Gendered and Socio-Ecological Dynamics of Mangrove Ecosystem Services in Guinea-Bissau's Coastal Communities

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Abstract

Mangrove forests are vital for sustaining the livelihoods of coastal communities in Guinea-Bissau through their numerous ecosystem services, such as coastal protection, fish nurseries, and raw materials. Guinea-Bissau's weak institutions and limited public funding combined with climate change renders the population financially and socially vulnerable to changes in mangrove cover. In recent decades, national and international restoration initiatives have intensified their interventions in rural villages, aiming to address the disputed decline in mangrove cover. However, the lack of understanding around the drivers of changes in mangrove cover means that local communities' reliance on and perceptions of mangroves are sometimes disregarded in favour of restoration practices. In an attempt to increase the visibility of local communities' perceptions and understanding of mangroves, and to move away from the tendency to place blame solely on the easy-to-target protagonists of environmental degradation, this study aims to explore the socio-ecological and gendered dynamics of mangrove utilisation and examine the influence of restoration initiatives on these dynamics in four coastal villages in the region of Quinara, Guinea-Bissau. To achieve this, a mix of qualitative and quantitative data was collected using semi-structured interviews, questionnaires, field observations, and a literature review. This study reveals that, although there are various understandings of and dependencies on mangrove ecosystem services, primarily influenced by factors such as gender roles and proximity to mangrove forests, the majority of participants regard provisioning and regulating services as essential components of well-being, strongly associated with rice farming. The study further shows that, despite gender differences in the reliance and use of mangroves, the consequences of changes in mangrove cover affect all gender groups similarly, as there is strong collaboration and complementarity between genders within villages. Finally, this study demonstrates that restoration initiatives, driven by specific agendas, restrain local communities' use of mangroves without addressing critical concerns related to food security and environmental hazards. Restoration initiatives, by only targeting women in gender-related components of their programme, fail to address the needs and concerns of all gender groups and of household dynamics. This research has shown that restoration initiatives have not adequately addressed the realities of local communities' dependence on mangrove ecosystems, and this can increase grievances among poor people dependent on mangroves, whose access is now being restricted. This research concludes by shedding light on opportunities for new pathways towards mangrove restoration initiatives that not only make space for local communities to be involved in the entire process but are also more responsive to the multiple underlying layers of interactions, uses, and experiences surrounding mangroves and their services.

Keywords: Mangroves, Ecosystem services, Guinea-Bissau, Restoration, Gender

Resumo

Tarrafes e vital pa sostenê vida di comunidades di Guiné-Bissau através di vários serviços di ekosistema, suma proteção di costa i bolanha, peixe i lenha. Instituições frakas di Guiné-Bissau, finansamentu públiku limitadu i mudansa climátiku torna populason vulnerável na mudansa di cobertu di tarrafes. Na últimu dezenu, projetu di restauração, nasonal i internasonal, ten intensifikadu seus intervenções na tabancas. A falta di compreensão di mudansa na cobertura de tarrafes fassi ku vezes as comunidades locais ka ta leva na konta sua dependência i percepsion di tarrafes. Pa tenta aumenta visibilidade di percepsons i compreensão di tarrafes na nível lokal, es estuda ta tenta esplora dinâmicas sócio-ecológicos, suma di utilização de tarrafes i examina influências de projetu ke fassi restauração na quatro tabancas costeiras na região de Quinara, Guiné-Bissau. Es tese usa um mista di dados qualitativos i quantitativos através de entrevistas semi-estruturadu, questionários, observason di campo i revisão bibliográfica. Es estuda ta mostra ki, mesmu ki há diferentes entendimento i dependências di serviços de ekosistema di tarrafes, principalmenti influensiadus pa fatores suma differencia di género (midjeres i homis) i proximidadi a tarrafes, maioria di participantes considera serviços di provisão i regulação komponente essencial pa bem-estar, especialmente pa relaçao di tarrafes k bolanhas. Es estuda ta mostra também ki, mesmu kom diferenças di género na utilização di tarrafes, konsekuénsia di mudansa na cobertura de tarrafes afeta tudu grupo de género de mismo manera, pabia i tem um grande kolaborason i komplementaridadi entre midjeres i homis di tabanca. Finalmente, es estuda ta mostrá ki projetu di restauração, limita usa di tarrafes pa comunidade lokal sem resolve preokupasons kritikus suma seguransa alimentáriu i riscos ambientais. Projetu di restauração, pa so ta usa midjeres na komponentes de género di se programa, ka resolve necessidade i preokupasons de tudu grupu de género i dinâmicas di família. Es tese ta mostra ki projetu di restauração ka abordó adequadamenti realidades di dependência di comunidades lokal di ekosistemas de mangrova, i es pode aumenta reclamações di pecadur dependente di tarrafes, ki agora ta sinti restritu. Es tese ta konklui pa papia di oportunidades pa novo caminu pa projetu di restauração di tarrafes, pa kel fassi tarbajdu k djintis di tabanka, pa k projetu percibi tudu manera ki djintis ta usa tarrafes. i também ser resposta pa múltiplu percepções, interações, utilizações i experiências k djintis tene k tarrafes i seus serviços.

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LIST OF ABBREVIATIONS

CICES – Common International Classification of Ecosystem Services

ESF – Ecosystem Services Framework

IBAP – Institute for Biodiversity and Protected Areas

INGOs – International Non-Governmental Organisations

LDC – Least Developed Countries

MA – Millennium Ecosystem Assessment

MEA – Millenium Ecosystem Assessment Framework

MSR – Mangrove Swamp Rice

NGOs – Non-Governmental Organisations

PAIGC – African Party for the Independence of Guinea and Cape Verde

SLR – Sea Level Rise

KRIOL VOCABULARY

Household – Fogon

Informal conversations - Djumbai

Kapok tree – Poilão

Mangrove - Tarrafe

Mangrove Swamp Rice (MSR) – Arroz de bolanha salgada

Transplanting – Paranta

Village – Tabanca

“Mangroves have a huge importance because without them we cannot continue working in our rice fields. Mangrove swamp rice are very important because this is where we see the rice that we eat.”

“Tarrafe tene grande importância, pabia sim tarrafe nô ka pudi kuntinua labra na bolanhas, i bolanhas i kaus mais importantes na odjá arruz pa bim kumé.”

1. Introduction

1.1. Ecosystem services and the significance of mangroves

The concept of ecosystem services has gained significant attention over the past two decades, particularly among policymakers and scholars. At its core, ecosystem services encompass the goods and benefits, both direct and indirect, that ecosystems provide to support human well-being (Audu, 2022; Costanza et al., 2017; Millennium Ecosystem Assessment (MA), 2005; Vo et al., 2012; Yang et al., 2018). This concept bridges the relationship between society and nature, emphasising the importance of ecosystem health for the sustainability of human communities. In recent years, policymakers and scientists have increasingly focused on conceptualising and theorising ES to emphasise the benefits nature offers to human populations (Mohamed et al., 2024). This focus is especially pertinent in the context of climate change and resource overexploitation, as ecosystem services play a critical role in strategies to mitigate these impacts. Safeguarding ecosystems that provide essential services, such as those ensuring food security and livelihoods, alongside regulating services like climate regulation, air quality, and water management, is crucial (Turner et al., 2009, as cited in Locatelli, 2016). These efforts not only address immediate human needs but also enhance resilience against climate hazards and promote long-term ecological and social sustainability.

It is within this context that mangroves are recognised as vital ecosystems for national and global strategies to mitigate the effect of climate change on people and nature (Uddin et al., 2023). Mangrove forests are essential in nature-based strategies for climate mitigation, livelihoods (including poverty alleviation, energy, and food security), and biodiversity, as they provide a wide range of valuable ecosystem services (Convention on Biological Diversity, 2014; Sofian et al., 2019; Nyangoko et al., 2020). Mangroves are "one of the most productive ecosystems in the world" (Lourenço et al., 2009), hence, mangroves are vital for "coastal inhabitants around the world, provide food security, sequester and store large quantities of carbon, regulate water quality, and protect the coast" (Global Mangrove Alliance, 2022). Amongst other services, they act as a natural barrier protecting coastal areas from sea level rise (Ring et al., 2023), and they are incredible fish nurseries, providing habitat for a variety of wildlife (Ring et al., 2023), making them widely valued for their biodiversity (Beeston et al., 2023). Restoring and protecting mangroves is essential not only for preserving the biodiversity within these forests and for dampening the effects of climate change, but also for sustaining the livelihoods of coastal communities.

1.2. Setting the context: The case of Guinea-Bissau

Guinea-Bissau, a coastal country located in West Africa, is home to more than 3000 km^2 of mangroves (9% of the national territory), accounting for 2.5% of global mangroves (Giri et al., 2011 as cited in Keleman et al., 2023). This makes it the second-largest area of mangroves in Africa (Vasconcelos et al., 2014). Guinea-Bissau has an incredibly rich biodiversity (Start, 2015) with a total of 26.4% of the country protected by six coastal, marine, or terrestrial protected areas (BioGuinea, n.d). The location of Guinea-Bissau at a site of converging ocean and regional upwelling events (Keleman et al., 2023), results in an extremely rich marine biodiversity along the coast.

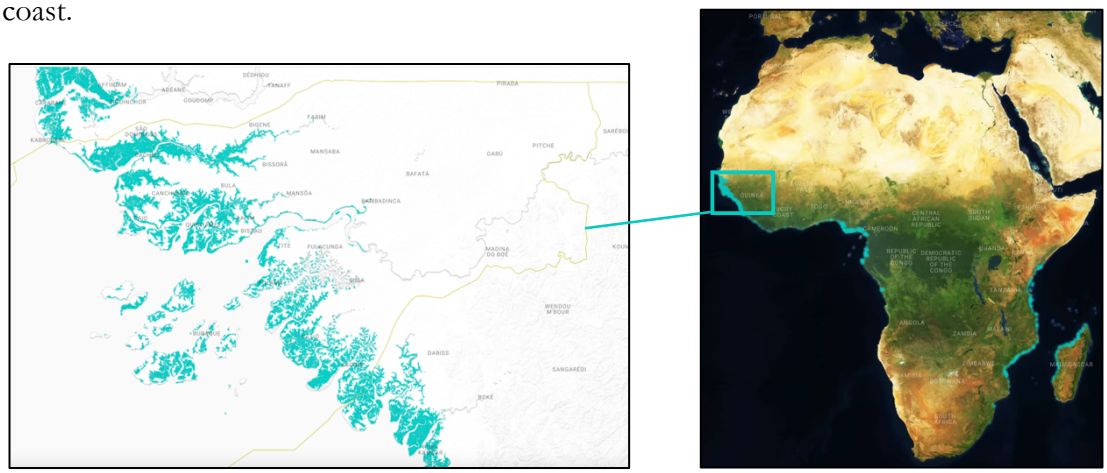


Figure 1 - The mangrove area in Guinea-Bissau in 2020 (Global Mangrove Watch, n.d)

However, Guinea-Bissau is also one of the smallest countries in Africa (Gippoliti & Dell'Omo, 2003) and ranks as one of the least developed countries (LDC) and also one of the poorest countries in the world (Start, 2015). This renders the country largely invisible to the international community, marked by geopolitical insignificance and global indifference (Vigh, 2022). Guinea-Bissau has experienced various periods of instability, including during the transatlantic slave trade from the 15th until the 19th century, then the Portuguese colonial occupation in the early to mid-20th century, which then led to an eleven-year liberation struggle from 1963-1974 (Gonçalves et al., 2024). On 24th September 1973, the country was declared independent by the African Party for the Independence of Guinea and Cape Verde (PAIGC). Portuguese colonial forces withdrew from the country a year later (Jaló, 2023). However, less than 50 years later, the country still endures political and economic instability, marked by militarised violence, a civil war (1998-1999) and a series of coup d'état (Gonçalves et al., 2024). The last two alleged coup attempts occurred in February 2022 (Jaló, 2023) and December 2023. These periods of instability have led to deep-rooted vulnerabilities with persistent crises, a malfunctioning economy, and a fragile sense of

statehood (Vigh, 2022). These factors, among others, leave the population heavily dependent on natural primary production and raw resources.

In this context, Guinea-Bissau's coastal ecosystem is essential for local communities, providing income, material goods, and food security (Santos & Mourato, 2022). Coastal communities rely on mangroves (*tarrafes* in Kriol) for various needs, including fuelwood harvesting, fishing, and building houses. Around 60% of Guinea-Bissau's GDP is generated from agriculture, fishing, livestock farming, and forest products (Havik et al., 2018), with 85% of the population relying on these natural capitals for their livelihoods (World Food Program, 2021). This dependence is particularly significant for women, who represent 51% of the population (UNIOGBIS, 2016) and account for 65% of those employed in primary production agriculture (FAO and ICRISAT, 2019). Women are primarily responsible for gathering wood, processing marine products like drying and smoking fish, and producing charcoal (Feka & Ajonina, 2011). Fish smoking is regarded as one of the key methods for preserving fish, requiring a substantial amount of fuelwood (Feka & Ajonina, 2011). Women also exclusively produce salt in the country mostly using mangrove wood (UNIVER-SEL, 2019).

Moreover, Guinea-Bissau has approximately 90, 000 hectares dedicated to Mangrove Swamp Rice (MSR) (*arroz de bolanha salgada* in Kriol) (Temudo, 2011; Écoutin et al., 1999). The technique is practised in coastal regions where mangroves are cleared to create rice fields (Cormier-Salem, 1999). Mangrove rice cultivation relies on saltwater ecosystems and tidal movements, requiring the construction of dikes to prevent saltwater intrusion and retain freshwater runoff (Sousa et al., 2023). However, disrupting natural hydraulic processes has resulted in soil acidification and high salinity levels, which hinder the natural regrowth of mangroves (Temudo & Abrantes, 2013).

In addition, climate change is influencing the decline in mangroves due to altered rainfall patterns, sedimentation, erosion, and salinisation (Alongi, 2022). Sea level rises (SLR) and irregular rainfall patterns are causing damage to dike structures, and threatening rice fields. These environmental challenges, coupled with economic pressures, are driving locals to explore livelihood transitions, such as a shift to cash crops (i.e., subsistence cashew farming), which accounted for approximately 223,000 hectares in Guinea-Bissau in 2012 (Catarino et al., 2015). Moreover, a lot of rice field abandonment coincided with colonial and post-colonial interventions, as well as the independence war (Temudo & Cabral, 2017). As a result, many former mangrove lands are left behind despite their significant environmental and social benefits.

While some reports claim that Guinea-Bissau's mangrove cover has declined by 32% over the past 40 years (IUCN, 2020; Lopes, 2022) and experienced a decrease of more than 75% in the 1980s (Mackenzie, 2010, as cited in Cummings & Shah, 2018), others suggest this might not be the case. Examining longer local and regional trends, some evidence indicates that mangrove cover has increased in the country (Temudo & Cabral, 2017). However, what is indisputable is that mangroves are essential for coastal livelihoods, and potential degradation, whether anthropogenic or environmental, threatens the future of coastal communities by jeopardising food security, increasing flood risks, and causing other adverse impacts.

1.3. Restoration initiatives and governance challenges

To address these challenges numerous governmental and non-governmental initiatives have aimed to restore and conserve mangroves in Guinea-Bissau since the mid-1990s (Temudo & Cabral, 2017). These initiatives focus on protecting mangroves through natural restoration, planting, alternative community livelihoods, and productive landscape restoration efforts. These initiatives include various projects (e.g., Arroz e Mangal, Tiniguena, To Plant or Not To Plant) implemented by International Non-Governmental Organisations (INGOs) like Wetlands International, and Bosque y Comunidad; local Non-Governmental Organisations (NGOs) (such as Palmeirinha, ODZH, and ADPP) as well as national strategies (e.g., the National Mangrove Law) and government efforts such as the implementation of the 'Ministry of Agriculture and Rural Development (MARD), the State Secretariat for Environment and Tourism, the Coastal Planning Office (GPC), and the Institute for Biodiversity and Protected Areas (IBAP)' (Madeira, 2016). This national institute, operating under the supervision of the Ministry of the Environment and with officials based in Bissau as well as in all protected areas, serves as the primary authority responsible for biodiversity protection in the country (IBAP, 2024).

