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Subsistance Fisheries Characteristics in Androy Madagascar Towards Sustainability

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Abstract

Recurring droughts lead to environmental degradation, reduce agricultural yields and render the social fabric of the Androy region highly vulnerable. Indeed, rural communities are restructuring their productive systems to exploit marine resources, despite the social constraints involved. This study aims to understand the dynamics of the community-led institutionalisation of marine fishing and to examine the socio-environmental management of this new productive model. The study was conducted in three coastal villages in Ambovombe district during April 2025. A total 93 of fishermen and several fisherwomen were sampled using purposive and snowball sampling techniques. Primary data were collected through in-depth guided interviews, focus-group discussions and informal conversations. The study's findings reveal the characteristics of small-scale fishers in Androy and the challenges they face. Subsistence fisheries tend to be deeply rooted in local communities, with 67% of participants being family members (Fly), reflecting historical links to adjacent fishery resources dating back to the 1990s as sources of household income (Gn) for 100% of respondents. Subsistance fishers face a variety of challenges to their livelihoods. These challenges are from socio-economics conditions (SuW ; SoL), climate variability (Cv) and environmental degradation, the most felt compromising ressources collection (Rs). Mean while, as from the political dimensions, government policies (Ste) are most felt problems. Androy coastal fishers face different threats, and have different coping mechanism and resources reflecting their traditions and values, and supporting social cohesion through seasonal ocean sacrifice (SC). Studies of the key characteristics of subsistance marine fisheries in Androy and the challenges they face are deemed very necessary for small-scalled fisreries sustainability.

Keywords: *Androy, Blue Economy, Climate Change, Governance, Subsistance Fishery, Sustainability.*

I. INTRODUCTION

Climate change is causing significant environmental changes, such as droughts, whose increasing frequency is accelerating forest decline [1,2], reducing vegetation cover and agricultural yields, and contributing to the expansion of barren areas [3]. The southern part of Madagascar is among the regions most affected by land degradation. It ranks first as the most degraded territory [4]. This situation is characterized by a decline in land productivity and/or degradation of soil organic carbon. The Ntandroy territories are, therefore, fully affected by the desertification process, as defined by the UNCCD. Droughts and rainfall deficits have significant negative effects on agricultural production and food security, leading to high vulnerability in the region [5]. This situation is all the more concerning as it will most likely be exacerbated by the effects of climate change according Potsdam Institute for Climate Impact Research. High rainfall variability combined with the fragility of ecosystems impacts the availability of natural resources in Androy. This is therefore a factor that jeopardizes their sustainable use and determines the livelihoods of the majority of rural populations in Androy.

Schumpeter [6], in his seminal reflections on the subject of innovation, uses the phrase "new productive combinations" rather than the term "innovation." This involves a restructuring of the productive apparatus and gives rise to new consumer needs. New productive combinations emerge, among other things, in the form of the exploitation of a previously untapped source of raw materials. Understanding the essential role of the ocean and its importance to coastal societies is closely linked to the ocean's health. Its origins could be attributed to the way of life of certain "seafaring peoples," whose ancestral customs and traditions were shaped by the sea, such as the coastal communities of Androy, in the Ambovombe

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District. It transcends the economic sphere; it is also integrative and inclusive, advocating a new economic model that addresses environmental, local, and societal challenges. The blue economy is resolutely anthropocentric. It is an economic system linked to the exploitation of marine resources (primarily fishing) and trade, and it specifically encompasses human activities related to the sea, whether direct or indirect.

The blue economy, which has evolved into a sustainable blue economy, offers a tremendous opportunity for new growth. This vision relies on and consumes marine resources a capital that must therefore be carefully managed to build a viable blue economy. The blue economy must therefore be focused on coastal communities; it must be inclusive and supportive, as highlighted in the report “Reviving the Ocean Economy” [7]. This is due to the vital and unbreakable bond that indigenous coastal communities maintain with the sea and its resources. The definitions, parameters, and various tools advocated for the blue economy emphasize the environmental (a healthy ocean), social (inclusive and equitable growth), and integrative (good governance) dimensions in the development of a sustainable blue economy or even a “regenerative blue economy” [8]. For aquaculture, a sector in which societal challenges are paramount (food security, income, and the well-being of coastal populations), the social issue of developing an aquaculture sector “that leaves no one behind” [9] has long been raised [10,11,12,13]. Because the sustainable development and use of ocean resources drive economic growth and improve livelihoods and community employment while preserving the health of the ocean. The vision of a sustainable blue economy is evolving; it must play an active role in the fight against climate change and biodiversity loss, and it must be able to contribute positively to these challenges, becoming “Ocean Positive” [14,15,16], capable of protecting or restoring marine and coastal biodiversity.

Fishing is a marginal activity that engages a minority of coastal residents and is not a traditional practice among the Ntandroy. Once considered taboo, it is believed that this practice is incompatible with pastoralism. Fisheries and marine resources have been exploited for only a few decades in Ntandroy territory after having long suffered from the impacts of climate change. During the First Malagasy Republic (around the 1960s), it evolved into a production system that provided a significant source of income for the underprivileged. The great famine of 1990–1992 gaves a major boost to the development of this activity, as fewer deaths were reported among fishing families during that tragic event.

