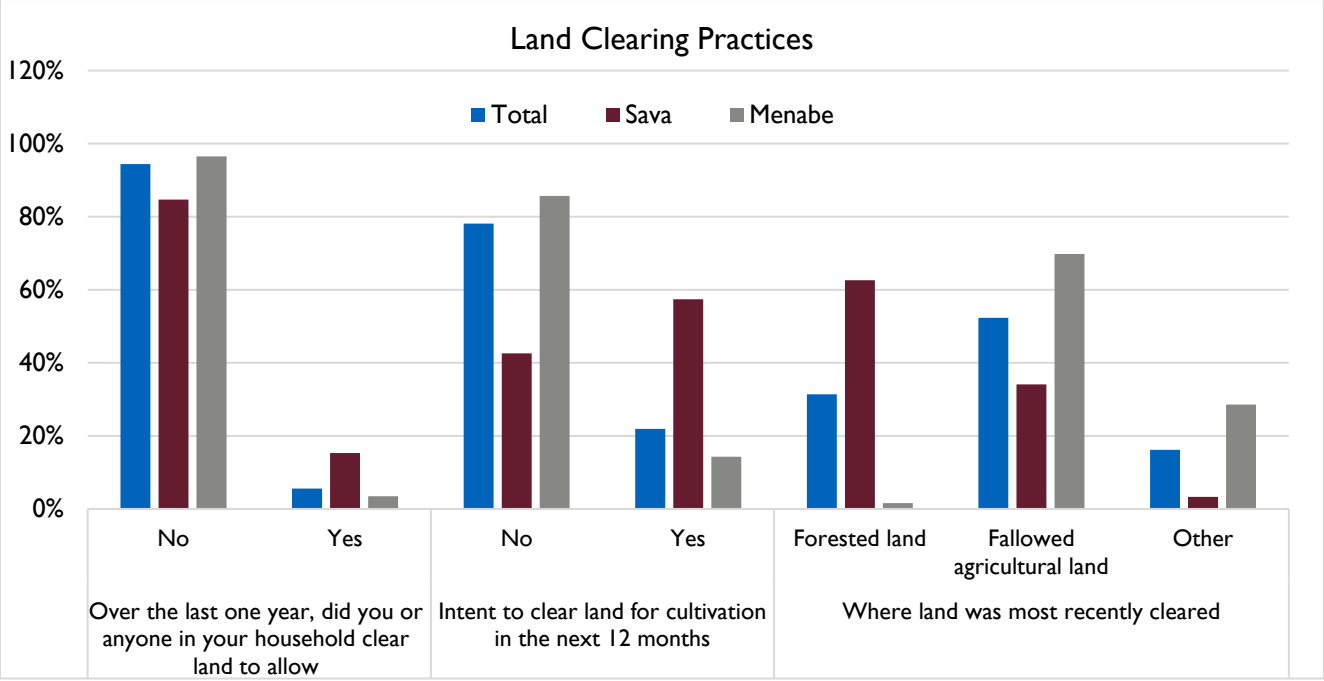


Figure 14: *Self-reported land clearing practices by region*

[12] Although zebus ownership in Menabe is less common, three zebus-owning HH own a large number of zebus. Excluding these households, the average HH ownership of zebus in Menabe is 0.40.

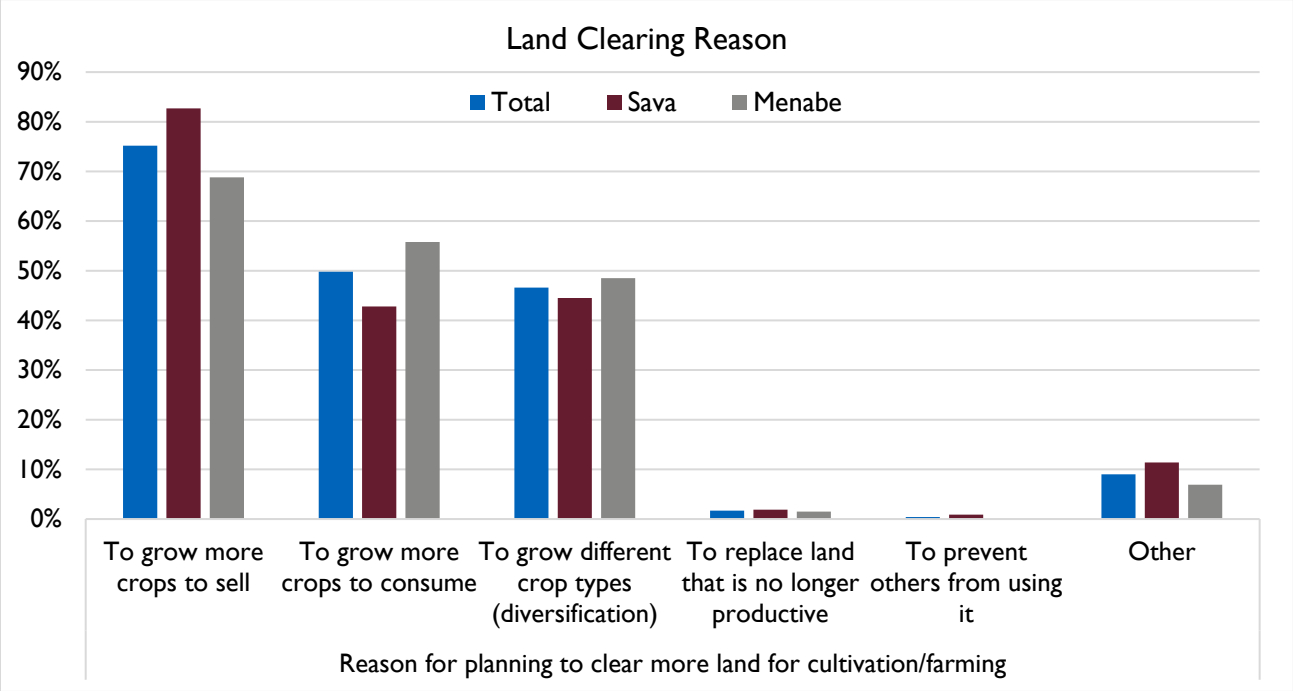


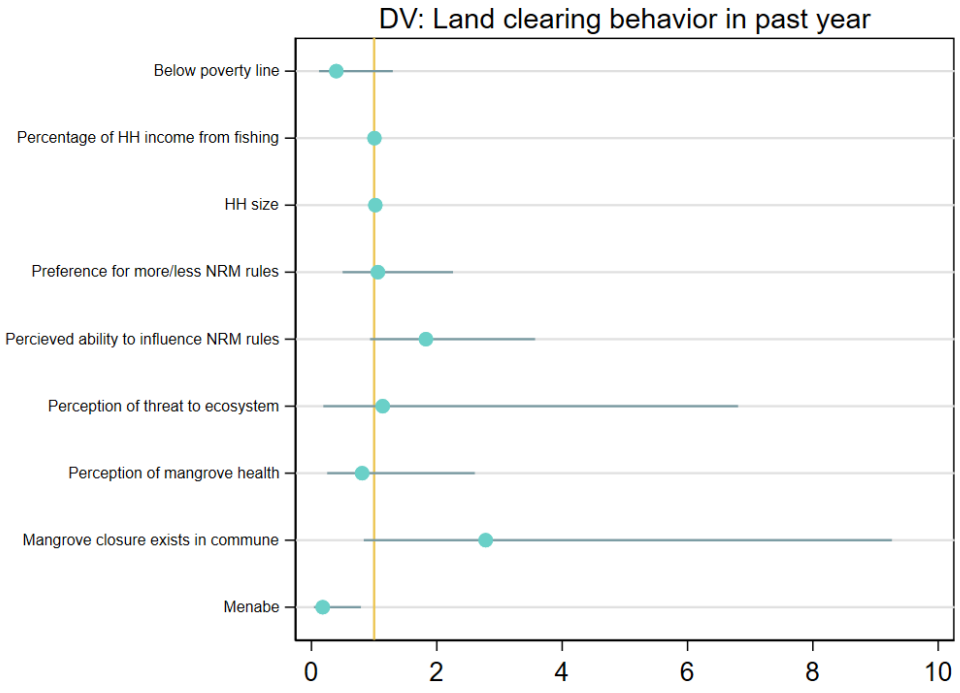
Figure 15: *Region for land clearing, by region*

The study ran a multivariate logit regression to investigate the profiles of HHs that have cleared land in the past 12 months and intend to clear land in the next 12 months. The results are displayed in Table 16 in odds ratio form and coefficient plots displayed in Figure 16. After accounting for regional factors related to land clearing, the percentage of income from crop farming and perception of the health of mangroves being healthier increases the odds of intending to clear land (1.02 and 1.98 more likely respectively). A HH below the poverty line is 82 percent less likely to have the intention to clear land.

Table 16: *Logistic regression result of household characteristics regressed on Land cleared and Intent to clear land (odds-ratio)*

	Model 1: Cleared land over the last 12 months	**Model 2: Intend to clear land in the next 12 months**
HH is below $1.90/day poverty line	0.40 (-1.53)	0.19*** (-4.87)
Percentage of HH income from crop farming	1.00 (0.53)	1.02* (2.07)
HH size	1.02 (0.38)	1.11 (1.85)
Attitude on NRM rules	1.06 (0.15)	1.32 (1.38)

	Model 1: Cleared land over the last 12 months	Model 2: Intend to clear land in the next 12 months
Perception of ability to influence NRM	1.83 (1.76)	1.55 (1.36)
Perceives ecosystem in general is under threat	1.14 (0.14)	0.57 (-1.52)
Perception of health of mangroves (higher healthier)	0.81 (-0.36)	1.98* (2.31)
Has mangrove closures in community	2.78 (1.67)	1.13 (0.25)
Menabe	0.18* (-2.28)	0.25*** (-3.48)
N	676	673



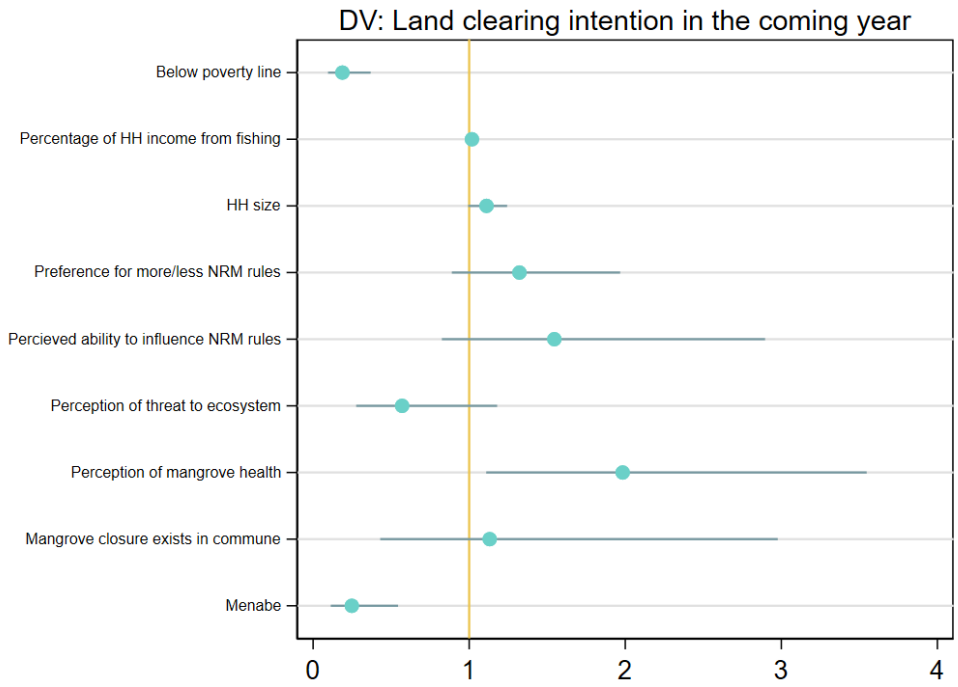


Figure 16: *Coefficient plot of logistic regression result, of household characteristics regressed on Land clearing and Intent to clear land (odds-ratio). 95 percent confidence intervals*

FISHING AND GLEANING PRACTICES

This section presents the result of the fishery module of the baseline survey. The survey first gathered information on HH fishing asset ownership, as well as gear lending and borrowing behavior. Then, the survey asked respondents to list up to three most frequently used fishing sites, as well as the fishing method, labor, trip length, and catch associated with fishing activities the HH undertakes at each site. These HH survey questions intended to approximate CPUE that is usually more directly measured through catch surveys at fishing sites. The fishery module asked respondents about the use of catch at each site and decision-making regarding use of the catch. The module also asked about overall security of access rights and conflict surrounding fishing sites. This section first presents HH fishing assets and methods used by HHs across the population of sampled villages across regions. Then, information on fishing trips across the main three sites of each HH are presented. Lastly, the study presents HH perceptions of access right security and conflict around fishing sites at the HH level of analysis.

FISHERY ASSET OWNERSHIP, LENDING, AND BORROWING

Figure 16 presents the prevalence of fishing gear ownership and lending, and Figure 17 presents prevalence of gear borrowing by region. Most HHs (96 percent) across both regions own fishing gear purchased with HH savings. Lending and borrowing are more frequent in Sava than in Menabe: 52 percent of HHs in Sava lend fishing equipment to others, of which 55 percent is in exchange for fish and 41 percent without exchange; 36 percent of HHs regularly borrow from others, of which 66 percent is in exchange for fish and 31 percent in exchange for nothing. In Menabe, only 36 percent of HHs lend

fishing equipment regularly, of which 48 is in exchange for nothing, 34 percent is in exchange for fish, and 14 percent is in exchange for money, and 25 percent of HHs regularly borrow fishing equipment in exchange for nothing or fish, and sometimes money. In Sava, 40 percent of HHs also buy other fishing materials needed for each trip, such as ice and light needed for night trips, whereas in Menabe, 13 percent of HHs do so. Almost no HHs in the sample borrows other fishing trip materials.

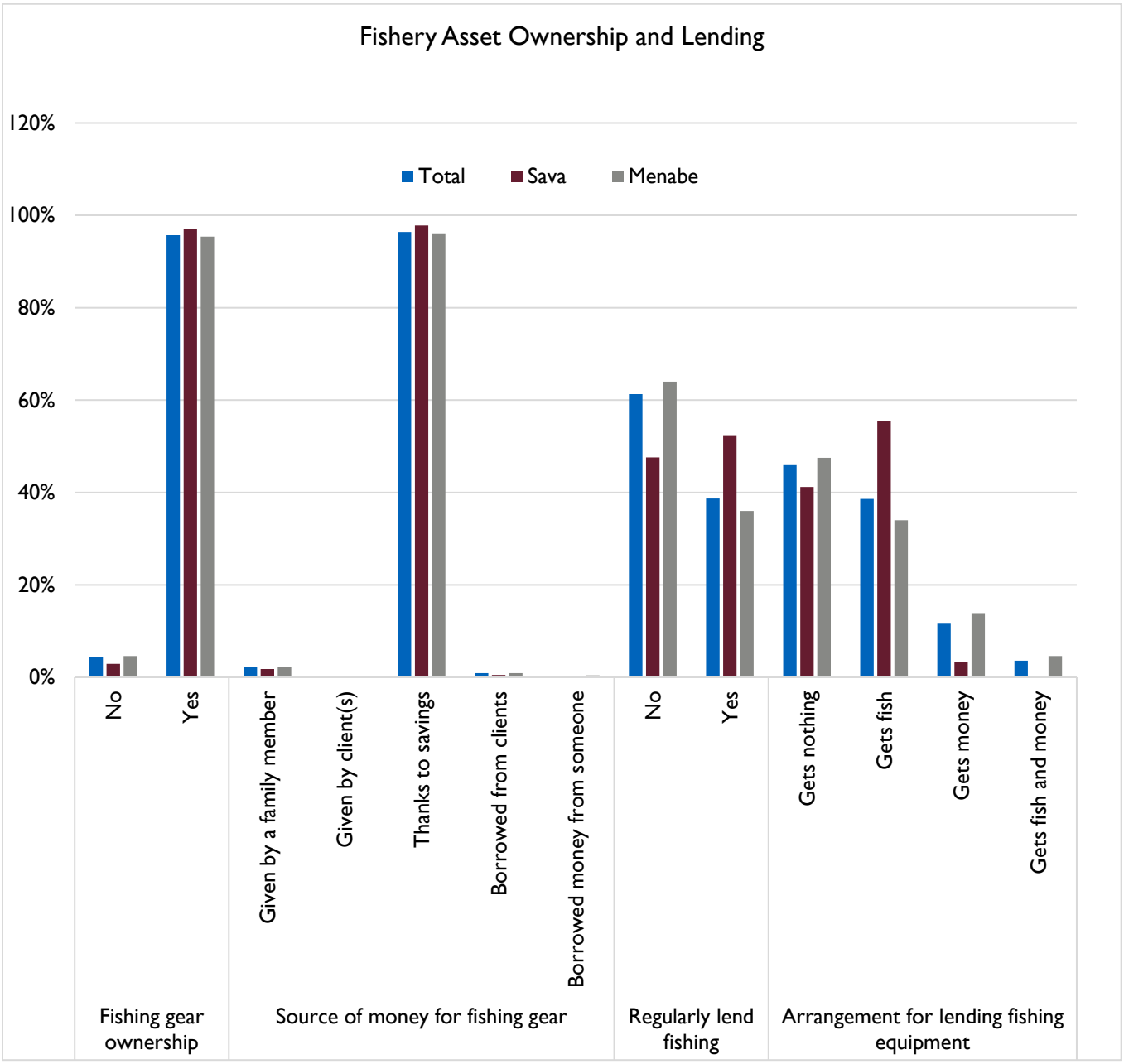


Figure 17. Fishery asset ownership and lending by region

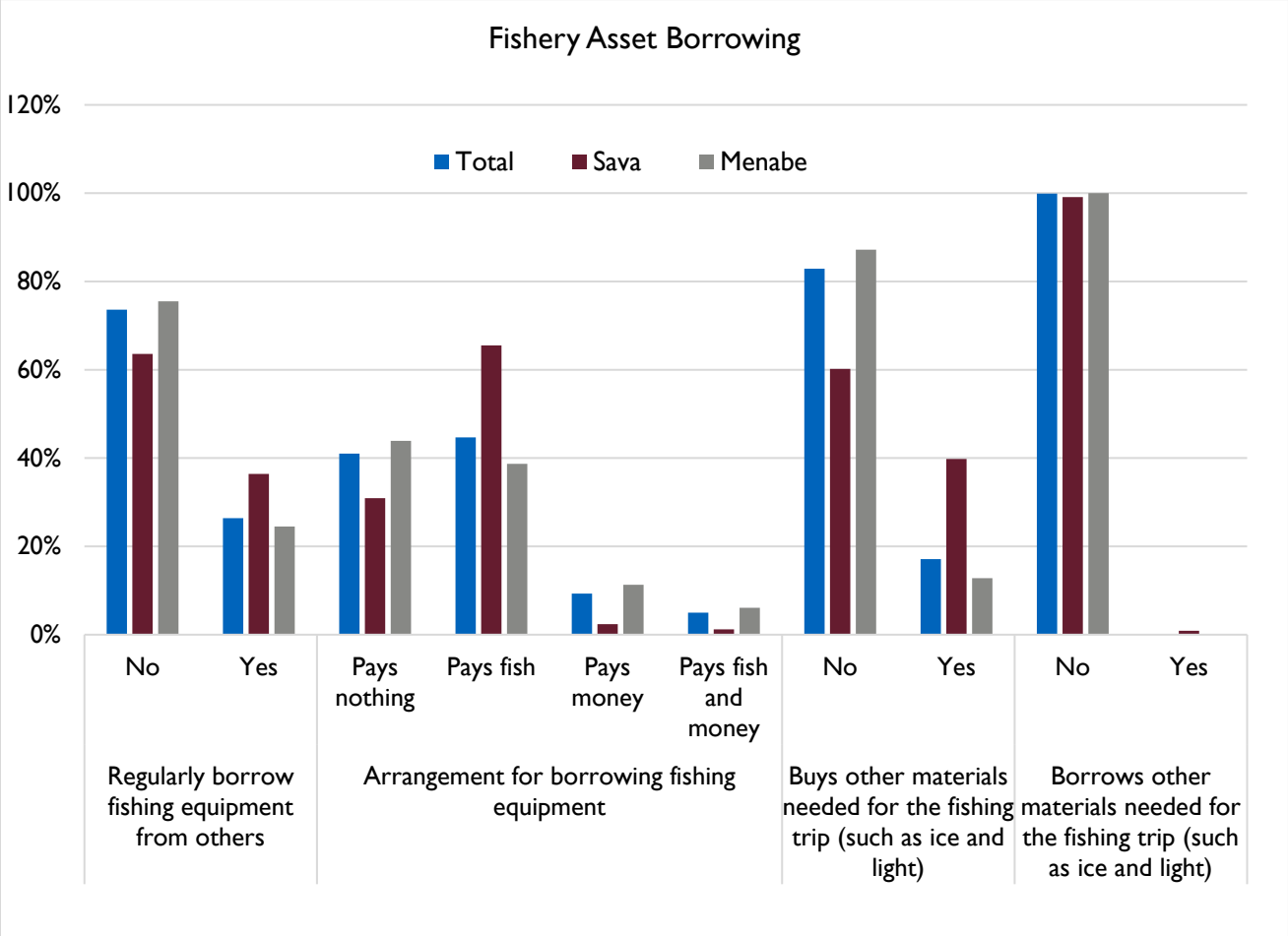


Figure 18: *Fishery asset lending, by region*

FISHING METHODS

Figure 19 presents the percentage of HHs that use each fishing method by region. In Sava, fishing HHs mainly use net fishing (i.e., Jarifa, ZZ, beach seine, mosquito net, purse seine, and gillnets), harpoons, line fishing (i.e., hook and line, handline, trolling line, and drift line), and diving. In Menabe, fishing HHs mainly use net fishing and line fishing. The most common fishing method employed across regions is net fishing, with 75 percent of fishing HHs in Sava and 87 percent of fishing HHs in Menabe employing this method. The second most common method in Sava is harpoons (45 percent), whereas in Menabe significantly fewer (five percent) use harpoons. The second most common method in Menabe is line fishing (40 percent), which is also used frequently in Sava (21 percent). In Sava, 15 percent of HHs undertake diving, and eight percent use fish/shrimp/lobster traps.

