Montclair State University

Montclair State University Digital Commons

Theses, Dissertations and Culminating Projects

5-2022

Gender roles in natural resource use in Madagascar

Sarahana Shrestha

Follow this and additional works at: https://digitalcommons.montclair.edu/etd

 Part of the Environmental Sciences Commons

ABSTRACT

Understanding the role that gender plays in natural resource use is crucial for effective conservation efforts. While Madagascar is a priority for international conservation due to its high levels of endemism and unsustainable natural resource use, there is little information on how gender roles affect forest product use. This study uses over seven years of data on gender roles within the extraction, use, and sale of natural forest and marine resources near Madagascar's largest national park to inform future conservation strategies. We found that gender significantly affects how one uses natural resources in Madagascar. Men were primarily responsible for the collection of natural resources; however, women were responsible for collecting nearly all resources in at least one household. Women purchased more of the natural resources they used, whereas men collected nearly all of their natural resources. More men than women collected resources for income and women primarily collected resources for subsistence. Of the resources they collected, women were significantly more likely to be responsible for the collection of animals than plants, and of aquatic rather than terrestrial resources. Gendered spaces resulted in women collecting most of the resources within rivers, whereas men collected most of the resources in ocean, agricultural, and forested lands. When age is an added factor, we found that while men were more responsible for collecting natural resources than women, boys were almost as likely as adult women to collect a resource, and girls were the least likely within a household to be primarily responsible for resource collection. A locally relevant understanding of how gender roles and needs intersect with natural resource use can help ensure the continued delivery of ecosystem services while protecting Madagascar's endemic species.

MONTCLAIR STATE UNIVERSITY

Gender roles in natural resource use in Madagascar

by

Sarahana Shrestha

A Master's Thesis Submitted to the Faculty of

Montclair State University

In Partial Fulfilment of the Requirements

For the Degree of

Master of Science

May 2022

College of Science and Mathematics

Department of Earth and Environmental Studies

Thesis Committee:

[redacted]

Dr. Clement Alo

Thesis Sponsor

[redacted]

Dr. Cortni Borgerson

Thesis Co-sponsor

[redacted]

Dr. Josh Galster

Committee Member

GENDER ROLES IN NATURAL RESOURCE USE IN MADAGASCAR

A THESIS

Submitted in fulfilment of the requirements

For the degree of Master of Science

by

SARAHANA SHRESTHA

Montclair State University

Montclair, NJ

2022

Copyright@2022 by Sarahana Shrestha. All rights reserved.

ACKNOWLEDGEMENTS

This research was funded by the International Union for the Conservation of Nature, Save our Species (IUCN-SOS 2018A-117) and the National Geographic Society (NGS-C021–17, NGS-55616C-20). We would like to extend our deepest gratitude to the communities of the Masoala. Without you, this project would have been impossible. I would like to thank Dr. Cortni Borgerson for being my mentor, being understanding, supportive, and encouraging me throughout the process of writing this paper. I express my sincere gratitude to Dr. Clement Alo, my advisor, for always being resourceful, and helping me choose Montclair State University for continuing my studies. I would also like to acknowledge Dr. Josh Galster for helping me by making everything easier and giving insightful comments. I am grateful to Patti Flatley, for always listening to me, and pointing me in the right direction when I was unsure. I would like to thank Rae Cade and Emily Rothamel for helping me, spending hours with me editing, practising, and cheering me on. I would also like to thank the Republic of Madagascar and Madagascar National Parks for their continued support.

Lastly, I would like to thank my parents, Ba, and Ma, for trusting and encouraging me to go to a foreign country to chase my dreams. Without you, I would not be where I am today. Thank you for always being an inspiration to me. I am most grateful to my brother, Shrey, for always loving me and pushing me to be better. I can’t forget to mention my dogs Snoopy and Kalu. Last but not the least, I am forever grateful for my best friends for being my moral support and always being there to listen to me.Thank you all for bearing with me, through the difference in time zones and through long periods where we go without seeing each other. I dedicate this degree to you.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Gender roles are socially constructed norms and practices that translate into different rights, opportunities, and constraints (Nightingale, 2006). These characteristics attributed to men and women are based on the socially constructed ideas of femininity and masculinity (Griffin, 2017). How different genders interact with their environment is shaped by differences in ideology, divisions of labor, property ownership, power, and authority (Järvilehto, 2005; Davis 2019). Gender is based on the sociological constructions that change with culture, place, and time, which is different from the biological differences between women and men (Lau, 2020). This construction of gender changes across different scales from individuals, households, communities, and internationally as they get repeated, adjusted, and changed through everyday practices (Nightingale, 2017). Hence, gender acts as another sociological layer that gives context to the spaces where genders 'belong,' and the tasks which they perform (Arora-Jonsson, 2014).

Gender roles are one of the key variables that determine one's access to, control over, and use of natural resources (Mwangi et al., 2011). This can be due to the social relations of one's access to resources due to the gender-based divisions of work, ownership of property, policies, and local norms (Crow & Sultana, 2002). For example, in many societies women oversee undertaking domestic work, including the collection of water for cleaning and cooking which may increase women's access to water. Similarly, in terms of ownership, in most of the world, men own property, which can disadvantage women's access to these properties (Agrawal, 2002).

Gender roles reinforce gaps in income, power, and responsibilities, and as such, influences how and why natural resources are used, exploited, and managed (Fongjong, 2008; Agrawal, 2009). Furthermore, gender roles can also create an imbalance in the access to, and benefits from natural resources (Nordman & Vaillant, 2017). Gender roles in natural resource management reflect how the roles are distributed within households and may vary between societies and can change over time (James et al., 2021). Men and women also have different knowledge about natural resources (Folasade, 2016; Lau, 2020). In many societies, women are seen as water managers, hence they decide where to collect the water from, and how to collect, transport and store it (Mwangi et al., 2011). As men migrate for work, women take over the role of agricultural labor, although traditional gender norms constrain the decision-making power of women (Holmelin, 2019). For example, in the Dagomba community in northern Ghana, farming is seen as a gender specific activity where harvesting is done mainly by women and land preparation for farming is done by men (Warner et al., 1997).

Given the distinct roles, experiences, and knowledge that each gender has, one might expect that conservation programs would be tailored to gender roles (Warner et al., 1997). Conservation programs often fail to address gender inequity (Lau & Scales, 2016; Massoi, 2019; James et al., 2021) and programs are rarely designed to consider the gender primarily responsible for the collection, use, and/or trade of the resources they manage (Folasade, 2016). While identifying the role of both genders and empowering women in natural resource management and conservation efforts has shown improvement (Upreti, 2001; Westerman, 2014; Leisher et al., 2016), less than 5% of research articles about gender and natural resource management clearly demonstrate how involving women can help improve conservation efforts (James et al., 2021). This hampers the efficiency and success of conservation

initiatives as they may fail to properly target resource users or worse, exclude the gender responsible for the resource entirely (Flintan, 2003).

Despite the extensive knowledge on the roles of men and women in the use of natural resources, conservation projects often remain gender blind (Brown & Fortnam, 2018; Kariuki & Birner, 2016). There is limited data on gendered participation in management of natural resources. Most of these projects treat gender as a women vs. men issue without acknowledging the differences in what each gender has to offer and how this difference can be used to maximize the effectiveness of conservation programs. The conservation efforts that incorporate gender as one of its key components are operating in a superficial manner, where they push for increase in participation of both genders, which can sometimes be unsustainable (Staples & Natcher, 2015). Increasing the presence of women in decision making without understanding the societal differences may further create disparities (Baynes et al., 2019). It is crucial to understand these social and cultural differences in gender roles in the use of natural resources and incorporating them into creating technical conservation solutions (Calhoun et al., 2016). Among the 17 Sustainable Development Goals (SDGs) set by the United Nations to embrace a universal approach to the sustainable development agenda, gender equality is the 5th goal along with life below water (goal 14), and life on land (goal 15). This reinforces the fact that gender and use of natural resources go hand in hand.

Madagascar, the largest island in the Indian Ocean, has been a priority for international conservation due to its high levels of endemism and unsustainable natural resource use (Ganzhorn et al., 2014). The country is also known as one of the eight ‘hottest’ biodiversity hotspots, which is an area with extreme species richness, high concentration of endemic species (Laourenco & Goodman, 2000; Myers et al., 2000). Most (70%) of more than 200,000 species that live in about 30 million acres of forest are endemic (Wilmé et al., 2006). All Malagasy amphibian and mammals, 92% of reptiles, more than 90% of plants, 74% of

butterflies, and 44% of birds are endemic to the island (Goodman & Benstead, 2003; Phillipson, et al., 2006; Krüger, 2007). The International Union for Conservation of Nature Red List of Threatened Species has listed 685 species in Madagascar as Critically Endangered, 1,797 as Endangered, and 1,250 as Vulnerable (IUCN, 2021). Nearly all of Madagascar's lemurs are threatened with extinction (IUCN, 2021), and at least 15 species of lemurs here have gone extinct in the past 2,000 years (WWF, 2021). Home to more than 800 endangered species, the island nation has received more than US$700 million in conservation funding since 1990, creating more than 500 conservation projects. However, the biodiversity here continues to rapidly decline (Waeber et al., 2016).

With a population of 27.69 million people (World Bank, 2020), the fourth largest island in the world, Madagascar has an area of 226,658 mi². It is a lower middle- income country with a Gross Domestic Product of $471.49 and a Gross National Income per capita of $1,500. About 80% of the total population is living in rural areas, where the poverty rate is increasing at a higher rate than in urban areas (World Bank, 2020). In 2019, 78% of the Malagasy people lived on less than $1.90 a day (World Bank, 2019). About 90% of the population depend on subsistence agriculture for livelihood (Holmes, 2007). The principal land use here is for rice agriculture. Traditionally, land is claimed through clearing and cultivation and is predominately used for rice agriculture (Kremen et al., 1999).

Traditional Malagasy gender norms often support the notion of men as breadwinners and heads of household responsible for decision-making, family representation, resource extraction, security, and organizing the community's political, economic, and social life (Nordman & Roubaud, 2009). The people in Madagascar largely depend on agriculture for their economy, however they also catch and sell other forest-based plant and animal products (Wright & Andriamihaja, 2003). While we know there are gender roles in agricultural duties -

men are generally responsible for tilling the rice fields, gathering firewood, building the family home and furniture, and public affairs, whereas women are responsible for growing crops, weeding the rice fields, fetching water, preparing daily meals, weaving, and caring for the health of the family (Nordman & Roubaud, 2009) - there is little information on the gender roles of forest product use in Madagascar. Effective conservation efforts in Madagascar require an understanding of gender roles in natural resource use, yet little research exists to inform such efforts.