The rise of these international and national initiatives stems from a largely disengaged (non-existent) state with minimal public funding, a weak legal framework, and inadequate infrastructure (Bertelsmann Stiftung, 2022; Bordonaro, 2009, Vigh, 2022). The country's history of instability has led to deep-rooted vulnerabilities and widespread poverty (Cross, 2016). This, combined with low ecological awareness and poor state management, has hindered the sustainable use of resources (World Bank, 2004). While the general population prioritises socio-economic issues over environmental concerns (Bertelsmann Stiftung, 2022), the government focuses on the welfare of the political and military elite in power (Jaló, 2023). Additionally, the decentralisation of the state without proper financial support has led (I)NGOs to step in, particularly in rural areas, to protect mangroves. Hence, no centralised body or comprehensive government legislation is dedicated to

mangrove protection in the country (Cormier-Salem et al., 2010). Instead, various initiatives are being implemented across different regions, often by multiple organisations working independently or with local communities. To some extent these efforts have facilitated the protection of this valuable ecosystem and the revival of numerous abandoned mangrove rice fields, contributing to the restoration of coastal mangrove areas. Some of these initiatives also aim to assist households in diversifying their incomes, aiming to reduce the reliance on forest resources and involving local communities in the process of restoration.

The main perspective of these international and local organisations is that, while these communities rely heavily on mangroves for various ecosystem services and products, their unsustainable use of these resources poses significant risks to mangroves (Wetlands International, 2024; Mangora, 2011). As mangroves degrade, lose functionality, or disappear entirely, the very resources that these communities depend on are threatened, leading to potentially severe consequences for their well-being and sustainability. However, in recent years, these restoration projects have also been criticised by scholars for failing to properly implement participative methods, marginalising local communities, and assuming that local populations are threatening natural resources (Temudo, 2012). Considerable emphasis is placed on the negative impact that local communities might have on their environment, with little acknowledgement that the root cause of resource depletion is the lack of economic alternatives (Mangora, 2011). Cormier-Salem and colleagues (2010), further argue that these restoration initiatives might be counterproductive when it comes to strengthening communities' self-reliance and self-governance. In some cases, these interventions have caused social shifts, particularly in villages, where traditional power held by elders and village chiefs has diminished and is sometimes contested as younger generations and state officials increasingly align with the influence of NGOs (Cormier-Salem et al., 2010), or, on the contrary, the elders and traditional authorities are bribed to align with NGO initiatives (Temudo, 2012).

In Guinea-Bissau, governmental regulatory interventions, such as the 2024 project of law on mangrove usage in protected areas[1], aim to restrict the use of mangroves by local communities. Although mangrove restoration and conservation initiatives claim to benefit local communities, these regulations often overlook community needs and their livelihood security. In certain cases, these initiatives and new legislation can be perceived as threats to income sources for mangrove rice farmers and other mangrove resource users (Bronstein, 2023), menacing their very food and

[1] 'Projecto de lei sobre restauração, conservação e utilização sustentável do mangal na Guiné-Bissau'

nutritional security. Moreover, there are instances where local knowledge of mangrove management is disregarded in favour of the implementation of Western-based knowledge (Temudo, 2012). Indeed, international and national NGOs often project onto communities a perceived need for interventions, proposing solutions to problems that may not exist (Temudo, 2012).

In this context, it appears crucial to prioritise collective empowerment and well-being rather than simply engaging communities in preconceived restoration efforts designed to appeal to funders and the public. As such, scholars have argued that restoration initiatives should never be imposed on local communities and that these communities should be the central focus of projects rather than secondary beneficiaries (Farvar et al., 2018). Given the context of poverty, climate change, and changes in mangrove cover as described above, there is an urgent need to understand the influence of restoration initiatives on local communities' use of mangroves. In particular, local communities' perceptions of mangrove ecosystem services and the importance for their livelihoods should be incorporated into the development of management strategies. These strategies should aim to prevent adverse environmental situations and promote the conservation and restoration of mangroves, ensuring the sustainability of ecosystem services for local communities.

1.4. Contextual social dynamics

The Millennium Ecosystem Assessment emphasises that "local communities are not just recipients of ecosystem services, but influence and shape the capacity of ecosystems to regenerate services" (Folke, 2005). Hence, it is important to conduct more studies on the perception and influence of local communities on the ecosystem services that mangroves provide. In particular, an issue associated with traditional understandings of community roles in conservation is the potential misinterpretation or misdefinition of the term 'community.' Indeed, a community is often erroneously perceived as a homogeneous group with a uniform social structure and shared interests in the management of resources and arrangements (Matarrita-Cascante et al., 2019; Borrini & Jaireth, 2007). The use of the term further reinforces the often-biased perception of local communities as static entities (Armitage et al., 2020). However, scholars have underlined that people hold multiple perceptions of the same environment depending on their values, opportunities, and livelihood (Borrini & Jaireth, 2007). Therefore, it is crucial to define what is meant by 'community' to acknowledge the heterogeneity within communities (Miller et al., 2020).

Recognising this heterogeneity coupled with the intersectionality of issues talked above, is particularly crucial for the scope of this research, which focuses on socio-ecological and gendered dynamics in selected communities of Guinea-Bissau. In this context, understanding the roles and interests of women and men in their environmental context is essential. Women's perspectives and uses of forests and mangroves often differ from those of men, and these perceptions of environmental issues have often been poorly considered in conservation programmes (Costa et al., 2017), reflected in gender gaps in the scientific literature and in management and governance. Moreover, while women may not always have obvious power, they invariably hold varying degrees of influence (Temudo, 2019). Due to societal and cultural norms, women and men occupy different positions when interacting with the environment, leading to distinct understandings and notions of it. Different gender groups can hold unique specific knowledge and capacities in natural resources management (Embalo, 2021; Keleman et al., 2024). Looking at the research gap on gender usages of mangroves in Guinea-Bissau, it is thus essential to examine how women and men view and utilise the ecosystem services of mangrove forests and how changes in mangroves might be affecting them differently.

Although gender roles vary in different ethnic communities and villages in Guinea-Bissau, women frequently assume similar responsibilities such as salt production, raw cashew nut harvesting, harvesting oysters, crabs or shellfish, and collecting wood fuel. Men are involved in rice farming activities, as well as gathering wood for building house structures and other purposes. Moreover, in rural areas, women face more challenges than men in accessing education, owning land, and participating in decision-making processes. To ensure the sustainability of all these activities, including the livelihood stability of different gender groups, it is essential to address gender specific needs in terms of resources, financing, and representation. Achieving this requires active engagement with local communities in studies and ecosystem management initiatives, in order to more deeply comprehend gender roles in the utilisation of mangrove ecosystems.

1.5. Unpacking the study focus

Overall, changes in traditional land use (Temudo & Cabral, 2017), changes in internal village dynamics (Cormier-Salem et al., 2010), climate change (Mendes & Fragoso, 2024; Santos & Mourato, 2022 ; Temudo & Cabral, 2023), food insecurity (Temudo & Abrantes 2013), and economic and socio-political challenges (Vigh, 2022) have led to shifts in livelihoods and land use in Guinea-Bissau, which, in turn, affect mangrove cover and the range of ecosystem services on which coastal communities depend. Additionally, the unstable political environment (Gonçalves

et al., 2024; Vigh, 2022), unenforced legal framework (Greenchoice, 2021), and limited public funding (World Bank, 2020) have intensified restoration initiatives in Guinea-Bissau, influencing coastal communities' interactions with mangroves in various ways.

Drawing from a literature review and local observations, as well as preliminary informal interviews and discussions with numerous researchers in Guinea-Bissau, it is evident that communities' perceptions of mangrove ecosystem services and the gender dimension of mangrove utilisation remain under-researched. Moreover, little research has been conducted on the influence and impact of mangrove restoration initiatives on local communities' interactions with mangroves. In this context, it is essential to examine the socio-ecological dynamics around mangrove use to understand local communities' perceptions of mangrove ecosystem services and the influence restoration initiatives can have on these dynamics. This understanding can guide the development of strategies to address the changes in mangrove cover in Guinea-Bissau. The coastal areas of Guinea-Bissau and their communities present an opportunity to apply interdisciplinary approaches that could contribute to a resilient future for all.

1.6. Research objective and research questions

The main objective of this thesis is to explore the socio-ecological and gendered dynamics of mangrove utilisation and the influence of restoration initiatives on these dynamics, in selected coastal communities in Guinea-Bissau. To achieve this objective, the following research question will be answered:

Main research question:

What are the socio-ecological and gendered dynamics of mangrove ecosystem services in the selected communities in Guinea-Bissau, and how do restoration initiatives influence these dynamics?

Sub-questions:

i. How do the selected communities rely on mangroves, and what dynamics influence this reliance?
ii. Are gendered dynamics influencing mangrove utilisation, and how does this impact reliance on ecosystem services?
iii. Do mangrove restoration initiatives influence local communities' interactions with mangroves?

2. Theoretical framework

2.1. Ecosystem Services – conceptualisation

The concept of ecosystem services gained momentum following the launch of the Millennium Ecosystem Assessment (MA) in 2001. This United-Nations led assessment is a collaborative effort among NGOs, governments, the private sector, and scientists, aimed at improving ecosystem conservation for the benefit of both people and nature (MA, 2005). Since then, various frameworks, conceptualisations, theories, and assessments have contributed to the evolution of the concept through different lenses, including The Economics of Ecosystems and Biodiversity project (TEEB), the Common International Classification of Ecosystem Services (CICES), and the Final Ecosystem Goods and Services Classification System (FEGS). These pluralistic conceptualisations of ecosystem services reflect the complexity of the relationship between human well-being and ecosystem functions (Costanza et al., 2017). Each new conceptual lens uncovers further interconnections between the environment and development, as well as the relationship between social, economic, and ecological factors, highlighting how ecosystem services contribute to human well-being in a multiplicity of ways.

As a unique wetland ecosystem, mangroves provide numerous services to people, which can be identified through the four categories (i.e., supporting, provisioning, regulating and cultural) of the Millenium Ecosystem Assessment Framework (MEA). However, although providing a complete description of the underlying processes behind ecosystem services as a solid conceptual basis, the MEA has been criticised for being too broad and not practically applicable (Czúcz et al., 2018). This is why, using the CICES classification (Haines-Young & Potschin, 2012) and drawing on previous research on mangrove ecosystem services, a series of three key final categories were identified for this research (see Figure 2) that are particularly relevant when examining the connections between local communities and mangrove services: provisioning services, regulating services and cultural services. Supporting services, such as primary production, oxygen production, and soil formation, which underpin all other services (MA, 2005), are not included in the CICES classification, as they are less applicable and practical when classifying tangible ecosystem services.

This section will expand on the different services provided by mangroves and used in this framework. First, **provisioning services** are all the services that directly support local livelihoods by meeting basic needs, including access to food (fisheries, wild food, medicines, etc), and timber (Afonso et al., 2021). Second, **regulating services** ensure the continued availability of these resources by maintaining ecosystem functions such as water regulation and soil fertility, mangroves

being recognised for their capacity for coastal protection and soil enrichment (Anu et al., 2024). These first two categories are interdependent: excessive extraction of provisioning services can degrade regulating services, while provisioning services depend on healthy regulatory functions. Thus, the sustainable use of these services requires balancing resource extraction with the need to maintain the ecosystem's capacity to deliver long-term benefits (Sarkar et al., 2024). Additionally, these services underpin local and regional supply chains, influencing broader regional economic dynamics (Sarkar et al., 2024). Finally, as social beings, humans also benefit from ecosystems through spiritual, religious, and recreational connections. A review by Moore and colleagues (2022) found that mangroves provide recreational and cultural value via tourism, but also are of religious and symbolic importance, and are importance for educational and traditional knowledge. **Cultural services** then encompass all non-material benefits derived from ecosystems, highlighting their importance in supporting human well-being and societal values (Moore et al., 2022). Additionally, the cultural heritages of mangroves are found to lead to stronger commitment to natural resources management (Teka et al., 2019)

One of the main pitfalls of the conceptualisation of ecosystem services, as classified above, is the tendency to focus on their monetary value (Rendón et al., 2019). Indeed, the emphasis on political and economic interests, especially in policies, can undermine the perspectives of local communities regarding the value of their environment (Samarakoon, 2004, as cited in Afonso, 2021). While the MA emphasises that all populations rely on and are affected by ecosystem services, the decline in these benefits due to anthropogenic and climatic pressures disproportionately impacts rural and poor populations (Reid et al., 2005, as cited in Cifuentes-Espinosa, 2021). Furthermore, the perspectives of communities are often overlooked in decision-making about the environment, especially in so-called developing countries, where economic instability forces local communities to make short-term decisions regarding natural resource use due to the lack of safety nets (Afonso et al., 2021). In such contexts, long-term sustainability is frequently disregarded, leading to the rapid overconsumption of resources to meet immediate needs. Consequently, this overexploitation can result in worsening conditions for the communities, creating a positive feedback loop that further exacerbates resource depletion (Afonso et al., 2021).

Recently, in search of a more holistic framework for ecosystem services, attention has been drawn to including the **disservices** that ecosystems can pose to human communities, such as acting as vectors for diseases or presenting dangers like the risk of drowning (Rendón et al., 2019). These risks and disadvantages are indeed crucial to consider in an Ecological Services Framework (ESF),

as these influence how people interact with their environment, affect their well-being, and consequently impact restoration efforts. Hence, to achieve an inclusive and holistic understanding of resource use and management an ESF should encompass both services and disservices and place a strong emphasis on local communities' perceptions and understanding of the ecosystem. In this sense, it is also crucial to recognise that local communities may have perceptions of a healthy ecosystem or sustainability that differ from scientific or academic viewpoints. Including these **diverse perspectives** in the methodology especially, for example in the way questionnaires are defined or in interviews, is essential to understanding and incorporating local communities' views on ecosystem health, both in the short and long term.

Overall, the use of an ESF in this research underscores the importance of such frameworks for highlighting the benefits ecosystems provide to people and also informs restoration efforts (Afonso, 2022). It draws attention to both well-recognised and less obvious services, aiding in trade-off analyses between development and restoration, in understanding the scale of economic activities relative to their ecological support, and providing financial compensation to preserve these services (Yang et al., 2018). By defining, addressing, and applying ESF in this academic research, but also in policy, conservation, restoration, and decision-making processes, it supports the valuation of nature's benefits for people and helps identify the drivers of ecosystem change.

2.2. Drivers of change

Changes in ecosystems are influenced by various factors, including **direct changes** such as land cover alterations, overexploitation, and climate change. Additionally, demographic shifts, economic factors, and local socio-political contexts play significant roles through their **indirect** impacts on ecosystems (MA, 2005; Lopes et al., 2022). Understanding these drivers of change within an ESF helps identify patterns in habitat destruction and alteration. By examining **direct drivers**, specific activities or landscape changes that directly impact ecosystem health and services can be assessed. Analysing **indirect drivers** further uncovers broader underlying causes, providing a more comprehensive understanding of the factors influencing ecosystem dynamics (MA, 2005). These direct and indirect drivers are closely interconnected and mutually influence one another. In Guinea-Bissau specifically, the country's socio-political and economic situation affects resource use (e.g., unsustainable fishing and forestry practices), changes in local land use and cover (e.g., sand mining, mangrove swamp rice), and species introduction and removal (e.g., cashew tree plantations). In this research, drivers of change are thus integrated to understand the factors that influence ecosystems to either lose or enhance their benefits for both nature and people, providing

deeper insights into the actions, consequences, and perspectives shaping human usage and environmental responses.

Incorporating these elements into the research framework can help inform restoration goals, ensuring they are sustainable and inclusive while engaging all stakeholders in decision-making processes. This approach ensures that restoration initiatives do not impose top-down solutions that overlook the socio-economic realities of local communities (Afonso et al., 2021). Instead, it involves these communities in meaningful ways, ensuring that their voices are heard and their needs addressed in a manner that supports both environmental sustainability and social equity. This method creates opportunities for sustainable ecosystem use that benefit everyone, especially vulnerable groups. Afonso and colleagues (2021) highlight the importance of such frameworks for gaining insights into the significance of mangrove ecosystem services on small scales and the interaction of local communities with mangrove habitats. Implementing such an approach is particularly important in contexts like Guinea-Bissau's coastline, where people are highly reliant on the ecosystem, face significant consequences from anthropogenic and climatic pressures, and are subjected to political and economic marginalisation and global environmental injustice.

2.3. Interactions between people and ecosystem services

These drivers of change inevitably affect the **well-being** of people who depend on these natural resources, as described in the MEA (2005). As ecosystems change, so do the services they provide to the people relying on them, which in turn impacts their well-being. Ecosystem services support human well-being by providing the **basic materials for a good lif**e (such as food, timber, and water management), and ensuring social and climate security (for example, by dampening climate-related catastrophes, serving as ceremonial places with cultural significance, and preventing social conflict over resources). These components vary depending on cultural, economic, and sociological aspects. It was found that many poor people tend to relate to well-being primarily through the basic materials for a good life, seeking to provide for their children and family (McMichael et al., 2005). This is crucial to consider within an ESF, as these factors influence people's well-being, shape how they interact with their environment, and ultimately affect conservation efforts. To achieve an inclusive and holistic understanding of resource use and management, an ESF should hence incorporate well-being components and place strong emphasis on local communities' perceptions and interactions with the ecosystem in question.