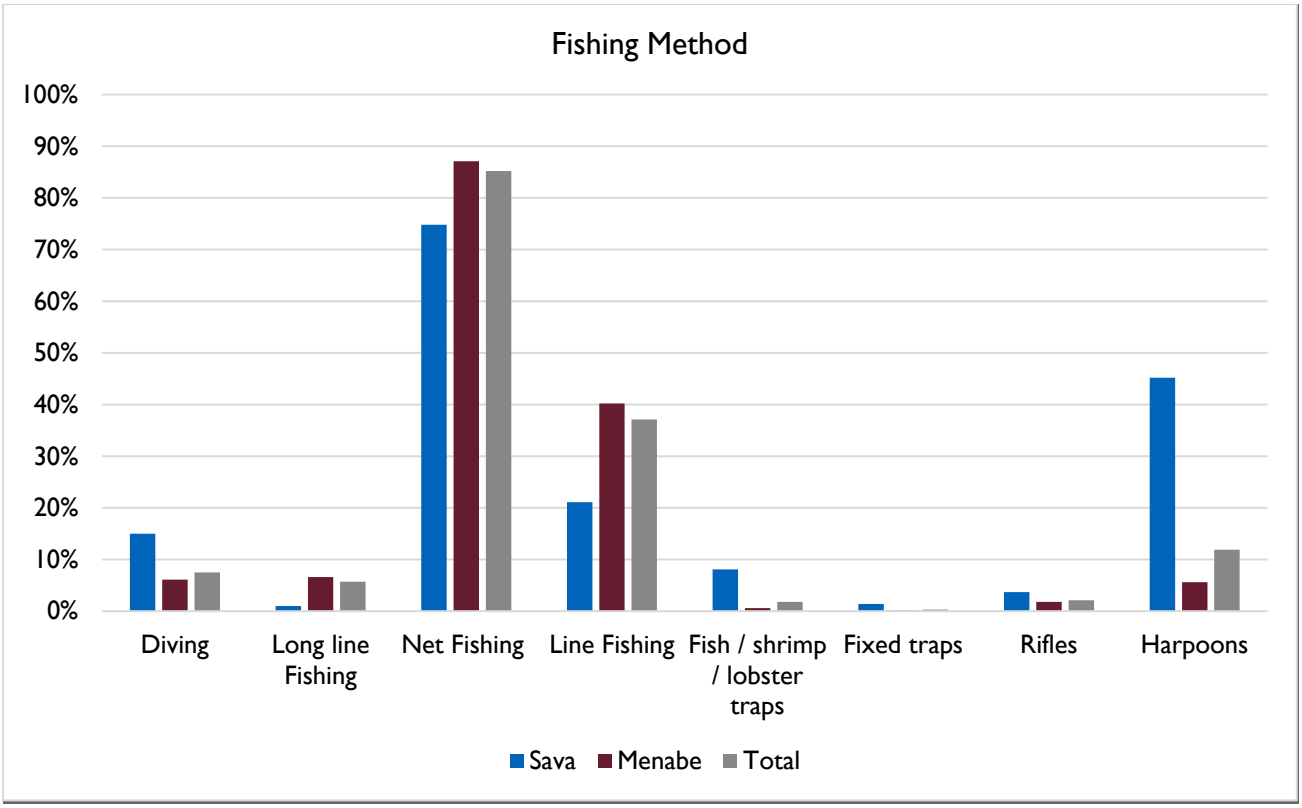


Figure 19: *Fishing method by region*

As for the use of pirogues, time of day, and season of fishing, in Sava, almost all HHs engage in fishing by pirogue, and in Menabe, 90 percent of fishing HHs fish by pirogue. In Sava, 10 percent of HHs also fish by foot, compared to 21 percent in Menabe. Across the region, most fishing HHs (98 percent) fish during the day, with 30 percent in Sava and 10 percent in Menabe also fishing at night. There are no HHs that only fish at night.

CATCH, LABOR, AND CPUE

Figure 20 presents the percentage of fishing HHs in each region that that self-reported catching each fish species group on their regular fishing trips. The catch species differs significantly across regions. In Sava, 71 percent of fishing HHs mainly catch big reef fish (groupers, jacks, barracudas, and big snappers), 46 percent catch small reef fish, 35 percent catch octopus, and 29 percent catch large *pelagics*, including tuna/bonito, marlin/sailboats, dolphinfish, king mackerel, and small *pelagics* across their main fishing sites. In Menabe, small *pelagics* comprise the main catch of 74 percent of fishing HHs, followed by large *pelagics,* at 34 percent. Small reef fish (28 percent), large reef fish (18 percent), and shrimp (16 percent) are also important catch species for a smaller percentage of fishing HHs in Menabe.

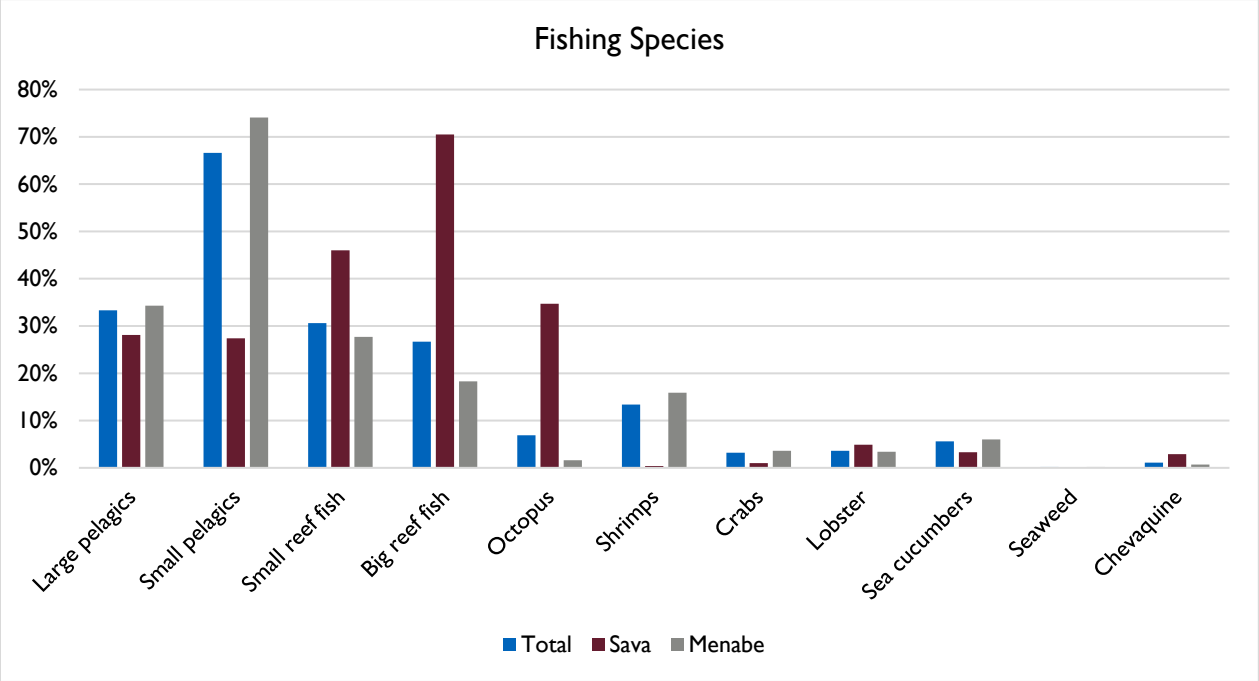


Figure 20: *Percentage of households that fishing HHs mainly catch in each fish species group, by region*

The study asked each HH the labor (number of people), catch (kg), and length of trip (hours) of a typical fishing trip at the three most frequented sites to capture catch per unit of effort (CPUE) data for each site. Respondents were asked, "In general, how many kilos of fish do you catch per trip?". The study team then took the average of each HH and reported the CPUE (kg per person per day)averaged across the most frequented fishing sites.

In general, fishing HHs in Sava go on 2.16-person and 5.41-hour trips (0.5 person-days on average), whereas fishing HHs in Menabe go on 1.81 person and 7.4-hour trips (0.6 person-days on average). HHs report an average of 14.25kg of catch per trip, similar across the regions. The average CPUE of a HH is similar across the regions at about 31.79 kg per person-day. However, when eliminating the outliers in catch size (larger than three standard deviations above the mean), the average CPUE in Sava is 20kg per person-day and the average CPUE in Menabe is 17kg per person-day.

This number is still higher than the CPUE documented by NGOs, WWF and BV, in Belo sur Mer in Menabe through participatory catch surveys, which documents a CPUE of between 8.9 to 12.7kg per fisher-day between 2017 and 2022 between their project baseline and endline.[13] However, these catch surveys directly observed the catch and trip information at marine areas. Fishers may consistently over- or under-estimate the catch size, labor, and trip length during recall through HH surveys. An investigation of the fisheries of the Menabe region, produced during the Plan d'Aménagement des Pêcheries (PAP), or Fisheries Management Plan, process for USAID Mikajy project team[14] uses farmer recall to estimate the regional CPUE as well. They estimate a 31.04 kg per pirogue-day for small *pelagic*

[13] Source: Monitoring data shared by WWF with INRM

[14] Source: "Diagnostic Global de la Pecherie Region Menabe", shared by USAID Hay Tao team with INRM

fish and 26.54 kg per pirogue-day for large *pelagic* fish. This number is more consistent with this study's estimates. If an average trip is taken by about two fishers in both regions, the CPUE converts to 15.02kg per fisher-day and 13.27kg per fisher-day, which is more consistent with estimates that also rely on recall. For comparability with other monitoring efforts, below in Table 17, the study reports CPUE at the unit of kg per person-per day by converting reported trip hours to days, as well as kg per person-trip, to kg per pirogue-trip, with and without accounting for outliers.

Table 17: *CPUE calculates under different definitions of units of effort.*

	With outliers				Without outliers			
	Mean	**Std. Err.**	**95 percent Conf.**	**Interval**	**Mean**	**Std. Err.**	**95 percent Conf.**	**Interval**
Kg per person-day								
Sava	35.98	2.86	30.36	41.60	20.78	1.03	18.76	22.80
Menabe	31.66	5.16	21.52	41.80	16.99	0.99	15.05	18.92
Kg per person-trip								
Sava	5.15	0.34	4.47	5.83	4.25	0.20	3.85	4.65
Menabe	9.15	1.55	6.11	12.18	4.90	0.28	4.35	5.46
Kg per pirogue-trip								
Sava	10.32	0.69	8.95	11.68	9.10	0.57	7.98	10.22
Menabe	15.70	4.37	7.12	24.28	8.34	0.49	7.37	9.30

CATCH USE AND DECISION-MAKING

Figure 21 presents fishing HHs' fishing catch use by region if the HH has the autonomy to make such decisions. Around two percent of fishing HHs in Sava and 88 percent in Menabe's use some (on average, 19 percent) of their catch for food. About 68 percent of fishing HHs in Sava and 48 percent in Menabe sell the majority (83 percent) of their catch to intermediary collectors, 29 percent of fishing HHs in Sava and 31 percent in Menabe sell the majority (76 percent) of their catch to the local market seller, whereas 29 percent of fishing HHs in Sava and 39 percent in Menabe sell most (70 percent) of their catch to some other person. A total of 97 percent of fishing HHs in Menabe report having a say in who to sell/give their catch to and how much to sell for, whereas in Sava only 84 percent report having a say.

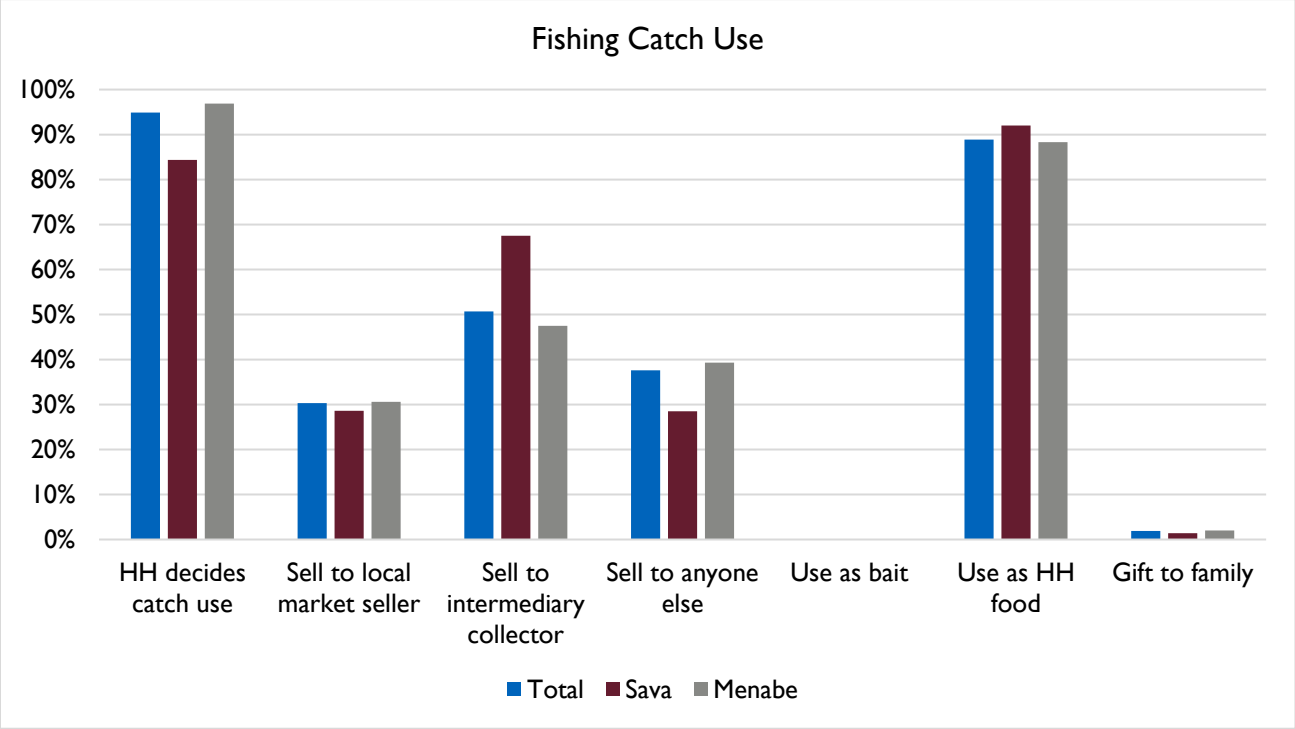


Figure 21: *Fishing catch decision and use, by region*

In general, about one-to-two persons per HH fish in both regions, and similarly, about one-to-two people make the decision about what to do with the catch. In Sava, about 87 percent of fishing HHs only have men who fish, and about 12 percent of fishing HHs have both men and women who fish, and 15 percent of fishing HHs do not make decisions about catch sales. About 18 percent make decisions by men only, 28 percent make decisions by women only, and 38 percent make decisions jointly by men and women. In Menabe, about 64 percent of fishing HHs only have men who fish, and about 36 percent of fishing HHs have both men and women who fish—more common than in Sava. Only four percent of fishing HHs do not make decisions about catch sales. About 66 percent make decisions by men only, 14 percent make decisions by women only, and 24 percent make decisions jointly by men and women.

ACCESS RIGHTS SECURITY AND CONFLICT

Figure 22 presents HH responses to perception of access rights security and reasons for feeling secure. Across sites per HH, 55 percent of HHs feel confident that they can continue to access their main fishing sites in the future. In Sava, more HHs (15 and 17 percent) feel not confident at all or only somewhat confident, respectively, compared to eight and nine percent, respectively, in Menabe. The most prevalent reason for confidence is lack of conflict in the area, and in Menabe about 30 percent of the reason for confidence is having formal access rights.

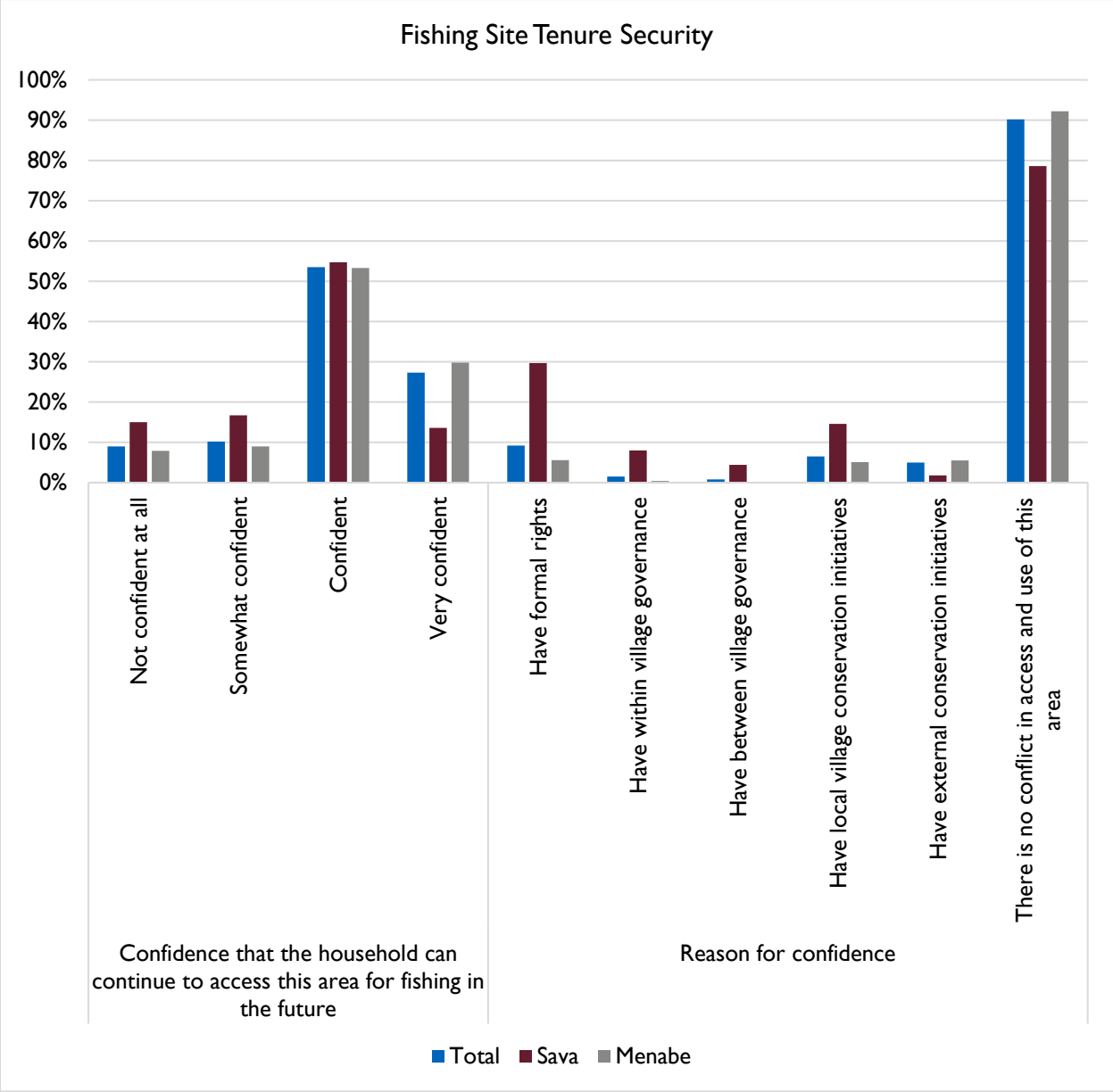


Figure 22: *Fishing site tenure security*

Figure 23 presents HH responses regarding disputes at their most frequented fishing sites. Twenty-one percent of fishing HHs report disputes related to accessing fishing sites, whereas in Menabe only four percent of fishing HHs reported disputes. In Sava, disputes related to rule compliance and enforcement, as well as fishing gear use rules, and 44 percent of HHs indicate that these disputes are between groups in the village, while 15 percent indicate that they are with groups in the village as well as an NGO. In Menabe, instead of disagreements regarding marine management rules, 51 percent of the disputes are about not having sufficient area to fish and 44 percent about not having a sufficient amount of fish. Forty-four percent of the disputes are among groups in the village.