The Masoala National Park is the largest national park and protected area in Madagascar. This north-eastern park is a conservation priority because of the endemism within the peninsula (Kremen et al., 1999). Many species, such as the red ruffed lemur, are only found in Masoala (Rigamonti, 1993). The Masoala National Park was designed to protect the lowland humid forests and promote forest conservation through community-based management (Kremen et al., 1999). The species diversity in the eastern forests is higher than other areas of Madagascar, and many of the highly threatened species are primarily found in the north-eastern highlands (Andreone et al., 2005). With threats to biodiversity due to land cleared for agriculture, overharvest of forest products such as ebony and rosewood, as well as non-timber forest products (plants and animals), and overfishing of lagoons, it is extremely important to work to protect the peninsula. Saving the biodiversity of the peninsula can help improve overall global conservation.

This study examines gender roles within the extraction, use, and sale of natural forest and marine resources over seven years near Madagascar's largest national park, the Masoala National Park, to inform future conservation strategies. We examine how gender roles result in differences in who collects natural resources, why and how they are collected, and whether those resources are sold. We also explore how such dynamics vary by the type of resource

collected, and whether that resource was a plant or animal, terrestrial or aquatic, or found in forests, agricultural spaces, rivers, or oceans, and by the age of its collector. This was done to see if there are any spatial variations in location of resource and if this affected what gender was primarily using the resource – for example if women were mostly using forest resources or agricultural resources, or if men were collecting more aquatic animals from oceans or rivers. To understand the intersectionality in the use of the resource along with gender, we also divided the resource users into four divisions – men, women, girls, or boys. Like how gender roles are defined differently in different cultures rather than through biological differences, we let each household define what it meant to be a child or an adult. By understanding the role that gender plays in the use of natural resources, we can tailor natural resource conservation efforts to consider their specific gender roles.

2. METHODS

2.1 Study Site: This study was conducted in the Masoala Peninsula, a forested coastal area in north-eastern Madagascar (Fig 1). The land mass of 4,254 km^2 contains the country's largest national park, the Masoala National Park, which protects 2,300 km^2 (880 mi^2) of contiguous lowland and mid-elevation rain forest and rises 1200 m above the sea level. The Masoala Peninsula is in a mountainous area far from road access (Kremen et al., 1999). More than 144,650 people live within 10 km of the park on the peninsula (Borgerson et al., 2022). Local people are mostly Betsimisaraka, the second largest ethnic group in Madagascar, and primarily rely on subsistence agriculture.

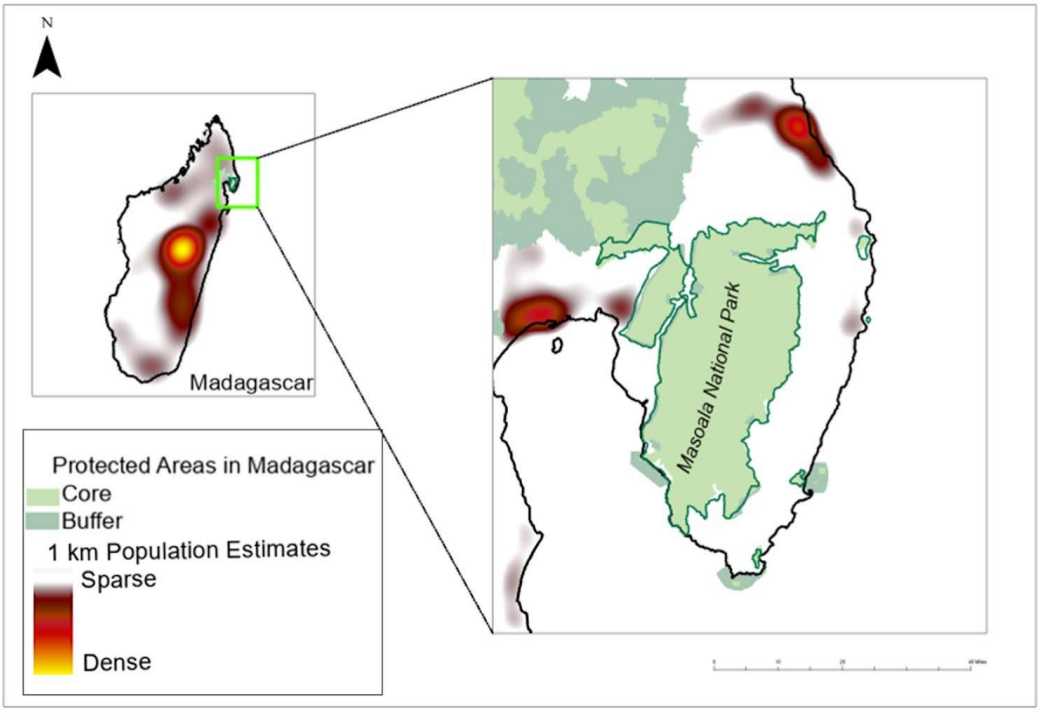

Figure 1. *Study region with the Masoala National Park.*

2.2 Ethics: The Republic of Madagascar, Madagascar National Parks, and Human Subjects Institutional Review Boards (Protocols No. 2010-0595 at the University of Massachusetts Amherst, No. 13-1862 and 15-2230 at the Harvard T. H. Chan School of Public Health, and No. 18-19-1349 at Montclair State University) approved all research. We obtained oral informed consent from all participants, as well as each community's local administrator.

2.3 Data Collection: We collected data on natural resource use within 13 communities over seven years (2015-2021). We surveyed all households in small communities; in communities with more than 50 households, we randomly selected study households using a grid system in each village and a zig-zag method to bisect all quadrants. We conducted surveys in Malagasy and asked each of the 1,255 households about their natural resource use during the prior year. For plant-based products, we asked whether the household members had used or purchased six categories of plant-based natural resources (firewood, palm thatch for construction, wood for construction, wood for transportation (boats), plants for medicinal use, honey collection,

and/or bark for fermentation) and/or cleared land during the prior year. For each category, if the household had used this good, we asked if they had collected themselves and/or purchased the good, the primary incentive for its collection and/or purchase (subsistence or sale), and the age-class (adult or child) and gender identity (woman/girl, man/boy) of the person primarily responsible for the collection and/or purchase of that resource. To define the age class of resource users, we asked the household if the person who was primarily responsible for collecting that resource was a child or an adult. This determination of age was based on how the household saw the member and we had no specific numeric cut off. Because extraction methods and their gender roles varied more widely for animal-based resources, we asked about the use and gender roles of five different methods of aquatic animal capture (net fishing, line fishing, free diving, sifting, and aquatic traps) and three different methods of terrestrial animal capture (trapping, sling shots, or gun). For each category, if the household had used this good, we asked if they had collected themselves and/or purchased the good, the primary incentive for its collection and/or purchase (subsistence or sale), and the age-class (adult or child) and gender identity (woman/girl, man/boy) of the person primarily responsible for the collection and/or purchase of that resource.

2.4 Data Analysis: To identify gender and age roles in natural resources collection and use, we calculated the percentage of households where men, boys, women, and girls were primarily responsible for obtaining each resource during the prior year, their primary incentive for collection (subsistence use/sale), the method used to obtain the resource, whether it was collected or purchased, and the percentage of the resource sold. To examine the potential role of gendered spaces in driving such variation in resource use, we tested whether gendered use varied between resources collected on land or in water, in forest or non-forest (agricultural) spaces, or in rivers or oceans. We used logistic regression analysis to test the correlation between gender and age on the primary incentive of resource collection and

the method used to collect the resource. Contingency analysis was used to test whether the variables in each hypothesis were independent.

3. RESULTS

Nearly all (99.92%) of the 1,252 households we interviewed over seven years (2015- 2021) used natural resources during the prior year. Most (98.56%) households used both wild plant (98.56%) and animal (88.90%) based products. Overall, natural resources were collected by men (77.08% of all household natural resource collection was done by men), whether those resources were plant (74.91% of products were collected by men) or animal-based forest products (78.25%). Women still lead the collection of all types of resources in at least one household (9.05% collected firewood, 8.49% collected palm thatch, 5.37% collected timber for construction, 3.41% cleared their own land, 2.08% collected wood for transportation). However, women collected significantly more forest animals than plants ($\chi 2=8.94$, $p=0.003$; 25.09% of animal resources vs. 21.75% of plant resources were primarily collected by the women within a household). Individuals sought natural resources either with the goal of using them for subsistence or selling them for income. Natural resources were almost entirely sought after for their subsistence uses by both men (88.09%) and women (93.96%), yet significantly more men collected resources with the primary goal of earning income than did women (11.91% and 6.04% of resources were collected with the incentive to earn income by men and women, respectively; $\chi 2=39.58$, $p<0.0001$). Natural resources were either collected directly or purchased. While both women (77.60%) and men (91.81%) directly collected most of the forest resources they used, women purchased significantly more than men ($\chi 2=121.00$, $p<0.0001$; 22.40% vs. 8.19% of resources used). Once acquired, both men (88.09%) and women (93.96%) used natural resources primarily for subsistence purposes and few were sold.

3.1 Gender variation in plant-based resource collection: In 78.20% of households, men were primarily responsible for collecting plant-based resources. For plant-based resources, there were distinct differences in how gender affected the primary incentive of collection ($\chi 2=17.75$, $p<0.0001$) and the method of collection ($\chi 2=108.98$, $p<0.0001$). Women were responsible in only 21.80% of households for collection of such resources. Fewer women collected plant-based resources (78.31%) than men (91.77%). Overall, 21.69% of the women purchased these resources compared to only 8.23% of men who purchased them. More men collected plant resources with the intention of selling those (5.29%) than did women (2.19%). Medicinal plants (51.84%) were the only plant-based resource where women were in charge of collecting it. All other plant resources were primarily collected by men. When women collected plant-based resources themselves, they mostly cleared land for agriculture (100.00% of land cleared by women was done so by themselves and not purchased/hired labor), medicinal plants (99.65%), and the bark of the tree for alcohol fermentation (92.59%), and firewood (76.36%). When women purchased resources, they primarily bought palm thatch (81.01%), timber for household construction (81.81%), boats (100.00%) and honey (93.24%) (Table 1). In less than 10% of households, women were primarily in charge for the collection of the resources except for medicinal plants (51.84% of households), honey (22.29%), and bark for alcohol fermentation (21.95%). For both genders, the primary incentive of collecting the resources was for subsistence use except for honey, where 28.68% men and 24.32% women collected it with the primary intention to sell it. Timber for construction and wood for transportation were the two resources women acquired solely through purchasing (none was collected).

Although more women purchased the resources than men, 52.01% of the total purchases made were made by men (Table 2). Medicinal plants (51.75% of the total households who collected and not purchased) were the only plant-based resource where more women than men were

responsible for obtaining the resource for the household, and for all other plant resources, men were mostly responsible for it. On the other hand, 100.00% of the medicinal plants purchased was by women followed by firewood (79.27%), honey (60.61%), and palm thatch (57.14%). Also, of those who primarily collected the resources with the primary incentive of subsistence, 82.96% were men, and for sales 79.44% of them were men. Similarly, the majority of those who collected with the primary incentive to sell and not use it themselves were men.