Fishing has therefore become a permanent source of income for coastal families. This observation stems from the research question of this study, which is formulated as follows: “How is small-scale fishing along the Androy coast managed from a community perspective with a view to achieving sustainable livelihoods?” Ecosystem degradation accelerated by climate change is forcing farmers to take up artisanal fishing in Amboro, Beaniky, and Beroroha as a subsistence activity combined with agriculture. The objectives of this article are: (1) to understand the dynamics of community-based institutionalization of marine fisheries and (2) to examine the socio-environmental management of the new productive combination: agriculture and community fisheries.

II. LITERATURE REVIEW

- *Blue Economy Concept*

The concept of the blue economy originated in the early 2000s when sustainable development was gaining traction globally. The term "*blue economy*" was coined by Gunter Pauli, a Belgian entrepreneur and sustainability advocate, in his book "*The Blue Economy : 10 Years, 100 Innovations, 100 millions Job*s", published in 2011 [17]. In his book, Pauli introduced the concept of a new kind of economy based on the efficient and sustainable use of ocean resources. He argued that the oceans are a source of untapped wealth and could solve many of the world's environmental and economic problems, such as climate change, energy scarcity, and poverty [18].

Pauli proposed a new business model that imitates the functioning of natural systems and creates value from waste and by-products. He highlighted the potential of aquaculture, renewable energy, and biotechnology sectors to drive economic growth while promoting environmental sustainability and social inclusion. Since then, the blue economy concept has gained recognition from international organisations such as the United Nations and the World Bank, as well as from governments, academia, and the private sector. It has become a key driver of sustainable development and a pathway to achieving the United Nations' Sustainable Development Goals (SDGs), particularly SDG 14.

According to the World Bank [19], blue economy is, “*the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem*". Accordingly, the concept of blue economy has become increasingly recognized, for instance, the European Union's Blue Growth strategy which aims to support sustainable growth in the maritime sector, recognizes the potential of oceans, seas, and coasts in creating jobs as well as spurring economic growth while ensuring the long-term sustainability of marine ecosystems in 2020. The blue economy, or the ocean or maritime economy, refers to the sustainable use of ocean resources for economic growth, improved livelihoods, and ocean health. The blue economy encompasses a range of sectors, such as fisheries, aquaculture, shipping, energy, tourism, and marine biotechnology. It's potential to contribute to sustainable development, and poverty reduction has gained attention from policymakers, scholars, and stakeholders [17]. However, the blue economy also faces modern challenges threatening its sustainability and potential benefits. Climate change, overfishing, pollution, and habitat destruction are significant threats to the health of oceans and their resources. These challenges affect the

environment and have economic and social consequences, such as losing biodiversity, livelihoods, and cultural heritage [20].

From a scholarly point of view, the blue economy requires a multidisciplinary approach that combines natural, social, and economic sciences to understand the complex interactions between human activities and ocean ecosystems. Scholars have emphazised the importance of policy coherence, governance frameworks, and stakeholder engagement to ensure the sustainable use of ocean resources. The role of innovation, technology, and finance in supporting the transition to a blue economy has also been highlighted in recent literature [21]. Overall, the blue economy offers opportunities and challenges that require a holistic and integrated approach to balance economic growth with environmental sustainability and social equity.

➢ *The Concept of Governance*

Internationally, there has been a growing realization that small-scale fisheries, both marine and inland, play a critical role in the provision of food, employment and livelihoods for millions of people. However, fisheries resources are declining, habitats are degrading [22], and food and livelihoods derived from fisheries are, as a consequence, increasingly at risk. Given the complexities, uncertainties and challenges prevalent in these coastal and inland fishery systems, conventional top-down, science-based and resource-centred management is no longer considered appropriate, and new forms of governance that address both societal and resource sustainability issues are required [23]. These new governance approaches are systems-orientated, holistic and integrated, interdisciplinary, participatory, responsive and adaptive; in addition, they recognize the plurality of sociolegal systems and the value of different knowledge systems [24]. Growing consensus among scholars and development practitioners points to "governance" as the most significant obstacle to enabling sustainable use of resources and securing a development path for developing countries that is sustainable and equitable [25, 26]. Increasingly, governance has taken centre stage in debates about the nature and role of the state in managing natural resources, the way in which the state interacts with other societal actors, the kinds of rules that shape these actions, and the plurality of social and legal systems [23, 24]. What, then, does governance mean in the context of natural resource management in the small scale fisheries subsector? What principles underpin the notion of governance and what approaches to and types of governance would best meet the needs of complex small-scale fisheries systems, in a way that is both socially just and ecologically sustainable?

By definition of governance, at its most general level, is about steering and guiding society and the economy through collective action to address problems and achieve common goals [23]. It is a difficult concept to define clearly, and there are a diversity of definitions and understandings. In the natural resource management arena, governance is thus increasingly interpreted in its widest sense as comprising "political, institutional, and cultural frameworks through which diverse interests in natural and cultural resources are coordinated and controlled" [27] with interactions between and across a wide diversity of governing actors. Such examples of definitions include here below :

« *Governance is about sharing responsibility and power ; it is about setting the policy agenda and objectives and about the processes of implementing management actions* ». [28].