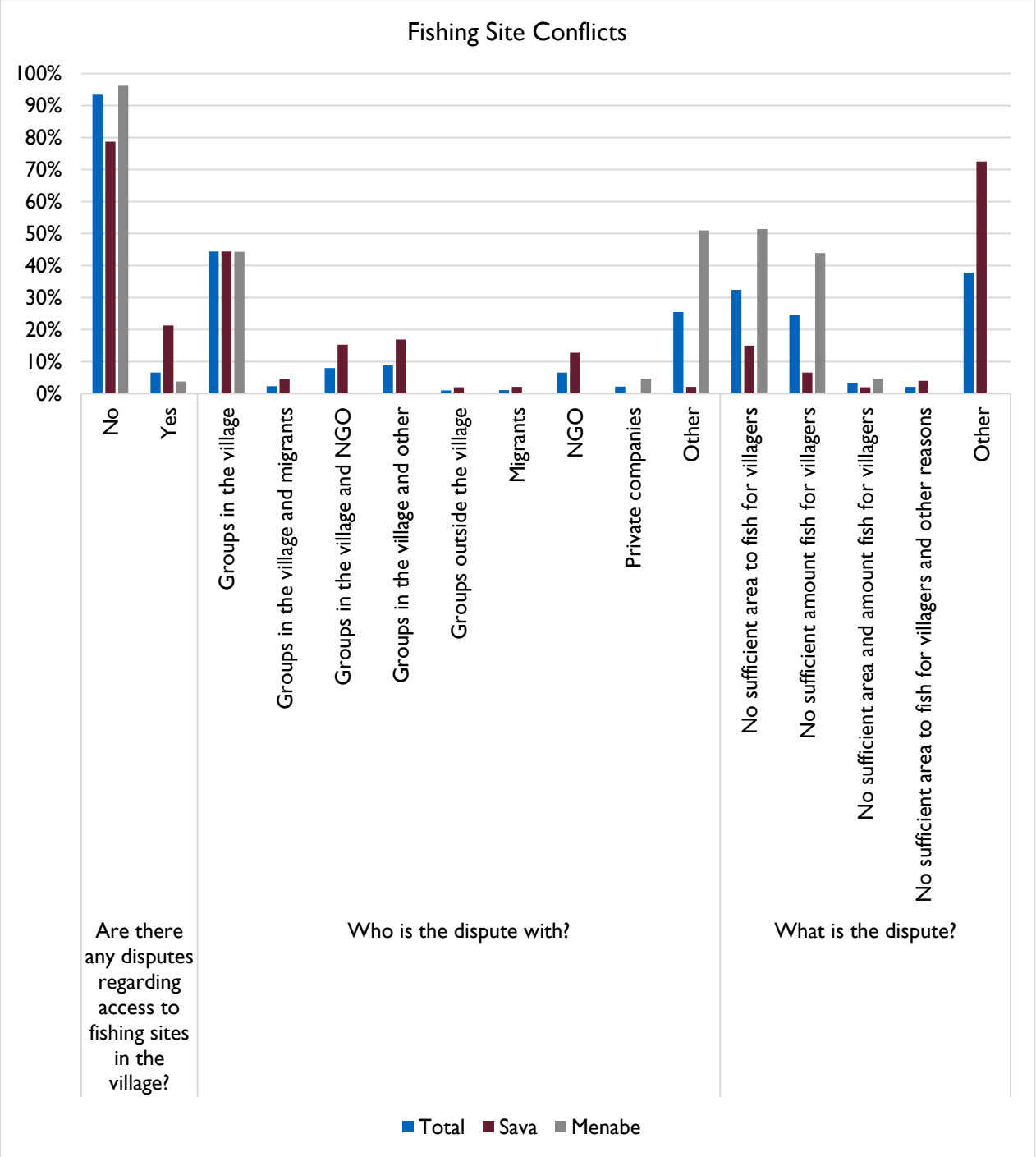


Figure 23: *Fishing site conflicts by region*

PERCEPTION OF FISHERY AND ENVIRONMENTAL CHANGE

The study asked fishing HHs their perceptions of change in fishing catch in the last five years, and about their perceptions of mangrove and fish stock changes between now and when they were a child, as well as the overall state of coral, mangroves and lagoons, and general environmental degradation.

FISHERY CPUE CHANGE

Figure 24 presents the perception of CPUE changes by fishing HHs by region. On a scale of one-to-five, (one being much easier, three being the same, and five being much harder), fishing HHs in Menabe report that fishing has become between much harder and harder (4.14), and fishing HHs in Sava reported it being the same and harder (both 3.8). In other words, 84 percent of HHs in Sava and 92 percent of HHs thought it was harder or much harder to catch the same amount of fish as five years ago, and only 6.4 percent in Sava and 0.6 percent in Menabe thought it was easier. When probed about reasons for their answers, for those that think it is harder, 68 percent in Sava mentioned increases in local fishermen competition (only 15 percent mentioned outside fishermen competition), 32.7 percent mentioned general climate change.[15] For those who thought it is harder, 14 percent attribute the decrease in CPUE to the increase in effort from environmental regulations, and eight percent thought decreases in environmental regulation were the reason for the decrease in catch per effort; in Menabe, similarly 64 percent mentioned climate change as the reason for CPUE decrease, while 43 percent cited an increases in local fishermen competition (16 percent outside fishermen competition).

[15] We did not ask to clarify what part of climate change they perceive to be the driver.

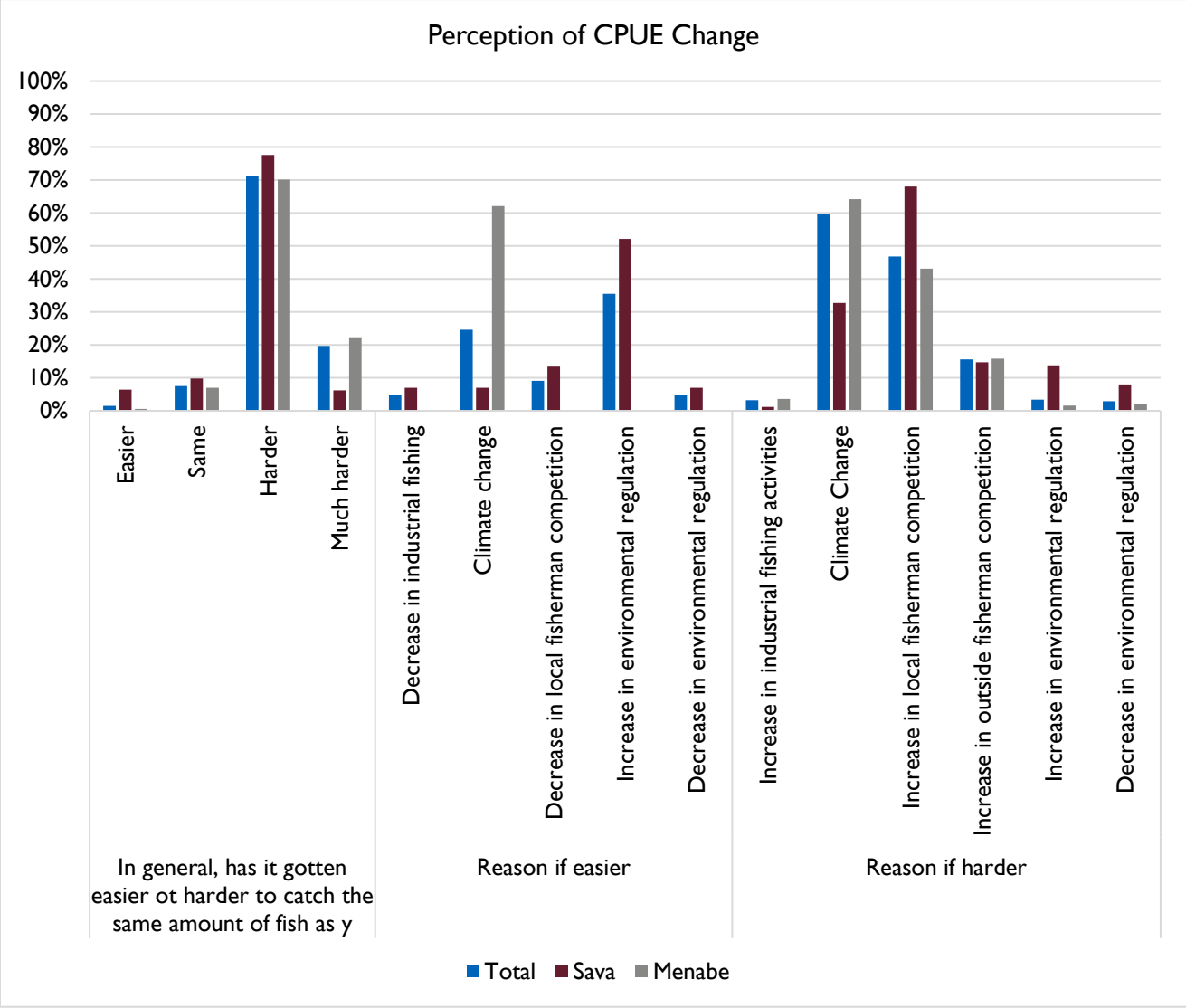


Figure 24: *Perception of CPUE change by region*

PERCEPTION OF ENVIRONMENTAL CHANGE

To gauge perceptions of change in natural resource availability, the study asked whether there is enough mangrove wood in the forest and fish in the sea to provide for the needs of everyone who lives in the community, both currently and when the respondent was a child. Results are presented in Figure 25.

More respondents perceive mangrove wood provision to be enough in Sava than in Menabe. In Sava, 31 percent of HHs perceive it as not being enough in the past and not being enough now, while 32 percent perceive it to be enough in the past and not enough now. In Menabe, most HHs (65 percent) believe mangrove wood to be enough in the past and now, while 22 percent perceived enough in the past but not enough now, and 12 percent perceived it to be not enough in the past and not enough now. For the HHs that perceived there to be enough in the past but not enough now, the survey asked why. The majority of these HHs (52 percent in Sava and 69 percent in Menabe) attributed it to cutting mangroves

to build houses. In Sava, respondents reported that more people in the village and cutting mangroves to make lime[16] to strengthen house durability are also major reasons. In Menabe, making *sokay* and building fences are also major reasons, while 36 percent of HHs in both regions also mentioned using mangrove wood for fuel as a reason.

With regards to fish stock in the sea, the majority of HHs (73 percent in Sava and 87 percent in Menabe) perceive having enough fish in the sea to provide enough food for everyone who lives in the community; 26.8 percent in Sava and 10.5 percent in Menabe perceive having enough in the past but not enough now. Among the respondents that perceive fish stock to have declined, 59.3 percent in Sava and 39 percent in Menabe attribute the decline to an increase in the number of fishermen in the village. About 22 percent across the regions attribute the decline to the use of destructive fishing gear and methods. In Menabe, 21 percent also note the increase in village population as a cause. Some HHs also mention environmental reasons, including climate change, the lack of rain, and degradation of coral.

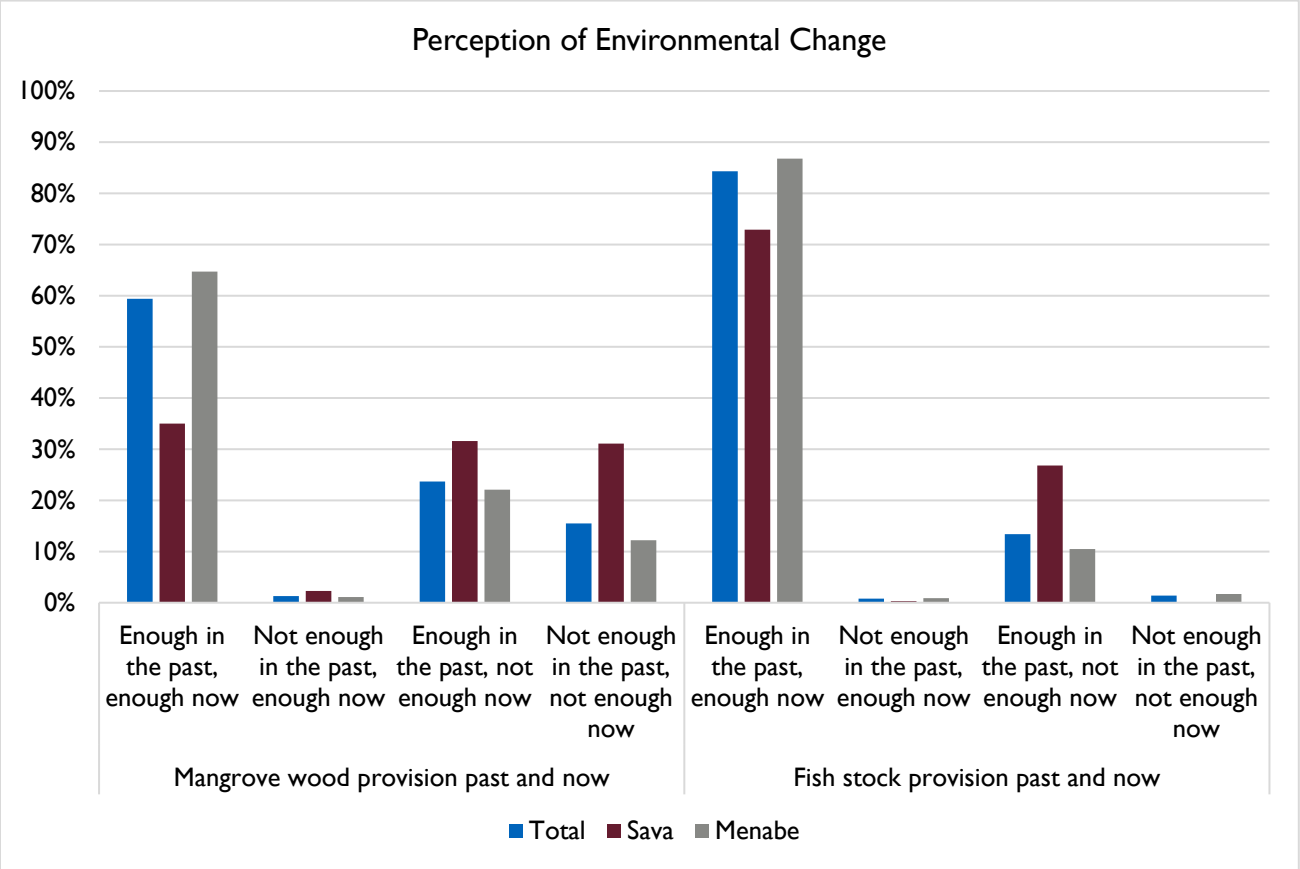


Figure 25: *Perception of environmental change by region*

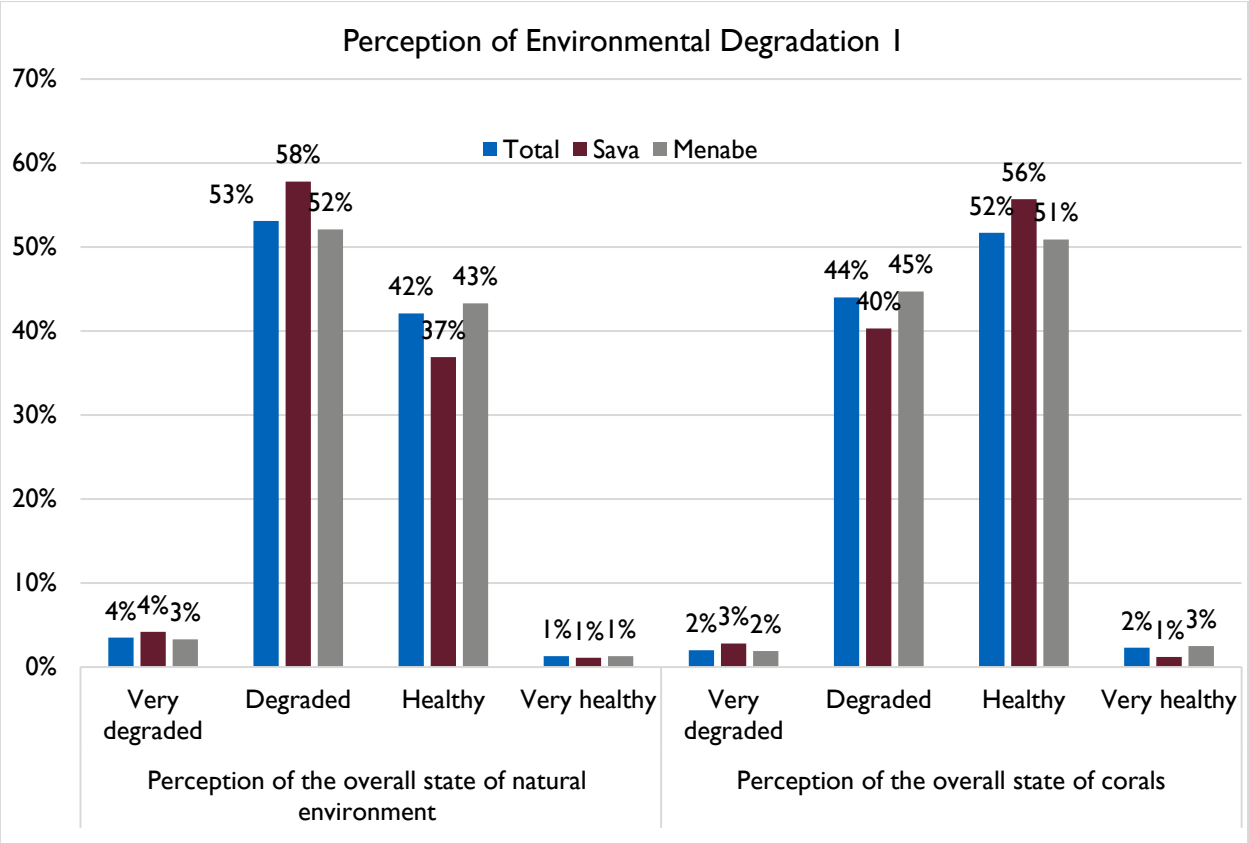
[16] The material locally known as *sokay* is a "sea-shell based lime produced in mangrove wood kilns and used as a render on houses." It is considered a status symbol and is often related to rise in household income (Scales et a., 2017).

PERCEPTION OF ENVIRONMENTAL DEGRADATION

The study asked each respondent whether they think the natural environment is healthy or degraded on a scale of one-to-four (one being very degraded and four being very healthy). Responses are presented in Figure 26.

About 56 percent of respondents across regions think the overall state of the natural environment is degraded or very degraded (average score of 2.3 across regions). When asked about the overall state of coral, about 44 percent of HHs answered that it was degraded or very degraded (average score of 2.5 across regions). With regards to mangroves, more HHs in Menabe perceive it to be degraded or very degraded (34 percent, an average score of 2.6) than in Sava (20 percent, an average score of 3). Similarly for lagoon health, 44 percent of HHs in Menabe perceive the state of lagoons to be degraded or very degraded (average score of 2.5) compared to 31 percent of HHs in Sava (an average score of 2.7).

When asked about threats to these ecosystems, about 65 percent of HHs across the region perceive that there are threats, with most respondents mentioning multiple threats. Out of the respondents that perceive threats to local ecosystems, climate change is most mentioned as a threat in both regions (58 percent). Illegal/ unsustainable logging is also mentioned often (31 percent across regions) as well as illegal/unsustainable fishing (25 percent across regions). In Sava, unsustainable farming is also mentioned by 18 percent of respondents. Some other responses mentioned are land clearing in Menabe, and fire, drought, cyclones, and climate change in Sava. Figure 27 presents the major threats mentioned in each region.