Table 1. *How women and men differently used, collected, or purchased plant-based resources over seven years on the Masoala Peninsula of Madagascar (2015-2021).*

Plant-Based Resources	**Gender of Individual Primarily Responsible for Collection in Household (% of Households)**		**How Women and Men Obtained Resources**				**Primary Incentives to Obtain the Resource**			
	Women	**Men**	**Women**		**Men**		**Women**		**Men**	
			Collected (%)	**Purchased (%)**	**Collected (%)**	**Purchased (%)**	**Subsistence-use (%)**	**Sale (%)**	**Subsistence-use (%)**	**Sale (%)**
Firewood	9.05	90.95	76.36	23.64	99.00	1.00	99.09	0.91	99.19	0.81
Palm Thatch	8.49	91.51	18.99	81.01	94.30	5.70	100.00	0.00	99.41	0.59
Timber for Construction	5.37	94.63	0.00	100.00	71.13	28.87	100.00	0.00	75.77	24.23
Wood for Transportation	2.08	97.92	0.00	100.00	68.09	31.91	100.00	0.00	74.19	25.81
Medicinal Plants	51.84	48.16	99.65	0.35	100.00	0.00	99.83	0.17	99.26	0.74
Bark for Alcohol Fermentation	21.95	78.5	7.41	92.59	21.88	78.13	88.89	11.11	88.33	16.67
Honey	22.29	77.71	6.76	93.24	82.56	17.44	75.68	24.32	71.32	28.68
Land Clearing	3.41	96.59	100.00	0.00	100.00	0.00	100.00	0.00	98.81	1.19
For All Resources	21.80	78.20	78.31	21.69	91.77	8.23	97.83	2.17	94.71	5.29

Table 2. *How and why men and women acquired plant-based resources on the Masoala Peninsula of Madagascar (2015-2021).*

Plant-Based Resource	**How Resources were Obtained**				**Primary Incentive for Resource Collection**			
	Collected		**Purchased**		**Subsistence-use**		**Sale**	
	Men (%)	**Women (%)**	**Men (%)**	**Women (%)**	**Men (%)**	**Women (%)**	**Men (%)**	**Women (%)**
Firewood	92.86	7.14	29.73	79.27	90.95	9.05	90.00	10.00
Palm Thatch	98.17	1.83	42.86	57.14	91.47	8.53	100.00	0.00
Timber for Construction	100.00	0.00	83.33	16.67	92.76	7.24	100.00	0.00
Wood for transportation	100.00	0.00	93.75	6.25	97.18	2.82	100.00	0.00
Medicinal Plants	48.25	51.75	0.00	100.00	48.02	51.98	80.00	20.00
Bark for alcohol fermentation	91.30	8.70	75.00	25.00	76.92	23.08	84.21	15.79
Honey	96.69	3.31	39.39	60.61	70.86	29.14	81.33	18.67
Land Clearing	96.43	3.57	-	-	95.51	3.49	100.00	0.00
For All Resources	90.46	9.53	52.01	47.99	82.96	17.04	79.44	20.56

3.2 Gender variation in animal-based resource collection: Similar to plant-based resources, men were responsible for collecting animal-based resources in 74.75% of households, compared to 25.25% of households where women were primarily responsible. The collection of animal-based products varied in terms of gender roles and what extraction method was used to collect them. Both men and women caught animals primarily with the goals of subsistence use, selling them only secondarily (Table 3). Comparatively more men collected the resource with the intention of selling it (24.80%) than women did (16.73%). Men sold a mean 26.81±SD37.19% of the meat they caught whereas women only sold a mean of 13.28±27.38%. Women were primarily responsible for collecting meat through sifting using a woven basket to catch small shrimp or fish (98.23% of all of the collection of this resource was done by women) and catching eels and fish in rivers using woven traps (52.17%). No women used slingshots to catch wildlife. Similarly, for animal-based resources, there were distinct differences in how gender affected the primary incentive of collection ($\chi 2=18.87$, $p<0.0001$). Both women and men caught animals primarily for subsistence use, with the exception of those caught by free diving (100.00% of women intended to sell their catch; 79.87% of men) and net fishing (87.50% of women; 65.90% of men) where they were primarily caught to sell them for meat. For these fishing activities, women were far more likely than men to engage in fishing with the primary goal of earning income (100.00% and 87.50% of fisher women, and 79.87% and 65.90% of fishermen intended to sell them respectively). The products of freediving and net fishing were the resources with the highest average sales for both the genders (Table 3).

Although more women collected the resources for subsistence than men, 78.85% of the resources collected for subsistence were done by men (Table 4). All the resources collected for subsistence were mostly collected by men except for resources collected by sifting

(98.13% of the total resources collected by sifting) and water trapping (54.55%). In terms of the resources collected primarily to sell, 86.49% of those were done by men. All the resources collected with the primary intention of sales were mostly collected by men except for resources collected by sifting (98.77% of the total resources collected by sifting was collected by women).

Table 3. *How women and men differently used, caught, or sold animal-based resources over seven years on the Masoala Peninsula of Madagascar (2015-2021).*

Animal-Based Resources Collection Method	**Gender of Individual Responsible for Collection (% of Households)**		**Primary Incentive for Collection**				**Percentage of Product Sold (Mean ± SD)**	
	Women	**Men**	**Women**		**Men**		**Women**	**Men**
			Subsistence-use (%)	**Sale (%)**	**Subsistence- use (%)**	**Sale (%)**		
Net Fishing	3.56	96.44	12.50	87.50	34.10	65.90	81.00 ± 6.00	65.00±31.56
Line Fishing	4.61	95.39	76.19	23.81	71.20	28.80	46.43±33.00	36.00±37.00
Water Trapping	52.17	47.83	100.00	0.00	90.91	9.09	14.58±27.00	15.00±33.54
Land Trapping	3.09	96.91	100.00	0.00	96.30	3.70	-	7.00±22.00
Free Diving	0.67	99.33	0.00	100.00	20.13	79.87	90.00±0.00	72.31±28.64
Slingshot	0.00	100.00	-	-	99.50	0.50	-	-
Gun	6.67	93.33	100.00	0.00	92.86	7.14	-	14.71±30.29
Sifting	98.23	1.77	84.00	16.00	88.89	11.11	20.00±31.00	11.27±24.76
Total	25.25	74.75	83.27	16.73	75.20	24.80	13.28±27.38	26.81±37.19

Table 4. *Subsistence and market collection of animal-based resources by women and men on the Masoala Peninsula of Madagascar (2015-2021).*

Method used to catch animals	**Animals collected for subsistence consumption**		**Animals collected for sale**	
	Women (%)	**Men (%)**	**Women (%)**	**Men (%)**
Net Fishing	1.33	98.77	4.67	95.33
Line Fishing	4.91	95.09	3.85	96.15
Water Trapping	54.55	45.45	0.00	100.00
Land Trapping	3.23	96.77	0.00	100.00
Free Diving	0.00	100.00	0.83	99.17
Slingshot	0.00	100.00	0.00	100.00
Gun	7.14	92.86	0.00	100.00
Sifting	98.13	1.87	98.77	1.23
Total	21.15	78.85	13.51	86.49

3.3 Gendered Spaces in Natural Resource Use: The location where resources were found had a significant effect on the gender responsible for collecting them. While men collected most resources in both aquatic (60.56% of aquatic resources collected) and land environments (81.66%), women were more involved in aquatic than land resource collection (Figure 2). For all natural resources, men collected most in agricultural areas (38.09%), followed by forests (25.84% of all resources used), oceans (12.73%), and rivers (0.42%). While women also collected most resources in agricultural areas (12.25% of all resources used), they were the main gender responsible for collecting natural products from rivers (8.08%), and rarely collected resources in forested areas (2.11%) or oceans (0.48%). The location of the resource significantly predicted the gender of the person who was primarily responsible collecting it (χ= 1,840.90, $p<0.0001$). Men were more likely to use resources in every environment except rivers, where women make up 95.11% of primary collectors of river-resources (Figure 3).

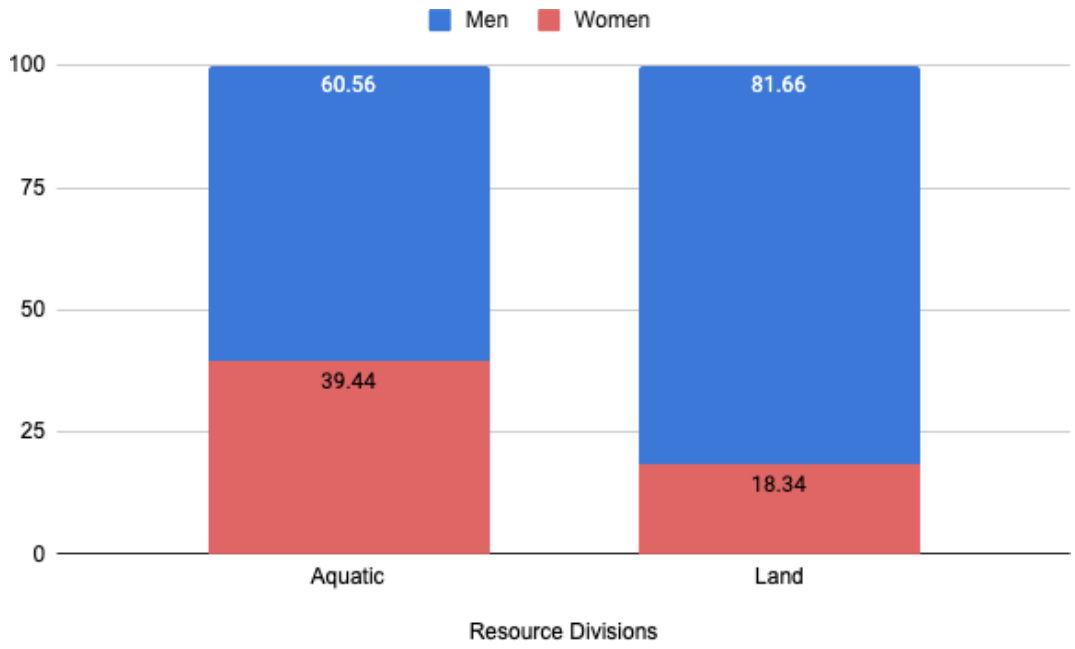

Figure 2. *The percentage of households that used resources during the prior year based on the type of the resource (aquatic/land) with the gender identity (woman, man) of the person who was primarily responsible for the collection of the resource.*