« *Governance is the whole of public as well as private interactions that are initiated to solve societal problems and create societal opportunities. It includes the formulation and application of principles guiding those interactions and care for institutions that enable them* » [28].

Central to these definitions of governance are the interactions and processes that occur among a diverse group of actors, including non-state actors, in the process of addressing societal issues and needs. The recognition of the importance of interactions across various governance actors has led to the coining of the term "interactive governance", which emphasizes the interactive and participatory nature of governance. While hierarchical governance suggests a top-down approach and expects governments to play a leading role, the interactive governance approach suggests that high levels of participation, information sharing and joint problem solving should guide planning, management and decision-making. These ideas are fundamental to the approach to governance envisaged in implementing the SSF sustainability.

III. METHODOLOGY

A qualitative methodological framework was chosen to address the research questions. Qualitative research allows for an understanding of individuals' meanings, interpretations, and subjective experiences, according to Denzil and Lincoln (2008) [29]. Understanding the reality of an experience, a process, or a phenomenon is contextual and must be grounded in the experiences of those who have lived through it, (…) [30].

Located in the far south of Madagascar, Androy is one of the country's most unique regions. Primarily known for the quality of its cattle and goat herds, Androy possesses staggering potential in both aquaculture and subsistence agriculture. Often perceived as a landlocked region with a semi-desert climate, Androy nevertheless remains a coastal area whose hidden treasures will open up to any community or professional venture eager to discover its potential. Investing in the fisheries value chain in this region means, above all, tapping into exceptional aquaculture potential along a 250 km coastline that remains largely undeveloped yet is rich in fishery resources.

To this end, the approach is guided by the selection of a study site characterized by specific bioclimatic,

ecological, and socioeconomic contexts that reflect its distinct socio-environmental issues. This approach presents a specific challenge for the historical, political (governance), and geographical understanding of social change and transformation, particularly regarding new practices such as small-scale marine fishing in the face of the consequences of climate change in *Amboro*, *Beaniky,* and *Beroroha*. The study highlighted the community-based system of fisheries combined with agriculture. This was achieved through: (1) assessing local perceptions of fisheries management; (2) evaluating the impact of fishing activities as a socioeconomic solution for local populations; and (3) determining the socio-environmental management system for marine fisheries.