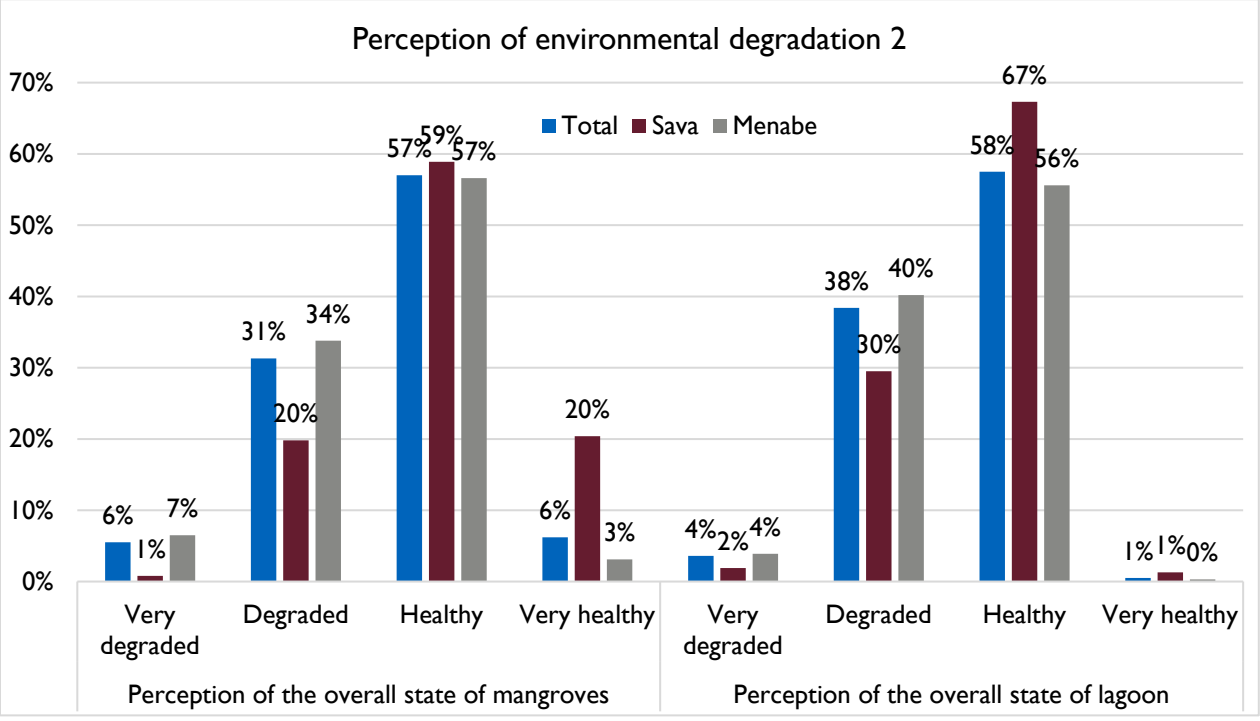


Figure 26: *Perception of environmental degradation by region*

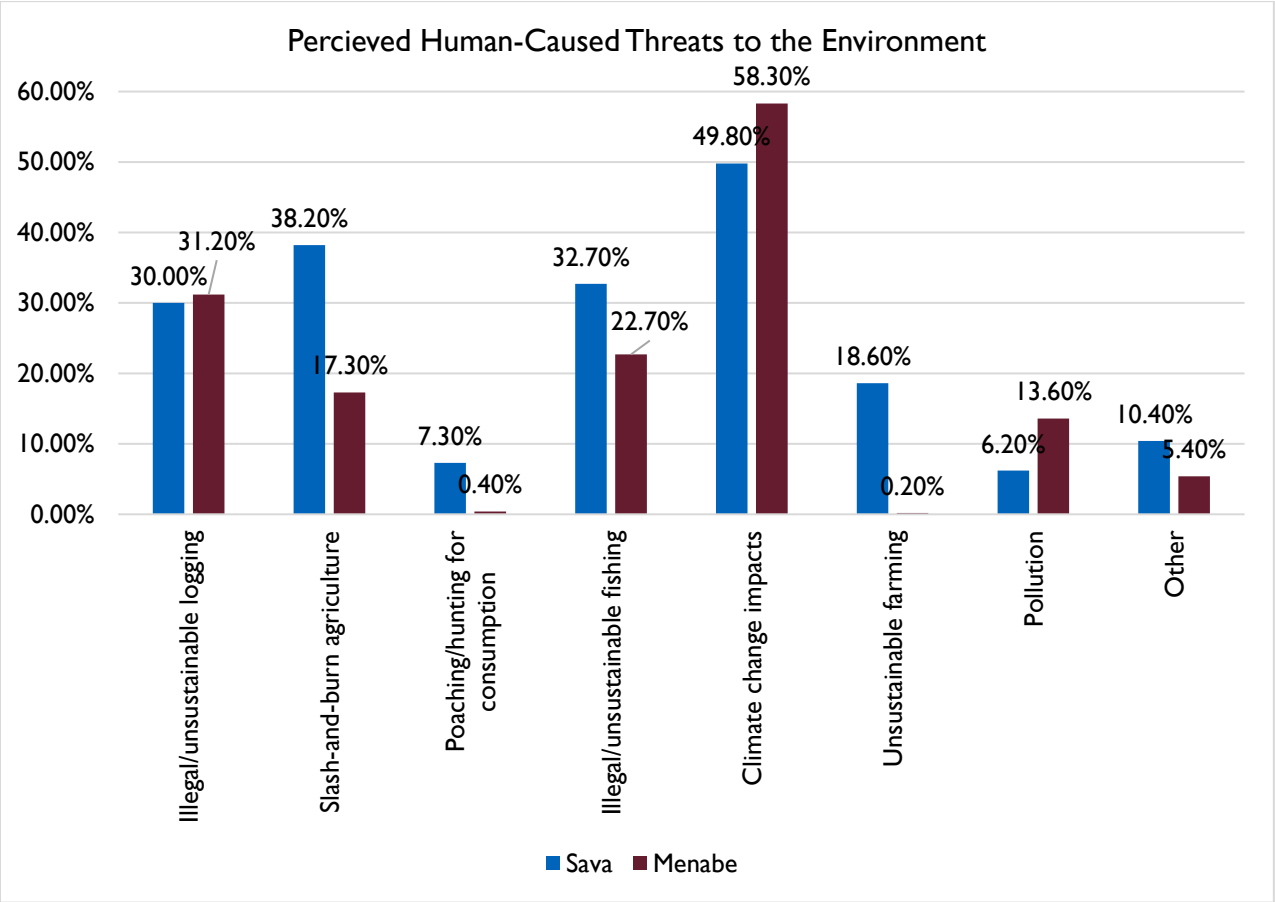


Figure 27: *Perceived threats to the environment*

AQUACULTURE PRACTICES

The study also asked seaweed farming HHs about decision-making on seaweed sales, and gender dynamics in seaweed farming and decision-making. Seaweed farming is only undertaken by HHs in Menabe in the sample (18 percent of HHs in Menabe). About 88 percent of seaweed farming HHs say that they sell the produce to someone in particular, and of these HHs, 78 percent sell to intermediary collectors. In the 22.4 percent that mention selling to other actors, when asked to elaborate, 31 percent mentioned selling to the person who trained them and gave them seaweed to farm. Some specifically mention BV, OF, and WWF.

Across Menabe, HHs report, on average, an equal number of female and male HH members farming seaweed. Table 18 displays the average intra-HH gender breakdown of seaweed farming and decision-making on seaweed sales. About 41 percent of seaweed farming HHs have only male HH members farming seaweed, 45 percent have only female members farming it, and 15 percent have both male and female engaged in it. HHs report more female HH members making decisions about seaweed sales than male HH members, with 15 percent of HHs reporting only male members makings decisions, 50 percent reporting only females making decisions, and 36 percent reporting both female and male members making decisions.

Table 18: *Within household gendered behavior and decision-making of seaweed farming*

	Percent of seaweed farming HHs
HH members who farms seaweed	
male only	40.5
female only	44.5
both male and female	15.0
Total	**100.0**
HH members who makes decisions about seaweed sales	
male only	14.5
female only	49.5
both male and female	36.0
Total	**100.0**

ATTITUDE TOWARDS AQUACULTURE

The study asked respondents if they thought seaweed and sea cucumber farming is good or bad for the village. The respondents answered on a scale of one-to-four, where one is very bad and four is very good. The results are presented in Figure 27. Although most respondents have a positive attitude toward aquaculture, HHs in Menabe have a better perception of aquaculture than those in Sava. On average, HHs in Menabe said seaweed and sea cucumber farming is good and very good (average score of 3.18), whereas HHs in Sava on average answered that it is either bad or good (an average score of 2.78). In other words, only seven percent of HHs in Menabe answered that it is very bad or bad; 66 percent answered that it is good, and 26 percent answered that it is very good. In Sava, 25 percent answered that it is very bad or bad; 71 percent answered that it is good and only four percent answered that it is very good.

When probed about the reason behind their answer (Figure 28), most respondents had more than one reason. For the HHs with positive views, 96 percent mentioned jobs and income provision (18 percent of women respondents mentioned this). About 16 percent also mentioned raising the status of the village. Very few (2.4 percent) mentioned protecting marine areas as a benefit of aquaculture. In Sava,

some households (3.5 percent) mentioned ethnic groups working together as a benefit, whereas in Menabe this reason was barely raised.

The majority of respondents with negative attitudes towards aquaculture see the curbing of fishing activities as a harm to the community brought by aquaculture. In both regions, the loss of fishing livelihoods was the most mentioned reason among respondents that view aquaculture negatively, mentioned by 92 percent of negative respondents in Menabe and 76 percent of respondents in Sava. In Sava, 64 percent of respondents also thought that aquaculture could bring social conflict to the village regarding marine area use, and 21 percent mention that it brings social conflict regarding who gets selected as a farmer. Other reasons mentioned in Sava include wrath from farming on sacred land, seaweed farmers not being able to practice other marine-based subsistence activities, and the disturbance to fishing activities in the village for subsistence. In Menabe, aside from the loss of fishing as a livelihood, 14.7 percent of respondents that view aquaculture negatively also mentioned social conflict regarding marine area use as a reason. In Menabe, a number of respondents also noted disturbance of water flow and the site in the village not being suitable for seaweed farming.

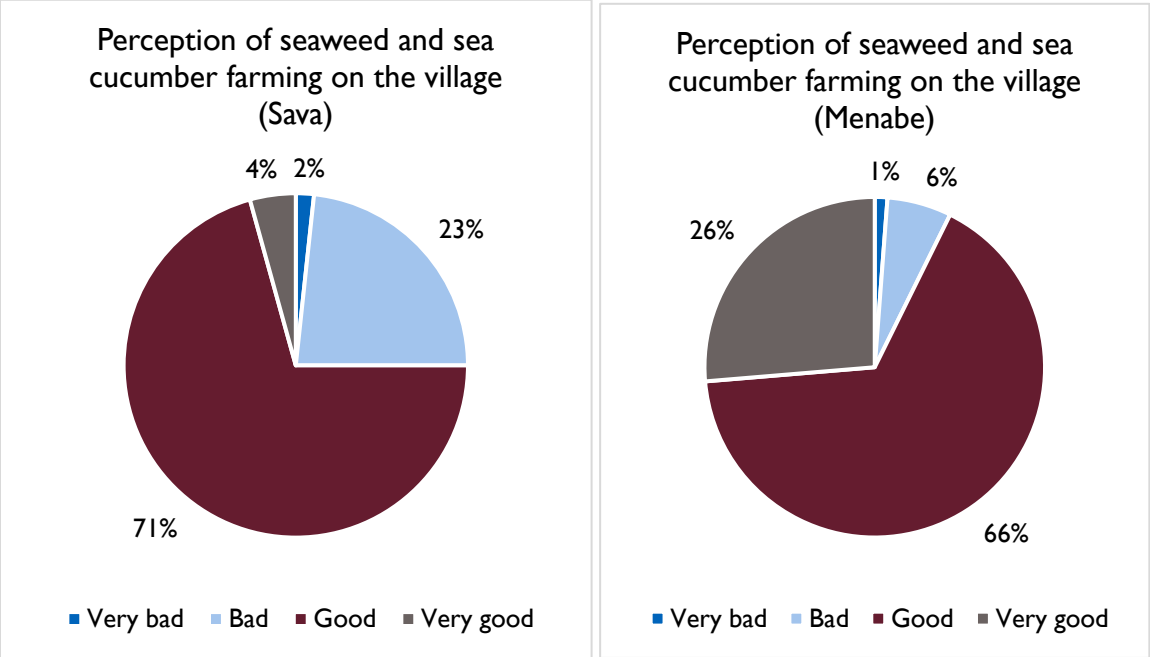
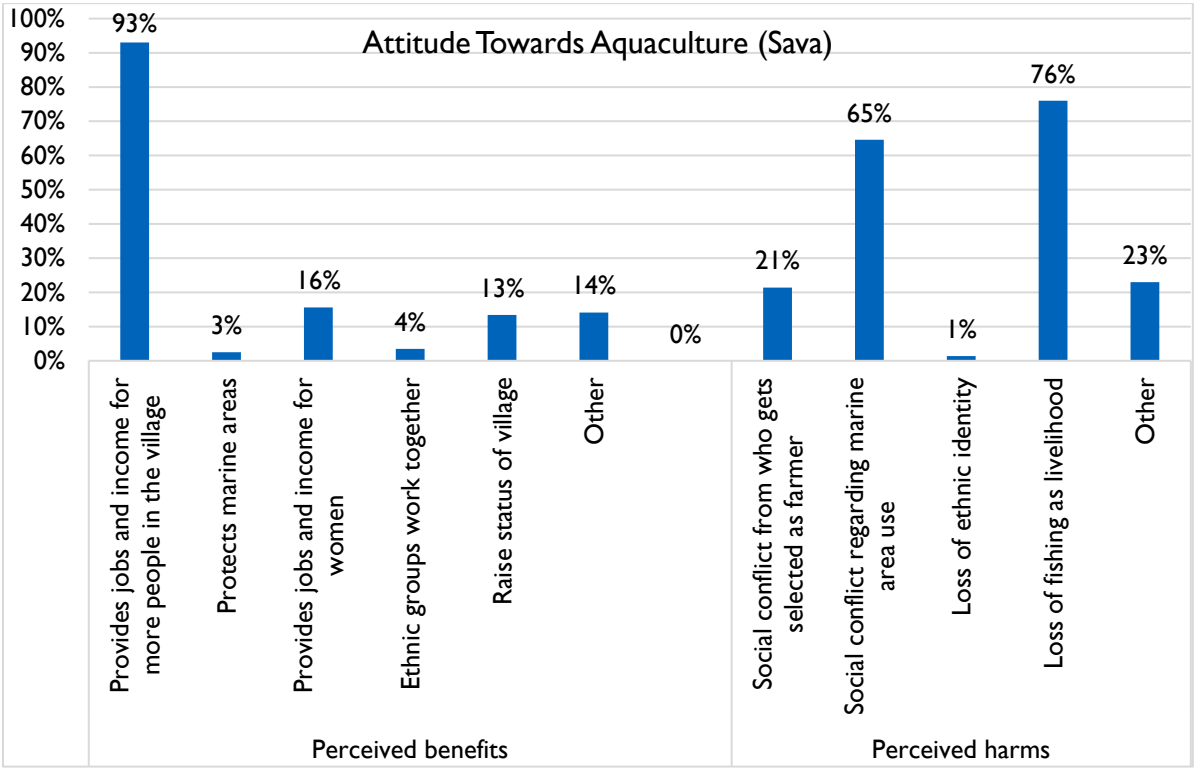


Figure 28: *Attitude towards aquaculture*



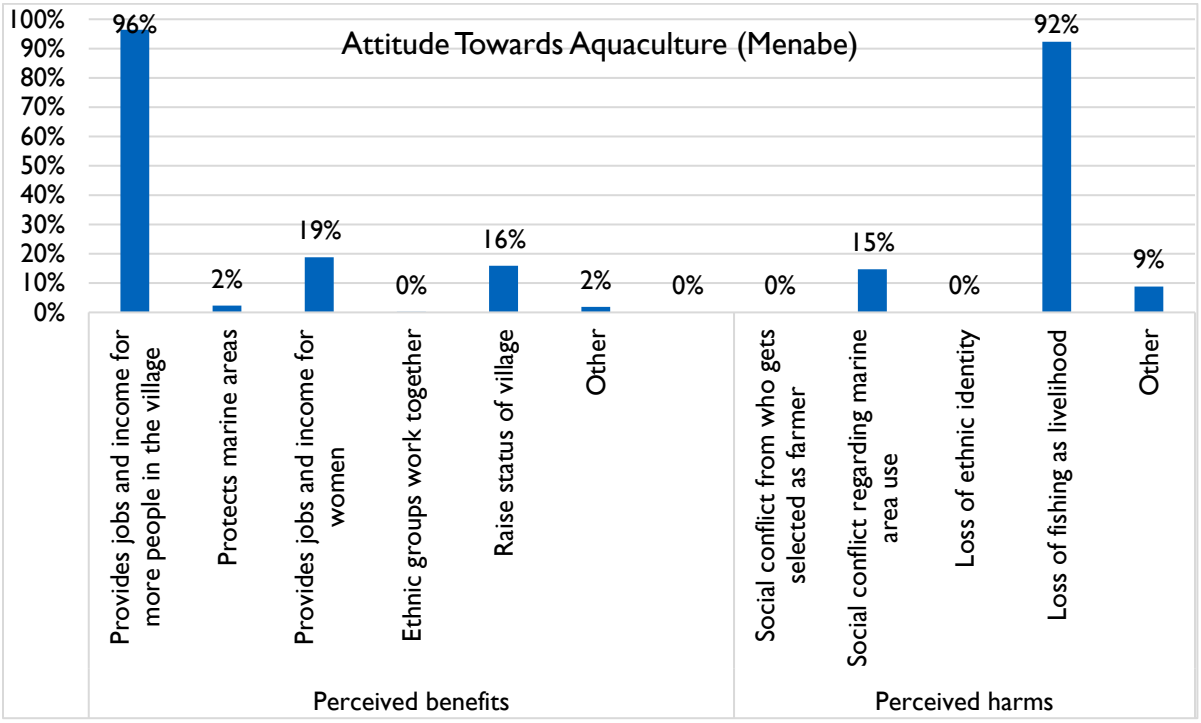


Figure 29: *Reasons given for the positive and negative perception of aquaculture.*

MARINE RESOURCE MANAGEMENT DECISION-MAKING AND PARTICIPATION

The study asked about the existence and participation in LMMA, as well as decision-making power and local participation in marine management in general. Figure 29 presents the results. This section also incorporates results from the long community survey with local fishery leaders regarding village participation in LMMAs.

MARINE RESOURCE DECISION-MAKING AND VILLAGE GOVERNANCE

Seventy-one percent of HHs in Sava have heard of LMMA compared to 57 percent in Menabe. The community leader long surveys indicate that all of the Sava's six study villages have LMMAs, and nine out of 11 of the study villages in Menabe have them. About 41 percent of HHs in Sava and 24 percent in Menabe attend LMMA meetings. According to community leaders, except for one village in Sava, all villages are part of the LMMA if there is an LMMA that governs their marine area. Of the villages that are part of an LMMA, all villages have a representative that attends the LMMA meetings.

However, their perception of the ability of village leaders to influence decisions of the LMMA varies. Village fishery leaders were asked if they agreed with the statement: "If the LMMA makes a decision or acts in a way that the village leader disagree with, there are ways for the village to express disagreement and influence the decision of the LMMA" (Table 19). Four out of nine leaders in Menabe disagree (four agree) and three out of five leaders disagree (one agrees and one strongly agrees). When asked whether the people in the village are generally satisfied with the decisions of the LMMA, the response is mostly satisfied or very satisfied in Menabe (five said satisfied and two said very satisfied), and mostly dissatisfied in Sava (three dissatisfied).

Table 19: *Community survey responses of village relation with LMMA, by region*

Do you agree with the following statement" "If the LMMA makes a decision or acts in a way that the village leader disagree with, there are ways for the village to express disagreement and influence the decision of the LMMA."				Are people in the village generally satisfied with the decisions of the LMMA?			
	Menabe	Sava	Total		Menabe	Sava	Total
Disagree	4	3	7	Dissatisfied	1	3	4
Neither agree nor disagree	1	0	1	Neither satisfied nor satisfied	1	1	2
Agree	4	1	5	Satisfied	5	1	6
Strongly agree	0	1	1	Very satisfied	2	0	2
Total	**9**	**5**	**14**	**Total**	**9**	**5**	**14**

When asked about how important marine resource decisions are made (Figure 30), while most HHs mention multiple sources of decision-making, 28 percent mention NGOs as the only or main decision-

maker. In Sava, the actors most mentioned are NGOs (61 percent) and LMMAs (55 percent), while 27 percent of HHs mentioned COBA/VOI (community-based organizations). Only a minority of HHs mentioned village president (seven percent), fokontany (nine percent), and communes (seven percent).

In Menabe, LMMAs take a smaller role and local decision-makers take a larger role. Households mention marine decision-makers to be mainly NGOs (46 percent), communes (33 percent), village presidents (25 percent), COBA/VOI (23 percent), government ministries (21 percent), and fokontany committees (10 percent), while only seven percent mention LMMAs. Few in either region mention regional/district government (eight percent).