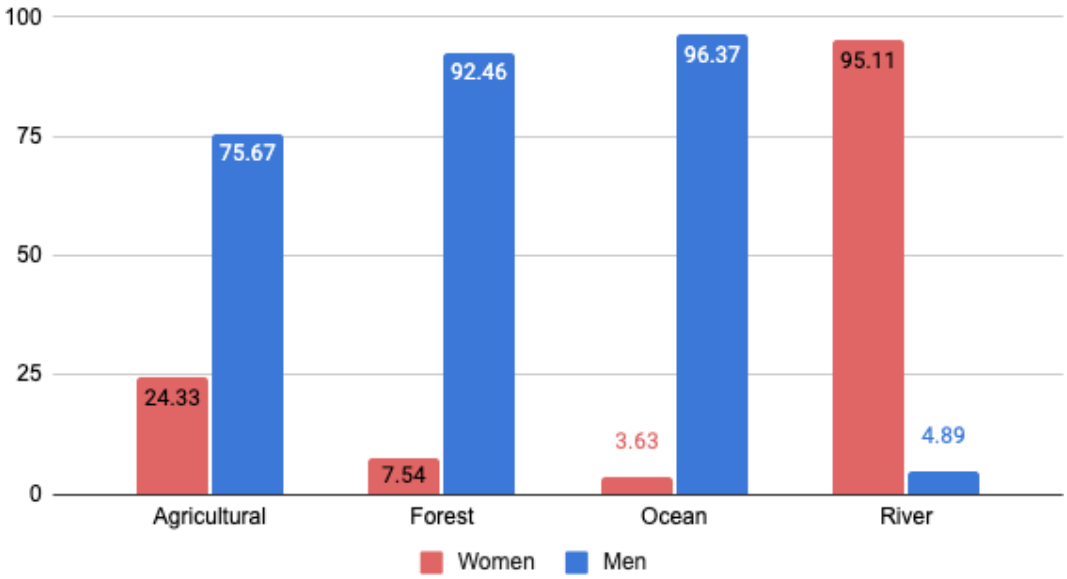

Figure 3. *The percentage of households that used resources during the prior year based on the location of the resource with the gender identity (woman, man) of the person who was primarily responsible for the collection of the resource.*

3.4 Role of Age and Gender in Natural Resource Use: Of men and women of all age classes, adult men (76.21%) were primarily responsible for the collection of natural resources followed by adult women (10.65%). Both young men and young women were rarely the primary individual responsible for the collection of natural resources in a household, however comparatively more boys (9.81%) were responsible than girls (3.32%). Individuals of all genders and ages mostly acquired natural resources by collecting it themselves. However, it is important to note that nearly a quarter (23.65%) of the natural resources acquired by adult women were purchased (Table 5), even though fewer women than men acquired such resources. Of all resources purchased by any age or gender, 56.11% were purchased by adult men, followed by adult women, young men, and young women (Figure 9). Similarly, of all resources caught or collected directly, almost three-fourths were by adult men (70.31%), followed by adult women (17.67%), boys (10.64%), and girls (1.39%). Most people of all age groups across both genders primarily collected the resources for subsistence use, only 13.42% of adult men collected them with a primary incentive of sales followed by girls, adult

women, and boys (Figure 10). Out of all the resources collected by the households with the incentive of sales, 80.83% was collected by adult men, 9.89% by adult women, 7.73% young men, and 1.55% young women. For plant-based resources, 69.00% adult men were primarily in charge of its collection followed by adult women (20.00%), boys (9.50%), and girls (1.30%). For animal-based resources, adult men were primarily in charge of its collection (51.00%) followed by boys (24.00%), adult women (19.00%), and girls (5.60%).

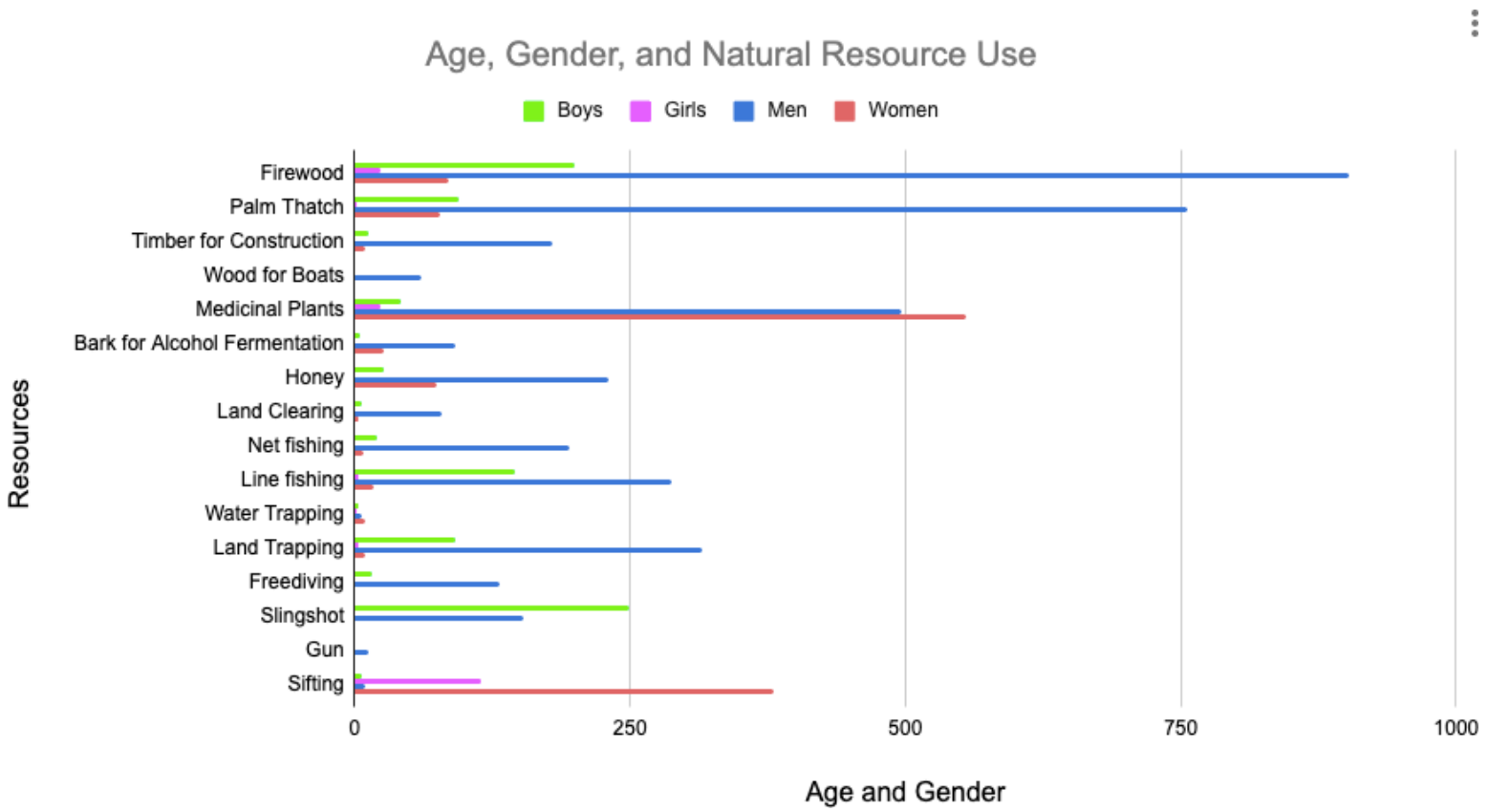

Figure 4. *The number of households (of the 1252 surveyed) where men, women, boys, and girls were the primary household members responsible for collecting different natural resources.*

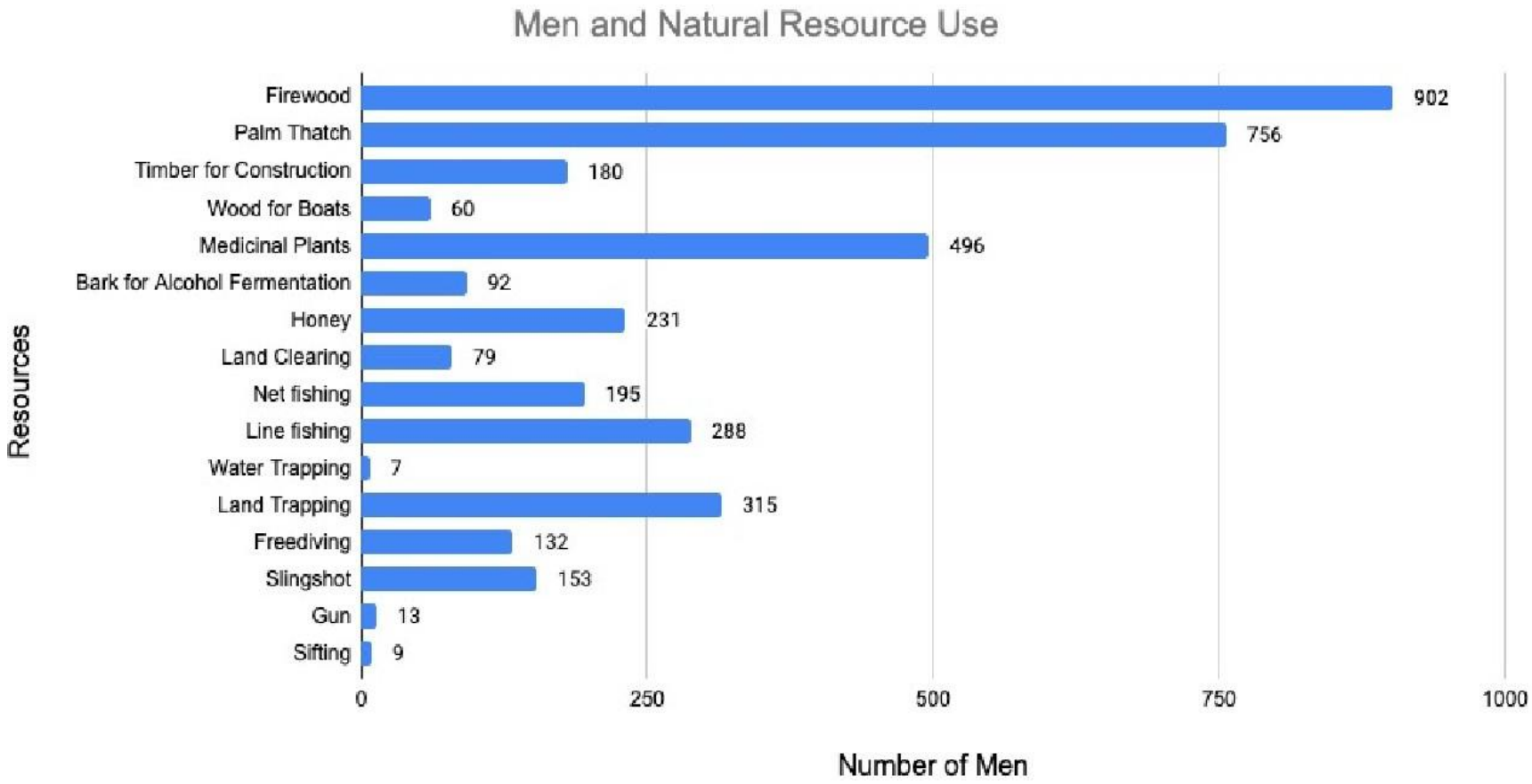

Figure 5. *The number of households (of the 1252 surveyed) where men were the primary household members responsible for collecting different natural resources.*