Moreover, an issue associated with traditional understandings of community conservation is the failure to address the multidimensional meanings of the word 'community' (Santos and Mourato, 2022). Indeed, a community is often erroneously perceived as a homogeneous group with a uniform social structure and shared interests in the management of resources and arrangements (Matarrita-Cascante et al., 2019; Borrini & Jaireth, 2007). The use of the term further reinforces the often-biased perception of local communities as static entities (Armitage et al., 2020). However, scholars have underlined that people hold multiple perceptions of the same environment depending on their values, opportunities, and livelihoods (Borrini & Jaireth, 2007). Hence it is important to acknowledge heterogeneity within communities (Miller et al., 2020). In this study, following Agrawal and Gibson's (1999) political approach to the term 'communities', deliberate efforts are made to define 'community' as an inclusive term that encapsulates and acknowledges the varied perceptions and interests linked to conservation, practices, and livelihoods. However, it is also recognised that the scope of this study limits the possibility of further elaborating on the different conceptualisations of the term (Santos & Mourato, 2022). Hence, in this research, the term 'community' will be used to include all the people living in the same *tabanca* (village in Kriol), while also acknowledging the multiplicity of actors.

2.4. Gender and ecosystem services

Although women and men have access to and benefit from ecosystem services differently (Fortnam et al., 2019), the gendered dimension of these services has been largely overlooked in scientific literature and conservation management measures and in environmental studies in general (Leach et al., 1995). Gender, a social construct influenced by relationships and culture (Butler, 2011 as cited in Yang et al., 2018), plays a critical role in the use and perception of ecosystem services. A systematic review by Yang et al. (2018) highlighted that the intersection of ecosystem services and gender is an emerging topic in scientific literature. However, only 0.7% of studies on ecosystem services include a gender dimension (Fortnam, 2019). Yang et al. (2018) highlighted the need for future research to explore how gender interacts with other social factors and to develop more relevant indicators for assessing ecosystem services from a gender perspective. To address this, the framework of this thesis will incorporate gendered factors that affect how people interact with and utilise their environment and will be included in the drivers of change influencing ecosystem services. Although ESF acknowledges the importance of gender, this research aims to provide a more detailed examination of these socio-ecological factors. In doing so, this thesis seeks to contribute to a more inclusive and nuanced understanding of gendered perspectives within such frameworks.

It is crucial to understand the gendered nature of the use, perceptions, and conservation of ecosystems. Indeed, the gendered experience of people with their landscape can sometimes lead to advantageous or disadvantageous situations for individuals and groups. As identity is complex and multidimensional, the experience of oppression is not the same for all (Maj, 2013). Having a gendered lens is central to understanding the participation and responses of people to interventions aimed at restoring ecosystems for their services (Elmhirst, 2022). It further increases the visibility of groups and individuals mostly affected by climate change and land degradation. Many important gender and environmental studies, including feminist political ecology, feminist environmentalism, and ecofeminism (Fortnam et al., 2019), emphasise the need to rethink gender dynamics in natural resource management (Joshi, 2021). Studies 'have highlighted that women often interact with, use, understand and value the environment differently than men (James et al., 2021). For example, studies that have looked at gendered perceptions of ecosystem services have found that, on average, although both genders value provisioning services, women value regulating and supporting services, whereas men found provisioning services more significant (Fortnam et al., 2019; Mponela et al., 2023; Yang et al., 2018). Hence, developing gender-sensitive frameworks is essential to promote more inclusive management practices. These perspectives provide valuable insights into understanding why the use of ecosystem services is gendered.

To incorporate this perspective into the research framework, using literature on gender and ecosystem services, gendered drivers were identified and integrated into the framework. Firstly, the **division of labour** between men and women (Rocheleau et al., 1997, as cited in Fortnam, 2019) results in differing uses of the landscape and, consequently, distinct interactions with ES. Secondly, women are often excluded or underrepresented in **decision-making** processes related to natural resource management (James et al., 2021; Sunderland et al., 2014). As discussed earlier, gender groups interact differently with the same environment. Excluding women from decision-making therefore overlooks an entire perspective on natural resource use, needs, and perceptions, which is essential for achieving holistic ecosystem management. Furthermore, women have less **access to natural resources** and **land ownership** rights compared to men (Costa et al., 2017; James et al., 2021; Sunderland et al., 2014). This disparity not only influences how individuals interact with their environment but also affects decision-making processes and the subsequent impacts on landscape changes and resource management (Mahour, 2016).

These gendered dynamics are embedded within broader categories of **opportunities** and **abilities**, which are shaped by cultural, social, and physical factors. Women, for instance, often face fewer

opportunities than men, as they are 'less likely to own land and resources, have less education and training, less access to institutional support, health services, and information, and fewer opportunities to participate in decision-making' (Amorim-Maia et al., 2022). Despite being disproportionately affected by climate change, women remain underrepresented in restoration initiatives (Embaló, 2021). Cultural norms and constraints further influence how gender groups interact with the environment, while **abilities,** such as access to education and resources, also play a significant role. Additionally, gendered expectations within households, such as childcare responsibilities, further shape the extent to which different groups can utilise available opportunities.

To conclude, gendered differences must be considered when assessing the importance of ecosystem services, as they shape how individuals interact with the landscape and influence their perceptions of the value of various ecosystem services. These factors then affect perceptions of the importance of ecosystem services as well as the importance of the conservation of the ecosystem. This is why applying a gender lens to ecosystem services framework, and including these gendered drivers, means recognising the multifaceted layers of landscape use, which can then inform better decision-making regarding management interventions and policy creation (Keleman et al., 2016).

2.5. Conceptual integration

The framework proposed in this study integrates the ESF of the Millennium Ecosystem Assessment (MA, 2005) and of the Common International Classification of Ecosystem Services (CICES), using its latest revised version from 2023. This integration leverages the specific classification provided by CICES to focus on identifying services directly linked to mangroves, enabling a more detailed and targeted analysis. It incorporates elements from the list of ecosystem services identified in mangrove ecosystems by Afonso et al. (2021) (Figure 2) into the CICES classification, providing a more refined inventory of mangrove services. Simultaneously, it combines this specificity with the broader conceptual framework of the MA, which explores the constituents of well-being and socio-ecological dynamics, offering greater depth. Integrating the MA's holistic and social perspectives with the CICES' quantitative classification aligns seamlessly with the methodology used in this research (See section 3), enabling a multiscale understanding of complex ecosystem changes through the combined use of quantitative and qualitative data.

The framework used in this study aims to provide a comprehensive understanding of the history, knowledge, and practices associated with mangrove services, rather than simply compiling a checklist of services (Totino et al., 2023). This approach recognises that classifications using a three-dimensional scale to assess mangroves' perceived importance like 'very important' or 'not important' used in studies of ecosystem services such as Atheull et al. (2009), lack depth and do not allow participants to lead and have control over the conversations. Ecosystem services can be an external concept to people, that requires careful translation for accurate communication. This is why this research aims to allow participants to define mangroves' importance themselves, avoiding pre-defined criteria and providing richer insights. Although the questionnaires focus solely on mangrove provisioning services relevant to the local context (see Table 1), as other categories are less tangible, interviews left space for participants to mention any category of services. This approach aims to translate local ontology and epistemology into meaningful insights.

Furthermore, the framework will integrate a gender dimension to address the identified gap in previous ESFs, which often lacked such a perspective. This inclusion draws on insights from various studies on gender and ecosystem services (Cifuentes-Espinosa et al., 2021; Fortnam et al., 2019; Mponela et al., 2023; Yang et al., 2018), as well as research on conservation and women (Costa et al., 2017; James et al., 2021). It will be conceptualised and integrated into both the sampling methodology and the data collection. The research will include participants of all officially recognised genders in Guinea-Bissau, with special attention given to ensuring that women have the opportunity to voice their viewpoints. Questions are designed to capture various aspects of gender roles, tasks, mangrove usage, division of labour, and access to resources and opportunities. While questionnaires will provide a broad understanding of the gendered use of ecosystem services, interviews will offer a deeper explanation of perceived importance and usage patterns.

Finally, the direct and indirect drivers of change outlined in the MEA (2005) will be integrated in the framework to identify patterns affecting local communities and mangrove cover. These drivers will inform the third research question, which explores initiatives for mangrove restoration and conservation and how these efforts are perceived by the communities. This information will be retrieved from the literature review to enhance the holistic understanding of the research. The concept of well-being will be used to explore how people perceive ecosystem services, recognising that ecosystem degradation often leads to a decline in human well-being. People's perceptions and use of an ecosystem are influenced by their immediate well-being needs. This understanding can

inform and enhance national and local mangrove management by aligning restoration efforts with the well-being priorities of communities.

Overall, the framework applied in this research aims to enhance understanding of how people use, interact with, and contribute to the restoration and conservation of their environment. It further seeks to comprehend coastal communities' perceptions of conservation and restoration initiatives. The objective is to expand the perspective to include the diverse dimensions of ecosystem service use and benefits, fostering a comprehensive understanding that acknowledges the varied experiences of landscape utilisation.

Table 1 - Provisioning Ecosystem Services in Guinea-Bissau

Mangrove ecosystem services	**Community-recognised use**	**References**
Capture Fisheries	Fish, crustaceans and molluscs are mostly extracted by women	Dias et al., 2022; Keleman, Sá & Temudo, 2024
Crops cultivation	Mangrove Swamp Rice	Temudo, 2011 Garbanzo et al., 2024 Dias et al., 2022
Aquaculture	Although the term is unfamiliar to local communities, farmers fish in their rice fields and some have fishing ponds, which could be considered a form of aquaculture.	Keleman, Sá & Temudo, 2024 Garbanzo et al., 2024
Wild Foods	Mangroves are recognised for 'hunger food' and 'children's food', as well as a place for hunting or collecting wild honey from beehives.	Temudo, 1998 Dias et al., 2022
Timber	Use of timber for cooking, salt production, selling, and building infrastructure	Dias et al., 2022 Diop et al., 2002 UNDP, 2021
Fibers & ornamental resources	Local communities use fibres for cordage or rope	Diop et al., 2002
Biomass fuel	Charcoal from mangrove wood	Temudo & Cabral, 2017 Dias et al., 2022 UNDP, 2021
Genetic resources	(no data)	
Medicine and pharmaceuticals	The Balantas, one of the ethnic groups, use the bark of Rhizophora mangrove species to produce medicine.	Temudo & Cabral, 2017

Water for non-drinking purposes	This will be linked to crop cultivation and agricultural irrigation (used in MSR).	(no data)

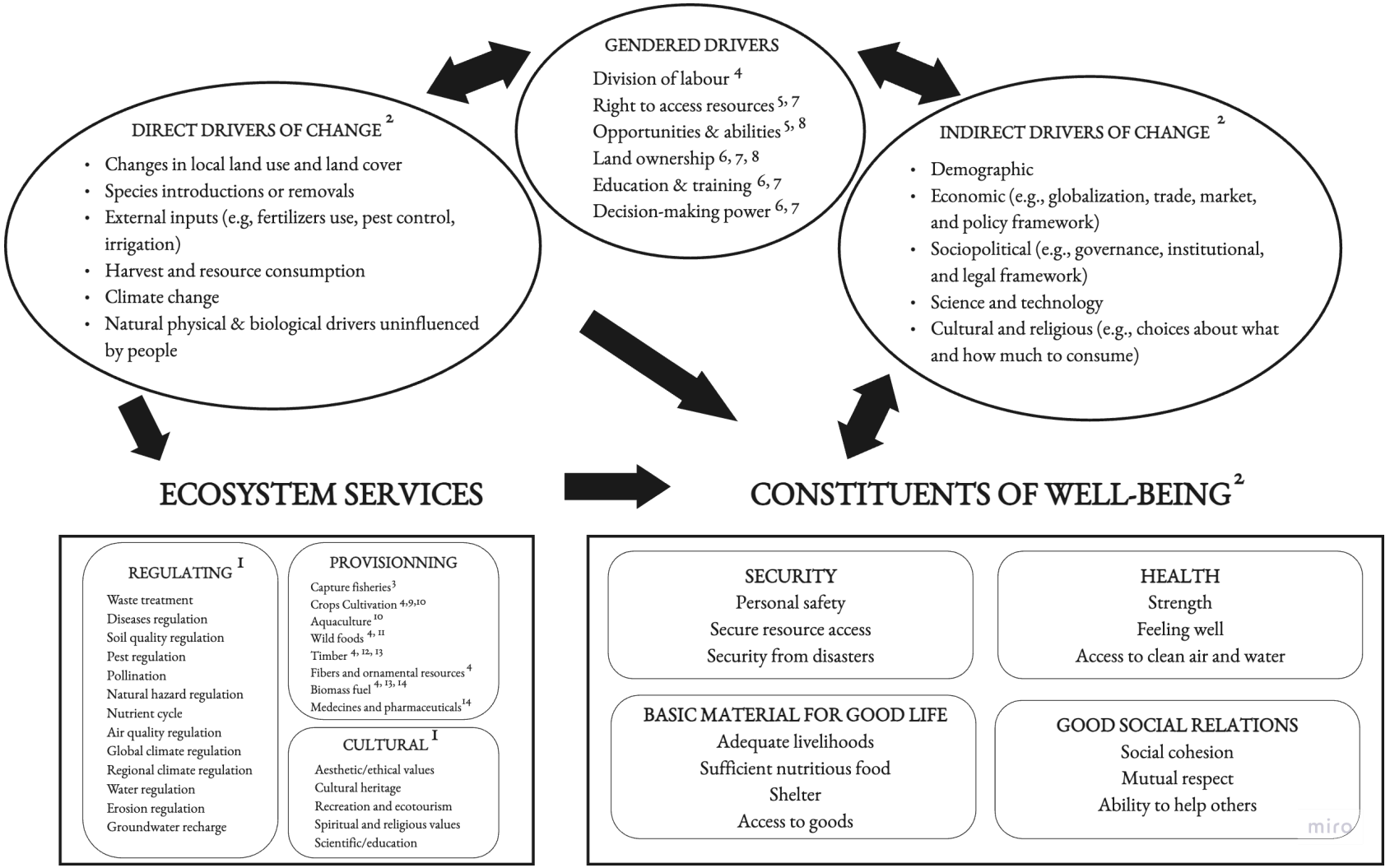


Figure 2 - Conceptual Framework

Sources: [1] Afonso et al., 2021; [2] MA, 2005; [3] Dias et al., 2022; [4] Fortnam et al., 2019; [5] Cifuentes-Espinosa et al., 2021; [6] Amorim-Maia et al., 2022; [7] Costa et al., 2017; [8] James et al., 2021; [9] Temudo, 2011; [10] Garbanzo et al., 2024; [11] Temudo, 1998; [12] Diop et al., 2002; [13] Embaló, 2021; [14] Temudo & Cabral, 2017.

3. Methodology

3.1. Character of the thesis work

This thesis utilises ethnographic and interpretative research methods to explore and understand the interactions between people and their environment. The research focuses on how these interactions are shaped by socio-political and cultural contexts, as well as how individual and community level perspectives are influenced by personal experiences and vice versa.

The research focuses on a case study of coastal communities' perceptions of mangrove ecosystem services and mangrove restoration initiatives in Guinea-Bissau. The case study is informed by a six-month internship conducted in Guinea-Bissau, where field research was conducted in various villages (see below, Section 3.4) from different ethnic communities. Preliminary observations and discussions provided valuable insights into the socio-environmental dynamics of the country and specific regions. This thesis is conducted in collaboration with the Malmon-DeSIRA project (see below, Section 3.3) which focuses on enhancing productivity and stabilising mangrove swamp rice production in Guinea-Bissau, while also deepening the understanding of the drivers and complexities of mangrove ecosystem changes. Data has been previously collected at the selected study sites as part of this project, facilitating access to villages and enabling access to previous questionnaires with data on ecosystem services for this thesis. This collaboration enhanced the feasibility of the research, especially given the logistical challenges of conducting fieldwork in Guinea-Bissau, including during the rainy season. It is further acknowledged that factors such as the need for help with translation, the influence of intermediaries, and variations in race, ethnicity, and culture may have introduced biases into the research process and impacted the responses or narratives obtained. These challenges related to positionality and power dynamics were carefully considered throughout the fieldwork and analysis and explicitly addressed in the study's limitations.