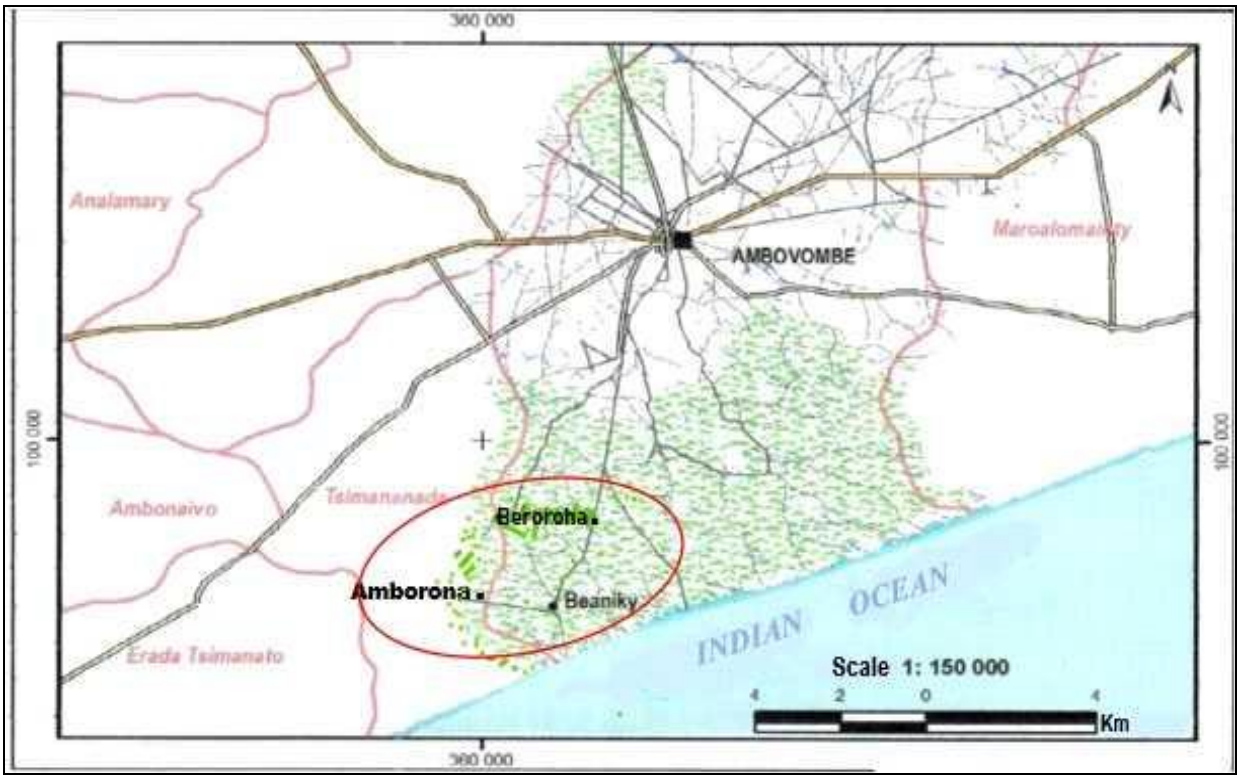


Fig 1 Study Sites Location in Ambovombe District

➢ *Sample and Sampling Method*

Sample sizes were designed to elicit in-depth information from key informants. Qualitative studies thus employed small samples consisting of a relatively small number of individuals, studied within their lived contexts. Participants were recruited to highlight the experiential reasons behind the new fishing practice (despite its social restrictions) and its productive combination with agriculture within a population targeted for the research question. The sample size was initially determined using the "targeted sampling strategy." This is a non-probability sampling procedure.The sample included participants from diverse groups in terms of gender and socioeconomic background. It consisted primarily of adult males who engaged in both farming and fishing or fishing alone, from three villages: Amborona, Beaniky, and Beroroha. This choice was appropriate because fishing (in canoes in the middle of the ocean) is not practiced by women. The age of the male participants ranged from 17 to 56 years. To that end, local authorities were contacted first to provide us with information and, above all, to identify, among others, male heads of households who engage in both fishing and agriculture, with or without equipment. They were expected to be familiar with the phenomenon of climate variability, particularly community perceptions and adaptation techniques related to fishing activities. These initial participants were asked to refer us to other fishermen who could answer our questions, and so on. The field study combined qualitative research and structured face-to-face interviews.

Nevertheless, women were recruited because they forage along the seashore with their children, searching for edible and marketable marine resources. Focus group discussions (FGDs) were used for another data collection method. These discussions were used to bring exclusively together a range of female and child respondents who could discuss and debate aspects related to SF governance. This choice has allowed women to express themselves freely, since in the presence of male participants, they are submissive. The right to speak is primarily reserved for male participants. They accompany their husbands to the fishing grounds, and while waiting for them to return to the boats, they sit along the riverbanks. The children do the same. The ages of the female participants range from 19 to 45. The sizes of the FGDs vary by village (Table 1). FGDs provided participants with the opportunity to explore different points of view and to formulate and reconsider their own ideas and understanding of their livelihoods and coping strategies related to access to and use of SF. This technique captures numerous views and perceptions simultaneously. In total, the sample consisted of 93 individuals, including the members of the focus groups conducted in each village.

Table 1 Participant Profiles

Characteristics	*Amboro*	*Beaniky*	*Beroroha*	Gender	Age Group	Number
Focus Group	17	22	18	Female	[19-45]	57
Direct interview	10	14	12	Male	[17-56]	36
N	**27**	**36**	**30**			**93**



Fig 2 Local Participants and Focus Groups

IV. DATA ANALYSIS AND PROCESSING

➢ *Data Preparation*

Data analysis was conducted using multidimensional methods with XLSTAT 2016 software : correspondence analysis (CA) and ascending hierarchical clustering (AHC). The primary purpose of these methods was to identify relationships between sociodemographic dynamics and the sustainable local management strategies for marine fisheries initiated by local farmers. The qualitative data collected from direct interviews were entered and cleaned in Excel by removing missing values or those that appeared to be outliers. Qualitative variables take the value 0 or 1. All quantitative variables were transformed into Reduced Centered Variables (RCVs) using the formula:

$$RCV = (xi - x) / \sigma$$

Where

X = The original raw value
$\boldsymbol{\mu}$ = The arithmetic mean of the population or sample
$\boldsymbol{\sigma}$ = The standard deviation, which measures the dispersion of the data.

It transforms different datasets to a standard normal distribution (mean = 0; SD =1) for comparison

➢ *Data Analysis and Processing*

- *Analysis of Perceptions and Characteristics of SF in Androy*

The analysis of marine fishing practices as mixed-income activities undertaken by the populations of the three coastal villages in the Ambovombe Androy District was conducted using a multivariate approach aimed at identifying the profiles of fishermen and their corresponding communities, the relationships between variables and the factors explaining the characteristics of the local fishery, as well as the barriers to the sustainability of this subsistence activity and the locally initiated adaptation strategies.

- *Dominance and Influence of Barriers to Subsistence Fishing*

To address the research questions, the development of a strategic matrix helped identify the dominant and influential variables. Inter-variable correlations help assess the role of marine fishing and the barriers hindering this community-based subsistence activity. The following steps were followed:

Multivariate statistical analysis, Multiple Correspondence Analysis (MCA), and Discriminant Analysis (DA) were used to obtain the inter-variable correlation matrix and define the strategic rectangle summarized in a table.

For the strategic rectangle, the following steps were taken:

Removal of insignificant variables and the lower diagonal part of the correlation matrix

Calculating the values of X and Y with X = L/P and Y= L*P

- L = Sum of the rows of the correlation matrix variables
- P = Sum of the columns of the correlation matrix variables

Sorting by descending order of X values: influential variables were selected from values greater than 1 (X>1) (colored yellow) in the rectangle.