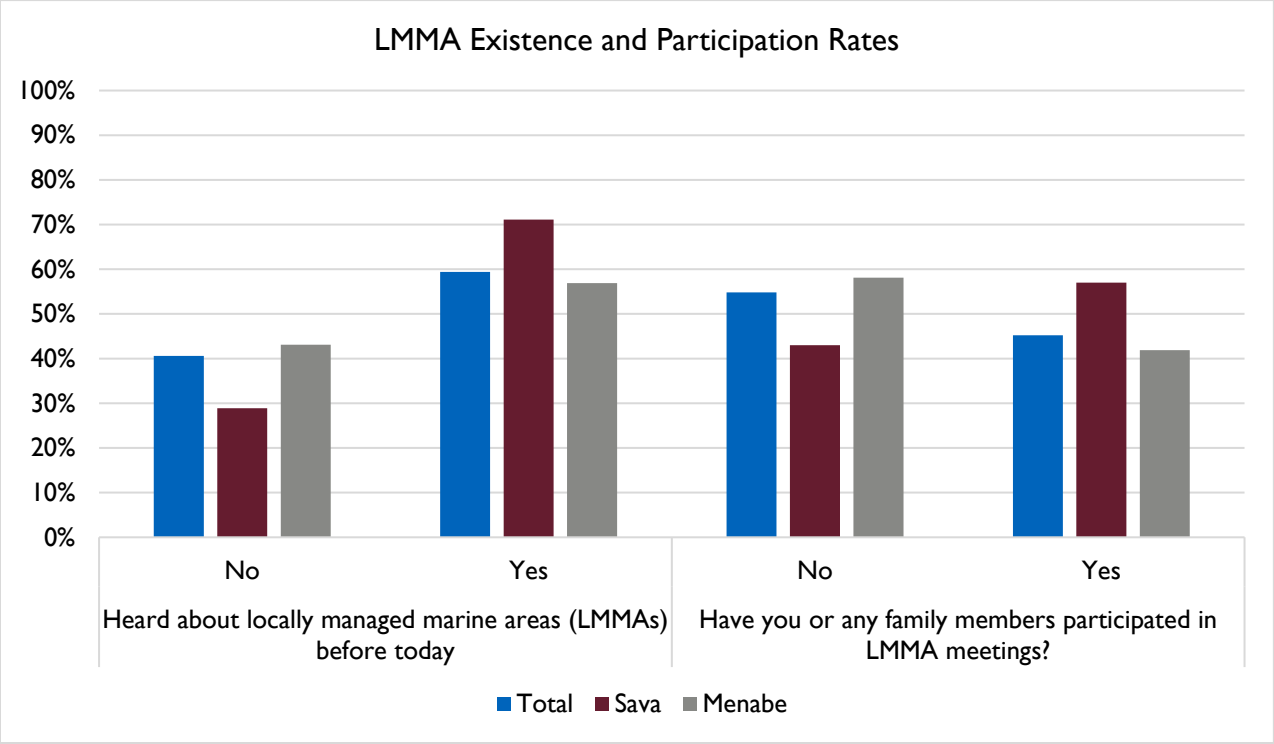


Figure 30: *LMMA existence and participation rates, region*

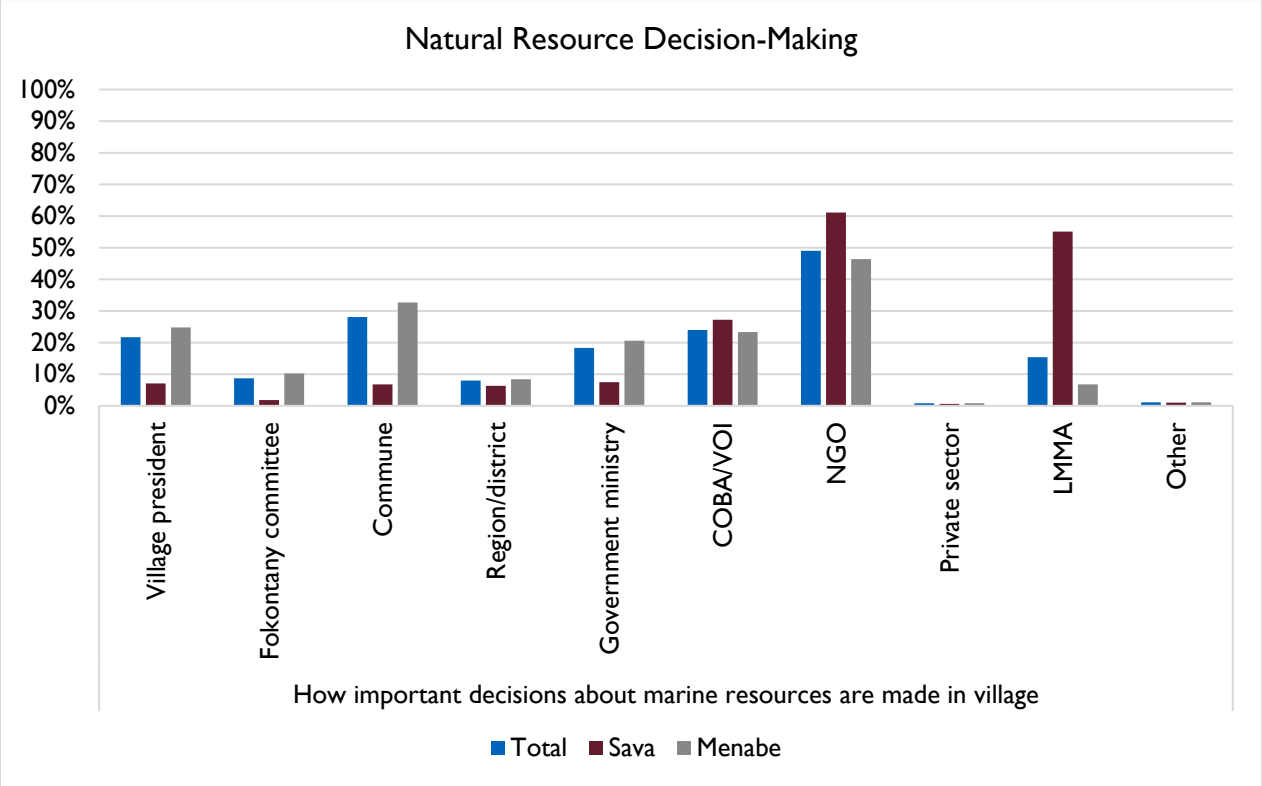


Figure 31: *NRM decision-making actors, by region*

Figure 31 presents HH responses for questions regarding general village governance, not necessarily related to resource management. Village decision-making is more participatory in Sava, with 68 percent of HHs indicating that group decisions are made by the whole villages instead of by the president (48 percent). Village meetings are held more often and attended more often. In Menabe, most village decisions are made by the village president (51 percent), and village meetings are held less frequently and attended less often.

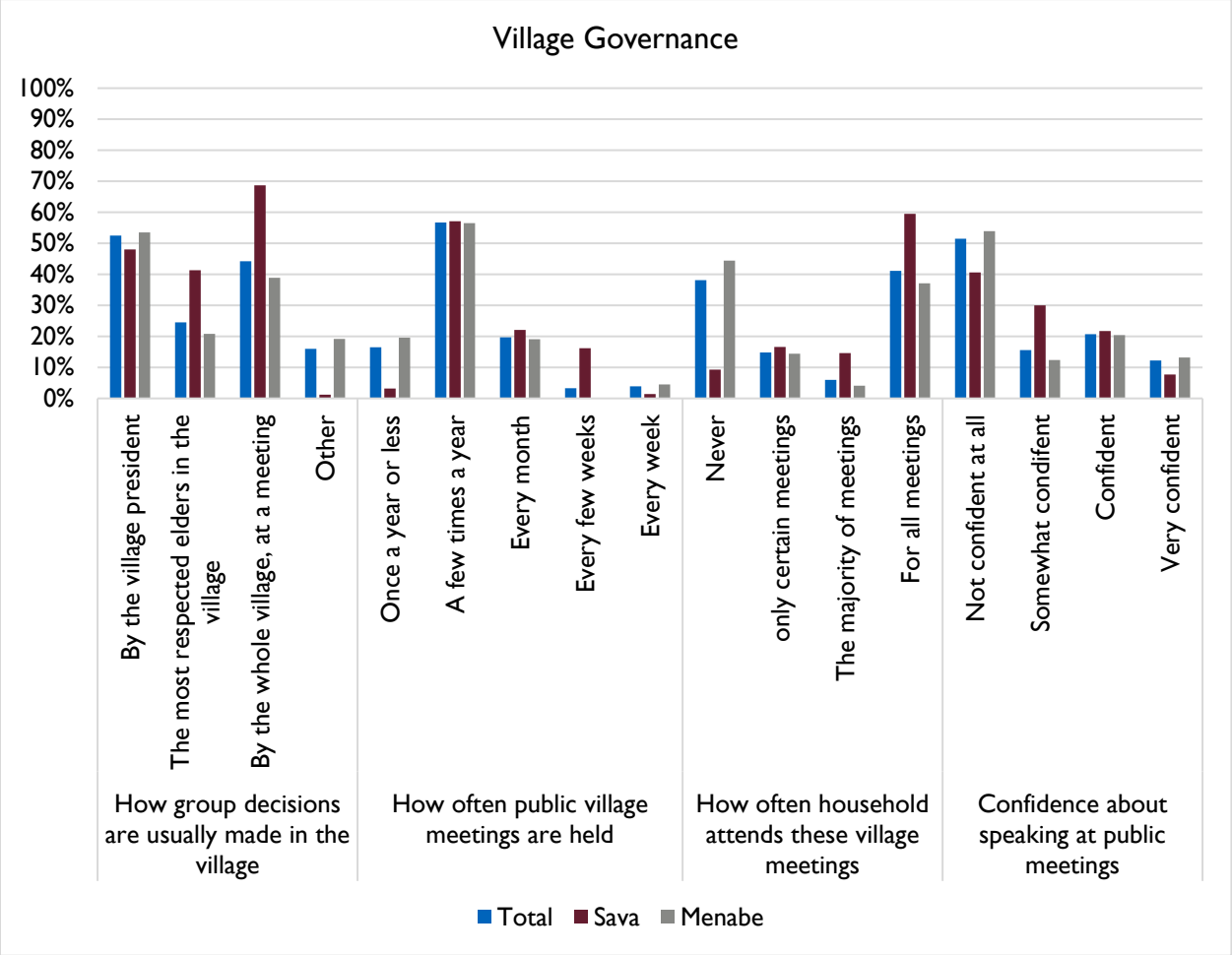


Figure 32: *Village governance by region*

RESOURCE MONITORING PARTICIPATION

Figure 32 presents the prevalence and type of participatory resource monitoring efforts by region. With regards to participation in resource monitoring efforts, more HHs in Sava (29 percent) participate than in Menabe (15 percent). In Menabe, the monitors tend to be compensated in cash (43 percent of monitoring HHs were compensated), and in Sava only eight percent of monitoring HHs were compensated. However, participating HHs across regions mostly perceive no benefits from participating (56 percent of participating HHs). Across regions, more males participate in monitoring, with 27 percent and 14 percent of HHs having a male member participating in resource monitoring in Sava and Menabe, respectively, compared to two percent of households having a female HH member participating in both regions. In Sava, the monitoring activities include fish catch size tracking (58 percent), control of protected areas (52 percent), assessment of catches (37 percent), and some ecological monitoring (11 percent). In Menabe, the monitoring activities include control of protected areas (56 percent), fish catch size tracking (31 percent), and ecological monitoring (23 percent). Across regions, HHs also mention frequent participation in fish gear and nets monitoring, as well as night diving and fishing monitoring in Sava.

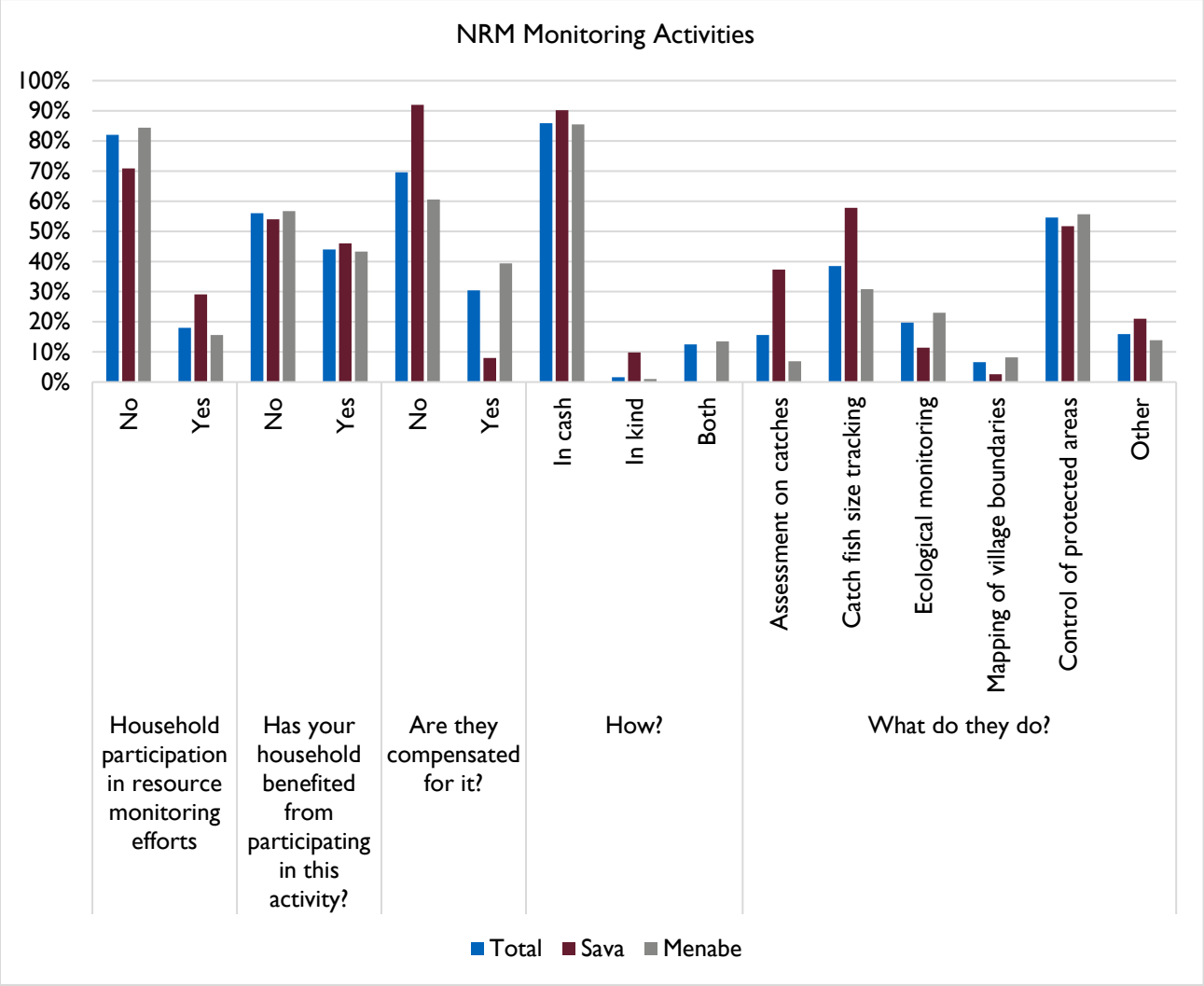


Figure 33: *NRM monitoring activities by region*

ATTITUDE TOWARDS NRM RULES

The study asked about the existence of a range of resource management rule types, including long-term closures, temporary closures, fishing gear restrictions, community aquaculture project closures, mangrove access restrictions in respondents' commune. The responses are presented in Figure 33. For those that answered that a rule-type exists, the study asked if the respondent would like more or less of the rule (Figure 36). For those that answered that a rule does not currently exist, the study asked whether respondents would like that type of rule in their commune (Figure 37).

Unsurprisingly, due to the prevalence of LMMAs, in Sava, almost all HHs report there to be fishing gear restrictions (100 percent), temporary closures (99 percent), mangrove closures (90 percent), and permanent closures (87 percent). Only 4.2 percent of HHs report there being aquaculture closures. Menabe HHs report fishing gear restrictions (86 percent), mangrove closures (81 percent), temporary closures (79 percent), permanent closures (46 percent), and aquaculture closures (9.2 percent).

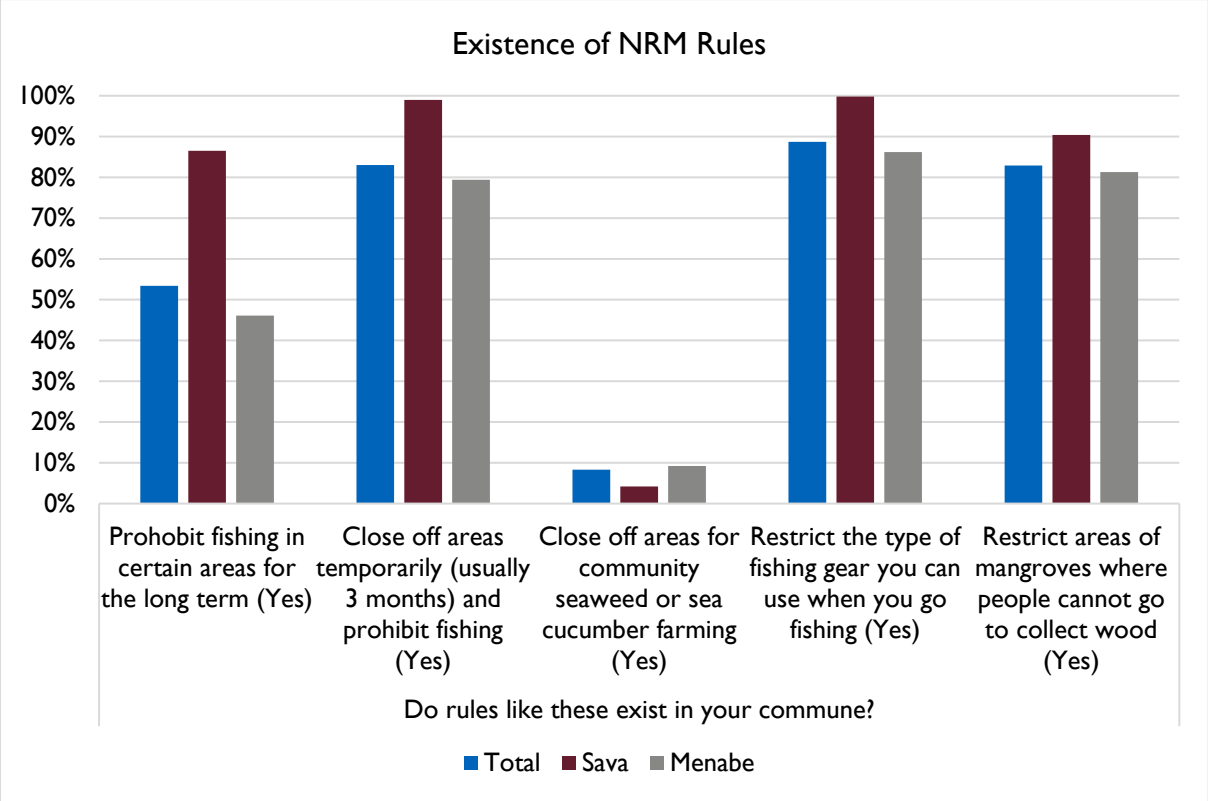


Figure 34: *Existence of NRM rules*

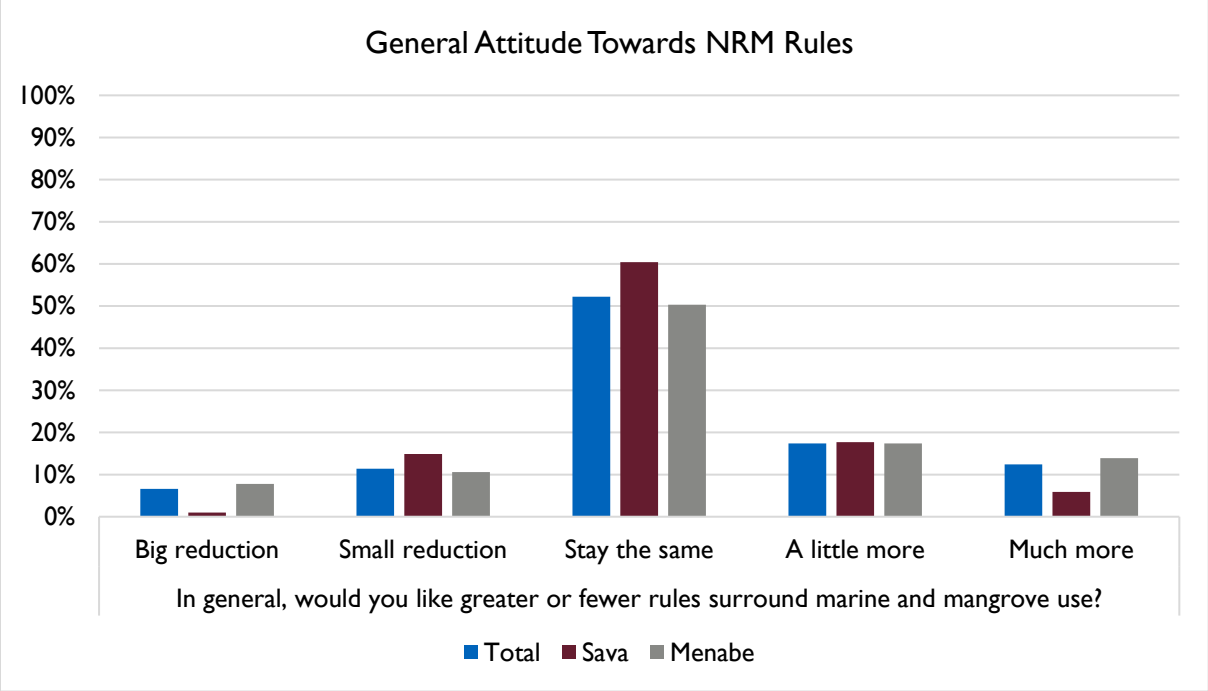
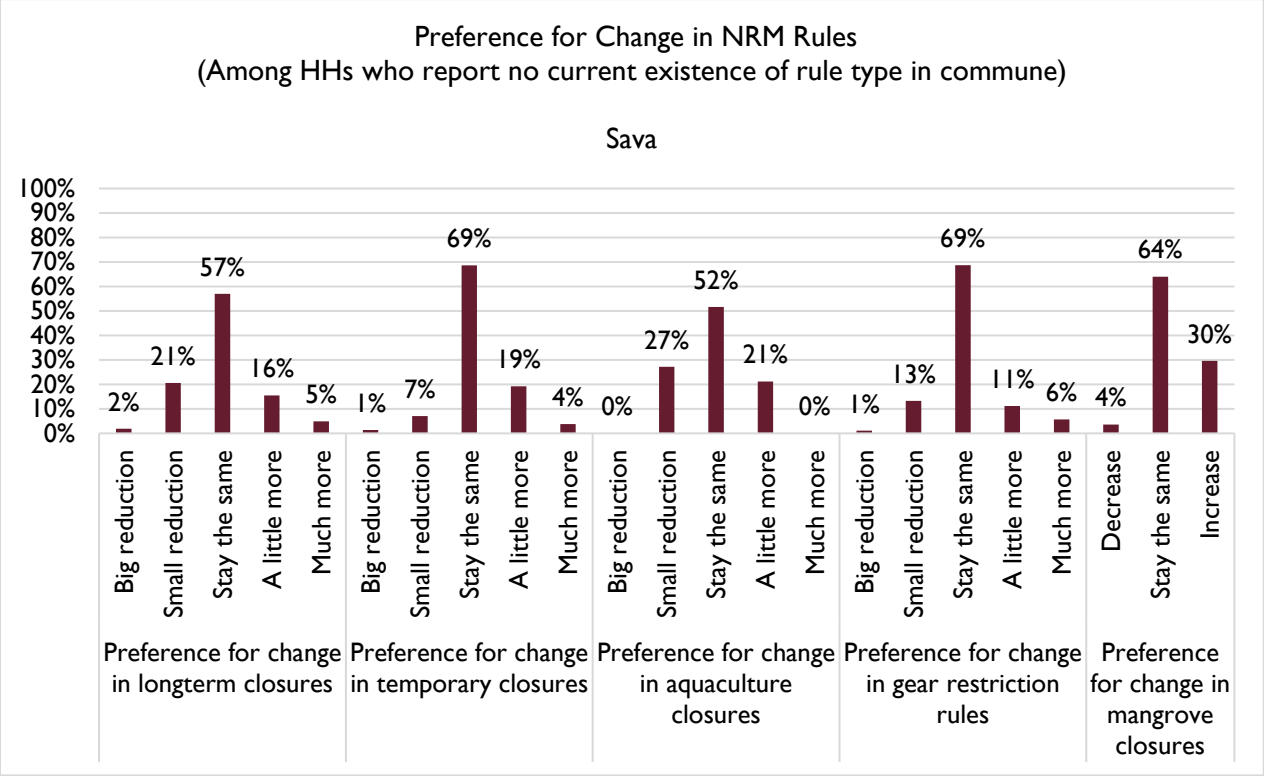


Figure 35: *General attitude towards NRM rules*

When asked about their preference for more or less rules, the HHs gave divided answers, especially in Menabe. When asked about marine and mangrove use rules in general, 60 percent of HHs in Sava and 50 percent of HHs in Menabe want the number of rules to stay the same. In Sava, 24 percent of HHs want more rules and 16 percent want less rules. In Menabe, 31 percent of HHs want more rules and 18 want less rules. Figure 26 shows the breakdown of the attitude towards NRM rules by type of rules.