Furthermore, is acknowledged that the researcher's positionality and interpretation of data may be shaped by personal beliefs and subjectivity, which could introduce inherent biases into the research. Therefore, deliberate efforts were made to minimise researcher biases and decolonise the research process by critically reflecting on the privileges, dynamics, and histories that affect both the research methodology and the interactions with participants. The methodology hence incorporates an engagement with the list of "Questions that won't go away" (see Appendix 1) by Long et al. (2016). This list provides researchers doing participatory research aimed at benefiting communities with a series of questions around ethical issues and reflexivity to guide practitioners

throughout the entire research process. The intention is to involve community members not only as subjects, but as active collaborators benefiting from the research. This approach aligns with equitable and decolonised research practices (Kashwan et al., 2021). However, it is acknowledged that this might still be insufficient, as decoloniality also requires recognition that local situations can never be fully grasped by external actors, particularly when power, race, and historical dynamics are at play.

3.2. Ethics of the thesis

The research adheres to rigorous ethical standards throughout all stages of the study, guided by the ethical research journey guidelines (Reid et al., 2019). This approach involves recognising the potential impacts of research, addressing power differentials in research agendas, processes, and reporting, and ensuring that research findings are shared in a manner that respects and benefits all participants (Reid et al., 2019). In alignment with the Belmont Report (1979) (de Vries, 2023), the research prioritises respect for all individuals, treating them as ends in themselves rather than means to an end. Confidentiality is upheld and participant selection was conducted without discrimination (see Section 3.5). Participants had the option to remain anonymous and retain the right to withdraw from the study at any time, even after data collection was complete. The research objectives were explained to the participants, and their consent was obtained verbally. This process ensured that participants were fully informed about the research and their rights, thereby upholding ethical standards throughout the study. Finally, the Malmon-DeSIRA project (see Section 3.3), has signed the Nagoya Protocol, ensuring ethical practices in the use of genetic resources and traditional knowledge.

3.3. The Malmon-DeSIRA project

Malmon-DeSIRA [FOOD/2019/412-700, DeSIRA_GB] is a 5-year project, funded by the European Union, focused on increasing the productivity of mangrove swamp rice and enhancing the understanding of the drivers and changes in the mangrove ecosystem in Guinea-Bissau. The project actively involves farmers in the co-production of knowledge, aiming to develop innovative solutions to threats like climate change, political instability, and socioeconomic transitions (Malmon-DeSIRA, 2024). The collaboration between the project and the thesis emerged naturally as the project needed a researcher to analyse previously collected ES questionnaire data. The need for analysis with no specific request from the project offered flexibility in analysis techniques and reporting. The fieldwork for this dissertation received financial assistance from the Malmon-DeSIRA project, funded by the European Union (Grant Contract FOOD/2019/412-700). The

project provided field support, including local accommodation in villages, and questionnaire datasets for the selected villages. This support also involved collaborative fieldwork with two local students, namely, Abudu Bacar Mané and Fidalgo António Damerim (former scholarship holders of the Malmon project), from Universidade Lusófona who assisted with knowledge of village accessibility, as well as cultural and language support during interviews. However, it is recognised that conducting a thesis in collaboration with an ongoing project can introduce certain biases. These may stem from the existing opinions and assumptions of the Malmon-DeSIRA project, as well as limitations in time that led to not being able to modify questionnaires (see Section 3.5.2). Additionally, while the students who are also involved in the data collection (see section 3.5) are experienced, their involvement may also introduce bias, as they might unintentionally project their own perspectives and hence influence participants' responses.

3.4. Study location

The case study focuses on Guinea-Bissau, a coastal country located in West Africa and member of the Small Islands and Developing States (SIDS). The country encompasses a mix of continental mainland as well as a group of islands (i.e., Bijagos Archipelago) of a total area of 36 125 km^2 (Lourenço, 2009; Santos and Mourato, 2022). Guinea-Bissau is divided into eight regions and the capital city, Bissau, which is designated as an autonomous sector. This study focused on the central region of Quinara, selecting four villages as study sites:
Bissassema de Cima (11°45'31.96"N;15°27'24.05"W), Foia (11°48'55.33"N;15°24'58.42"W), N'tchudé (11°49'55.91"N;15°25'11.10"W) and Djabada Portu (11°53'13.47"N;15°20'40.68"W).
In the rest of the paper, for simplicity, Djabada Porto and Bissassema de Cima will be referred to as Djabada and Bissassema, respectively. All selected villages belong to the Balanta ethnic group, one of the major groups represented in Guinea-Bissau, with 27% of the population (Gonçalves et al., 2024).

These villages were selected based on the following criteria: (i) their involvement (N'tchudé and Djabada) or non-involvement (Bissassema and Foia) in restoration projects led by the Institute of Biodiversity and Protected Areas (IBAP); (ii) their location and shared proximity to Bissau on the opposite side of the Rio Geba, allowing for local comparison; (iii) data collection by the Malmon-DeSIRA project in these villages, providing valuable context and data for this research; (iv) villages utilisation of mangroves; and (v) proximity of mangroves or *bolanha* to villages.

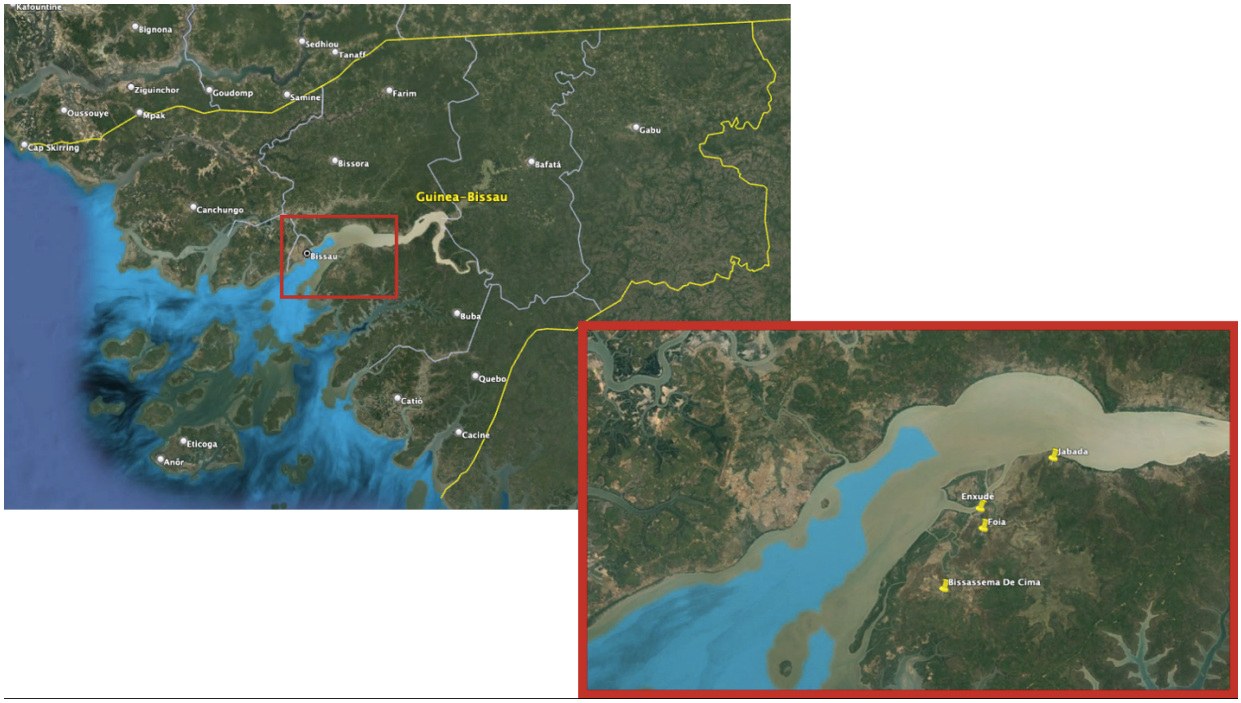


Figure 3 - Map of Guinea-Bissau with the location of the four selected villages (retrieved and modified from Google Earth, 2024)

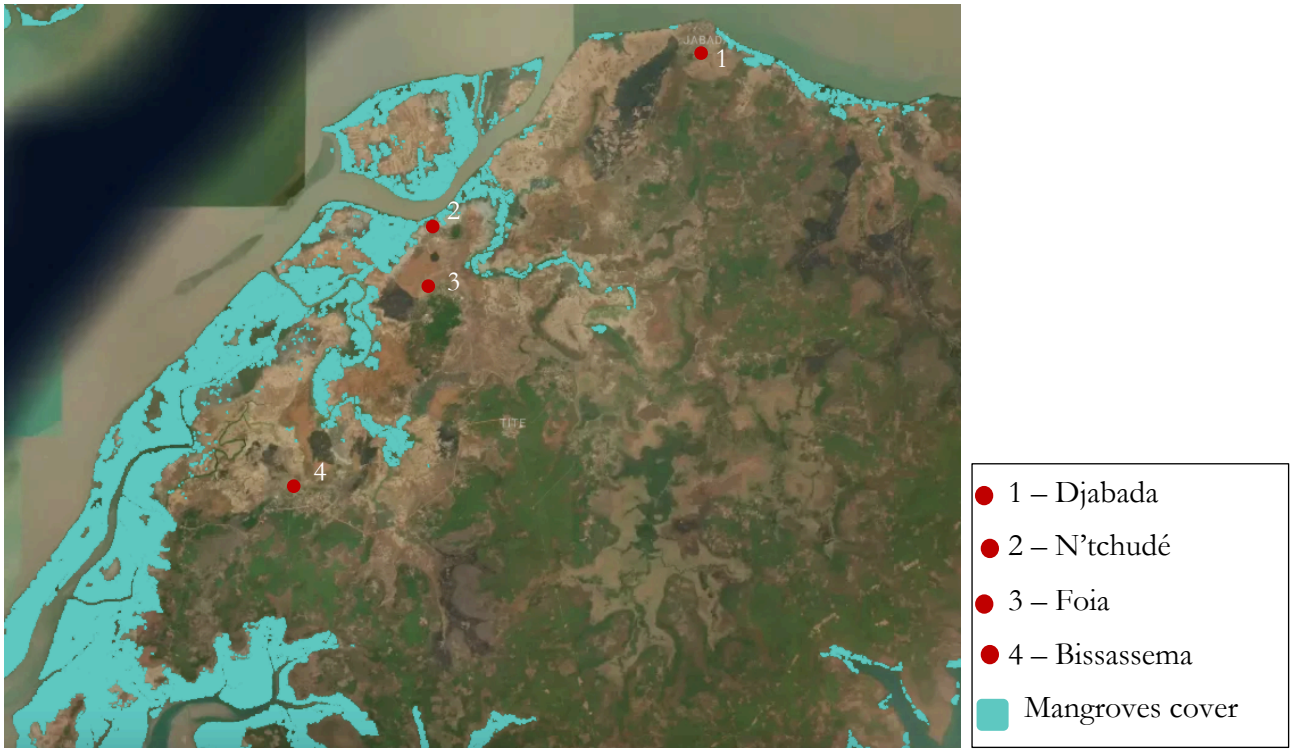


Figure 4 - Map of mangrove extent in the study area (retrieved and modified from Global Mangrove Watch, n.d.)

3.5. Data collection

Data was gathered from various sources of information, both qualitative and quantitative, using descriptive (Totino et al., 2023) and comparative analysis. The instruments for data collection included semi-structured interviews, questionnaires, participant and direct observations, field notes, and informal discussions. Purposeful sampling methods was used for both qualitative and quantitative data to 'maximise efficiency and validity'; for qualitative sampling is done until data saturation (see section 3.5.1) and for quantitative until data generalisability (see section 3.5.2) (Palinkas et al., 2015).

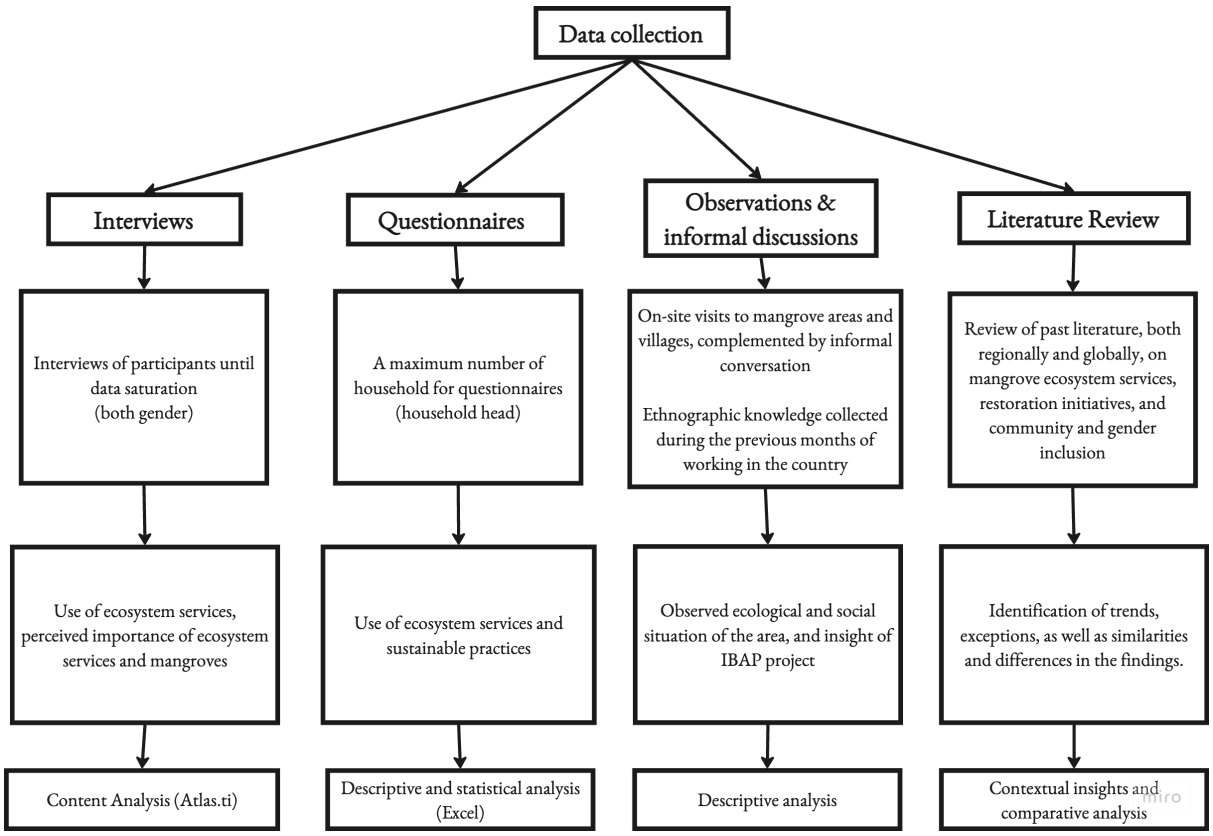


Figure 5 – Methodology for data collection and analysis

A cross-method triangulation was employed to cross-check information gathered through semi-structured interviews, questionnaires, observations and informal discussions, and literature review. This technique involved combining different qualitative and quantitative data collection methods to ensure complementarity and reduce bias in the data. By counterbalancing the weaknesses of one method with the strengths of another, it strengthens the results and conclusions of the study (Thurmond, 2001). This approach aims to enhance the validity and credibility of the research by ensuring a comprehensive and well-rounded exploration of the data sources and methodology

(Noble & Heale, 2019). The main results for each data collection method were added to a table and compared in the results (see Section 4). Discrepancies and similarities were discussed in the discussion and compared to past and present literature to gain insight into the reasons for these patterns (see Section 5).

Ecosystem services-oriented questions, focusing on perceptions and usage, were addressed through interviews, questionnaires, and observations. Gendered aspects were primarily explored in interviews, observations, and via the literature review. Although the questionnaires, designed by Malmon-DeSIRA, were not specifically gender-oriented, they included targeted questions for women related to wood usage, which will be used to complement other data. Restoration and conservation initiatives are investigated through a literature review of projects, governance structures, and past efforts within the region and globally and will be integrated in the discussion section. This is further supplemented by interviews, exploring how local communities perceive the specific initiative in their village, and cross-checked with informal conversations and observational notes gathered during eight months in the country.

3.5.1. Semi-structured interviews

Semi-structured interviews in selected villages were conducted following the interview guide (see Appendix 2), after prior oral informed consent. Interviews were conducted by the main researcher, with the assistance of the two students mentioned above. The interview sampling was conducted door-to-door, focusing solely on individuals aged 18 and above (often the household head, as is culturally expected) who are connected to mangroves through usage, activities, or other involvement. The number of interviews conducted was guided by data saturation. For each participant, both gender and village of residence were recorded. Occasionally, interviews were carried out simultaneously with both men and women due to time or language limitations. It is important to note that the research took place during the rainy season, a period when villagers are deeply engaged in agricultural tasks, which restricted their availability for interviews. As a result, most interviews were conducted primarily in the early morning, late afternoon, or evening. Interviews were also conducted over multiple days in order to include people who might not have been available on earlier days. Interviews lasted on average five minutes instead of the fifteen minutes that were planned, because participants used short answers despite attempt to engage in the process of *djumbai* (informal conversations in Kriol).