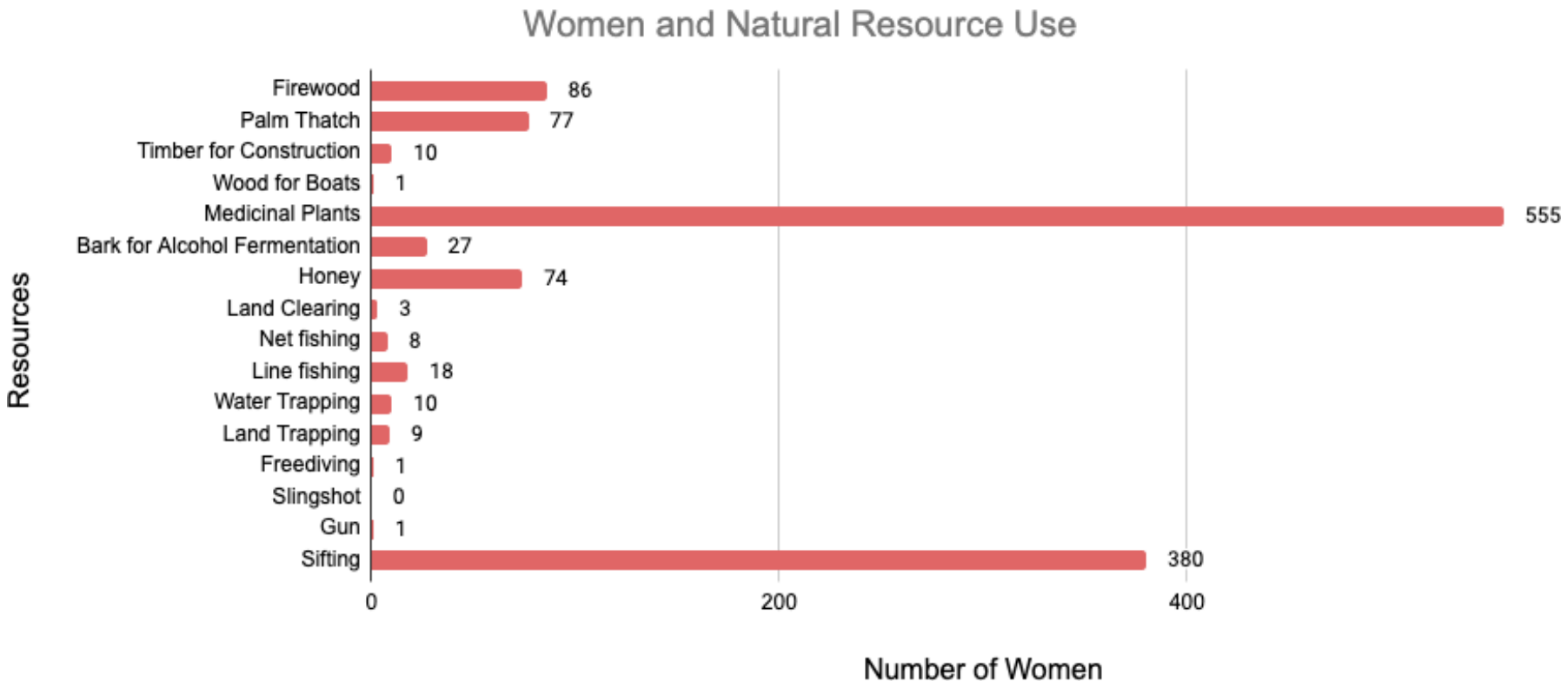

Figure 6. *The number of households (of the 1252 surveyed) where women were the primary household members responsible for collecting different natural resources.*

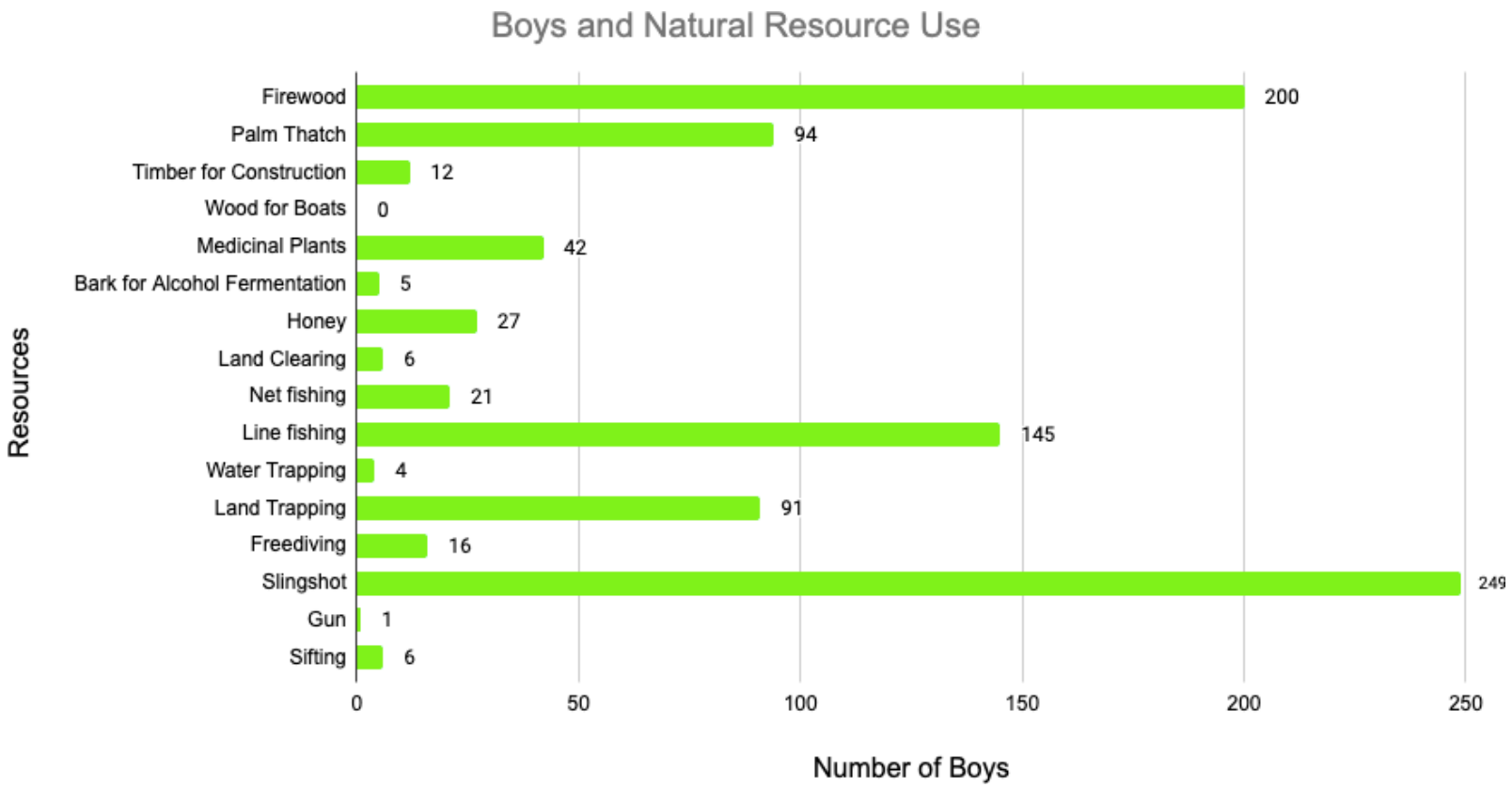

Figure 7*. The number of households (of the 1252 surveyed) where boys were the primary household members responsible for collecting different natural resources.*

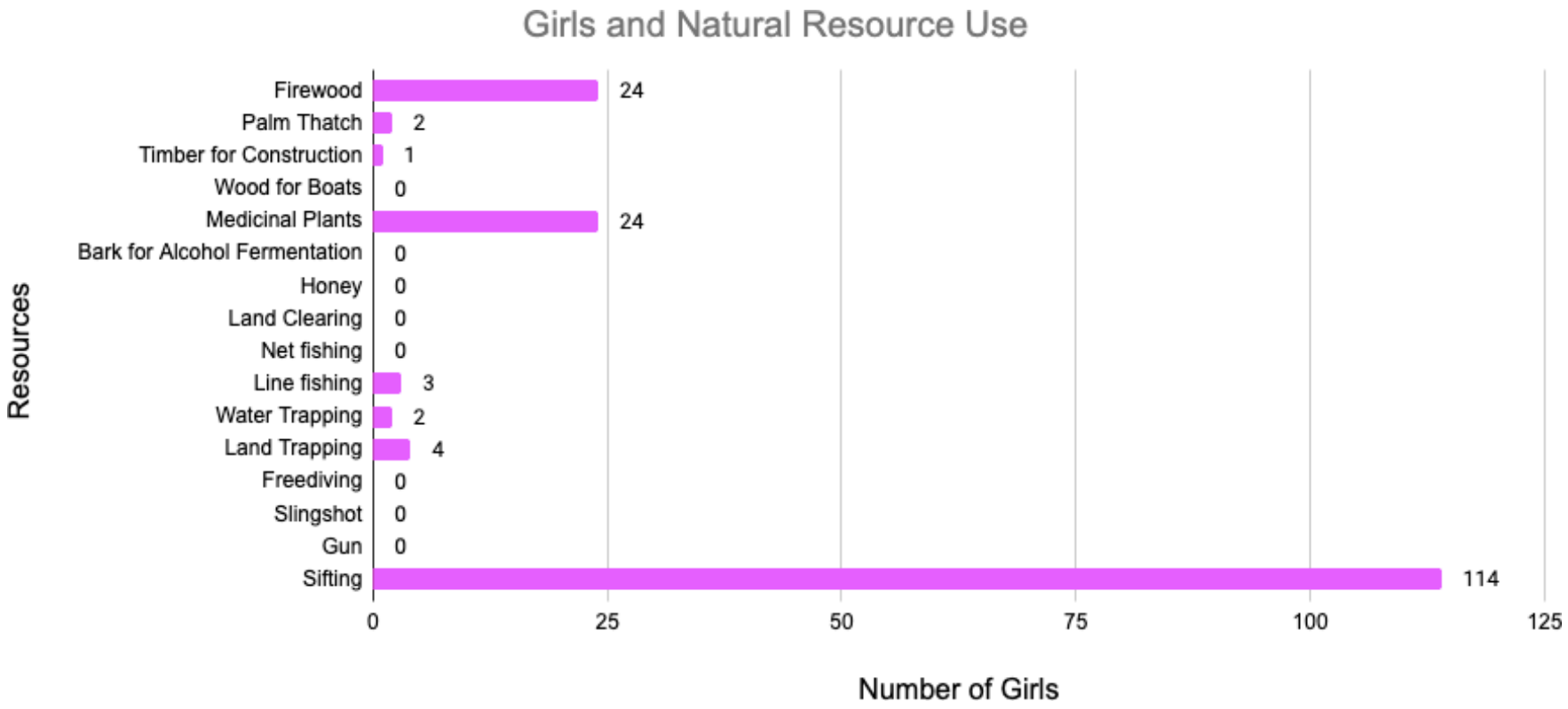

Figure 8. *The number of households (of the 1252 surveyed) where girls were the primary household members responsible for collecting different natural resources.*