Sorting in descending order of Y values, considering all the highest values in the influential variables up to a significant deviation to be classified as dominant and influential variables (colored green) in the rectangle. The variables examined were categorized into three groups through participant discourse analysis as presented here below (Table 1).

Table 2 Variables Used for the Strategic Rectangle

Variable	Coding
• ***Characteristics***	
Seaside	*Ss*
All family members	*Fly*
Daily subsitance	*Dly*
Gain	*Gn*
Agriculture sector	Agr
Sustainable activities	SuW
Alternative activity	ALa
Fishery products	ReS
Life Solution	SoL
• ***Challenges***	
Tabous	*Tb*
Good season	GoS
State	*Ste*
Variability of climate	*Vc*
Bad season	*Bse*
Materials Boat	MaT BoT
• ***Coping system***	
Ocean Sacrifice	*SC*
Banana peel	*BaS*
Goat (beige)	*GaT*
Vessel washing	*VsV*

Source : Fieldwork, 2025

➢ *Prioritization of Local Fishing in Androy in Light of the Constraints Faced by Fishermen*

The prioritization of respondents' answers regarding the characteristics of their livelihoods, the constraints they face, and customary governance practices was determined by ranking the variables according to the degree of importance indicated in the responses of male participants. The explanatory variables were organized and structured to support the sustainable management of small-scale marine fisheries by fishermen:

- Variables with a p-value greater than 0.2 (α error risk), considered non-significant in an exploratory approach, were eliminated to retain only the most relevant variables for the analysis. Similarly, the lower half of the correlation matrix, which was redundant due to symmetry, was not taken into account.
- The upper diagonal of the correlation matrix was used.

Only variables above the diagonal whose absolute values exceeded the significance threshold for inter-variable correlations of 0.429 were retained. This value was calculated for the 36 surveyed fishermen using the following formula:

$$|\rho| > \frac{t_{\alpha=0,05}}{\sqrt{n-2+t^2_{\alpha=0,05}}}$$

Where,

|ρ| : Significance threshold/level
tα : Student-Fisher's T-test = 1,96
n : Number of observations = 93

V. RESULTS AND DISCUSSION

Subsistance fisheries refer generally to the act of catching fish, and to activities happening before and after the fishing itself.

➢ *Local Representation of Fisheries*

An analysis of trends in variables related to the representation of subsistence fishing practices shows a clear decline (in red) across the three classes as measured by the Tb variable. While fishing was once considered taboo, since the 1990s it has become a daily activity (Dly) because fishing generates income (Gn) for 100% of households. Two-thirds (67%) of families (Fly) are involved in it (children, women, and men). Fishing is linked to social cohesion within households and communities.



Fig 3 Subsistance Fisheries are Done by Families and Communities

Under the impact of climate variability (Cv), community subsistence activities (SuW) are under serious threat. Agriculture (Agr) can no longer sustain household life, and fishing is an activity closely linked to household culture and tradition through the ritual practice of sacrifice (SC), with all family members participating in festive gatherings by the seasides (Ss).

Table 3 Prospections of Variables Related to the Practice of SF Androy

Variable	*Ss*	*Fly*	*SC*	*Dly*	*Tb*	*Gn*	*Agr*	*GoS*	*SuW*	*Cv*	*90's*
Classe 1 (33%)											
Classe 2 (40%)											
Classe 3 (27%)											

In Androy then, coastal fisheries communities are often marginalized and vulnerable communities, who live in poverty with little access to basic health, sanitation, educational or infrastructural services. They are vulnerable to social ills and health pandemics such as malaria. They are vulnerable to external factors such as climate change and natural disasters ; often poorly organized. They include not only the fishers (harvesters) themselves, but also the people involved in all pre- and post-harvest activities (Fly); these are primarily women and children.

➢ *Challenges and Vulnerabilities of Vulnerable Fisheries*

- *Climate and Environmental Constraints*

Local communities are already vulnerable and marginalized; furthermore, subsistence fishing, by its very nature, is an unpredictable activity, which is why every April of the year (SC), the sacrifice for the ocean is called for. This variable is an exogenous factor that influences (in yellow) fishing (X=4.60; Y=16.48) so that the seasonal baseline is established. The availability of the resource (in white) and the seasonality of the resource (ReS) depend on weather and climate conditions (Cv) by 70%. Given their already marginalized and vulnerable nature, small-scale fishers are particularly susceptible to external factors, such as the effects of climate change.

The environmental dimension of the blue economy is concerned with protecting the health of ocean ecosystems. This dimension encompasses a range of environmental issues such as biodiversity conservation, climate change mitigation and adaptation, pollution prevention, and ecosystem-based management. The principles of this dimension focus on ensuring that economic activities do not compromise the ecological sustainability of ocean resources. While the Blue Economy offers many opportunities, it also presents several challenges that must be addressed to ensure its sustainable development. Some of the main challenges include:

- *Logistical Constraints*

Fishing in Androy is carried out using traditional methods. It is practiced by fishermen, either individually or in groups, using various types of non-motorized boats (paddle and sail) or by shore fishing within a very limited range. Catching techniques are varied: fishing with various nets, longlines, traps, and gillnets; harvesting by hand; and spearfishing with or without free diving. The most commonly used boats for traditional sea fishing are outrigger canoes originating from Toliara.