To minimise bias in data collection, the researcher learned Kriol to conduct interviews and follow basic conversations. However, some individuals did not speak Kriol but rather their ethnic

language (e.g., Balanta), and the researcher's ability to follow everything being said was limited. Hence, the two students from the Malmon-DeSIRA project provided translation when needed. Besides, many women had difficulty speaking or understanding Kriol, which made it more challenging to engage with them. Those who did not speak Kriol were not interviewed. Additionally, more than three women referred us to their husbands, saying it would be better to speak with them instead. Around five women in the villages did not feel comfortable speaking with us, providing justifications such as their husbands not being at home, being unwell or fatigued, or having limited proficiency in Kriol.

Moreover, the interviews were conducted in a way that encouraged participants to lead and have control over the conversations. Questions were crafted to reflect the local communities' understanding of mangroves, focusing on their perceptions of the importance of mangroves and their usage patterns. The main topic was introduced without limiting the participants' scope of discussion, guiding them to share their perceptions of mangroves, the benefits they derive, and their concerns or opinions freely. This left space for participants to mention any category of service. If certain topics were not addressed, specific questions were introduced to shift the focus again to the topic (e.g., Santos & Mourato, 2022).

To align with the local ontology and participants' understanding, questions were formulated based on previous ethnographic knowledge, ensuring they were relatable and comprehensible. As a result, it was not feasible to ask direct questions such as "What does a healthy mangrove forest look like to you?" The concept of a 'healthy' environment does not resonate with people in these villages. Instead, discussions focused on topics like rising tides, the importance of mangroves and rice fields, changes in land use and cover, and the protection and planting of mangroves.

To ensure participants were involved and benefit from the study, at the end of each session, space and time was provided for participants to ask questions about the project, mangroves, or any other matters of interest. Both the student and the researcher then provided detailed explanations about mangrove ecosystem services when asked, and offered advice on planting, restoring abandoned rice fields, or protecting existing ones. This approach was intended to encourage a two-way exchange, rather than a purely extractive process, fostering an environment where both parties could benefit from shared information. If participants asked about accessing the results (in the form of a short video summary) or how the data would be used, the option to share their WhatsApp number was offered, which was often the only available method for internet-based

communication. For those without a personal contact or access to a smartphone, the option to provide the number of someone they trusted was given. Sharing results in these remote villages, where access to phones and internet is limited, proved challenging. Only two participants, one from Bissassema and one from Foia, provided their phone numbers. In Djabada, the video summary will be sent to a student, who has relatives there, to show to the village committee on his next visit. In N'tchudé, there was no request for a summary or project updates. The summary will be sent in February 2025, to allow the research to be finalised and for a video summary to be constructed.

3.5.2. Questionnaire – secondary data

Household (*fogon* in Kriol) surveys about the use of ecosystem services were conducted by the two students of Malmon-DeSIRA, in February, August and September 2024 in the village of N'tchudé, Bissassema, Djabada and Foia (see Appendix 3). The sampling technique involved surveying every household in a village to include as many households as possible. A minimum of 60% of all households in each village was achieved by returning during different months and revisiting households that were previously unavailable. The questionnaire focused solely on provisioning services, as these are the most tangible services to survey. The questionnaires were carefully designed by the Malmon-DeSIRA project, with questions informed by prior knowledge of the communities' use of ecosystem services and designed to closely reflect local ontological perspectives. For example, the questionnaire uses June 7, 1998, as a time marker. Since many people do not have a precise perception of time, using a significant date helps them orient themselves temporally. This date marks the start of the civil war, a vivid event in the memories of many, thereby enabling people to situate themselves more easily when this reference point is used.

The questionnaire aimed to determine which type of wood, mangrove or non-mangrove (referred as forest wood in this paper), was most used for timber and biomass fuel, and to explore potential other mangrove ecosystem services usage such as ropes, medicines, and wild foods. It also sought to understand the methods, patterns, and drivers of wood collection, as well as the sustainability of these practices, considering factors such as distance, mangrove species, season, preferences, opportunities, and economic means. Questions about timber usage, such as wood cutting, cooking, and smoking preferences, were directed specifically at women and household heads to ensure information was gathered from both gender groups, conforming to the division of labour within households. Participants had multiple choices available, allowing them to answer both forest and mangroves for the same service.

3.5.3. Observations & informal discussions

A wealth of ethnographic knowledge was gathered during the eight months spent in Guinea-Bissau, which included a six month MSc internship working for Wetlands International, followed by two months of research for this thesis with the support of Malmon-DeSIRA. Through regular fieldwork in three regions of the country (i.e., Cacheu, Quinara, and Cantanhez) time was spent discussing topics such as rice farming, living conditions, economic situations, and mangrove usage with villagers, local students and NGO representatives. Additionally, a literature review, field observations, informal conversations, and insights from NGOs and governmental organisations, gathered through participation in seminars, forums, and meetings, provided a diverse range of information. This informed the researcher on the multifaceted socio-ecological, political, and economic context of the country. All these insights were recorded on the researcher's phone or computer as preliminary understanding, feeding into the research's purpose.

An informal conversation (see Appendix 4), lasting around 30 minutes was held with the project coordinator of IBAP for the restoration taking place in the study sites. The project coordinator was informed that the conversations was for the purpose of an academic research to understand better the dynamics and viewpoints of IBAP, after collecting data in these village. Since the selected villages had only this initiative implemented for mangrove restoration, the objective was to gather additional information about the institute beyond reports and online sources. The interview began with the coordinator providing a brief overview of the project's objectives and the rationale behind its establishment, including the criteria for selecting or excluding specific villages. This was followed by discussions on the observed outcomes of the planting initiatives and the potential ecological and social improvements they could foster. Finally, the interview explored the approaches to monitoring and evaluating the project to ensure its sustainability. It was not allowed to record this conversation; hence the researcher wrote down notes on their phone after the interview ended.

During the dedicated two months of research, field notes, pictures, and observations from both participants and non-participants, was used to verify and cross-check the information gathered during interviews and through questionnaires in the study sites. This helped analyse patterns of influence that may have affected responses, including aspects related to the researcher's positionality and variations due to the questionnaires being conducted by different individuals.

It also helps cross-check findings from other data collection methods to unveil complementarities or discrepancies.

Throughout the whole time spent in Guinea-Bissau, and especially during the months of field work, the process of 'storying' was engaged, aiming to share and interact rather than adopting the stance of a detached outsider merely extracting information. Recognising that transparency about the presence and identity of the researcher, as well as the objective of the research, and living in villages, may encourage people to share more openly, a more collaborative and open exchange was attempted during the data collection process.

3.5.4. Literature review

The literature review was used to develop an understanding of the ecological and social dynamics associated with mangrove ecosystem services and to explore how restoration initiatives incorporate community perspectives, both in Guinea-Bissau and globally. The main research engine used was Google Scholar, along with various paper recommendations from academic peers. Terms and keywords such as 'mangrove ecosystem services,' 'Guinea-Bissau mangrove restoration,' 'community perceptions,' 'drivers of mangrove changes,' 'gender and ecosystem services,' 'gender dynamics Guinea-Bissau,' and 'Mangrove Swamp Rice' were used to filter the results. This provided insights into policies, laws, and governance related to mangroves in Guinea-Bissau and examined both past and present conservation and restoration efforts, including their impacts on local communities at national and global scales. Overall, the literature review was employed for comparative purposes in the discussion section of the study, examining global literature and past studies to identify trends or exceptions in findings, as well as similarities or differences in the data, and to cross-validate findings from other data collection tools by comparing how scholars have previously described these issues.

3.6. Data analysis

3.6.1. Interviews

A total of 66 interviews were conducted across the four villages: 21 in Bissassema, 16 in Foia, 12 in N'tchudé, and 17 in Djabada. The number of interviews conducted in each village depended on data saturation, particularly in smaller villages like Foia and N'tchudé, where shared meanings were stronger, as well as the availability and willingness of participants to engage in interviews. Five interviews were excluded for various reasons: either due to insufficient content (e.g., interviews lasted under five minutes where the participant struggled to understand the questions), because

recording was not permitted and the researcher could not capture all details, or because the interviews were irrelevant (e.g., participants who had no connection to or use for mangroves). Additionally, some participants misunderstood the questions; for instance, participant 11 associated mangroves with *bolanha*, resulting in responses focused solely on rice field work. Hence, out of the 66 interviews conducted, 61 were imported into the content analysis software Atlas.ti. From these final imports, 20 interviews were conducted with women, and 41 with men.

Interviews were transcribed by one of the students into Kriol, then translated to English for analysis by the researcher. The interview transcriptions were processed using Atlas.ti. The data uploaded to Atlas.ti was organised into distinct group categories, specifically by village (Bissassema, Foia, Djabada, and N'tchudé) and gender (men and women). This categorisation facilitated comparisons between villages based on previously outlined criteria, such as participation in restoration initiatives, as well as the distance and access to mangroves and how these factors might influence villagers' perceptions of mangrove ecosystem services. Additionally, it enabled comparisons between gender groups regarding resource usage, division of labour, rights to access resources, and opportunities or abilities.

The comparisons and analyses were facilitated by creating codes based on the categories from the theoretical framework, aligning them as closely as possible with the theory (Table 2). However, some categories from the theoretical framework were excluded from Atlas.ti, as they were not mentioned clearly or in sufficient detail during the interviews and may only be relevant for the literature review. By establishing these categories, quotes and keywords from the interviews were highlighted and matched to their corresponding categories. This approach enabled further analysis, such as examining the frequency of mentions of specific ecosystem services, drivers of change and patterns discussed during interviews. The inclusion of group categories for villages and gender enabled comparisons of similarities and discrepancies both between villages and across gender groups. As a result, data on direct and indirect drivers of change, as well as gendered ecosystem service uses, were extracted into Microsoft Excel, and graphs were created from the coded data. The quotes highlighted through the coding process were then used to answer the research questions in a logical manner by analysing the specific narratives within each category and identifying similarities or discrepancies.

Table 2 - Coding categories in Atlas.ti

Main category	Sub-Category
Direct drivers of change	Changes in local land use/cover
	Environmental change
Indirect drivers of change	Economic
	Sociopolitical
Gendered drivers	Decision making
	Division of labour
	Opportunities and abilities
	Right to access resources
Constituents of well-being	Security
	Basic material for good life
	Health
	Good social relations
Mangrove plantation	Perception of planting
	Perception of project
Provisioning services	Biomass fuel
	Capture fisheries
	Crop cultivation
	Medicines
	Timber
	Wild food
Regulating services	Erosion regulation
	Soil quality regulation
	Water regulation

3.6.2. Questionnaires

A total of 280 household questionnaires were conducted across four villages: 97 in Bissassema, 57 in Foia, 35 in N'tchudé, and 91 in Djabada. This corresponds to at least 60% of all households in each village. The smaller number of household questionnaires in Foia reflects the village's smaller size compared to the others, indeed Djabada and Bissassema have many more households than the two other villages. In N'tchudé, the lower number was also due to farmers spending significant

time working in the rice fields on the island in front of the village. With the additional time spent commuting to the island, they returned to the village much later than in other villages, leaving little time to conduct the surveys before sunset.

Due to gender roles division within a village, questionnaires were conducted with household heads, which most of the time was a man. Hence, it is important to note that questionnaire surveys may obscure gender differences within households (James et al., 2021). This will be considered in the discussion of the study's limitations.

The questionnaire data on ecosystem services usage were transferred into Microsoft Excel for storage and subsequently cleaned to ensure consistency across all villages, thereby facilitating meaningful comparisons. Data from all villages were consolidated into a single Excel sheet, which included a summary section where total responses for each service were calculated, and basic arithmetic operations were conducted. Responses of 'YES' were assigned a value of 1, and 'NO' a value of 0, to produce a final score for each village and each service. This final score was divided by the number of households interviewed in each village to calculate percentages for each response, enabling comparisons between villages. The dummy variable does not account for differences among mangrove species. For the scope of this thesis, the goal is to understand the extent of mangrove use compared to other types of forest use. Consequently, households using one or multiple mangrove species (e.g., Rhizophora and Avicennia) were assigned the same value. However, they could select both forest and mangrove resources for the same service if they preferred, showing overlapping resource use.

3.6.3. Field observations

Field observations collected during the fieldwork, including notes, photographs, and an informal interview with the IBAP representative, were compiled into a document. This information was used to cross-verify data from interviews and questionnaires by organising it into a comparative triangulation table (see Table 6) to identify both complementarities and discrepancies.

4. Results

This section is organised to present findings in an order that corresponds to the three sub-research questions, while integrating elements of the conceptual framework to structure the sub-sections. The structure facilitates an understanding of the main findings by integrating data from questionnaires, interviews, and field observations. The **first section** presents the **local community's perceptions of mangroves** and their reliance on them, drawing on insights from both interviews and questionnaires. The **second section** discusses **gender-specific findings**, such as **rights to access mangrove resources** and **opportunities** or **abilities** in relation to extracting and using these services. Finally, the third section focuses on mangrove cover change and restoration initiatives, identifying the drivers of this change. This section also examines **the impact of restoration initiatives** in these villages and the related perception of planting and the project by participants. This final section concludes by highlighting **sustainable practices** already in use that are linked to mangrove ecological processes. At the end of the section, a comparative table summarising data triangulation across themes and data sources is presented (see Table 6).

4.1. Local communities' perception of mangroves and current uses

> "Mangroves have huge importance because without them we cannot continue working in our rice fields. Mangrove swamp rice are very important because this is where we see the rice that we eat." (Participant 52 - Man – Djabada)

4.1.1 Provisioning services

As revealed in the interviews, across the four villages within the Quinara region, local communities maintained a close connection to the mangroves, primarily linked to rice production. It was evident that people viewed mangroves as a valuable ecosystem that underpins their food security. This relationship encompasses not only rice production, and recognition of the fertile soil of mangroves, but also capturing fisheries, with resources such as fish and crabs, and the collection of wood used for cooking and smoking fish. **Provisioning services** was the category of ecosystem services that was mentioned the most (97% of participants mentioned it), especially mangrove wood providing **timber** (41%) and **biomass fuel** (48%), as well as **capturing fisheries** (36%) (see Figure 12 and Table 5).

Wood for biomass fuel

Using questionnaire data (see Table 3 and Appendix 6), it appeared that in Djabada and Bissassema, households primarily use forest wood for cooking (88% and 92% respectively), while Foia and N'tchudé rely on mangroves as their main source (93% and 100% respectively). Across all villages, questionnaire data showed that most households reported using mangrove wood for cooking salt (villages average of 63%), though Bissassema shows a slight variation, with more households using forest wood for this purpose (66%). In Djabada, a woman shared that she previously used mangrove wood for cooking salt but now relies on plastic sheets provided through the PADES project in collaboration with IBAP. In N'tchudé, households also previously used mangrove wood for salt cooking but now plastic sheets, given by the same project, are used to extract salt from the *bolanha*, with eight women reporting this use. While most households across villages use mangrove wood for cooking salt, questionnaire data showed that they tend to prefer forest wood for smoking fish (67% villages average) except in N'tchudé, where mangrove wood is primarily used (91%). Households in Djabada and Foia tend to prefer mangrove wood over forest wood, except for smoking fish. In Djabada, while conducting questionnaires, three participants mentioned during informal conversations that they avoid using mangrove wood (Avicennia sp.) for smoking fish because it turns fish black. Instead, they used to use *poilão* (Kapok tree in Kriol), which is said to give the fish a better colour.