The majority of HHs do not have aquaculture closures in their communes (96 percent in Sava and 91 percent in Menabe). In Sava, out of the HHs that do not currently have aquaculture closures, 64 percent would not like to have aquaculture closures. Their attitudes on mangrove and temporary closures are more positive, with 88 percent wanting mangrove closures and 77 percent wanting permanent closures for the extreme minority of HHs not having them. In Menabe, 83 percent of HHs without aquaculture closures in their commune do not want them. In general, HHs in Menabe that do not report NRM rules in their commune do not want new rules.

Of the minority of HHs that have aquaculture closures in their commune in Sava, 27 percent would like a small reduction, 21 percent would like a little more, and 52 percent would like it to stay the same. In Menabe the attitude is even more divided, where of the minority of HHs that have aquaculture closures in their commune, 37 percent want much more, 11 percent want a little more, 32 percent want either a big or small reduction, and only 20 percent want it to say the same.



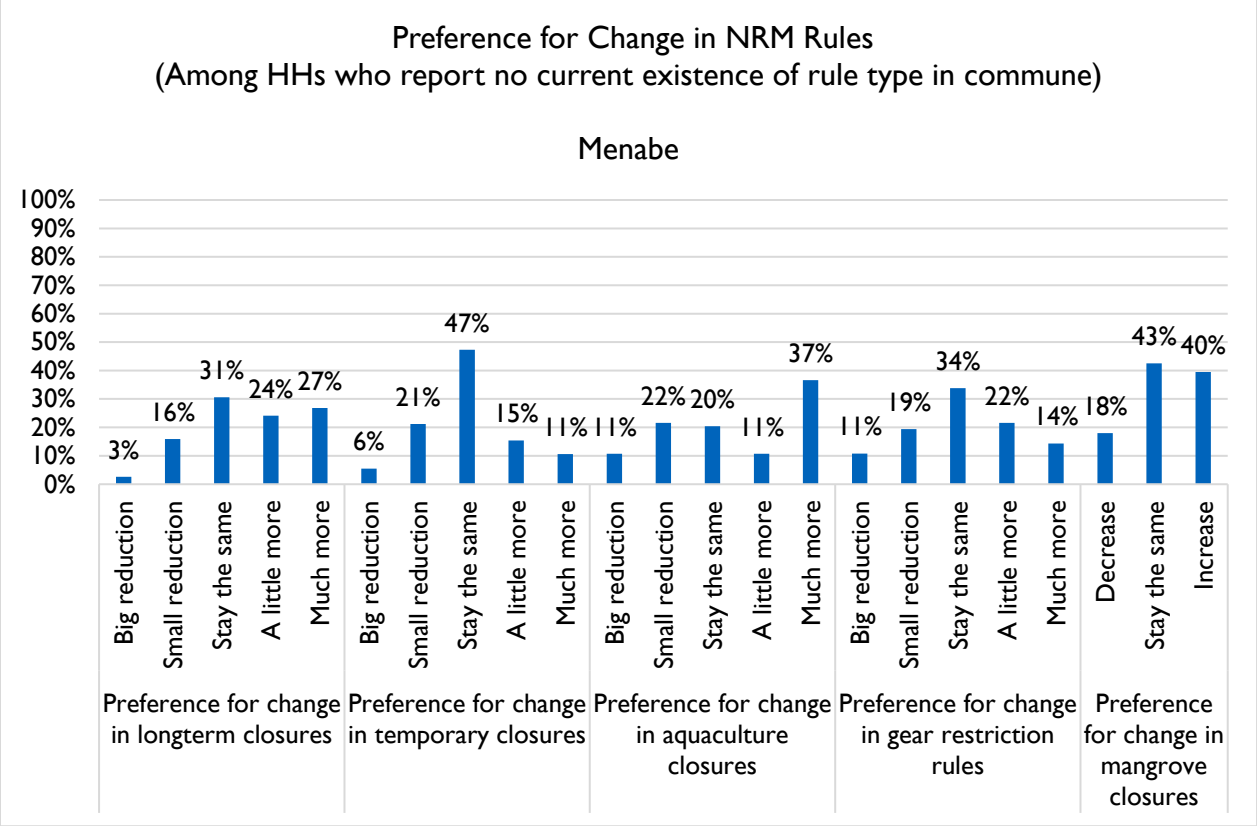


Figure 36: *Preference for change in NRM rules*

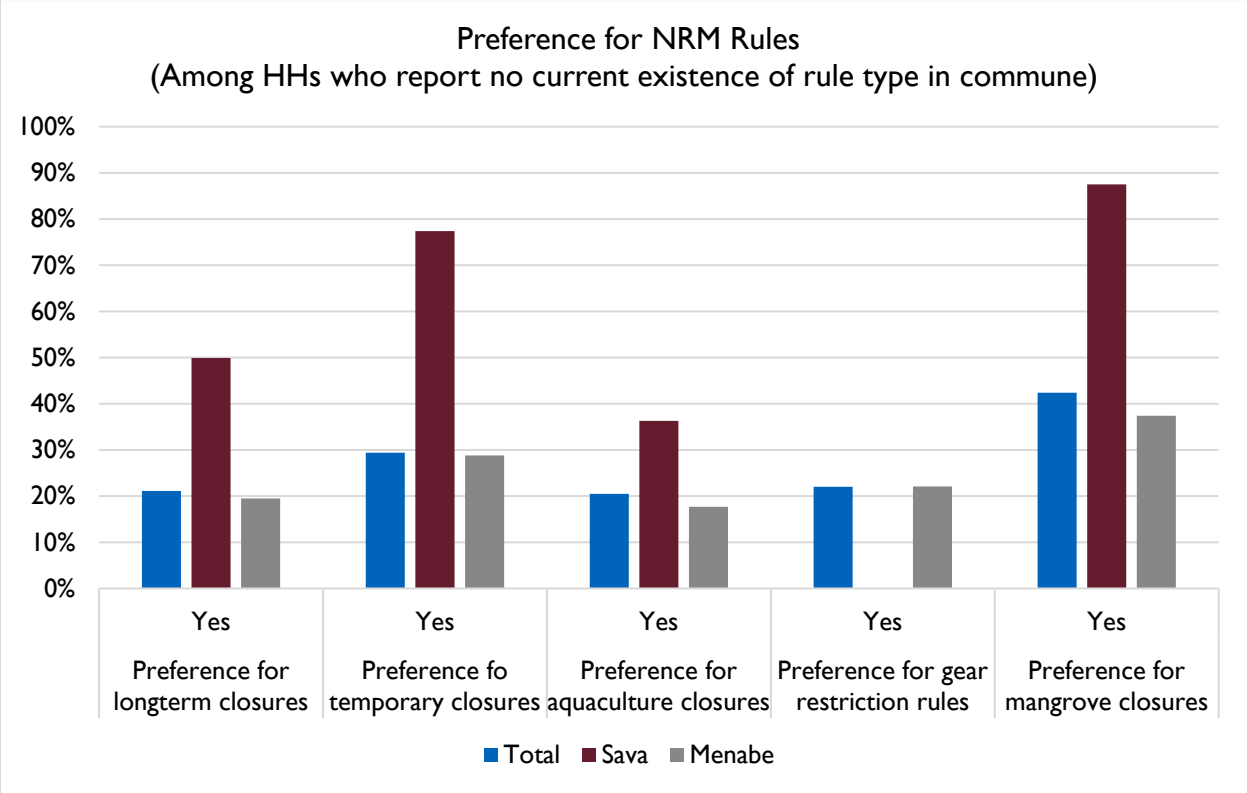


Figure 37: *Preference for NRM rules*

The study ran bivariate and multivariate regressions to investigate which HH characteristics are most associated with more positive attitudes towards aquaculture and aquaculture closures. These characteristics included those related to commercial and subsistence use of fish catches, poverty, experience with aquaculture closures, experience with aquaculture, attitudes on temporary closures in general, attitudes on NRM rules in general, and perceived ability to influence NRM rules. For the bivariate regression, the study team excluded seaweed farming HHs from the sample after learning from the multivariate regression that seaweed farming is highly correlated with positive aquaculture views.

Table 20 displays the bivariate regression results. HHs with positive views on aquaculture tend to have a HH size about one person larger, are less likely to be a fishing HH, earn a lower percentage of their HH income from fishing, and also use a lower percentage of their fishing catch for HH consumption. In other words, HHs with positive views of aquaculture rely on fishing less for commercial and subsistence use. None of the NRM participation and environmental perception indicators are statistically significantly correlated with aquaculture views in a bivariate analysis.

Table 20: *Difference between non-seaweed farming households with positive view of aquaculture and negative view of aquaculture.*

Non-seaweed farming HHs only	Positive views of aquaculture		Negative views of aquaculture		Difference	
	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
HH demographics						
HHH education (category)	104.00	2.00	414.00	1.72	0.28	0.30
Household size	106.00	3.61	422.00	4.40	-0.79	0.05*
Native to the village	106.00	0.57	422.00	0.49	0.07	0.46
Fishing HH	106.00	0.74	422.00	0.52	0.22	0.01**
Gleaning HH	106.00	0.31	422.00	0.15	0.15	0.14
Monthly HH income	106.00	628,047.12	422.00	432,866.25	195,180.87	0.32
Poverty status (below $1.90/day poverty line)	106.00	0.17	422.00	0.36	-0.19	0.00***
Fishing reliance						
Income from fishing	106.00	251,349.54	422.00	152,688.87	98,660.67	0.26
Percentage of HH income from fishing	106.00	49.81	422.00	35.04	14.76	0.07+
Percentage of catch used for HH consumption	76.00	21.60	283.00	15.35	6.24	0.02*
Land clearing practices						
Cleared land in the past year	106.00	0.09	422.00	0.05	0.04	0.27
Intend to clear land in the next 12 months	105.00	0.31	422.00	0.24	0.08	0.38
NRM participation						
Participate in LMMA meeting	67.00	0.50	274.00	0.45	0.05	0.67
Preference for more NRM rules	105.00	0.37	411.00	0.20	0.17	0.41
Perception of having influence over NRM decisions	106.00	1.46	419.00	1.34	0.12	0.41

Non-seaweed farming HHs only	Positive views of aquaculture		Negative views of aquaculture		Difference	
	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
Environmental Perception						
Perceived fishing catch increase/decrease in the past 5 years	82.00	3.99	303.00	4.10	-0.11	0.12
Perceived health of overall state of the natural environment	106.00	2.33	419.00	2.37	-0.04	0.79
Perceived existence of threats to local ecosystems	104.00	0.65	417.00	0.61	0.05	0.64
Perceived health of corals	100.00	2.68	391.00	2.49	0.19	0.06+
Perceived health of mangroves	82.00	2.72	404.00	2.61	0.11	0.56
Perceived health of lagoon	93.00	2.65	386.00	2.51	0.14	0.40

Table 21 and Figure 38 displays the results of the multivariate regressions, where the team looked at association of each variable while controlling for the association of other characteristics. For attitudes on the benefits or harm of aquaculture for the village (Model 1), after controlling for the more positive attitude in Menabe that may be due to regional differences aside from HH characteristics, seaweed farming HHs tend to view aquaculture 0.31 points more positively on a scale of one-to-four. Two characteristics negatively associate with aquaculture attitudes. All else equal, a HH that uses more of its fishing catch for HH consumption tends to think of aquaculture more negatively. The perception of a higher ability to influence NRM decisions also negatively influences aquaculture attitudes. Other characteristics are not statistically significantly associated with attitudes towards aquaculture.

The study also estimated a model adding perception of fishing CPUE change in the past five years as an explanatory variable, and only estimating the model with the fishing households as our sample. Controlling for all other variables, the perception of CPUE change has no statistically significant effect on perception of aquaculture and the coefficient size is also close to zero. The team also looked at pair-wise correlations between the perception of fishery CPUE change and perception of aquaculture, and the result shows that the two characteristics are not correlated with each other (0.06 with p=0.13).

Regarding support for closing marine sites for aquaculture, having a positive attitude towards temporary closures in general is associated with an increase in support for closures for aquaculture. However, being a seaweed farming HH decreases support for closures for aquaculture by about the same

magnitude. Percentage of income from fishing is also associated with support for aquaculture closure, but not by a substantively meaningful magnitude.

Table 21: *Linear regression of HH characteristic on perception of aquaculture and support for aquaculture closures*

	Model 1: Do you think seaweed and sea cucumber farming is good or bad for the village?	**Model 2: Would you like a rule like [aquaculture closures] in your [commune name] or no?**
	b/t	**b/t**
HH is below $1.90/day poverty line	0.10 (1.12)	-0.08 (-1.32)
Percentage of fishing catch used for HH food	-0.01* (-2.55)	0.00 (0.45)
Percentage of HH income from fishing	0.00 (1.23)	0.00 (1.59)
Seaweed farming HH	0.31** (3.08)	-0.21*** (-3.59)
Have existing closures for aquaculture in commune	0.08 (0.30)	
Support for longer temporary marine closures	-0.04 (-0.66)	0.05 (1.34)
General support for more NRM rules	0.13 (1.86)	0.08* (2.10)
Perceived ease of influencing village NRM decisions	-0.10** (-3.15)	0.05* (2.02)
Menabe	0.36*** (4.46)	-0.09 (-1.57)
N	551	506
r2	0.21	0.19

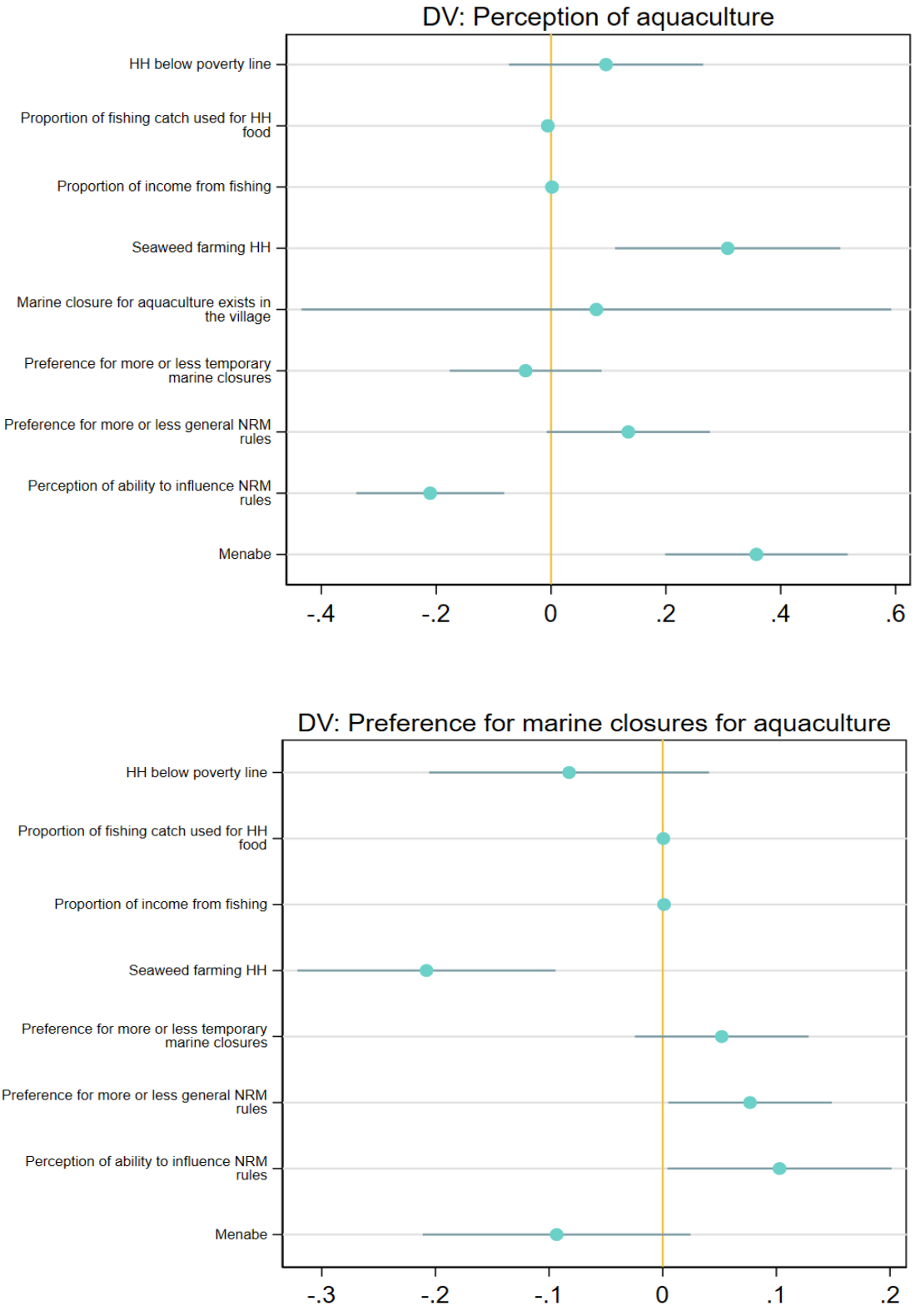


Figure 38: *Coefficient plot of regression on perception of aquaculture. 95% confidence interval*

LEARNING QUESTIONS

The Nosy Manga MEL framework contains two learning questions (LQs) regarding the potential impact of seaweed farming which the HH baseline survey can inform. The study investigated the difference in expected HH and village-level outcomes between existing seaweed farming HHs and non-seaweed farming HHs, as well as the different proportion of seaweed farming HHs in the village. However, it is important to keep in mind that the baseline data can only provide information on the association of key characteristics and behavior with seaweed farming but cannot attribute the cause of the difference to seaweed farming.

The study was unable to make causal claims attributing seaweed farming to the differences observed between HHs because of possible selection bias. Whether a HH farms seaweed, and whether a village has more seaweed farming activities, are not due to random decisions. It is very plausible that HHs and villages with certain pre-existing characteristics are more likely to adopt seaweed farming. Thus, the study cannot rule out the possibility that differences observed between seaweed farming HHs and non-seaweed farming HHs, as well as differences between villages with lots of seaweed farming activities and villages with no seaweed farming, are due to pre-existing differences in HHs and villages that are more prone to adopt seaweed farming activities, instead of due to changes from seaweed farming.