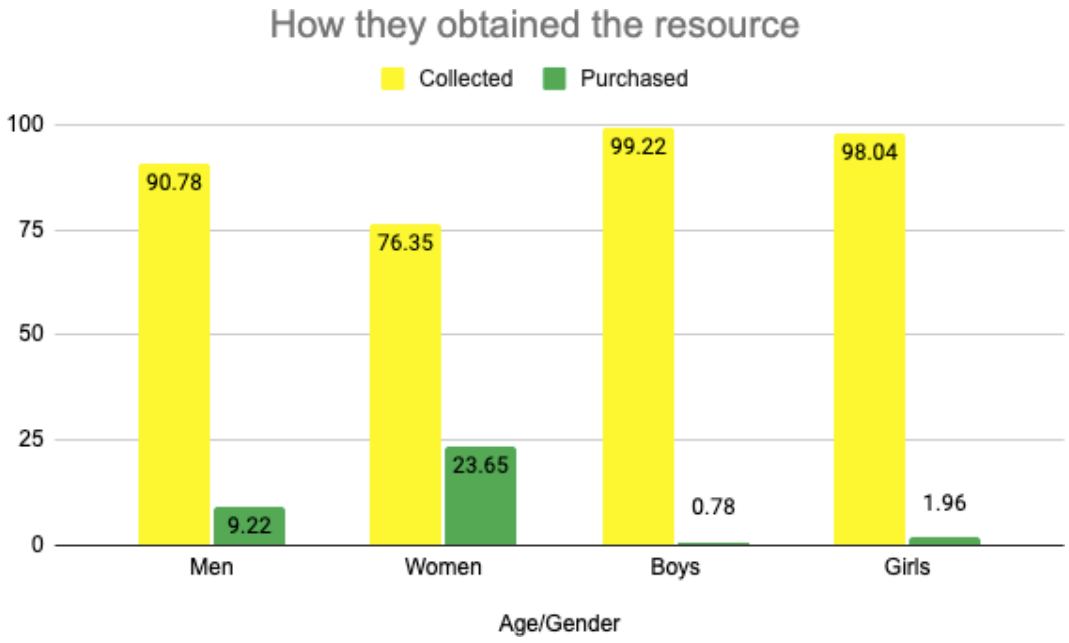

Figure 9. *Gender roles (man/woman) with difference in age (adult/young) in households that used, collected, or purchased resources during the prior year on the Masoala Peninsula of Madagascar (2015-2021).*

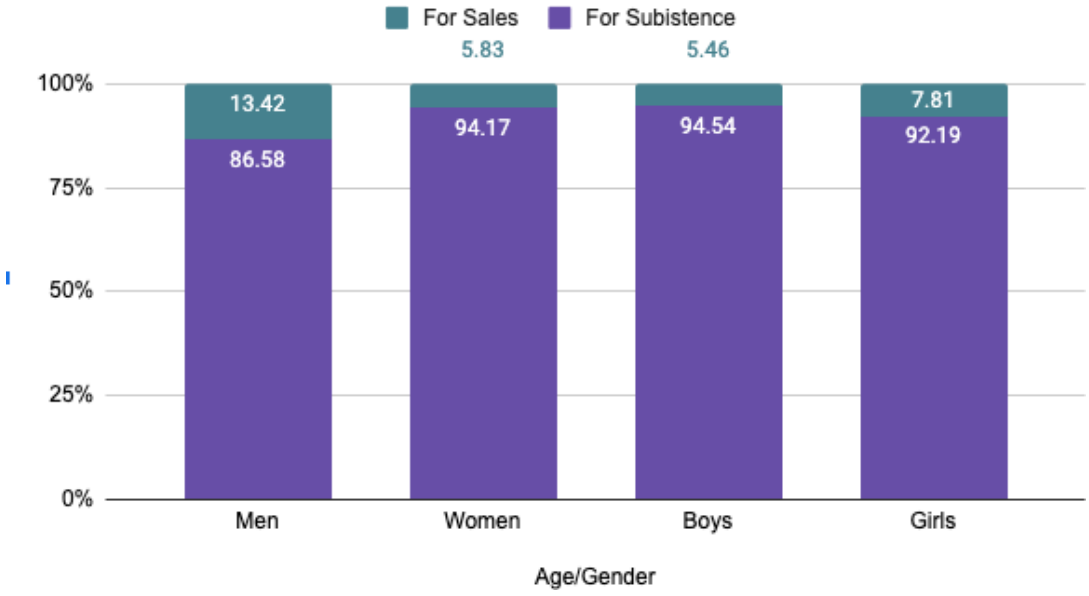

Figure 10. *Gender roles (man/woman) with difference in age (adult/young) in households with their primary incentive of collection (sales or subsistence use) during the prior year on the Masoala Peninsula of Madagascar (2015-2021).*

There were significant differences between ages in their use of natural resources. Age affected both the primary incentive of collection of the resource ($\chi 2=37.32$, $p<0.0001$), and the method collection of the resource ($\chi 2=81.14$, $p<0.0001$). Girls were the least responsible

in the household for natural resource collection. The only resources young women were responsible for acquiring were medicinal plants, firewood, timber, land clearing for agriculture, palm thatch, and animal products collected through sifting, water trapping, and line fishing. While girls only collected fourteen percent of medicinal plants and firewood, they collected two-thirds (66.00%) of all freshwater shrimp and small fish caught by sifting. Girls did not acquire trees for transportation, honey, bark for alcohol fermentation, or any wildlife caught by slingshot, net fishing, guns, or free diving. Girls acquired more resources than women or boys with the primary incentive of selling them (Figure 10) and purchased more than twice the amount of resources than boys (Figure 9). In contrast, boys were responsible for the collection of all resources except trees for transportation (Figure 7). In fact, boys were more involved in the collection of natural resources than either adult women or girls (Figure 4).

4. DISCUSSION

Gender significantly affects how one uses natural resources in Madagascar. Recognizing the roles that each gender plays in the extraction, use, and sale of natural forest and marine resources can help tailor conservation strategies in Madagascar's national parks to specific gender roles. Taking gender into consideration in regard to natural resource conservation can help understand how, why and who is responsible for each resource, if there is a difference in the way each gender is using them, and how this can be managed (Kristjanson et al., 2019). While men were primarily responsible for the collection of resources in most households in Masoala, women were responsible for collecting nearly all resources in at least one household. This adds complexity to the narrative that women have limited access to forest resources, so men are mostly in charge of collecting firewood or medicinal plants from the forest (Mwangi et al., 2011). While the use of forest products has gendered differences, these

differences change with the local culture, gender norms, and the resources being used. So, involvement of both genders should be ensured for effective management of the resources.

While most natural resource collection was for subsistence purposes, almost all women collected natural resources for subsistence, while more than a tenth of men collected resources with the intent to sell them. Similar to other regions of eastern Madagascar (Järvilehto, 2005), men in the Masoala region of Madagascar are primarily responsible for earning the household's income, whereas women are responsible for managing household finances once income has been earned. This may explain why women purchased nearly one-quarter of the resources that they used, whereas men purchased less than a tenth of their resources. Majority of the resources collected for sale were by men, so to control the sale of a resource, the strategies need to be specific to men. That is, when the policies related to the sales of a resource are tailored to how or why men sell them, these policies can be effectively enacted. Women either have their husband or another male relative, or hire men, to extract many of the resources they need (Kellert et al., 2000). Women purchased most of the resources they used. Hence, conservation efforts to target women need to be focused on the purchase of resources. Conservation organizations should be aware that policies which regulate the purchase of natural resources will also most negatively affect women. I suggest that there be paired efforts which help women access more affordable and sustainable alternatives, while also controlling the purchase of these resources. Increasing women's representation in policy making can help acknowledge and understand what the women need and incorporate that into sustainable conservation of resources.

Although more women purchased the resources than men in Masoala, more than half of the total purchases were made by men. It is also important to recognize that even though men also purchase resources, they collect more resources than they purchase. In order to control the

purchase of a resource, the strategies need to include the purchases made by both men and women, depending on the resource. This is important because globally, women, especially in low-income households, spend most of their income on the family's basic needs whereas men spend it on their own personal needs (Agrawal, 1994). So, if the purchase of a resource is regulated or restricted, women will be at a disadvantage.

Men acquired almost all of the resources in forest, ocean, and agricultural areas. This is likely explained by the presence of gendered spaces. Despite which gender uses a natural resource, going to the forest is an element of a man's identity in both regions of Madagascar (Korhonen, 2004) and mainland Africa (Mwangi et al., 2009) resulting in the potential for forests to become male-dominant spaces for resource collection. Men collected more aquatic animals by freediving, net fishing, and line fishing, which are mostly done in oceans and terrestrial animals using slingshot, land trapping and guns, which are mostly done in forests, where less women in each household are seen collecting the resources.

Plant-based resource collection was highly gendered in Masoala. Men acquired majority of all the plants, with the exception of medicinal plants, where both men and women are in charge of their collection. To control the direct collection of plant-based resources, conservation programs need to be focused mostly on men, except for medicinal plants. Similar to the Masoala, medicinal plant collection was found to be predominantly done by women in other regions of Madagascar including Lac Alaotra and Kianjavato (Borgerson et al., 2018a; Borgerson et al., 2018b). This contrasts with Ankarafantsika in the north-west where it was mostly done by men (Borgerson et al., 2019). Regardless of who is collecting the resource, every household acquired medicinal plants from the forest in the Masoala. This illustrates the importance of medicinal plants in terms of community healthcare where these plants are crucial resources for the communities' healthcare.

Similar to Masoala, firewood was mostly obtained by men in the Kianjavato and Ankarafantsika regions of Madagascar (Borgerson et al., 2018b; Borgerson et al., 2019) and in Tanzania (Massoi, 2019). However, this is not universal, in the Lac Aloatra region of Madagascar firewood was collected by more women than men (Borgerson et al., 2018a). In Nigeria, it was found that the exploitation of forest resources is also affected by the difference of gender of the person using the forest where men acquired more forest timber and animals, and women acquired non-timber forest products (Eneji et al., 2015).

Of the resources they collected, women were more likely to collect animals than plants, specifically aquatic ones. Women were primarily responsible for collecting small freshwater shrimp and fish in rivers through sifting using woven baskets, and larger freshwater eels using woven traps. Women collected almost all resources collected from rivers. In marine areas, women are commonly seen doing inshore fishing whereas men are often seen doing coastal or offshore fishing (Calhoun et al., 2016). Women are considered the gatekeepers in collecting water from the river for their households (Nounkeu & Dharod, 2021), and have an area farther downstream where they wash themselves, their dishes, and clothing, where men are typically not present (Ravololomanga, 1992). Women may collect the resources in rivers during their daily activities. This explains why women were responsible for almost half of the aquatic resources compared to less than one quarter of land resources. In a study done in Mexico, Peru, Senegal, South Africa, and Vietnam, globally significant marine fishing countries, it was found that women's contribution in the fisheries sector is often excluded from fisheries decision making although the contribution by women to the fisheries in these countries is substantial (Harper et al., 2017). So, in Masoala, because women are most involved in collection of resources in river ecosystems, women must be included in the design of projects

for the conservation of watersheds in ways where they can contribute their knowledge about such ecosystems and be involved in their sustainable management.