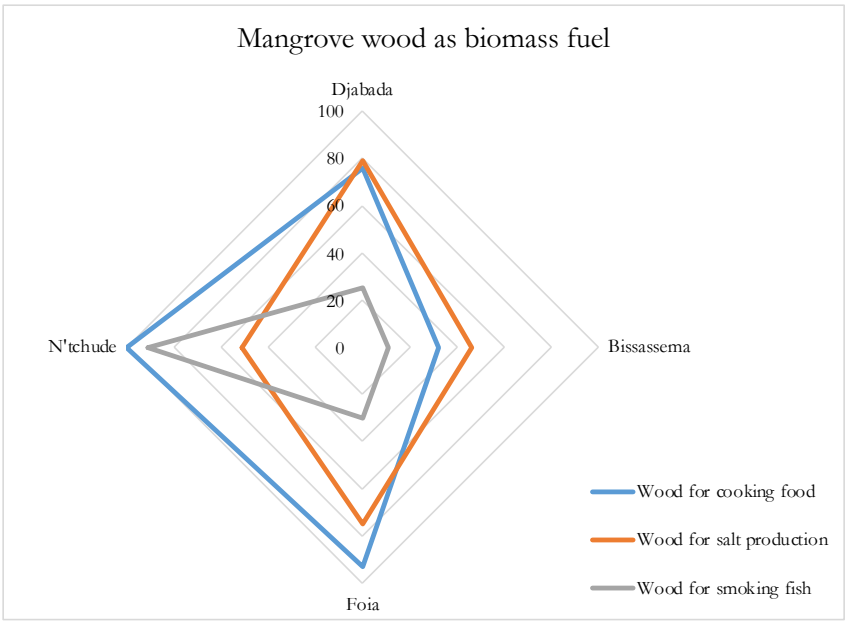
> "INT: Is there a place where you never go to cut mangroves […]?
> PAR: Yes, there are some places, the ones that are far away because they are hard to access." (Participant 12 – Bissassema)

Overall, questionnaire data (see Figure 6) demonstrate that they are some **intervillage differences** with no specific patterns in the use of fuelwood for the household. While the village of N'tchudé use mangrove wood for all fuelwood purpose, the village of Bissassema use mainly forest wood. This might be explained by the distance needed to access mangrove wood, Bissassema being further away from a mangrove forest then N'tchudé.

Table 3 - Percentage preference for mangrove and forest biomass fuel use across villages.

Fuelwood		Djabada	Bissassema	Foia	N'tchudé
Wood for cooking food	Mangrove	76%	32%	**93%**	**100%**
	Forest	**88%**	**92%**	39%	3%
Wood for salt production	Mangrove	**79%**	46%	**75%**	**51%**
	Forest	24%	**66%**	12%	6%

Wood for smoking fish	Mangrove	25%	11%	30%	**91%**
	Forest	**88%**	**90%**	**75%**	14%



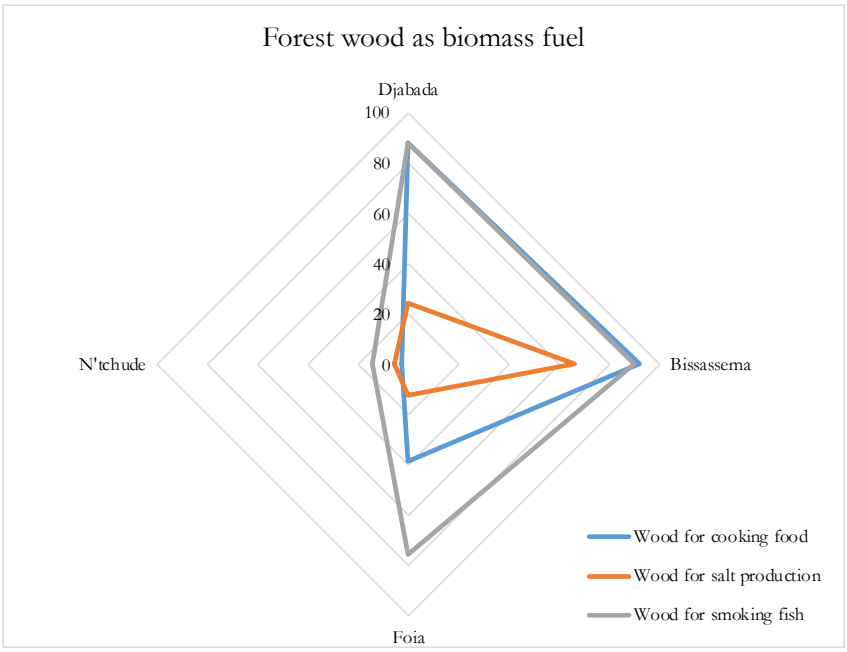


Figure 6 - Radar charts illustrating the percentage preference for mangrove and forest biomass fuel usage in each village.

Moreover, from interview discussions, mangrove wood was shown to be especially valued for biomass fuel as the wood was considered superior to other types. Three participants explained that its higher density allows it to burn more efficiently, a quality particularly appreciated for cooking as exemplified by this statement: "Mangrove wood is heavy and works well for the fire […].

Mangrove wood is better for cooking because it is denser compared to inland forest wood, which is lighter." (Participant 4 – Woman – Bissassema).

Wood for timber

Questionnaire data (see Table 4 and Figure 9) revealed that all villages use mangrove wood exclusively for bridge construction, with Rhizophora sp. as the dominant choice in N'tchudé (63%) and Foia (74%), and Avicennia sp. in Djabada (36%) and Bissassema (49%). Mangrove wood is also used almost exclusively for **dam dike construction** (villages average of 93%), where poles are set in 2-4 rows inside the dike, typically tied together with natural fibre ropes before being filled with mud. Moreover, mangrove wood is also primarily used to **strengthen dams** by constructing dikes across marigots, sea branches, or rivers (villages average of 92%). This refers to strong poles split into at least two branches on one end, placed obliquely against the vertical poles to support the inner structure of the dike. In Djabada, one participant referred to using sand-filled bags and abandoned ropes to close a river, strengthening the dam structure. Plastic ropes, rather than natural fibres, are used to tie the beams of the inner structure.

Figure 7 – Avicennia spp. used to build a fence in the rice fields; to repair a dike; to strengthen dam.

Results from the questionnaires further indicated that, across all villages, 82% of households primarily use forest wood for **house construction**, especially for roofing. Indeed, mangrove wood is used by only 15% of households for this purpose. For **fencing** (i.e., to enclose gardens or protect rice fields from cattle during the rainy season), mangrove wood is generally preferred (82%), though Djabada has a majority of households using forest wood (58%).

Figure 8 - Avicennia spp. for cow's fences; Rhizophora spp. for house structure; Laguncularia spp. for house fences

Overall, the questionnaire data demonstrate some inter-village similarities in the use of mangrove wood as timber. All villages consistently use mangrove wood for constructing dikes and dams, including reinforcing dike structures, likely because these are built within the mangroves for rice cultivation. This might indicate a proximity factor as bridge and dam structures are typically constructed to protect mangrove swamp rice fields, hence mangrove is easily accessible for this timber usage. Although not mentioned during interviews, the resistance and durability of the wood is probably the primary factor for selection. Lastly, a majority of the households in all villages use forest wood for house structures and roofing.

Table 4 - Percentage preference for mangrove and forest timber use across villages.

Timber wood		Djabada	Bissassema	Foia	N'tchudé
Wood to build a bridge	Mangrove	**55%**	**88%**	**98%**	**100%**
	Forest	8%	3%	0%	0%
Wood to build a dam	Mangrove	**78%**	**94%**	**98%**	**100%**
	Forest	5%	1%	0%	0%
Wood for reinforcing a dam's dike structure	Mangrove	**75%**	**96%**	**98%**	**100%**
	Forest	9%	2%	2%	0%
Wood for house roofing	Mangrove	4%	21%	21%	29%
	Forest	**97%**	**82%**	**84%**	**77%**
Wood for house structure	Mangrove	5%	36%	37%	51%
	Forest	**97%**	**78%**	**82%**	**71%**

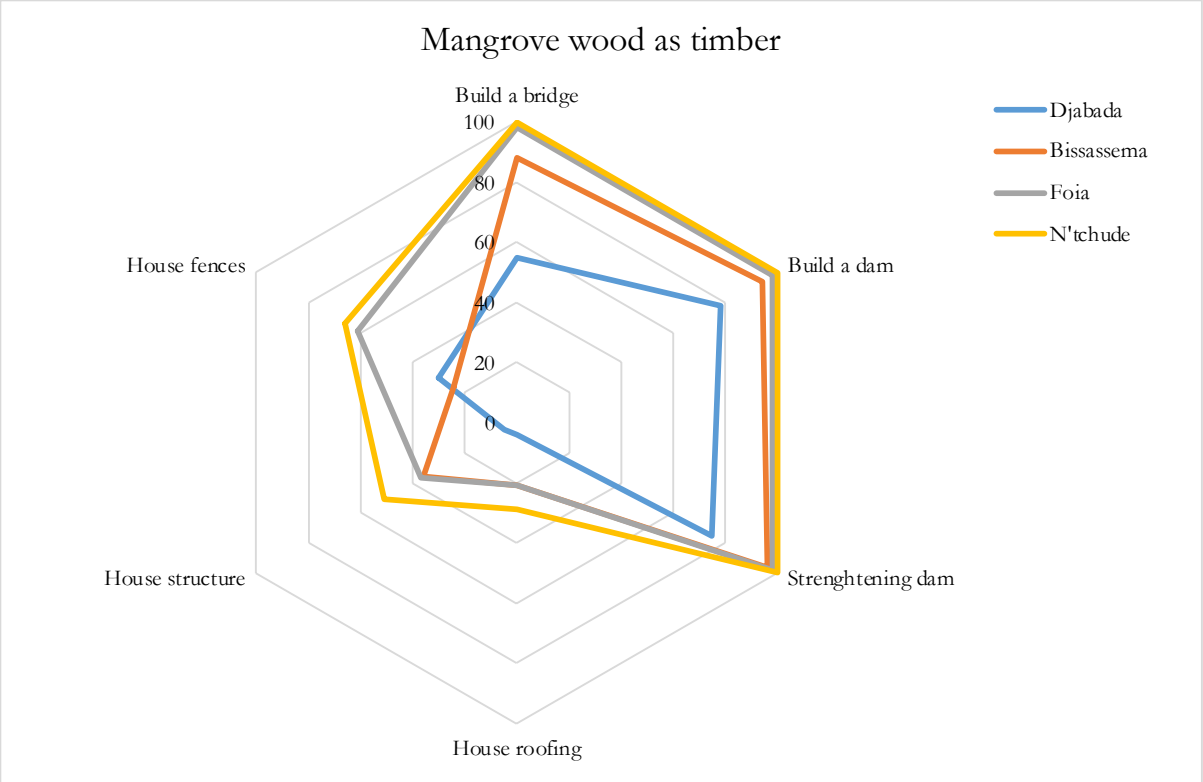


Figure 9 - Radar chart illustrating the percentage preference for mangrove timber usage in each village.

Additional provisioning services from mangroves

The questionnaire findings indicate that additional services from mangroves, such as charcoal, medicines, and wild food, are less frequently utilised. For wild food, only two participants in Djabada mentioned that they previously relied on mangroves for food during periods of scarcity, but they now rely on the security provided by harvests and purchase imported rice. Just 3% of households reported hunting in the mangroves. Approximately half of the households (51%) across all villages collect honey from mangrove forests (see Figure 10), although only three households in Djabada reported intentionally placing beehives in the mangroves.

The sale of wood outside personal use is uncommon, and charcoal production primarily depends on forest wood (27%). In N'tchudé, only 2.9% of households produce charcoal, compared to approximately 40% in other villages. For medicinal purposes, a small percentage of households (8%) reported using mangrove wood, primarily for treating itchy skin, improving skin and blood health, and alleviating pain and inflammation (see Appendix 5).

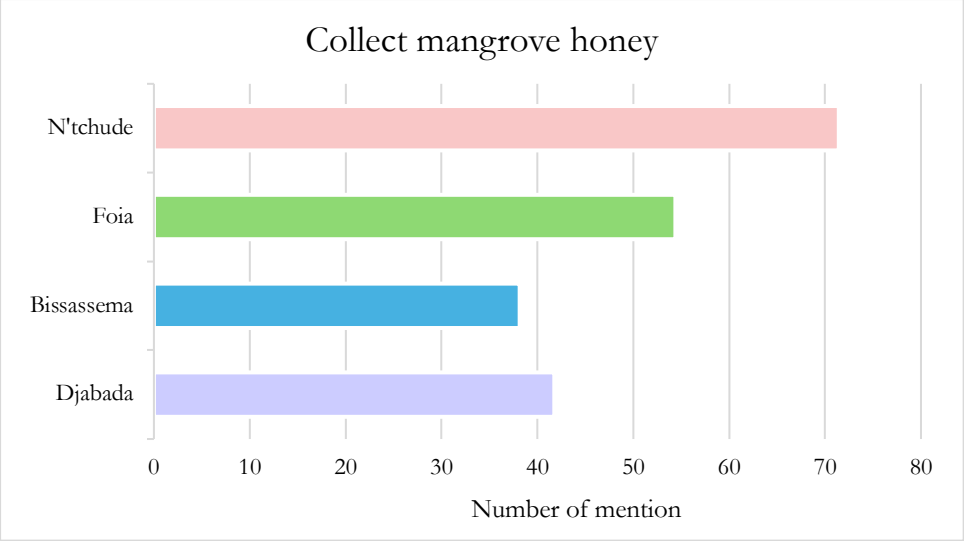


Figure 10 - Percentage of participant who collect honey in the mangroves

Forest wood is the predominant choice for plough handles in Djabada households, with 99% selecting it for rice farming. In Bissassema, forest wood is also the primary option (85%), although some households also use Avicennia sp. (42%) (multiple responses were allowed). Foia and N'tchudé demonstrate greater variability: in Foia, 65% of participants use mangrove wood and 67% use forest wood, while in N'tchudé, 77% use mangrove wood and 40% use forest wood. Additionally, very few households use mangrove wood for making ropes.

Figure 11 – Traditional hand plough for rice agriculture

4.1.2. Regulatory services

Mangrove regulatory services were not addressed in the questionnaires; however, interviews highlighted their importance, with 54% of participants recognising the regulatory functions provided by mangroves (see Figure 12 and Table 5). The graph and table below illustrate the number of times these services were mentioned during interviews, particularly emphasising their role in coastal protection through water flow and erosion regulation. Notably, 36% of participants identified mangroves as crucial for safeguarding rice fields by regulating water flow and preventing erosion (10%). As explained by a farmer from Bissassema: "The closer the mangroves are to the rice fields, the better they can prevent salty water from causing damage. If the mangroves are far from the dikes, salty water can easily cause damage, gradually eroding the dikes. This is why it is beneficial to have mangroves close to the rice fields to protect against salty water." Additionally, 15% of participants acknowledged the role of mangroves for soil quality regulation: "If you open new rice fields in the mangrove areas, the rice will grow better, and the yield will be higher." (Participant 16 – Man – Bissassema).

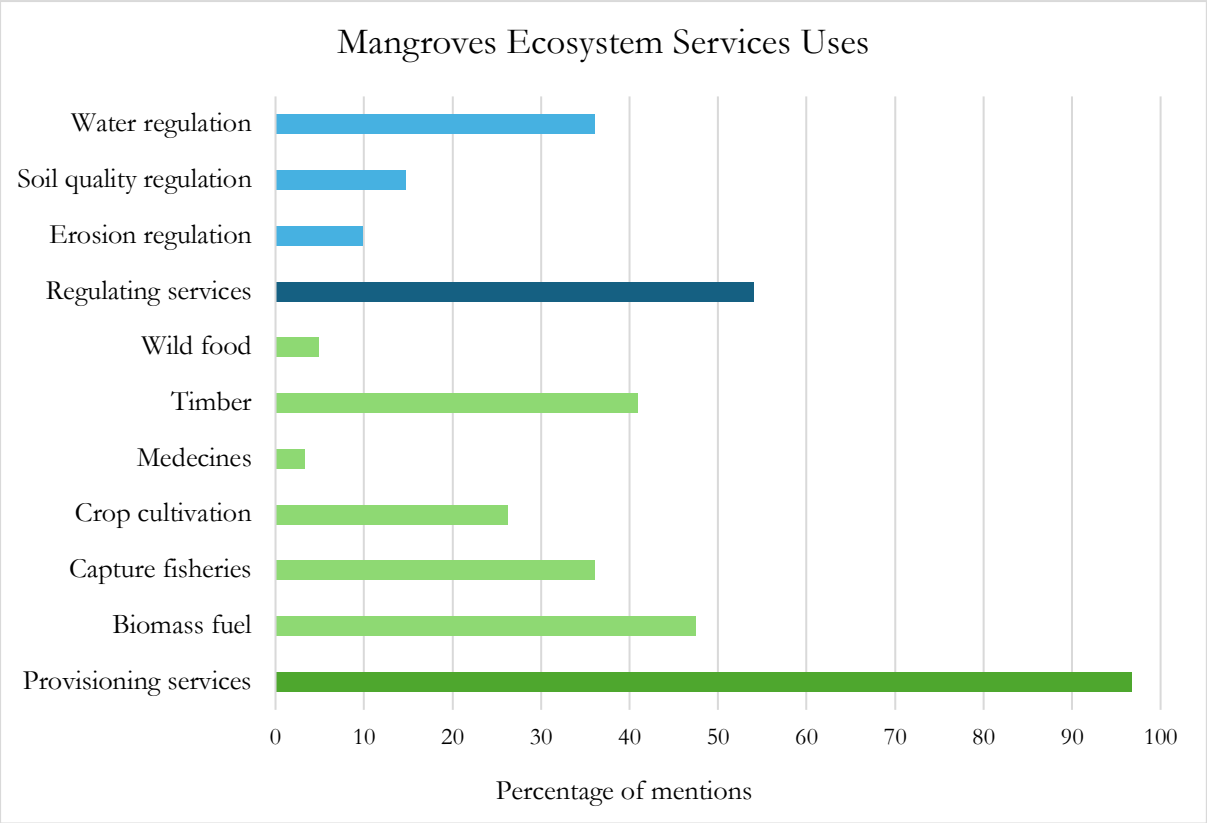


Figure 12 – Number of mentions of regulating (blue) and provisioning (green) mangrove ecosystem services during interviews, all villages and gender groups combined.