LEARNING QUESTION 1

How farmer recruitment criteria (as well as the technical support to farmers) can influence final results in terms of substitution of unsustainable practices, poverty reduction (most vulnerable) and community engagement (buy-in from community leadership and willingness to engage into project activities)?

For LQ1, investigating the association between seaweed farming and HH resource use behavior, well-being and engagement in resource governance can shed light on the possibility that selection of farmers can maximize impact. The study looked at differences in key outcome characteristics between existing seaweed farming and non-seaweed farming HHs in villages with seaweed farming, while controlling for other HH characteristics.

The study regressed whether a HH undertakes seaweed farming on several outcomes: unsustainable practices (over-fishing captured through income from fishing, average catch amount per trip, as well as land clearing behavior and intention), engagement with LMMA (participating in LMMA or local government), and perception of environmental degradation and environmental threat. The coefficient of seaweed farming from the multivariate analysis are displayed in Table 22. The HH demographics controlled for include gendered household head type, HH head education, HH size, native or immigrant, fishing HH, gleaning HH, HH ethnic category, and HH monthly income. Through a comparison of difference test (pair-wise t-test), the study learned that seaweed farming HHs tend to be less educated, more likely to be native to the villages, and more likely to be a fishing HH. HH size, gleaning practice, monthly income, and poverty status are not statistically significant between the two groups (Result provided in Appendix B).

After controlling for these HH characteristics, including HH monthly income, the result shows that seaweed farming HHs earn 60,367 Ariary (USD 13.73) less income from fishing and rely about eight

percent less on fishing for monthly income (statistically significant at the p<0.10 level). This shows that seaweed farming HHs rely less on fishing for their livelihood, thus may be less prone to engage in overfishing. Seaweed farming is not statistically correlated with land clearing behavior and intention to clear land. However, the existing seaweed farming HHs in the sample are located in Menabe where land clearing behavior is less prominent.

Seaweed farming is not statistically correlated with any of the participation outcome variables in the multivariate analysis, including participating in LMMA, being an active member of the local government, attending village meetings and confidence to speak at public meetings. With regard to environmental perception, seaweed farming HHs view that the state of the mangroves are healthier, and they perceive a greater decline in fishing catches in the past five years (significant at the p<0.10 level). However, being a seaweed farming HH has no effect on perception of the health of other resources, nor impression of threat to the environment.

Table 22: *Coefficient of Seaweed farming on models each regressing seaweed farming on key Nosy Manga outcomes of interest, controlling for HH demographics*

Outcome (Dependent variable)	Coefficient of Seaweed farming HH	p-value of coefficient
Poverty		
households below $1.90/day poverty line (Predicted)	-0.01	0.93
Fishing reliance		
Income from fishing	-60,367.02	0.03 *
Percentage of HH income from fishing	-8.14	0.07 +
Percentage of HH income from gleaning	5.05	0.03 *
Land clearing practices		
Cleared land in the past year	0.03	0.63
Intend to clear land in the next 12 months	-0.05	0.35
NRM participation		
Participate in LMMA meeting	0.06	0.59
Preference for more/less NRM rules	0.09	0.75
Environmental Perception		

Outcome (Dependent variable)	Coefficient of Seaweed farming HH	p-value of coefficient
Perceived health of overall state of the natural environment	0.14	0.20
Perceived existence of threats to local ecosystems	0.11	0.21
Perceived health of corals	0.11	0.39
Perceived health of mangroves	0.28	0.02 *
Perceived health of lagoon	0.14	0.23
Perceived fishing catch increase/decrease in the past 5 years	0.18	0.10 +

LEARNING QUESTION 2

How does integrating sustainable aquaculture and creation of new livelihood opportunity in a landscape, facilitate local conservation initiatives and objectives and help reach improved environmental protection consensus among space users?

The study looked at the correlation between the proportion of village HHs that farm seaweed, and local conservation initiatives, local monitoring participation, and consensus on environmental protection on the village level. Table 23 displays the responses from community leaders of relevant questions. Among these villages, a higher proportion of village HHs farming seaweed are associated with greater satisfaction with LMMA (pairwise correlation coefficients of 0.45) and villages with conservation initiatives (0.55), but less village participation in resource monitoring (-0.53). Since the study had only 11 villages, no conclusions were made regarding the population of villages. This question at the village level is better answered by monitoring qualitative data.

With the HH survey dataset, the study team also examined the correlation between viewing aquaculture positively for economic impact, and on views on health of the ecosystem, preference for more or less NRM rules, and engagement with village NRM decision-making. All the variables of interest are only weakly correlated with having a positive view of aquaculture for its economic impact (correlation coefficient smaller than 0.08, and not statistically significant).

Table 23: *Seaweed farming prevalence in villages in Menabe, as well as community leader survey responses of village engagement with marine governance, conservation initiative, and existence of marine conflicts*

Village	Total # of HHs	Percentages of HH that farms seaweed	"Are there any conflicts around [seaweed farmer's marine] access rights?"	"Is there an LMMA that governs the marine areas of the village?"	"Are people in the village generally satisfied with the decisions of the LMMA?"	"Are there any conservation initiatives or reserves in this village?"	"Do you feel like you or the village representative can influence important decisions about marine resource management?"	"Do village members participate in resource monitoring efforts?"	"What resource"?
Village 1	Under 50	0		No		No	Yes	Yes	Marine, Forest
Village 2	Over 500	4	No	Yes	Neither satisfied nor dissatisfied	Yes	Yes	Yes	Mangroves, Marine, Forest
Village 3	Over 500	13	No	Yes	Satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 4	50 to 100	18	No	Yes	Dissatisfied	No	No	Yes	Mangroves
Village 5	50 to 100	20	No	Yes	Very satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 6	50 to 100	23	No	Yes	Very satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 7	50 to 100	32	No	Yes	Satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 8	50 to 100	33	No	No		Yes	Yes	Yes	Mangroves
Village 9	50 to 100	50	No	Yes	Satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 10	50 to 100	75	No	Yes	Satisfied	Yes	Yes	Yes	Mangroves, Marine
Village 11	50 to 100	93	Yes	Yes	Satisfied	Yes	Yes	Yes	Mangroves, Marine

Conclusions

Several important conclusions emerge from these findings related to the difference in poverty level between regions, NRM governance decision-makers, drivers of opposition to aquaculture, and framing of restorative aquaculture programs to obtain local buy-in.

The proportion of HHs under the poverty line, facing moderate to severe food insecurity and lacking basic access to electricity and water for household use is substantially higher in study villages in Menabe than in Sava. Excluding outliers, the average monthly income in Menabe is 82 percent that of Sava. The HH characteristics associated with those under the poverty line are slightly different between Sava and Menabe. In Menabe, fishing HHs and HHs where the HH head or spouse was born in the village are more likely to be in poverty, compared to in Sava where HH education level is the HH characteristic most strongly associated with poverty. Further analysis at lower administrative levels, coupled with community leader responses, can be used to provide a clearer picture of the concentration of poverty, public service access, and profiles of the most vulnerable HHs within regions.

Land clearing and the intention of land clearing, mostly in forested land, widely exists in Sava, motivated by commercial agriculture to grow more, and more diverse crops, and for household consumption. This practice and intention also exist in Menabe but it is less frequent. The percentage of income from crop farming and perception of health of mangroves, and not being under the poverty line, are closely associated with having the intention to clear land.

Overall, LMMAs are more prevalent in Sava, but marine resource decision-making seems to be more decentralized to involve local leaders at the village, fokontany, and commune level in Menabe than Sava. This observation is puzzling as non-resource group decisions seem to be more decentralized at the village-level in Sava than in Menabe, where more group decisions are made at public village meetings (70 percent versus 39 percent) rather than by the village president, and where public village meetings are more often held and attended. However, in both regions, NGOs are mentioned as the most prominent actor in marine management.

While most HHs in both regions views aquaculture positively, the results imply there may be some obstacles obtaining local buy-in on the Nosy Manga program in certain areas, especially in Sava. With regards to perception of aquaculture, the survey results indicate that the majority of HHs have a positive view of aquaculture (75 percent of HHs in Sava and 92 percent of HHs in Menabe think that seaweed and sea cucumber farming are good for the village). However, a quarter of HHs in Sava view aquaculture negatively in Sava compared to only eight percent in Menabe and may be unwilling to engage with aquaculture programs. The HH survey indicates that these HHs perceive aquaculture as in competition with fishing livelihoods and creating conflict on marine use. Thus, in Sava where HHs reported more existing conflicts around the use of marine areas for fishing, and internal disputes as well as disputes with NGOs regarding existing rules regulating fishing activities in marine areas, the support for aquaculture is lower. While most fishing HHs feel confident they can continue to access their fishing sites, a substantial proportion in Sava (32 percent) do not. Multivariate analysis also shows that after controlling for non-HH level regional differences, it is fishing for HH consumption,

instead of for commercial exchange for income, that is associated with negative perceptions of aquaculture.

Aside from competition with fishing interests, there is another reason for negative perceptions of aquaculture related to marine area use. For the two villages in Sava that refused to be surveyed, as well as indicated by some of the surveyed respondents in other villages, the local population opposes aquaculture programs because they perceive the identified aquaculture sites to be on their sacred land. Moreover, while the majority of HHs perceive aquaculture positively, there may be further obstacles when identifying farming sites and negotiating site access rules. When asked about the closing of marine areas for aquaculture as a rule, a large majority of HHs are against it (80 percent overall).

These nuanced findings indicate the need to develop context-specific strategies for participant recruitment as well as negotiation of marine sites for aquaculture and rules regarding site access for fishing. More detailed village-level and fishing site-level analysis can be used to identify if these sentiments and disputes are concentrated in particular fishing sites and villages to tailor localized approaches. On a more positive note, HHs who currently participate in seaweed farming as well as those who currently have aquaculture closures in their community tend to view aquaculture more positively, implying that the hurdle may exist largely in initial access.

The result also points to the need for a more qualitative understanding of how local populations connect their environmental perception, demand for NRM rules, and HH economic motivations connected to fishing. This knowledge can inform how the benefit of Nosy Manga aquaculture programs, as related to environmental protection and increasing fish diversity and abundance, can be better presented to local populations, in addition to presenting it as a viable economic and subsistence alternative to fishing instead of a competitor.

Currently, only two percent of HHs overall connect aquaculture activities to marine and fish population protection, mostly viewing it as an economic opportunity unconnected or opposing fishery. However, there is local demand for conservation efforts. While most of the study population is opposed to marine closures for aquaculture, they are not opposed to other conservation initiatives. They are largely indifferent to current levels of marine and mangrove-use rules in their communities which are very widespread with the near-universal presence of LMMAs (with attitudes in Menabe being more divided). The study population does perceive their ecosystem to be degraded (57 percent) and under threat (65 percent) by mainly climate change but also some unsustainable fishing. Though, despite the perception of environmental degradation and decreased fishing CPUE, the majority of HHs (73 percent in Sava and 87 percent in Menabe) still perceive having enough fish in the sea to provide enough food for everyone who lives in the community.

APPENDIX A: Nosy Manga Baseline Survey Instrument Summary

HH Survey

- **Module 1 Respondent details:**
  Gender, age, education, literacy, ethnicity, migration status (birthplace, time in current village, migration reason), main occupation.
- **Module 2 HH Roster:**
  Gender, age, education (school attendance status for under 18), literacy, main occupation.
- **Module 3 HH Assets:**
  Household assets, transport/farm/livestock assets, pirogue ownership and borrowing/renting, farmland ownership and rental, access to electricity, solar panel ownership. Other Poverty Probability Index indicators.
- **Module 4 Livelihood:**
  Three most important livelihoods for the household and proportion of income from each source.
- **Module 5 Fishery:**
  HH members who fish, HH monthly income from fishing activities, perceived change in CPUE, fishery assets and its borrowing/lending:
    - Per fishing site: technology used, effort, fish species, catch quantity, proportion of the catch for selling and household consumption, who makes selling decisions, disputes regarding site access.
- **Module 6 Gleaning:**
  HH members who glean, HH monthly income from gleaning activities, perceived change in CPUE:
    - Per gleaning site: effort, species, catch quantity, proportion of the catch for selling and household consumption, who makes selling decisions, disputes regarding site access.
- **Module 7 Seaweed and Sea Cucumber Farming:**
  HH member that participates in aquaculture, HH monthly income from sea cucumber and seaweed farming, who do they sell to, and which HH member makes selling decisions and decisions about the use of aquaculture income (for HH's that don't participate in aquaculture, we ask about awareness, attitude towards aquaculture, and perceived effect of aquaculture activities in the village).

- **Module 8 Savings, Lending, and Borrowing:**
  Have/does not have savings, use of savings, frequency and source of borrowing, household income last month, mobile banking use.

- **Module 9 Food Security and Coping Strategies:**
  HEARTH Toolkit household food security (past 12 months) and coping strategy modules.

- **Module 10: Participation in Groups and Associations:**
  Who makes village decisions; HH participation in local groups and associations; confidence in speaking in village meetings.

- **Module 11 Participation and Attitudes Towards Resource Management:**
  Understanding of what resource management is, who makes village marine and mangrove governance decisions, HH level of participation and perceived influence in meetings; LMMA familiarity and participation; existence and attitudes towards different conservation rules, and general attitude towards conservation and conservation rules; participation and attitudes towards resource monitoring.

- **Module 12 Energy Use and Mangrove Conservation:**
  Energy source, attitude towards mangrove conservation, and perception of mangrove and marine fishery resource change; land cleaning for farming.

Community Survey (Long and Short)

- **Module 1 Respondent Details (Included in Short Survey)**

- **Module 2 Village Infrastructure:**
  Primary and secondary school distance and fee, health center distance and level, market distance, local shops supply level, existence of community center, dock, existence of active mobile phone network and electricity supply, microfinance office, and access point distance.

- **Module 3 Village Livelihoods and Marine Access Rights (in Short Survey):**
  Three most important village issues, village size, local ethnic groups, electricity and drinking water access, main village livelihoods for each livelihood: # of households participating, primarily done by women or men, primarily done by any particular ethnic group; main fishing and gleaning practices, for each practice: # of households participating, primarily done by women or men, primarily done by any particular ethnic group; sites for fishing and gleaning, for each site: name, distance, user access rights, other village access, conflicts and conflict details; seaweed and sea cucumber farming: # of households participating, primarily done by women or men, primarily done by any particular ethnic group, marine access rights, other village access, conflicts and conflict details.

- **Module 4 Governance of Marine Areas**:
  LMMA existence, age, decision maker, existence of fisheries, corals and mangrove management plans and regulations, existence of designated protected areas (where, access

rules), village membership, LMMA meeting frequency and village participation, perceived village influence, and satisfaction with LMMA.

- **Module 5 Local Conservation Initiatives:**
  Local resource management organizations, local conservation initiatives including marine reserves, for each initiative/reserve: name, decision maker, rules, who monitors, rule breaking, any problems.

- **Module 6 Perception of Natural Resource Management (in Short Survey):**
  Existence and agreement regarding different resource management rules, perception of seaweed and sea cucumber farming; for short survey, here we ask about local resource decision making and influence; for long survey only: monitoring activities and participation.

- **Module 7 Ethnic Relations (in Short Survey):**
  Main decision makers, perceived influence, who attends village meetings, most disadvantaged ethnic groups, fishery dependent ethnic groups, ethnic groups' primary fishing technology, other non-village groups who use resource cooperative-conflictual ethnic relationship scale, cooperative ethnic groups, ability to work together if paired.

APPENDIX B: Summary Statistics for Key Outcome Areas

Table 12: *Migration across regions*

	Sava		Menabe		Total		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Raised in village since childhood							
No	39.2	3.038	47.4	4.097	45.9	3.414	*
Yes	60.8	3.038	52.6	4.097	54.1	3.414	
Total	100		100		100		
Migrated							
Migration reason - Economic							
No	22.2	4.074	27.3	5.521	26.5	4.732	*
Yes	77.8	4.074	72.7	5.521	73.5	4.732	
Total	100		100		100		
Migration reason - Marriage							
No	83	3.744	93.8	2.514	92.1	2.23	*
Yes	17	3.744	6.2	2.514	7.9	2.23	
Total	100		100		100		
Migration reason - Conflict							
No	97.4	1.31	84.6	4.666	86.5	3.99	***
Yes	2.6	1.31	15.4	4.666	13.5	3.99	
Total	100		100		100		
Migration reason - Other							
No	100	0	99	0.394	99.1	0.331	*
Yes	0	0	1	0.394	0.9	0.331	
Total	100		100		100		

Table 13: *Dwelling characteristics*

	Sava		Menabe		Total		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Main material of the walls							
Metal	0.5	0.33	4.5	1.94	3.8	1.6	**
Cement	0.2	0.24	2	1.24	1.7	1.02	
Vondro/Ravina/ Palme/Zozoro/Falafa	72	2.89	60.1	4.15	62.2	3.48	

	Sava		Menabe		Total		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Wood	27.3	2.87	31.9	4.06	31.1	3.38	
Other	0	0	1.6	0.34	1.3	0.28	
Main material of the roof							
Metal	32.3	3	26.6	3.89	27.6	3.24	*
Vondro/Ravina/ Bozaka	67.7	3	73.4	3.89	72.3	3.24	
Other	0	0	0.1	0.06	0	0.05	
Main material of the floor							
Ciment	10.3	2.03	23.5	3.81	21.1	3.18	***
Planche	30.6	2.85	8.8	2.3	12.7	1.99	
Palme/ Bambou/ Rapaka	30.5	2.86	0.2	0.14	5.6	0.69	
Ground	2.3	1.01	11.8	2.65	10.1	2.2	
Woven mat	9.2	1.84	54.5	4.14	46.4	3.42	
Other	17.1	2.45	1.2	0.94	4	0.92	
Household access to electricity							
No	23.7	2.61	72.8	3.9	64.1	3.25	***
Yes	76.3	2.61	27.2	3.9	35.9	3.25	

Table 14: *Access to electricity, water, and cooking fuel*

	Sava		Menabe		Overall		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Main source of electricity							
Electrical grid	0	0	3.4	3.38	2.1	2.11	.
Solar panels	91.3	1.95	89.1	5.62	89.9	3.57	
	8	1.88	7.5	4.69	7.7	3	
Other	0.7	0.52	0	0	0.3	0.2	
Main source of drinking water							
Tap of the village	1.6	0.94	0	0	0.3	0.17	***
Well of the household	7.6	1.41	10.8	2.83	10.3	2.34	
Well of the village	88.2	1.82	84.4	2.86	85.1	2.37	
Spring	1	0.5	0	0	0.2	0.09	
River/ surface water	1.6	0.62	4.7	0.63	4.2	0.52	
Main cooking fuel							
Charcoal	14.3	2.33	21.9	3.69	20.6	3.08	.
Wood	66.4	3.03	63.7	4.13	64.2	3.44	
Both	19.3	2.52	14.4	3.07	15.3	2.56	

Table 15: *Borrowing and lending*

	Sava Percent	Menabe Percent	Total Percent	Signif.
Frequency of borrowing money from other people in the last year				
Never	65.8	60.4	61.3	.
Once or twice in the last year	33.8	36.2	35.8	
Once per week	0.5	3	2.5	
Every day, or almost every day	0	0.5	0.4	
Who is borrowed from				
Family	64.8	54.1	55.8	
A local businessperson/shop owner	23.2	40.6	37.8	
NGO	0	0.2	0.1	
Other	18.9	13.1	14	
In the last year, how many people have you been asked to lend money to?				
None	56	50.8	51.7	.
1-2 people	21.7	25.4	24.7	
3-5 people	15.4	17.4	17.1	
6-10 people	4	3.3	3.4	
More than 10 people	2.9	3	3	

Table 16: *Mobile money use*

	Sava Percent	Menabe Percent	Total Percent	
Members of household using mobile money	29	32	32	
Ability of household members to withdraw mobile money	93	93	93	
Ability of household to use mobile money at local shops	6	9	9	
Ability of household to use mobile money to trade/send money to individuals	97	93	93	

Table 17: *Resilience – shock recovery*

	All		Sava		Menabe			
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
Shock severity	763	1.13	294	0.88	469	1.19	-0.31	0.06
Ability to recover from shock	222	3.07	86	2.79	136	3.12	-0.33	0.12
Corrected ARSII index	221	3.38	86	3.07	135	3.43	-0.36	0.09

Table 18: *Resilience – social capital*

	All		Sava		Menabe			
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
Bonding social capital	764	3.29	294	3.48	470	3.25	0.23	0.04
Bridging social capital	764	2.45	294	2.81	470	2.37	0.44	0
General social capital	764	2.87	294	3.14	470	2.81	0.34	0

Table 19: *Resilience – food security (FIES)*

	Little or no	Moderate	Severe	Moderate or severe
	Percent	Percent	Percent	Percent
Sava	76	23	1	24
Menabe	28	56	16	72
Total	35	51	14	65

Table 20: *Land ownership*

	Sava		Menabe		Overall		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Housing status							
Owner	87.8	2.21	83.9	3.29	84.6	2.74	.
Tenant	3.5	1.33	9.1	2.69	8.1	2.23	
Lodger/friend	5.5	1.49	5.1	1.87	5.1	1.56	
Other	3.2	1.19	1.9	1.24	2.1	1.04	
Land ownership							
No	32.1	3.12	12.5	2.78	16.1	2.37	***

	Sava		Menabe		Overall		
	Percent	SE	Percent	SE	Percent	SE	Signif.
Yes	67.9	3.12	87.5	2.78	83.9	2.37	
Land ownership recognition by state or head of fokontany							
Not officially recognized	42.5	4.01	45.6	4.57	45.2	3.93	***
State	20.9	3.07	45.5	4.79	41.8	4.18	
Fokontany	25.4	3.42	8.9	3.17	11.3	2.73	
Both	11.2	2.84	0	0	1.7	0.46	
Land ownership for building a house elsewhere							
No	49.2	3.15	48.5	4.11	48.6	3.42	.
Yes	50.8	3.15	51.5	4.11	51.4	3.42	

Table 21: *Agricultural land and livestock ownership*

	All		Sava		Menabe			
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Diff.	p-val
Area of land farmed by your household (in ares)	395	145.66	274	176.41	121	122.6	53.81	0.04
Percentage of farmed land owned by HH	394	0.8	273	0.78	121	0.82	-0.04	0.6
Area of farmland owned by your household (in ares)	83	128.39	3	38.41	80	130.88	-92.47	0.03
Goats	485	2.1	226	0.03	259	2.73	-2.71	0
Sheep	485	0.01	226	0.05	259	0	0.05	0.16
Chicken or duck (or other poultry)	485	6.59	226	9.77	259	5.61	4.16	0
Pig	485	0.66	226	0.01	259	0.87	-0.86	0
Zebu	485	1.16	226	0.56	259	1.34	-0.78	0.26

Table 22: *Fishing method*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Fish by boat/foot							
Foot	0.4	0.45	9.6	3.25	8.1	2.74	***
Boat	92.7	2.04	89.2	3.26	89.7	2.76	
Both	6.9	2	1.2	0.42	2.1	0.5	
Fish in day/night							
Day	70.7	3.67	90.5	3.24	87.3	2.78	**
Night	12.3	2.7	4.1	2.18	5.4	1.88	
Both	17	2.95	5.4	2.54	7.3	2.18	
Fish year round							
Yes	9.2	2.25	5.8	2.23	6.3	1.9	.