Other factors that make fishers vulnerable are the lack of potential gear and boats (Fig. 4) to earn higher incomes, In particular, logistic factor (MaT : X=1,97 ; Y=17,53) dominate in fisrt position and influe fishers household subsistence. Boat is an influential material

(BoT : X=3,71 ; Y=13,74) for maritime fishery, otherwise, the activity is only practised along the banks (Ss : X=2,75 ; Y=16,97). The development of infrastructure, such as ports, harbours, and coastal facilities, is often essential for the growth of the Blue Economy. However, the lack of adequate infrastructure can be a significant barrier to the development of some sectors.



Fig 4 Fishers Building Boats and Repairing Nets

- *Governance Requirement (National)*

Vulnerability is also experienced because of political factors, such as poor organization and representation in national government structures and policies. The challenge that small-scale fisher communities in Androy face include: political or historical marginalization and lack of voice in decision-making. National government (Ste : X=4,59 ; Y=16,48) highly affects fishing sector that limit access to harvesting resources, and the gendered nature of fishing activities.

Table 4 Correlation of Dominance and Influence between Variables Related to SF in Androy

Variables	**X=L/P**	**Y=L*P**
MaT	1,97	17,53
Ss	2,75	16,97
Dly	2,75	16,97
Ste	4,59	16,48
SC	4,60	16,48
GoS	3,16	14,20
BoT	3,71	13,74
ReS	0,79	19,17
SuW	0,54	19,74
SoL	0,11	8,81

This key point is also clearly reflected in certain principles published for a sustainable blue economy and by the Ocean Panel. It has been the subject of extensive research. According to Bennett et al. [33], effective governance of the blue economy must be inclusive, while Lubchenco et al. [34] emphasize an ecosystem-based approach as a priority for a sustainable blue economy. According to Paquet [35], governance corresponds to a mode of regulation that does not rely exclusively on market mechanisms or state interventions, but rather draws on civil society. It refers to the act of steering a system and coordinating collective action [35] in which "the organizational order is negotiated to a greater extent among the system's actors" [36]. This term implies capacities exercised by multiple actors and reflects the "multiplicity of decision-making venues" [37]. SSF have a weak political voice and little power in decision-making.

- *Governance of Socioecological Systems*

Governance interactions are crucial in the management of small-scale fisheries. They have multiple interacting systems (social, ecological, economic, political and historical). Actors in marine and coastal governance can include individuals, families, communities, various state departments, private-sector actors, international actors, as well as affluent and marginalized societal groups from macro to micro levels. Small-scale fishers often have a rich local and indigenous knowledge of the environment, which is often passed down orally from generation to generation. Apart from the unpredictability in terms of the availability of fish, access to space and resources are governed by environment local knowledge. Then, fishing is a highly variable lifestyle, and fishers and their families often live in a volatile institutional environment. Fisheries represent a potential activity (SuW :X=0,54 ; Y=19,74) to earn higher incomes. Particularly, fishers who have their own gear and boats could be translated to better security. Local fisheries ameliorate fishers living conditions, they are a potential and subsistence alternative (SoL : X=0,11 ; Y=8,81).



Fig 5 Fishery Products Sold in Local Markets

They have local and indigenous methods of managing local resources to ensure sustainable subsistence. Traditional and ecological knowledge systems guide these activities. Five key variables (SC ; BaS; Bse; GoT; and VsS), based on local knowledge related to the socio-environmental governance of SSF (shown in red), are sequenced one after another (Fig. 6). In addition to the sacrificial practice (SC) involving a beige-coated goat (GaT) for the coastal areas and the ocean, sociocultural and environmental prohibitions are enforced. SSF is subject to the constraints of good weather and the right season; for example, banana pots (BaS) are prohibited in the area. Furthermore, washing dishes (VsS) in seawater causes bad weather, impacting access to fishery resources. These variables of traditional governance govern and frame the sustainability and development of SF in Androy as an alternative subsistence activity (Gn; ALa and SoL) to agriculture in the context of climate variability.

According to Nagy and Nene (2021) [38], the goal should be to develop modes of blue economy governance tailored to each region of the world, particularly in Africa, rather than imposing a single model originating from the Northern Hemisphere.