Table 5 - Number of mentions of mangrove ecosystem services during interviews and their corresponding percentages relative to the total number of participants interviewed, all genders and villages combined

Ecosystem Services	Number of mentions	Percentage
Provisioning services	59	97%
Biomass fuel	29	48%
Capture fisheries	22	36%
Crop cultivation	16	26%
Medecines	2	3%
Timber	25	41%
Wild food	3	5%
Regulating services	33	54%
Erosion regulation	6	10%
Soil quality regulation	9	15%
Water regulation	22	36%

4.1.3. Importance of mangrove as a constituent of well-being

Food security through rice production emerged as the primary constituent of well-being for all participants across villages, a theme consistently apparent in both interviews and questionnaires and in informal discussions. Participants' sense of well-being was evident when they highlighted how mangroves provide essential resources that support rice production. They warned that the loss of this ecosystem would lead to serious consequences, including hunger. One man in Djabada noted: "If mangroves are not there, nobody can work because the tides come in strongly. Now, compared to before, it is causing tiredness in the village, because if the rice fields are damaged, there won't be rice, and hunger will increase."

Additionally, **social conflicts over resources** were mentioned during interviews, with two participants highlighting that resource access — whether to mangroves or rice fields — can lead to conflicts among farmers and families. They described increased competition over rice fields, noting that if a farmer allows mangroves to regrow in their field, others should not cut them to avoid conflict. Another farmer from Foia added: "Mangroves bring problems between families. For example, if you work in someone else's location, this can create issues in the village, leading to conflict.". One constituent of well-being then is this access to mangroves, intrinsically linked to *bolanha*, that plays a role in contributing to dampening social conflicts. Overall, in the challenging

socioeconomic context of Guinea-Bissau, with high food insecurity, rice yield stands as the primary measure of well-being for these four communities in the region of Quinara.

4.2. Gendered interactions, connections and perspectives on mangroves

During the interviews, participants across all gender groups consistently linked mangroves to rice production in response to questions about the importance of mangroves, the potential for their increase or decrease, and the benefits they provide. Rice production was frequently cited as a primary advantage of mangroves. Both gender groups highly valued **provisioning services**; however, **women** more frequently mentioned **fisheries** (52%) and **biomass fuel** (52%), while **men** more often referred to **crop cultivation** (37%) and **timber** (41%). **Regulating services** were mentioned more often by men (61% compared to 33% for women). **Water regulation** was mentioned by both groups, whereas **soil quality** and **erosion regulation** were only mentioned by men. These results correlate with tasks typically performed by each gender group and gender **abilities**, as observed during fieldwork. Figure 13 displays the number of mentions for each service, including responses given after follow-up questions by the researcher.

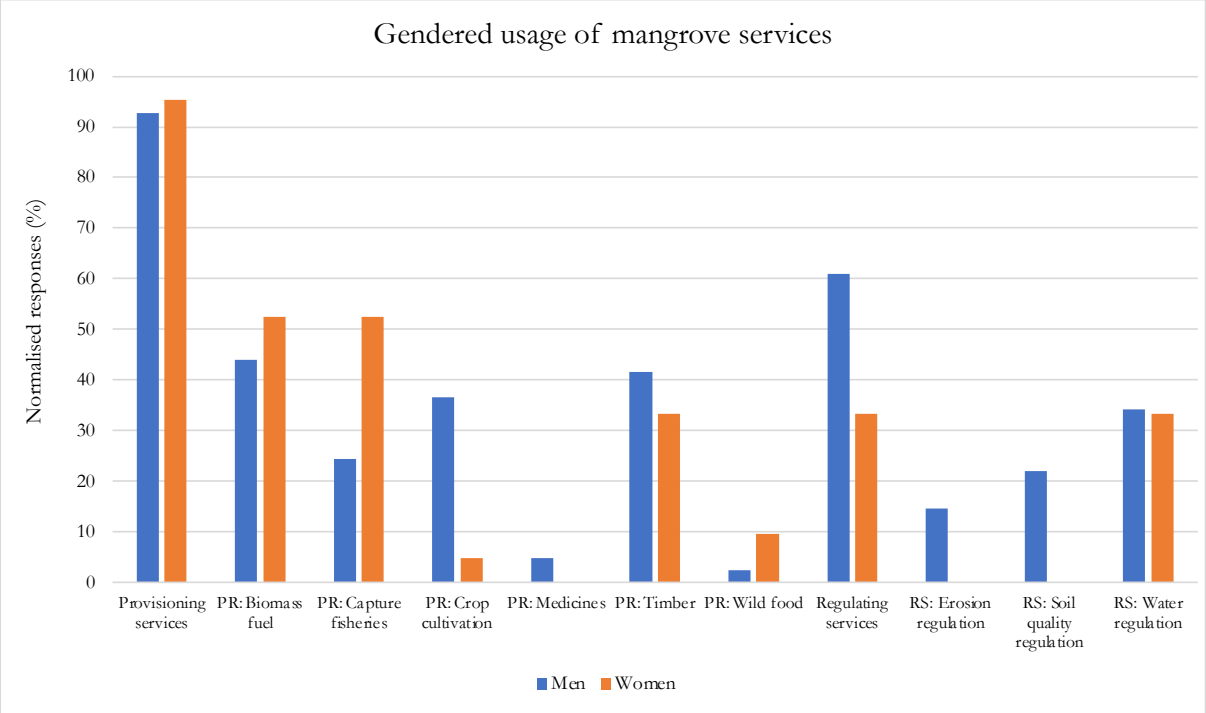


Figure 13 – Normalised count of gendered usage of mangrove ecosystem services from interviews, across all villages.

4.2.1 Rights to access resources and decision-making power – timber harvesting by women

Questionnaires (see Figure 14) revealed that mangrove timber harvesting for fuel (e.g., cooking, smoking fish, or salt production) is exclusively conducted by women, occasionally with the help of young boys if resources permit (i.e., money or time). In contrast, interviews and field observations noted that men collect mangrove wood primarily for structural uses, such as house construction, fences, or ploughs.

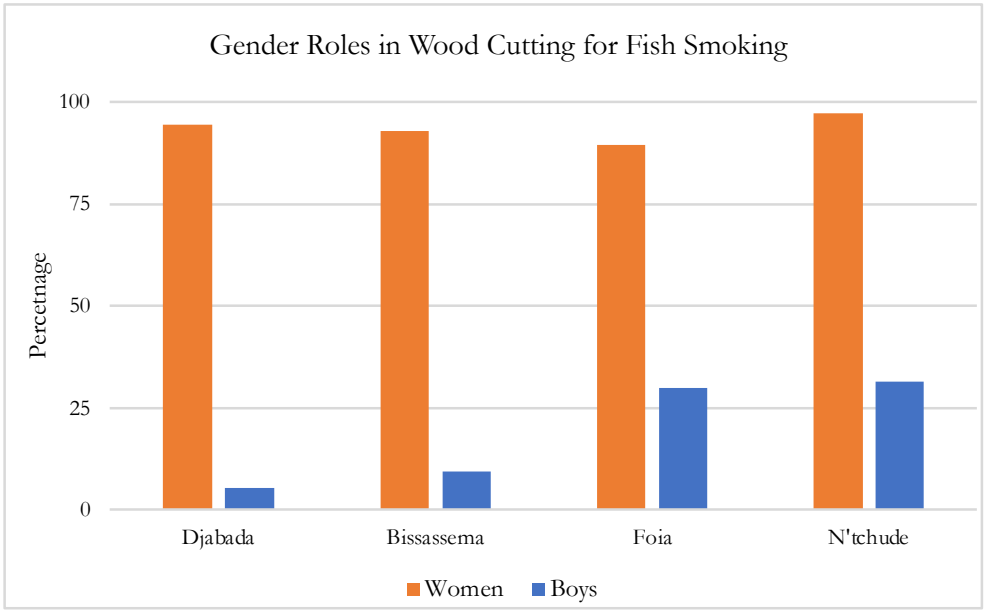


Figure 14 – Questionnaire data on percentage of responses for gender roles in wood harvesting for smoking fish

Throughout interviews, it appeared that women were often asked by men to stop cutting mangroves as it damages rice fields, as explained by a man from Djabada: "[…] For three years now, we've told the women to stop cutting. If they cut green or wet mangroves, they're only asking for trouble—it will cause us hardship." If women cut down mangrove wood, then it is the dry wood or far from the rice fields. Most of the time, this was an initiative or an obligation by men, and especially in the villages of N'tchudé and Djabada (where there is project intervention), but this was also noted for Foia and Bissassema as was explained by a woman from Foia: "It is the men who give the authorisation to women regarding where they can go to cut wood because it is the men who work in the rice fields." And by a man in Bissassema: "[…] One year, women cut down a lot of wood there, and we saw how it significantly contributed to the destruction of the rice fields. This is why we now prevent them from cutting mangroves in the areas near the rice fields."

It became evident that the **restrictions on woodcutting have impacted women**, who now need to travel further to gather wood, either from distant mangroves or other forest areas. This additional distance is more physically demanding, and as previously mentioned, other types of wood are less efficient for biomass fuel than mangrove wood. Additionally, they can no longer sell mangrove wood to Bissau, resulting in the loss of **a source of income**. This impact was acknowledged from time to time such as through this statement from a man in Djabada: "Men prevent women from cutting down mangroves; hence, there are advantages [in the mangroves] for men but not for women."

However, this impact is balanced by all participants' focus on community food security and the understanding that, despite the division of labour, both families and village benefit—or suffer —from the quality of rice yields. This was clearly explained by one farmer in Djabada: "If we don't take care of the mangroves, none of us—men, women, or our children—will have food." Moreover, through informal discussions, it was noted that many women have independently decided that it is best to stop cutting mangrove wood to help preserve the ecosystem, recognising the long-term importance of sustainable practices for community well-being.

4.2.2. Gendered interaction with mangroves – opportunities and abilities

It appears through interviews and questionnaire data that **gender roles are very clear in household provisioning**. However, recently, due to the decline in mangrove cover, **women** mentioned in interviews that they have been **impacted** in terms of **access to resources**, as well as **opportunities** and **abilities** for income-generating activities. Indeed, as mentioned above, women have been prevented from cutting down mangroves, as this is believed to create large empty spaces within the mangroves. While this ultimately benefits everyone in terms of rice production and the protection of rice fields, women previously relied on selling this wood to generate some income, which is now impossible, as explained by a woman from Bissassema: "You know, we used to cut down mangroves to sell in Bissau. But now, people have told us to stop. If we cut them, the water will damage the dikes, so we stopped cutting and selling mangroves."

In terms of **gender abilities**, it was mentioned during an interview that Balanta women cannot row canoes to access remote areas of the mangroves; often, they cannot reach certain places or collect as much as they need due to the distance and their lack of financial means to pay for assistance by young boys. Hence, they are dependent on men to row the canoe if they need to transport wood by the river.

Moreover, although women often engage closely with mangrove ecosystems through activities like fishing, crabbing, and timber extraction, many redirected questions to their husbands or other men, citing a lack of expertise to answer the interview questions. As participants expressed, **mangroves** are **strongly associated** with **rice production** and, therefore, with labour in the rice fields, which is primarily **performed by men**—though women play an important role in rice transplanting (*paranta* in Kriol).

Overall, when directly asked whether men and women share the same advantages, the response was almost always affirmative (67% women, and 45% of men responded "yes"). Despite a **division of labour** in activities such as wood cutting, rice cultivation, and fishing, differing **decision-power abilities,** and restricted **access to resources** for women, all benefits ultimately contribute to the household. Thus, even if one activity is impacted by the decline in mangroves, it appears not to matter which gender is affected, as the consequences impact the whole household.

4.3. Mangroves cover change & restoration efforts

This section will first describe the drivers that contribute to changes in mangrove cover and, consequently, the ecosystem services provided. It will then expand on participants' perceptions of mangrove planting and the restoration project, drawing insights from interviews. The section will conclude by highlighting insights from interviews, questionnaires, and observations regarding sustainable practices in mangrove use across the villages.

4.3.1. Drivers of change in mangrove cover

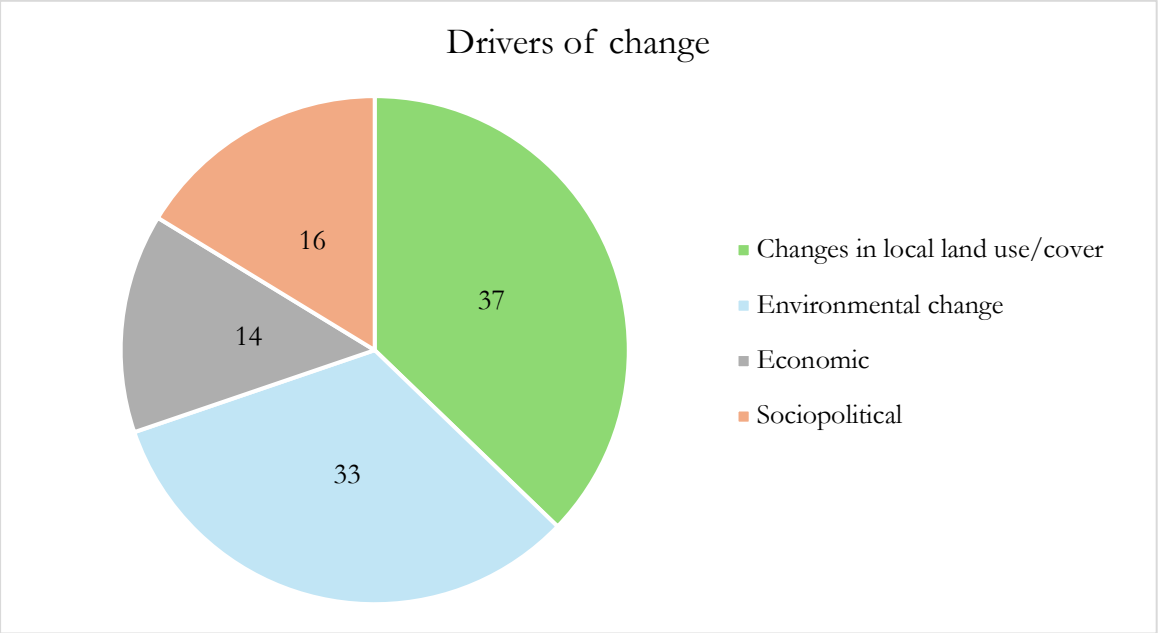


Figure 15 – Relative percentage of mentioned drivers of change during interviews

Changes in land use/cover

"The mangroves used to be very close, but now they are quite far away."
(Participant 18 - Man – Bissassema)

Informal conversations with villagers and field visit reveal that in every village, there has been a change in mangrove cover, with a decline in mangroves in the surroundings of all villages. During interviews, 32% of participants stated that mangrove cover will decline (see Figure 18), explaining that it will decrease because people are cutting them down to create new rice fields or to use for timber and biomass fuel. As explained by a participant in Foia: "[Mangroves] will decrease because people work with them a lot, like opening new rice fields. This is why mangroves have a tendency to decrease even more."