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
No	90.8	2.25	94.2	2.23	93.7	1.9	
Fish dry season only							
No	31.8	9.1	27.1	9.94	27.9	8.37	.
Yes	68.2	9.1	72.9	9.94	72.1	8.37	
Fish wet season only							
No	54.2	9.96	70.7	9.85	67.9	8.27	.
Yes	45.8	9.96	29.3	9.85	32.1	8.27	

Table 23: *Fishing CPUE*

	Total		Sava		Menabe			
	N	Mean(SD)	N	Mean(SD)	N	Mean(SD)	Diff.	p-val.
Average length (hours) per trip	563	7.08	171	5.4	392	7.4	-2	0.01
Average number of people per trip	541	1.87	170	2.16	371	1.81	0.35	0.03
Average catch (kg) per trip	563	14.25	171	11.09	392	14.85	-3.76	0.36
Average response to change in catch per trip	562	-0.76	170	-0.75	392	-0.77	0.02	0.8
Average CPUE per trip	541	32.41	170	35.98	371	31.66	4.32	0.46

Table 24: *Acquaculture attitudes*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Perception of seaweed and sea cucumber farming on the village							
Very bad	1.7	1.01	1.2	0.89	1.3	0.77	***
Bad	23.3	3.01	6.1	1.78	8.8	1.6	
Good	70.7	3.23	66.3	3.97	67	3.39	
Very good	4.3	1.4	26.3	3.78	22.9	3.21	
Perceived benefits							
Provides jobs and income for more people in the village	93	2.06	96.4	1.64	95.9	1.45	

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Protects marine areas	2.5	1.36	2.3	1.43	2.4	1.26	
Provides jobs and income for women	15.6	2.98	18.8	3.5	18.4	3.06	
Ethnic groups work together	3.5	1.5	0.2	0.12	0.6	0.23	
Raise status of village	13.4	2.85	15.9	3.44	15.6	3.01	
Other	14.1	2.72	1.9	1.33	3.5	1.22	
Perceived harms							
Social conflict from who gets selected as farmer	21.4	5.98	0	0	8.3	2.83	
Social conflict regarding marine area use	64.6	6.88	14.7	4.94	34.1	6.71	
Loss of ethnic identity	1.4	1.4	0	0	0.5	0.55	
Loss of fishing as livelihood	76	6.5	92.3	3.2	86	3.8	
Other	23	6.62	8.8	3.54	14.3	3.9	

Table 25: *Perception of environmental change*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
In general, has it gotten easier or harder to catch the same amount of fish as 10 years ago?							
Easier	6.4	1.69	0.6	0.26	1.5	0.36	***
Same	9.8	2.51	7	2.92	7.5	2.49	
Harder	77.6	3.39	70.1	4.53	71.3	3.85	
Much harder	6.2	2.08	22.3	4.01	19.7	3.39	
Reason if easier							
Decrease in industrial fishing	7	6.97	0	0	4.8	4.81	
Climate change	7	6.97	62.1	22.12	24.6	10.84	
Decrease in local fisherman competition	13.4	9.11	0	0	9.1	6.37	
Increase in environmental regulation	52.1	13.75	0	0	35.5	11.3	
Decrease in environmental regulation	7	6.97	0	0	4.8	4.81	
Reason if harder							
Increase in industrial fishing activities	1.2	1.23	3.6	1.58	3.2	1.36	
Climate Change	32.7	4.41	64.2	4.97	59.6	4.27	
Increase in local fisherman competition	68	4.21	43.1	5	46.8	4.31	
Increase in outside fisherman competition	14.7	3.51	15.8	3.63	15.6	3.14	
Increase in environmental regulation	13.8	2.83	1.6	1.49	3.4	1.35	
Decrease in environmental regulation	8	2.82	2	1.69	2.9	1.5	

Table 26: *Perception of resource change*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Mangrove wood provision past and now							
Enough in the past, enough now	35	3.14	64.7	4.13	59.4	3.48	***
Not enough in the past, enough now	2.3	0.93	1.1	0.92	1.3	0.78	
Enough in the past, not enough now	31.6	3.21	22.1	3.66	23.7	3.07	
Not enough in the past, not enough now	31.1	3.13	12.2	2.72	15.5	2.34	
Fish stock provision past and now							
Enough in the past, enough now	72.9	2.94	86.8	2.96	84.3	2.49	*
Not enough in the past, enough now	0.3	0.29	0.9	0.86	0.8	0.71	
Enough in the past, not enough now	26.8	2.93	10.5	2.66	13.4	2.26	
Not enough in the past, not enough now	0	0	1.7	1.21	1.4	0.99	
Perception of the overall state of natural environment							
Very degraded	4.2	1.39	3.3	1.64	3.5	1.37	.
Degraded	57.8	3.09	52.1	4.1	53.1	3.41	
Healthy	36.9	2.97	43.3	4.02	42.1	3.34	
Very healthy	1.1	0.77	1.3	0.85	1.3	0.71	
Perception of the overall state of corals							
Very degraded	2.8	1.2	1.9	1.25	2	1.06	.
Degraded	40.3	3.35	44.7	4.23	44	3.58	
Healthy	55.7	3.39	50.9	4.22	51.7	3.58	
Very healthy	1.2	0.77	2.5	1.34	2.3	1.13	
Perception of the overall state of mangroves							
Very degraded	0.8	0.63	6.5	2.28	5.5	1.88	***
Degraded	19.8	2.66	33.8	4.03	31.3	3.37	
Healthy	58.9	3.2	56.6	4.21	57	3.51	
Very healthy	20.4	2.57	3.1	1.26	6.2	1.17	
Perception of the overall state of lagoon							
Very degraded	1.9	1.02	3.9	1.82	3.6	1.53	*
Degraded	29.5	3.15	40.2	4.27	38.4	3.61	
Healthy	67.3	3.24	55.6	4.3	57.5	3.65	
Very healthy	1.3	0.79	0.3	0.15	0.5	0.19	
Perception of current threats to these ecosystems in community							

No	27.9	2.95	36.4	3.98	34.9	3.35	.
Yes	72.1	2.95	63.6	3.98	65.1	3.35	

Table 28: *Village governance*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
How group decisions are usually made in the village							
By the village president	48	3.16	53.5	4.05	52.5	3.39	
The most respected elders in the village	41.3	3.14	20.8	2.94	24.5	2.55	
By the whole village, at a meeting	68.7	2.97	38.9	4	44.2	3.36	
Other	1.2	0.67	19.2	3.26	16	2.7	
How often public village meetings are held							
Once a year or less	3.2	0.96	19.6	3.5	16.5	2.85	***
A few times a year	57.1	3.12	56.5	4.21	56.7	3.46	
Every month	22.1	2.62	19.1	3.11	19.7	2.57	
Every few weeks	16.2	2.22	0.2	0.12	3.3	0.51	
Every week	1.4	0.73	4.5	1.63	3.9	1.32	
How often household attends these village meetings							
Never	9.3	1.88	44.4	4.15	38.1	3.52	***
Only certain meetings	16.6	2.34	14.4	2.86	14.8	2.39	
The majority of meetings	14.6	2.4	4.1	1.38	6	1.23	
For all meetings	59.5	3.14	37.1	3.87	41.1	3.27	
Confidence about speaking at public meetings							
Not confident at all	40.6	3.15	53.9	4.12	51.5	3.43	***
Somewhat confident	30	2.91	12.4	2.42	15.6	2.09	
Confident	21.7	2.48	20.4	3.43	20.7	2.85	
Very confident	7.7	1.68	13.2	2.8	12.2	2.32	

Table 29: *Village governance by ethnic categories*

	Menabe-Veza		Menabe- Sakalava		Menabe- Other		Sava-Betsimisaraka		Sava- Other		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	
How group decisions are usually made in the village													
By the village president	52.4	4.76	55.3	8.71	59.5	15.14	50.4	3.43	32.6	7.81	52.5	3.39	
The most respected elders in the village	21.7	3.62	19.2	4.14	16.7	10.94	43.7	3.43	25.6	7.29	24.5	2.55	
By the whole village, at a meeting	39.4	4.69	31.6	7.93	50.3	15.73	65.3	3.29	90.4	4.88	44.2	3.36	
Other	19.9	3.8	14.8	6.78	21.8	13.46	0	0	9	4.72	16	2.7	
How often public village meetings are held													
Once a year or less	15.5	3.64	25.7	8.48	47.6	17.6	2.9	1.01	5.1	2.89	16.5	2.85	***
A few times a year	57.2	4.93	57.5	8.73	46.8	17.47	57.5	3.39	54.8	7.83	56.7	3.46	
Every month	22	4.01	13	3.16	4.6	2.99	21.4	2.82	26.5	6.99	19.7	2.57	
Every few weeks	0.3	0.16	0	0	0	0	16.6	2.43	13.7	5.5	3.3	0.51	
Every week	5	2.14	3.7	1.4	1	1.07	1.6	0.84	0	0	3.9	1.32	
How often household attends these village meetings													
Never	43.6	4.85	41.6	9.12	57.9	15.34	9.8	2.07	5.7	4.22	38.1	3.52	***
Only certain meetings	10.8	2.89	25.3	8.17	23.8	13.48	17	2.59	13.8	4.98	14.8	2.39	
The majority of meetings	3.9	1.37	7.2	5.28	0	0	16.5	2.73	2.1	2.09	6	1.23	

	Menabe-Veza		Menabe- Sakalava		Menabe- Other		Sava-Betsimisaraka		Sava- Other		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	Percent	SE	
For all meetings	41.8	4.7	25.9	6.09	18.3	11.01	56.6	3.43	78.3	6.38	41.1	3.27	
Confidence about speaking at public meetings													
Not confident at all	57.7	4.77	46.2	8.95	35.9	15.01	42.6	3.44	27.6	7.18	51.5	3.43	*
Somewhat confident	10.5	2.5	16.4	5.65	21.8	13.46	32.1	3.22	16.9	5.34	15.6	2.09	
Confident	17.7	3.81	29	8.56	26.4	14.01	21.3	2.68	24.5	6.59	20.7	2.85	
Very confident	14.1	3.39	8.4	4.78	16	10.86	4.1	1.32	31	7.76	12.2	2.32	

Table 30: *NRM governance*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Heard about locally managed marine areas (LMMAs) before today							
No	28.9	3.01	43.1	4.05	40.6	3.37	**
Yes	71.1	3.01	56.9	4.05	59.4	3.37	
Have you or any family members participated in LMMA meetings?							
No	43	3.6	58.1	5.4	54.8	4.34	*
Yes	57	3.6	41.9	5.4	45.2	4.34	
How important decisions about marine resources are made in village							
Village president	7.1	1.45	24.8	3.54	21.7	2.93	
Fokontany committee	1.8	0.77	10.2	2.21	8.7	1.82	
Commune	6.8	1.36	32.7	4.01	28.1	3.37	
Region/district	6.3	1.32	8.4	2.38	8	1.97	
Government ministry	7.5	1.37	20.6	3.24	18.3	2.68	
COBA/VOI	27.2	2.63	23.3	3.57	24	2.97	
NGO	61.1	3.05	46.4	4.08	49	3.42	
Private sector	0.6	0.4	0.8	0.83	0.8	0.68	
LMMA	55.1	3.15	6.8	1.19	15.4	1.47	
Other	1	0.63	1.1	0.83	1.1	0.69	
How group decisions are usually made in the village							
By the village president	48	3.16	53.5	4.05	52.5	3.39	
The most respected elders in the village	41.3	3.14	20.8	2.94	24.5	2.55	
By the whole village, at a meeting	68.7	2.97	38.9	4	44.2	3.36	
Other	1.2	0.67	19.2	3.26	16	2.7	
How often public village meetings are held							
Once a year or less	3.2	0.96	19.6	3.5	16.5	2.85	***
A few times a year	57.1	3.12	56.5	4.21	56.7	3.46	
Every month	22.1	2.62	19.1	3.11	19.7	2.57	
Every few weeks	16.2	2.22	0.2	0.12	3.3	0.51	
Every week	1.4	0.73	4.5	1.63	3.9	1.32	
How often household attends these village meetings							
Never	9.3	1.88	44.4	4.15	38.1	3.52	***
Only certain meetings	16.6	2.34	14.4	2.86	14.8	2.39	
The majority of meetings	14.6	2.4	4.1	1.38	6	1.23	
For all meetings	59.5	3.14	37.1	3.87	41.1	3.27	
Confidence about speaking at public meetings							
Not confident at all	40.6	3.15	53.9	4.12	51.5	3.43	***
Somewhat confident	30	2.91	12.4	2.42	15.6	2.09	
Confident	21.7	2.48	20.4	3.43	20.7	2.85	
Very confident	7.7	1.68	13.2	2.8	12.2	2.32	

Table 31: *Attitudes towards NRM rules*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Some places prohibit fishing in certain areas for the long term. Do rules like this exist in your commune?							
No	13.5	1.94	53.9	4.13	46.6	3.49	***
Yes	86.5	1.94	46.1	4.13	53.4	3.49	
Some places close off areas temporarily (usually 3 months) and prohibit fishing and gleaning to increase growth of species such as octopus, shrimp and crabs. Do rules like this exist in your commune?							
No	1	0.64	20.6	3.39	17	2.8	***
Yes	99	0.64	79.4	3.39	83	2.8	
Some places close off areas for community seaweed or sea cucumber farming. Do rules like this exist in your commune?							
No	95.8	1.05	90.8	2.56	91.7	2.11	*
Yes	4.2	1.05	9.2	2.56	8.3	2.11	
Some places restrict the type of fishing gear you can use when you go fishing. Do rules like this exist in your commune?							
No	0.2	0.23	13.8	3.01	11.3	2.48	***
Yes	99.8	0.23	86.2	3.01	88.7	2.48	
Some places restrict areas of mangroves where people cannot go to collect wood. Do rules like this exist in your commune?							
No	9.6	1.94	18.7	3.55	17.1	2.94	*
Yes	90.4	1.94	81.3	3.55	82.9	2.94	
Would like more or fewer rules? (Permanent closures)							
Big reduction	1.9	1.03	2.6	2.08	2.4	1.52	***
Small reduction	20.6	2.89	15.9	4.65	17.2	3.44	
Stay the same	57	3.52	30.6	5.46	38	4.13	
A little more	15.5	2.45	24.1	5.08	21.7	3.73	
Much more	4.9	1.61	26.8	5.18	20.7	3.79	
Would you like to see an increase or a decrease in the length of time that the reserves are closed for?							
Big reduction	1.4	0.73	5.5	2.47	4.6	1.94	***
Small reduction	7.1	1.57	21.2	3.93	18.1	3.09	
Stay the same	68.6	2.99	47.3	4.78	52	3.81	
A little more	19.2	2.57	15.4	3.54	16.3	2.81	
Much more	3.8	1.21	10.6	2.78	9	2.18	
Would like to have more or fewer of these? (gear restrictions)							
Big reduction	0	0	10.7	10.13	9.8	9.3	.
Small reduction	27.2	11.78	21.6	12.16	22.1	11.17	
Stay the same	51.6	13.16	20.4	12.13	23	11.18	
A little more	21.2	10.98	10.7	9.15	11.6	8.43	
Much more	0	0	36.6	13.91	33.5	12.71	
Would you like greater or fewer restrictions on the type of fishing gear you can use?							
Big reduction	1.1	0.67	10.8	3.13	8.8	2.51	***

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Small reduction	13.3	2.17	19.4	3.5	18.2	2.81	
Stay the same	68.7	2.94	33.8	4.04	41	3.41	
A little more	11.2	1.92	21.6	3.94	19.5	3.17	
Much more	5.7	1.46	14.3	3.26	12.6	2.62	
Would you like to see an increase or a decrease in the area of mangroves that is protected (where wood cannot be removed)?							
-1	3.6	1.28	18	3.73	15.2	3.03	***
0	64	3.22	42.5	4.5	46.7	3.71	
1	29.6	3.06	39.5	4.51	37.6	3.68	
97	1.6	0.94	0	0	0.3	0.19	
98	1.2	0.59	0	0	0.2	0.12	
Would you like a rule like this in your commune or no? (Permanent closure)							
No	50.1	7.65	80.5	4.58	78.9	4.37	***
Yes	49.9	7.65	19.5	4.58	21.1	4.37	
Would you like a rule like this in your commune or no? (Temporary closure)							
No	22.6	22.13	71.2	8.91	70.6	8.81	.
Yes	77.4	22.13	28.8	8.91	29.4	8.81	
Would you like a rule like this in your commune or no? (Aquaculture closure)							
No	63.7	3.69	82.3	3.34	79.5	2.9	***
Yes	36.3	3.69	17.7	3.34	20.5	2.9	
Would you like a rule like this in your commune or no? (Gear restriction)							
No	100	0	77.9	9.88	78	9.84	.
Yes	0	0	22.1	9.88	22	9.84	
Would you like a rule like this in your commune or no? (Mangrove closure)							
No	12.5	7.2	62.6	10.5	57.6	9.57	***
Yes	87.5	7.2	37.4	10.5	42.4	9.57	
Are there other rules about natural resource use that exists in your commune?							
No	93	1.63	99.8	0.12	98.6	0.32	***
Yes	7	1.63	0.2	0.12	1.4	0.32	
In general, would you like greater or fewer rules surrounding marine and mangrove use?							
Big reduction	1	0.65	7.8	2.52	6.6	2.08	**
Small reduction	14.9	2.23	10.6	2.58	11.4	2.15	
Stay the same	60.4	3.11	50.3	4.19	52.2	3.49	
A little more	17.7	2.44	17.4	3.3	17.4	2.74	
Much more	5.9	1.44	13.9	2.96	12.4	2.44	0

Table 32: *NRM monitoring*

	Sava		Menabe		Total		Signif
	Percent	SE	Percent	SE	Percent	SE	
Household participation in resource monitoring efforts							
No	70.9	2.69	84.4	2.94	82	2.47	**
Yes	29.1	2.69	15.6	2.94	18	2.47	
Has your household benefited from participating in this activity?							
No	54	5.17	56.7	10.23	56	7.44	.
Yes	46	5.17	43.3	10.23	44	7.44	
Are they compensated for it?							
No	92	2.59	60.6	10.2	69.6	7.58	***
Yes	8	2.59	39.4	10.2	30.4	7.58	
How?							
In cash	90.2	9.54	85.5	12.67	85.9	11.75	.
In kind	9.8	9.54	1	1.01	1.6	1.26	
Both	0	0	13.5	12.66	12.5	11.74	
What do they do?							
Assessment on catches	37.3	5.22	6.9	5.21	15.6	4.28	
Catch fish size tracking	57.8	5.17	30.8	9.92	38.5	7.22	
Ecological monitoring	11.4	3.66	23	9.05	19.7	6.6	
Mapping of village boundaries	2.6	1.48	8.2	5.83	6.6	4.19	
Control of protected areas	51.7	5.25	55.7	10.27	54.6	7.47	
Other	21	4.26	13.9	5.61	15.9	4.26	

APPENDIX C: Nosy Manga Full Baseline Survey Instrument