It is evident that differences in resource use and knowledge have created some sort of segregation in how these different spaces are used. ‘Spaces,’ according to Edward T. Hall, is a silent language or hidden dimension that shapes human action. Social and gender norms related to ‘masculinity’ and ‘femininity’ can create spatial dynamics which in turn creates these gendered spaces (Nightingale, 2006, Rocheleau et al., 1996). It is also important to recognize that the differences in the spaces and places where men and women use can create gendered spaces (Rocheleau & Edmunds,1997). We found that the location where resources were found had a significant effect on the gender responsible for collecting them as men collected most resources in agricultural lands, forests, and oceans, whereas women collected nearly all river- resources. This supports the notion of ‘gendered spaces’ as there are differences in how men and women used these spaces and the resources found there.

Gender-based mapping can help maintain a balance in how each gender uses these resources to not only preserve biodiversity, but also protect the sources of livelihood of the people. Some other examples of such gendered spaces are seen in the Northwest province of Cameroon where cultural practices restrict women’s activities around certain restricted areas (Fonjong, 2008). Similarly, in certain rainforest societies, men are responsible for collection of products from primary forest whereas women are responsible for collecting them from secondary forests or around their homes (Elias, 2016). In many communities, women’s spaces are between spaces that are controlled by men (Rocheleau & Edmunds, 1997). This creates restrictions in women’s access to trees and their products in primary forest and makes them dependent on men (Ikdahl et al., 2005). In some customary management systems, taboos that restrict pregnant or menstruating women from collecting certain resources (Colding & Folke,

2001). Gender roles are geographically varied depending on the social interpretations of the norms prevalent there (Scundberg, 2015). This difference in gendered spaces must be studied in Madagascar to understand what contributes towards this gendered stratification that creates such physical separation of the genders.

Age adds an additional layer to gender roles in how natural resources are accessed and used. While men were more responsible for collecting natural resources than women, boys were almost as likely as adult women to collect a resource. In Masoala, girls were the least likely within a household to be primarily responsible for resource collection, and boys were more involved in the collection of natural resources than either adult women or girls. This finding was similar to the Ankarafantsika region in the northwest where girls were seen collecting the least number of resources in each household and boys were seen collecting more resources than any other gender or age group in the households (Borgerson et al., 2019), and to southwestern Madagascar, where boys often go fishing with their fathers and brothers, while girls from the same families often work at home (Moreira et al., 2016). Since there is a higher percentage of boys than girls who are collecting the resources, studies on why there is less involvement of girls in comparison to boys of the same age group must be conducted. Girls in Madagascar tend to remain in schools longer than boys (Kellum et al., 2020), which may explain their reduced involvement. There needs to be an emphasis on creating programs to increase the attendance of boys in schools, as this could help reduce the unsustainable use of natural resources in the area from an early age for both boys and girls. However, it is also important to note that girls are both acquiring more resources than women or boys with the intention of selling them and are purchasing more resources than boys. As gender is inextricably linked with other social factors such as race, ethnicity, disability, language, and social class, it makes each person’s experience unique. With these multiple intersections with

the differences in race, age, class, and marital status, it is important to take intersectionality into account (Davis, 2019). For example, not all women or men have the same experiences. In certain ethnic groups in Ghana, after marriage, the status of a woman changes socially and economically within a household from being a 'junior woman' to a full 'cooking wife' after successfully bearing children. With this change of status, the responsibility of the woman also changes (Warner, 1997). Similarly, the level of education also adds another layer to this change of role as well. In Mexico, Bolivia, Kenya, and Uganda, there was an increase in likelihood for a woman with a higher level of education to be entrusted with representing the household in the forestry committee (Coleman & Mwangi, 2013).

The difference between the roles played by men and women are not only a consequence of environmental issues, but also a cause of environmental change (Lau & Scales, 2016). When this difference in how each gender's role in the use of natural resources is not understood, it can further exacerbate the inequalities that exist between women and men. In Senegal, women's access to and control over land and forests were restricted with negative impacts on their sources of livelihood and income due to the lack of proper understanding of gender dynamics in forestry there (Bandiaky-Badji, 2011). In India, when there was a greater representation of women, there was an increase of improved conservation outcomes by 11% (Agrawal, 2010b). Sustainable natural resource management policies that have a deeper understanding of cultural and social norms about gender and natural resource use can ensure efficient management of resources. Simplistic treatment of gender by treating men and women as homogenous groups (Westervelt, 2018) can be counterproductive towards achieving gender equity in natural resource management. It is important for conservation strategies to reflect the complexity of gender, first, by acknowledging that gender is not a

universal, binary concept; but understand it through the layers of intersectionality such as age, socioeconomic status, and marital status (Kojola, 2019).

5. CONCLUSION

Having a gendered approach in natural resource management programs is extremely important for the success of conservation programs. This helps us understand what each gender can contribute, given the distinct roles, experience, and knowledge that each gender has in terms of specific resources and help manage them (Wright et al., 2016; Majekodunmi, 2018). As we understand the pressures on the extraction of natural resources, and its impacts on the local wellbeing, we can develop a national level management strategy. Finding the balance, so that the local Malagasy population can use the forest to support their livelihood and income without further depleting the resources is necessary to protect not only the endemic biodiversity, but also to ensure an equitable environment for the people there.

In conclusion, we recommend that conservationists and policy makers combine their efforts and have a gendered approach in creating natural resource conservation programs on the Masoala peninsula. There should be comprehensive gendered approaches that focus on the locally defined differences between women and men in how they use the natural resources. In Masoala, we found that watershed conservation may be more effective if it includes women, and forest and marine if it targets men, however, to reach all households both genders must be included. Efforts to reduce the sale of resources should target men, but such efforts are likely to have the greatest negative effects on women (who purchase most of their resources) and should be paired with mitigating actions targeted toward female buyers. Efforts to affect the decisions of the next generation of resource users, should know that while boys collect most resources, perhaps because of their lower involvement in education, girls may be increasingly using this education to leverage such resources through selling and purchasing more than boys

of the same age. Acknowledging what implications these differences have, can help create an equitable, community-based natural resource management program. However, while doing so, conservation managers must ensure to provide a sustainable alternative to the resources that they are regulating, so the needs of the local population are not hampered. A locally relevant understanding of how gender roles and needs intersect with natural resource use can help ensure the continued delivery of ecosystem services while protecting Madagascar's endemic species.

REFERENCES

Agrawal, B. (2002). Environmental action, gender equity and women's participation. *Development and Change*, 1–44.

Agrawal, B. (2009). Gender and forest conservation: The impact of women's participation in community forest. *Ecological Economics, 68*(11), 2785–2799. https://doi.org/10.1016/j.ecolecon.2009.04.025

Agarwal, B. (2010a). Does women's proportional strength affect their participation? Governing local forests in South Asia. *World Development, 38*, 98–112.

Agarwal, B. (2010b). The impact of women in Nepal's community forestry management. *ICIMOD, Sustainable Mountain Development, 57*, 26–29.

Allendorf, T. & Yang, J. (2017). The role of gender in local residents' relationships with Gaoligongshan Nature Reserve, Yunnan, China. *A Multidisciplinary Approach to the Theory and Practice of Sustainable Development,* 185–198.

Andreone, F., Cadle, J. E., Cox, N., Glaw, F., Nussbaum, R. A., Raxworthy, C. J., Stuart, S. N., Vallan, D., & Vences, M. (2005). Species review of amphibian extinction risks in Madagascar: Conclusions from the global amphibian assessment. *Conservation Biology, 19*(6), 1790–1802. https://doi.org/10.1111/j.1523-1739.2005.00249.x

Arora-Jonsson S. (2014). Forty years of gender research and environmental policy: where do we stand? *Women's Studies International Forum, 47*, 295–308.

Aswani, S., Flores, C. & Broitman, B. (2015). Human harvesting impacts on managed areas: ecological effects of socially-compatible shellfish reserves. *Reviews in Fish Biology and Fisheries, 25*, 217–230.

Bandiaky-Badji, S. (2011). Gender equity in Senegal's forest governance history: why policy and representation matter. *International Forestry Review, 13*, 177–194.

Baynes, J., Herbohn, J., Gregorio, N., Unsworth, W. & Tremblay, E.H. (2019). Equity for women and marginalized groups in patriarchal societies during forest landscape restoration: the controlling influence of tradition and culture. *Environmental Conservation, 46*, 241–246.

Borgerson, C., McKean, M. A., Sutherland, M. R., & Godfrey, L. R. (2016). Who hunts lemurs and why they hunt them? Biological Conservation, 197, 124–130. https://doi.org/10.1016/S0006320716300556.

Borgerson, C., Vonona, M. A., Vonona, T., Anjaranirina, E. J. G., Lewis, R., et al. (2018a). An evaluation of the interactions among household economies, human health, and wildlife hunting in the Lac Alaotra wetland complex of Madagascar. Madagascar Conservation & Development, 13(1), 25–33. https://doi.org/10.4314/mcd.v13i1.5.

Borgerson, C., Johnson, S. E., Louis, E. E., Holmes, S. M., Anjaranirina, E. J. G., et al. (2018b). The use of natural resources to improve income, health, and nutrition within the forests of Kianjavato, Madagascar. Madagascar Conservation & Development, 13(1), 45–52. https://doi.org/10.4314/mcd.v13i1.6.

Borgerson, C., Randrianasolo, J. F., Andraina, T. R., Anjaranirina, E. J. G., Randriamady, H. J., et al (2019). Wildlife hunting in complex human- environmental systems: How understanding natural resource use and human welfare can improve conservation in the Ankarafantsika National Park, Madagascar. Madagascar Conservation & Development, 14(1), 37–45. https://doi.org/10.4314/mcd.v14i1.7.

Borgerson, C., Johnson, S.E., Hall, E. et al. (2022). A national-level assessment of lemur hunting pressure in Madagascar. *International Journal of Primatology, 43,* 92–113. https://doi.org/10.1007/s10764-021-00215-5

Boyer-Rechlin, B. (2010). Women in forestry: a study of Kenya's green belt movement and Nepal's community forestry program. *Scandinavian Journal of Forest Research, 25,* 69–72.

Brown, K. & Fortnam M. (2018). Gender and ecosystem services: a blind spot. *Ecosystem services and poverty alleviation: trade-offs and governance*, 257– 272.

Calhoun, S., Conway, F. & Russell, S. (2016). Acknowledging the voice of women: implications for fisheries management and policy. *Marine Policy, 74*, 292–299.

Clark, M. (2012). Deforestation in Madagascar: consequences of population grown and unsustainable agricultural processes. *Global Majority E-Journal*. 61-71.