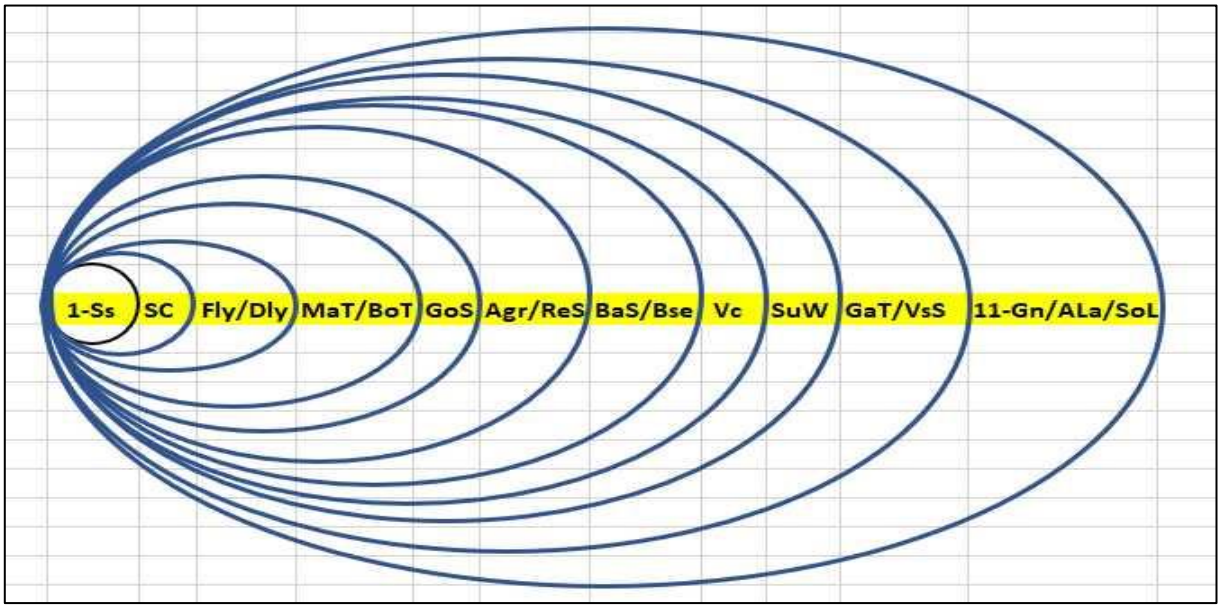


Fig 6 SF Variables Ranking in Androy

VI. DISCUSSION

Fishing plays an important role in providing additional income, particularly for fishermen in the Androy region, to offset low agricultural yields resulting from water shortages caused mainly by delayed rains and, consequently, climate variability. Fishing, like agriculture, helps reduce the economic vulnerability of fishing communities. Nevertheless, many obstacles remain to be overcome in optimizing the vulnerability reduction process, which could lead to increased capacity and even enable communities to become resilient.

- *Characteristics of Development-Vulnerable Small-Scale Fisheries*

The blue economy: a development opportunity for the Androy region. The fisheries value chain supports just over 17,000 fishermen and their families, representing a total of approximately 52,500 people. In 2017, small-scale marine fishing accounted for 86% of the total national catch of marine fishery products, or 75,084 tons. The Androy region, where agriculture suffers from repeated droughts and where the food and nutrition situation is a cause for concern, is rich in fishery resources. These resources are underutilized by local communities.

Small-scale fisheries take many forms. They comprise women, men and children, who are engaged in any number of activities as they practised in Androy, including longlining, purse seine fishing, pearl diving, buying and selling fish. Small-scale fisheries in Androy is rural, part-time or full-time, coastal subsistence, chronically poor or vulnerable, in a few cases, relatively prosperous. Considering small-scaled fihseries development of Androy of this disparate group is, therefore, a complex undertaking. The view that open access fisheries act as a method of poverty prevention, absorbing surplus rural labour and providing a safety net in times of crisis [39].

➢ *Community Fisheries Towards Poverty Reduction*

It also adopts the term poverty reduction, that considers a number of factors as important in reducing poverty, such as better health care and education [40]. Taking the concept of poverty in this broader sense, there are many different aspects that contribute to poverty reduction. These do include provision of basic necessities but can also include reduction of vulnerability, increased participation and good governance, pro poor economic growth and equity. Many small-scale fisheries are poor, which suggests that development mechanisms for small-scale fisheries share similarities with these general poverty reduction mechanisms. However, there are a number of issues that particularly affect small-scale fisheries, which must be taken into account in creating a framework of development needs aimed at reducing poverty and vulnerability and stimulating development in small-scale fisheries.

Béné and Friend [39] argue that poverty in small-scale fisheries is often caused by issues such as geographical and political isolation. Jentoft et al. [41] noted the increasing recognition that: “what is happening inside small-scale fisheries is often due to what happens outside of them”; and that “the well-being of men and women involved in small-scale fisheries relates more broadly to how they live and thrive in communities and how they are involved in decision-making than on securing healthy ecosystems”. Similarly, suggest that it is caused by power imbalances and lack of secure access rights to resources and assets. We note the importance of access to roads, education, health services and clean water, as well as the need for measures to address vulnerability and improved governance through co-management and decentralisation [41].

➢ *SSF Multisectorial Vulnerabilities*

In addition, the dangers associated with fishing and threats to coastal communities as a result of climate change are significant security concerns for small-scale fisheries. Thus, while the framework does consider basic necessities (including food security) and safety at sea as important concerns of small-scale fisheries, it further considers issues affecting the security, or vulnerability, of small-scale fisheries, such as tenure and access rights, climate change, and social safety nets. It also considers governance issues in the context of participation, including issues such as transparency, accountability, cooperation and collaboration between those dealing with fisheries issues, improving resource governance, and combatting corruption. This is because poor governance can be a source of many ills for the poor, and a lack of proper resource governance is particularly detrimental to the lives of small-scale fisheries.