Colding, J. & Folke, C. (2001). Social taboos: "invisible" systems of local resource management and biological conservation. *Ecological Applications, 1,* 584–600.

Coleman, E.A. & Mwangi, E. (2013). Women's participation in forest management: a cross-country analysis. *Global Environmental Change, 23,* 193–205.

Crow, B., & Sultana, F. (2002). Gender, class, and access to water: three cases in a poor and crowded delta. *Society and Natural Resources (15)*, 709–724. https://doi.org/10.1080/08941920290069308

Davis, S. L. (2019). Understanding and improving gender equity in conservation. *Journal of the American Institute for Conservation, 58(*4), 202–216.

Di Ciommo, R.C. & Schiavetti, A. (2012). Women participation in the management of a marine protected area in Brazil. *Ocean & Coastal Management, 62*, 15–23.

Elias, M. (2016). Gender and forests: climate change, tenure, value chains and emerging issues. *Routledge.*

Eneji, C. V. O., Ajake, O., Mubi, M., & Husain, M. (2015). Gender participation in forest resources exploitation and rural development of forest communities in Cross River State, Nigeria. *Journal of Natural Sciences Research, 5*(18), 61–71.

Fonjong, L. (2008). Gender roles and practices in natural resource management in the northwest province of Cameroon. Local environment. *The International Journal of Justice and Sustainability, 13*(5), 461–475. https://doi.org/10.1080/13549830701809809

Ghazanfar, S.A. & Beentje H. (2006). African plants: biodiversity, ecology, phytogeography and taxonomy. Royal Botanic Gardens Kew.

Golden, C. D., Bonds, M. H., Brashares, J. S., Rasolofoniana, R. B., & Claire, K. (2014a). Economic valuation of subsistence harvest of wildlife in Madagascar. *Conservation Biology*, 234–243. https://doi.org/10.1111/cobi.12174.

Golden, C. D., Rabehatonina, J.G.C., Rakotosoa, A. & Moore, M. (2014b). Socio- ecological analysis of natural resource use in Betampona Strict Natural Reserve. *Madagascar Conservation & Development, 9(*2), 83–89. http://dx.doi.org/10.4314/mcd.v9i2.4

Goodman, S.M. and Benstead J.P. (2003). The natural history of Madagascar. University of Chicago Press.

Griffin, G. (2017). A dictionary of gender studies. *Oxford University Press, Oxford, UK.*

Harper, S., Grubb, C., Stiles, M. & Sumaila, U.R. (2017). Contributions by women to fisheries economies: insights from five maritime countries. *Coastal Management, 45*(2), 91–106. https://doi.org/10.1080/08920753.2017.1278143

Holmelin, N.B. (2019). Competing gender norms and social practice in Himalayan farm management. *World Developmen*t (122), 85–95. https://doi.org/10.1016/j.worlddev.2019.05.018

Holmes, C. (2007). Linking livelihoods, land stewardship, and resource conservation in the Antongil Bay landscape, Madagascar. *Wildlife Conservation Society Working Paper no. 32,* 6–16.

Ikdahl, I., Hellum, A., Kaarhus, R., & Benjaminsen, T. A. (2005). Human rights, formalisation and women's land rights in southern and eastern Africa. *Institute of Women's Law, Department of Public and International Law, University of Oslo.*

Independent Evaluation Group and World Bank Group. (2021). Approach paper: *Madagascar country program evaluation.*

James, R., Gibbs, B., Whitford, L., Leisher, C., Konia, R., & Butt, N. (2021). Conservation and natural resource management: where are all the women? *Oryx, 55*(6), 860–867. https://doi.org/10.1017/S0030605320001349

Järvilehto, L. (2005). Men and women of the forest livelihood strategies and conservation from a gender perspective in Ranomafana National Park, Madagascar. *University of Helsinki.*

Kariuki, J. & Birner, R. (2016). Are market-based conservation schemes gender-blind? A qualitative study of three cases from Kenya. *Society and Natural Resources, 29,* 432–447. https://doi.org/10.1080/08941920.2015.1086461

Kellert, S.R., Mehta, J.N., Ebbin, S.A. & Lichtenfeld, L.L. (2000). Community natural resource management: promise, rhetoric, and reality. *Society and Natural Resources, 13,* 705–15.

Kellum, J., Randrianarimanana, H., Andrianaivosoa, L.M.& Telingator, S. (2020). USAID Madagascar gender analysis report. *Banyan Global.*

Kojola, E. (2019) Indigeneity, gender, and class in decision-making about risks from resource extraction. *Environmental Sociology, 5,* 130–148.

Krause, D.W., Hartman, J.H. & Wells, N.A. (1997). Natural change and human impact in Madagascar, eds SM Goodman, BD Patterson. *Smithsonian Institution Press, Washington, DC,* 3-43.

Kremen C., Razafimahatratra V., Guillery R.P., Rakotomalala J., Weiss A., Ratsisompatrarivo J.-S. (1999a). Designing the Masoala National Park in Madagascar based on biological and socioeconomic data. *Conservation Biology.* https://doi.org/10.1046/j.1523-1739.1999.98374.x

Kremen, C., I. Raymond, K. Lance, A. Weiss. (1999b). Monitoring natural resource use on the Masoala Peninsula, Madagascar: a tool for managing integrated conservation and development projects. *Conservation Biology*, *13*(5) 63-84.

Krüger, M. (2007). Composition and origin of the Lepidoptera faunas of southern Africa, Madagascar, and Réunion (Insecta: Lepidoptera). *Annals of the Transvaal Museum, 44,* 123-178. https://hdl.handle.net/10520/EJC83655

Lau, J.D. and Scales, I.R. (2016). Identity, subjectivity and natural resource use: How ethnicity, gender and class intersect to influence mangrove oyster harvesting in The Gambia. Geoforum, 135-146. https://doi.org/10.1016/j.geoforum.2016.01.002

Lau, J.D. (2020). Three lessons for gender equity in biodiversity conservation. Conservation Biology, 34(6),1589-1591. https://doi.org/10.1111/cobi.13487

Leisher, C., Temsah, G., Booker, F., Day, M., Samberg, L., Prosnitz, D. et al. (2016). Does the gender composition of forest and fishery management groups affect resource governance and conservation outcomes? A systematic map. *Environmental Evidence, 5*, 1–10.

Lloyd, C., Sorichetta, A. & Tatem, A. (2017). High resolution global gridded data for use in population studies. *Scientific Data 4,* 170001.https://doi.org/10.1038/sdata.2017.1

Lourenco, W.R. & Goodman, S.M. (2000). Biogeography of Madagascar. *Memoires de la Societe de Biogeographie, Paris.*

Macgregor, S. (201&). *Routedge Handbook of gender and environment.* Routledge, New York.

Mai, Y.H., Mwangi, E., & Wan M. (2011). Gender analysis in forestry research: looking back and thinking ahead. *International Forestry Review, 13,* 245-258.

Majekodunmi, A.A. (2018). Nigeria: Using Gender Mainstreaming Processes to Help Protect Drinking Water Sources of the Obudu Plateau Communities in Northern Cross River State. *Office of the Special Advisor on Gender Issues and Advancement of Women, Gender, Water and Sanitation: Case Studies on Best Practices*. United Nations: New York.

Massoi, L. W. (2019). Gender roles and practices in natural resource management among the Kilosa Maasai in Tanzania. *Tanzania Journal of Development Studies,* 102-116.

Molden, D., Verma, R. & Sharma, E. (2014) Gender equality as a key strategy for achieving equitable and sustainable development in mountains: the case of The Hindu Kush–Himalayas. *Mountain Research and Development, 34*, 297–300.

Mwangi, E., Meinzen-Dick, R., & Sun, Y. (2011). Gender and sustainable forest management in East Africa and Latin America. *Ecology and Society, 16*(1), 17.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kents, J. (2000).

Biodiversity hotspots for conservation priorities. *Nature. 403,* 853–858. Nightingale, A. (2006). The nature of gender: work, gender, and environment.

Society and Space, 165–185.

Nightingale, A. (2017). Environment and gender. *International encyclopedia of geography*, 1–13.

Phillipson, P., Schatz, G., Lowry II, P. & Labat, J. (2006). Catalogue of the vascular plants of Madagascar.

Purcell, S.W., Ngaluafe, P., Aram, K.T. & Lalavanua, W. (2016). Trends in small-scale artisanal fishing of sea cucumbers in Oceania. *Fisheries Research,183,* 99–110.

Razavi S. (2016). The 2030 Agenda: challenges of implementation to attain gender equality and women's rights. *Gender and Development, 24*, 25– 41.

Rigamonti, M.M. (1993). Home range and diet in red ruffed lemurs (*Varecia variegata Rubra*) on the Masoala Peninsula, Madagascar. In: Kappeler, P.M. Ganzhorn, J.U. (eds) *Lemur Social Systems and Their Ecological Basis. Springer, Boston, MA.* https://doi.org/10.1007/978-1-4899-2412-4_3

Spain, D. (1993). Gendered spaces and women's status. *American Sociological Association,* 137-151. https://doi.org/10.2307/202139

Staples, K. & Natcher, D.C. (2015). Gender, decision making, and natural resource co-management in Yukon. *Arctic, 68*, 356–366.

United Nations Development Programme. (2019). Africa human development report 2019, New York: *United Nations Publications*.

Upreti, B.R. (2001). Contributions of community forestry in rural social transformation: some observations from Nepal. *Journal of Forest and Livelihood, 1*, 31–33.

Warner, M.W., R.M. Al-Hassan & J.G. Kydd. (1997). Beyond gender roles? Conceptualizing the social and economic lives of rural peoples in Sub-Saharan Africa. *Development and Change*, *28*(1), 143–68.

Westerman, K. (2014) Guidelines for integrating gender into conservation projects. *Conservation International, Crystal City, USA.*

Westervelt, M.O. (2018) A co-wife for the cow: gender dimensions of land change and livelihood shift among Loita Maasai of Southern Kenya. *Human Ecology, 46*, 815– 829.

Wilmé, L., Goodman, S.M. and Ganzhorn, J.U. (2006). Biogeographic evolution of Madagascar's microendemic biota. *Science*, *312*(5776),1063–1065.

World Bank, (2020). Data Madagascar. http://data.worldbank.org/country/madagascar World Bank. (2020). Madagascar country economic memorandum: scaling success, building

a resilient economy. *World Bank, Washington, DC.*

World Bank. (2019). Madagascar country data. *World Bank, Washington, DC.* https://data.worldbank.org/country/MG

Wright, P. C. & Andriamihaja, B. 2003. The conservation value of long-term research: A case study from the Parc National de Ranomafana. In: Goodman, S. M. & Benstead, J. P. (eds.). The natural history of Madagascar. Pp. 1485-1488. Chicago: University of Chicago Press. WWF 2001.

Yang, Y.C.E., Passarelli, S., Lovell, R.J. & Ringler, C. (2018). Gendered perspectives of ecosystem services: a systematic review. *Ecosystem Services, 31,* 58–67.