Finaly, the framework of SSF development in this study (Fig.7) considers participation extensively, including equal participation of women, it also deals with a number of other governance concerns that could hamper development of small-scale fisheries. These concerns briefly, including transparency, access to justice, participation of civil society and institutional capacity building. It is important to deal with these issues, as a lack of resources a serious constraint on government effectiveness) and the prevalence of corrupt practices in regions where small-scale fisheries are found make these important issues affecting the development of small-scale fisheries.

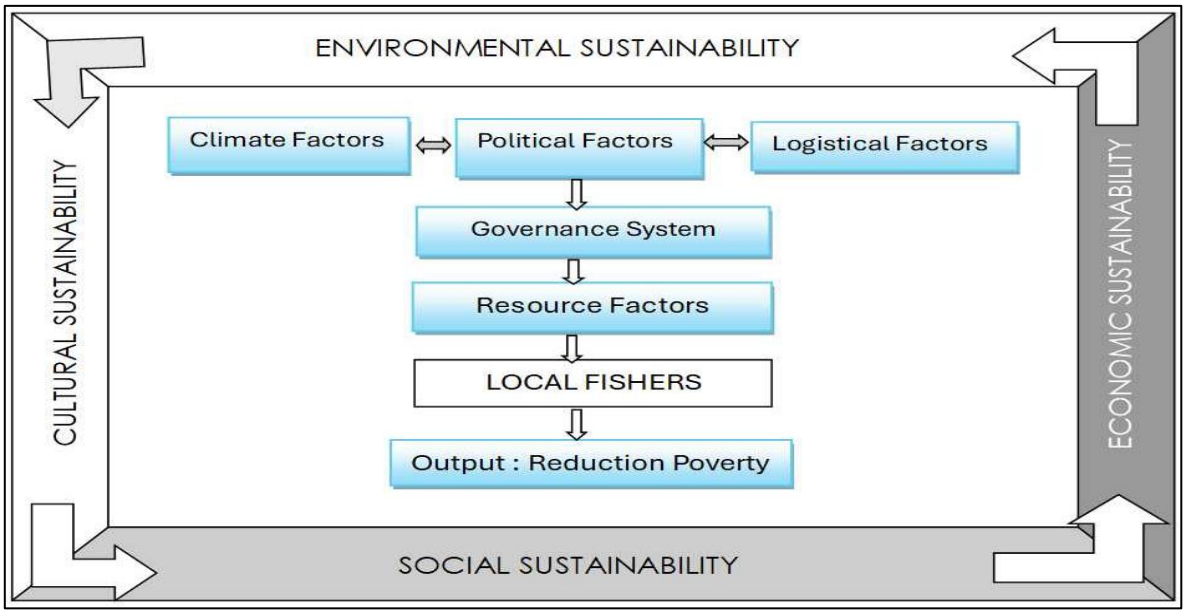


Fig 7 Framework for Analysing Sustainability of Sustainable Fisheries in Androy

VII. CONCLUSION

Local fishers of the three research locations face a variety of challenges to their livelihoods. They are generally faced with the same constraints, natural condition, socio-economic problems, equipement obstacles and governance bias. As the source of their daily livelihood is in the sea with uncertain results, therefore fishers are at risk of uncertainties. Specifically, contraints undermining the sustainability of SF in the research eareas are that weather has been an increasingly difficult to predict. Strong wind and wave height seasons occur, many fishers do not go fishing by April. Communitary fishers in Androy initiate different coping mechanism reflecting their beliefs and supporting social cohesion through seasonal ocean sacrifice by offering a beige goat. In addition, SF in Androy face of the fishing equipement challenges including longline, gillnets, lobster nets and spearguns, boat etc …Those are the ways for community fishers to overcome fish resources problem so that they can continue fishing activities. Subsistance fisheries in Androy continue to play a critical role in global food production and coastal livelihoods, but are increasingly vulnerable specifically to climate change and others pressures. While the principles underpinning the SF encompass the good governance what is notable about them is the overriding emphasis on the principle of recognizing, respecting, promoting and protecting human rights . It is acknowledged the vital role of women in subsistance fisheries in Androy and that equal rights and opportunities should be promoted. An understanding of the local context and existing systems of resource use and governance is thus necessary to devise institutional arrangements that are legitimate, workable and adaptable. Fisheries governance and development have evolved from a focus on biological approaches to the conservation of resources, to a more people-centred approach that recognizes fisheries as sources of livelihoods, sites of expression of cultural values and identities, and a buffer against shocks for fisheries-dependent communities.

COMPLIANCE WITH ETHICAL STANDARDS

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- *Author's Contribution*

The first author collected, processed and drafted this article. The other authors read and corrected the manuscript. All the authors read and approved the final manuscript.

- *Statement on Free and Informed Consent for Participants Under the Age of 18*

The researchers have not excluded male participants who are heads of households and/or unmarried minors aged 17, even though they cannot legally give consent for their participation in a research project. Their participation is, however, necessary for the purposes of the research, simply because they are already legitimate heads of households, or because they are becoming involved in and committed to fishing activities. At a local level, they are recognised as being responsible for their opinions and participation. They freely consent to share their views on the management of the sector. Furthermore, the involvement of children described in this article merely reflects the direct observations made in the field, which substantiate the characteristics of Subsistence Fisheries in Androy.

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