Moreover, 73% of interview participants in Djabada expressed that mangroves would decrease as they do not see improvements from the project, and erosion and high tides are becoming more severe than ever. It seemed that participants in Djabada were more pessimistic, with significantly more responses focused on decline compared to those from N'tchudé: "[Mangroves] will decrease because we planted them, but they did not grow, and the tides take away the mud, causing the mangroves to fall. High tides are increasing more than before." (Participant 51 – Man – Djabada)

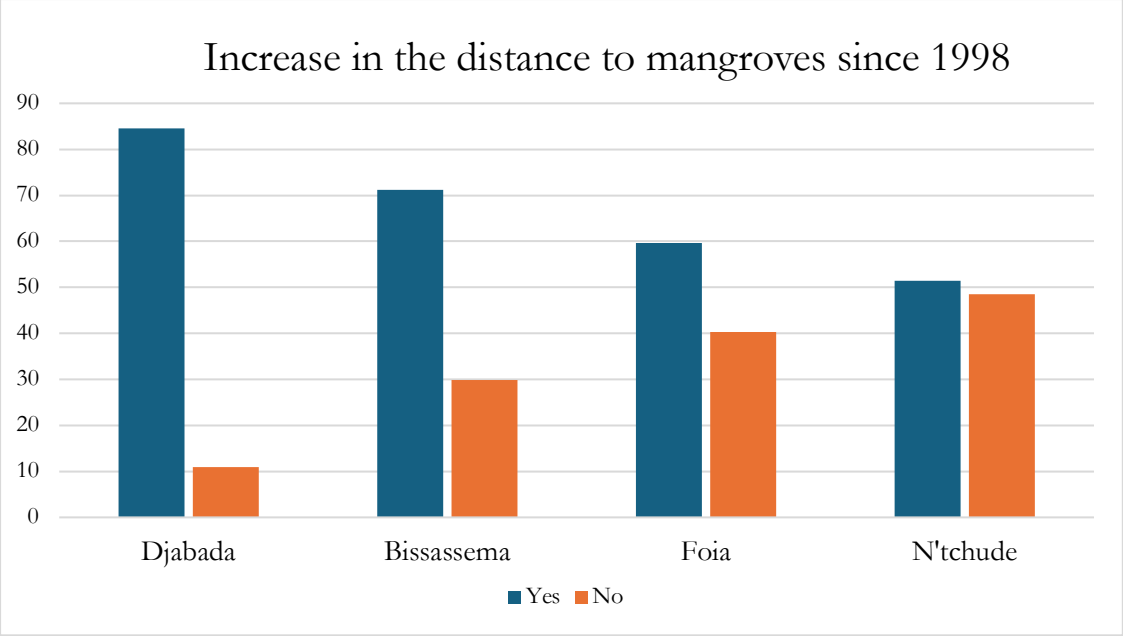


Figure 16 – Questionnaire data on the percentage of responses regarding whether the distance from the mangroves has increased since 7 June 1998

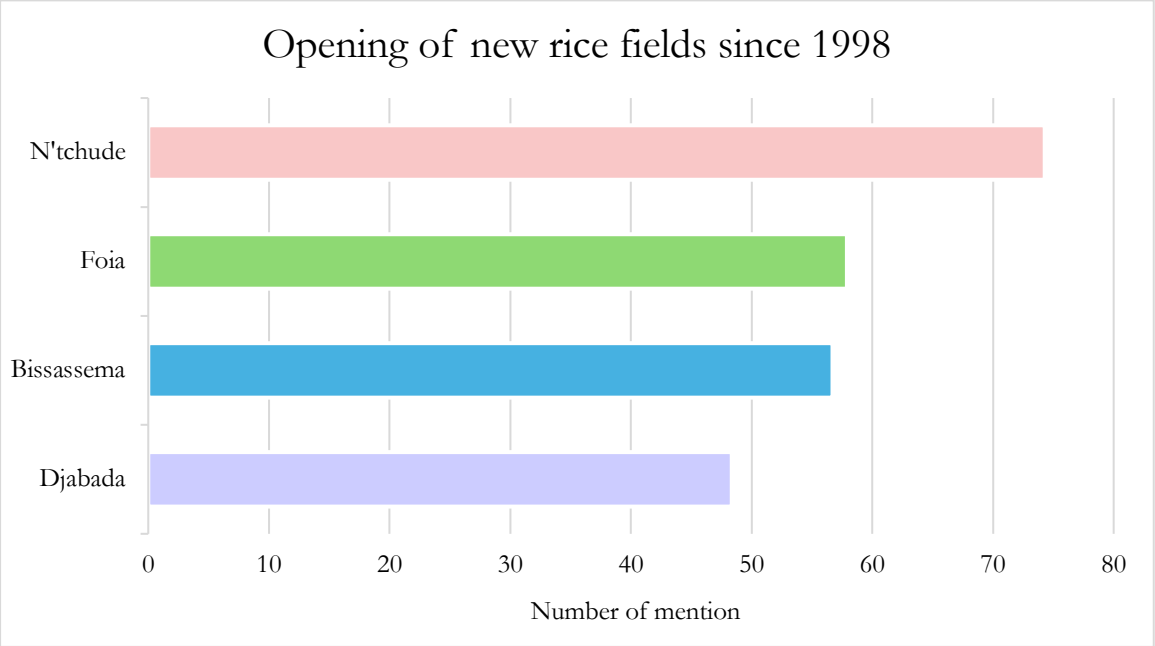


Figure 17 – Questionnaire data on the percentage of participant who opened new rice fields since 7th of June 1998

Through questionnaires, it is evident that all villages have been opening new rice fields, especially in N'tchudé, with 74% of households answering this question, compared to 48% in Djabada (see Figure 17). However, when asked during interviews whether they think mangrove cover will increase or decrease in the future (10 to 20 years) more than half (60%) of interview participants

stated that they believe mangroves will increase (see Figure 18). The reasons varied, including that they have stopped cutting down (wet) mangroves, that salty water is entering the rice fields (likely due to erosion and sea level rise), allowing mangroves to return, and in villages with project interventions, participants believe the mangroves will increase because they are being actively planted through these initiatives. Additionally, some people have noticed mangroves growing around their rice fields. Two participants also stated during interviews that if mangroves are cut down, they tend to regenerate naturally as exemplified here: "I do not think mangroves can ever disappear; they can only increase, and they also reproduce. When you cut them, you can see others growing next to it." and here: "[Mangroves] will increase. If you cut a lot, they grow back a lot.".

Interviews revealed that 83% of participants from N'tchudé responded that they believe mangroves will increase due to planting mangroves through the project. However, this could be biased due to the interview being conducted the same day as the IBAP project arrived in N'tchudé. One participant from the nearby village of Foia also stated that mangroves will increase because they have planted them in N'tchudé.

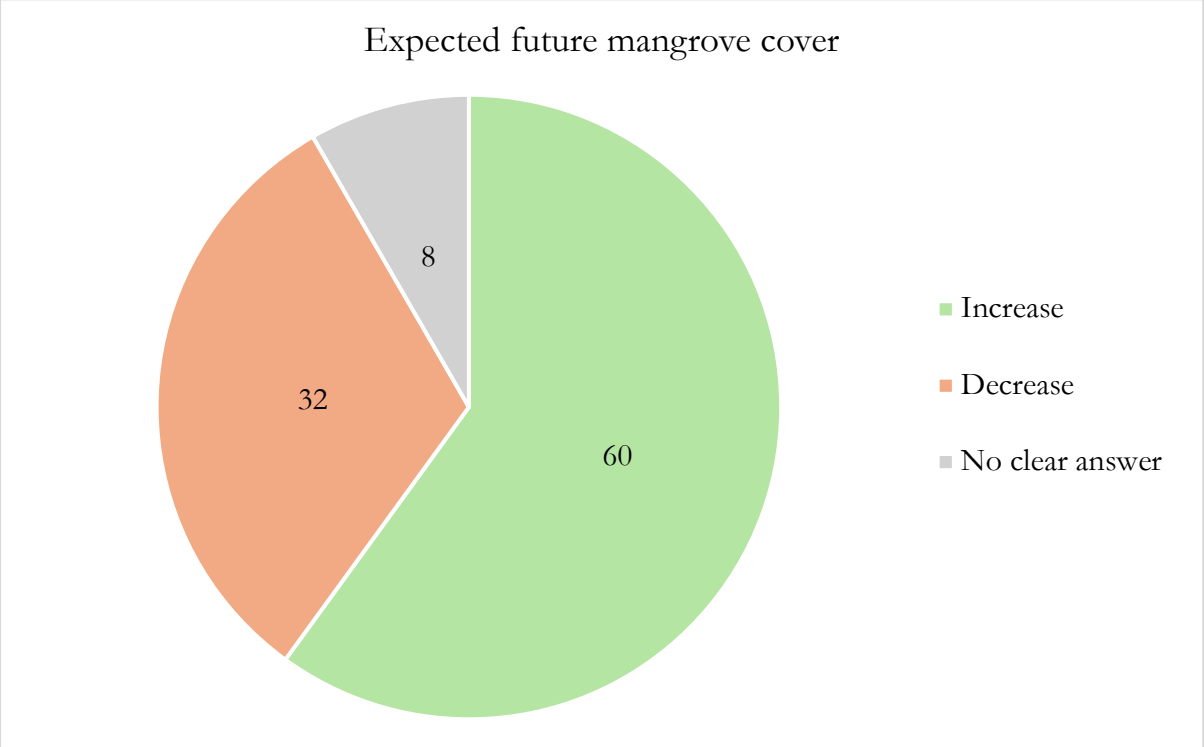


Figure 18 – Relative percentage of responses regarding whether mangrove cover will increase or decrease in the village.

Environmental change

"[…] the tides take away the mud, causing the mangroves to fall. High tides are increasing more than before." (Participant 51 – Man – Djabada)

It became apparent during field work, that despite rice production clearing mangrove spaces, this decrease is now amplified by sea level rise causing coastline erosion, with high tides increasing and damaging the rice fields and the mangroves. This was especially visible in the village of Djabada – a village where the impacts of mangrove cover loss and erosion are most evident – where almost every participant mentioned these factors and showed clear preoccupations for the coming years and the high tides coming in more than ever before (see Figure 19 and 20).

Some participants from Djabada shared insights during interviews about how the landscape once appeared compared to today, often through recounting stories from the past such as these two examples: "When we were little, if you stood looking at the sea, every place was closed, but now there are gaps […]." and "Before I was born, mangroves were there because we heard our grandfathers tell us about the tides. When we were taking out the cows, there were a lot of mangroves; before, you could cross the river and see a lot of mangroves. But now, mangroves are damaged because salty water is taking them down every day; they are falling".

Another environmental change noted by participants during informal conversations was the shift in rainfall patterns. People mentioned that, nowadays, men are sometimes unable to work in the rice fields due to excessive water (i.e., intense rainfalls during high tides prevent drainage (Temudo & Cabral, 2017), while at other times, dry conditions prevent the mangroves from regenerating. Field observations and informal conversations have highlighted the formation of tannes (i.e., hyper-saline zones) and the reduction of soil fertility in upper fields due to the extended duration of the dry seasons and higher temperatures.

Figure 19 - Visible erosion along the coastline of Djabada Portu

"The high tides come in, and the rice fields get damaged." (Participant 57 - Man – Djabada)

Figure 20 - Flooded rice fields in Djabada Portu due to high tides and rainy season

Economic

Economic drivers of change were identified through the interviews, particularly when discussing financial means for transport to reach forested areas or the ability to pay for new housing materials. Overall, from the interviews and questionnaires, it appears that mangroves are not exploited for economic incentives or profit but are primarily used to meet household basic needs. This is exemplified in the questionnaire data, particularly regarding salt production, where an average of 58% across villages is produced for household use and 20% for both household use and selling.

Three women mentioned that they lack the financial means to transport wood from distant areas, as one woman in Djabada explained "We do cut mangrove wood, but we cut more forest wood. You search for a car that can bring you there, but for the mangroves, it is difficult to find a canoe; this is why we cut more forest wood." This suggests that due to financial constraints, such as the difficulty in finding a canoe or hiring help for rowing, women tend to cut forest wood instead of mangrove wood. Although they ultimately go to the forest and pay for a car to transport the wood home, finding a canoe seems to be more difficult, even when money is available.

Additionally, some participants have stopped using mangrove wood for house structures, mentioning they now have the financial means to use zinc. This change has led to a reduced reliance on mangrove wood and instead increased demand for forest wood to support the roofing structures. However, it must be noted that this is mainly the case in N'tchudé, where, based on field observations, the availability of tall mangrove trees is limited. Mangroves can still be used for structures with zinc, provided the resource of tall mangrove trees is available.

Finally, through field observations, informal conversations, and interviews, many participants expressed a sense of powerlessness regarding the restoration of mangrove cover. They believe little can be done without external assistance to restore mangroves and protect their rice fields. One participant in Bissassema stated, "We do not have the means to stop this." Upon further questioning, participants shared that they lack the time, money, or knowledge to invest in planting mangroves. Therefore, they emphasised the need for support from external organisations that could provide livelihood compensation and help reduce the strain on mangroves (e.g., through providing plastic sheets for salt production).

Sociopolitical

Within the context of this study and the drivers of change influencing mangrove cover in the selected study villages, it appears that the IBAP restoration project is the primary sociopolitical driver affecting the resource use of mangroves. During an informal conversation with the IBAP project coordinator, it was explained that the project came to do awareness raising on the importance of mangroves and resources they provide and on the techniques for planting. They engaged people from the village and colleagues from Bissau in the planting restoration initiative.
The selection of village was based on the level of commitment or interest and considering potential benefits for women. The coordinator mentioned that young people in the communities have been highly active, although their report stated otherwise (Instituto da Biodiversidade e das Áreas

Protegidas, 2021). IBAP has put into place an education system in schools to teach the importance of mangroves to younger generations. In questionnaires and interviews, household heads (woman or man) were the ones giving answers, as culturally expected, which means there is little data input from younger generations.

It was mentioned that there is now much less mutual assistance among farmers compared to the past, which makes it more difficult to select locations for restoration. It was further mentioned that significant political challenges have complicated the implementation of the project in Djabada. In this village, the island was chosen by IBAP because the communities were more focused on rehabilitating the *bolanhas* (rice paddies) than on restoring mangroves. This island is far from the village and farmers must row to get there. New rice fields were recently opened there to account for the loss of fertility in the upper lying fields of the village.

A notable aspect is that participants had varied responses during interviews when asked about what the project provided in return. Some mentioned that everyone involved received money, others noted that tools were given to the village, while some emphasised that they participated solely because of its importance to their community and would have done so without financial compensation, such as one woman in N'tchudé: "I went because the project came to help us here in our village, and for this, I am happy. I would have gone even if they did not pay us, simply because I want to help." However, during the informal interview, IBAP's project coordinator, denied any direct financial compensation and stated that only livelihood compensation (e.g., food for work such as rice, oil, beans, canned fish, etc) or infrastructures (e.g., rice milling machines, wells, etc) for the villages were given. In exchange for the participation of people from the village in the plantation, plastic sheets for salt production were given to the village as well as machines for grinding rice, horticulture tools, etc. Furthermore, interviewed participants provided conflicting statements, with some mentioning that only women participated, others stating that only men were involved, and some claiming that the areas they planted had grown very well, while others said the opposite — that the planting had not been successful at all.

4.3.2. Mangroves restoration initiatives

Perception of planting

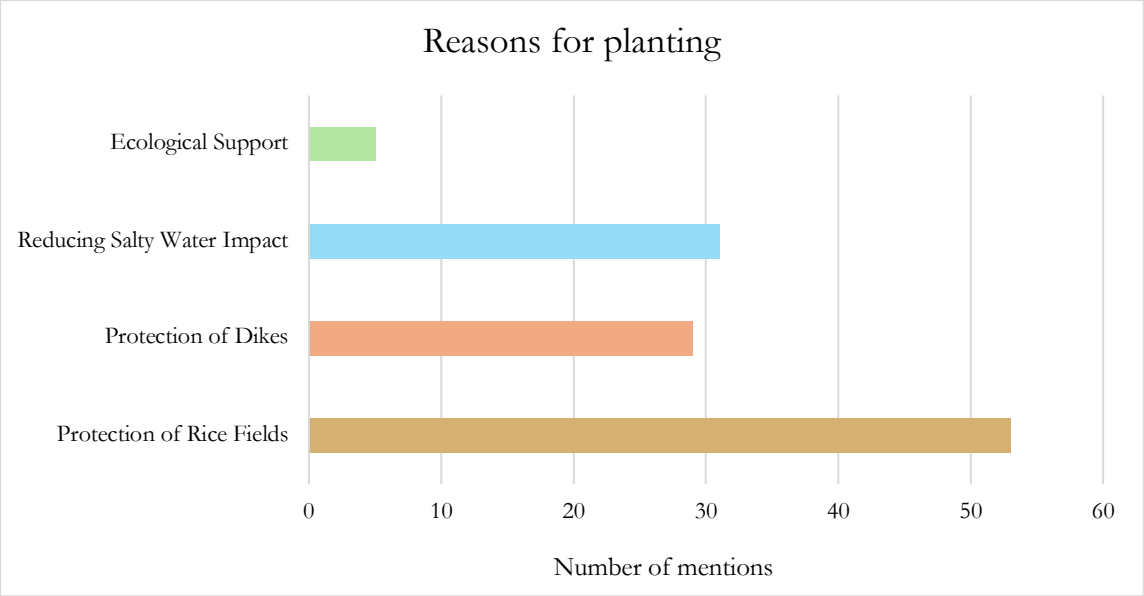


Figure 21- Number of mentions recorded in questionnaire responses for reasons for planting

When asked in questionnaires about their views on planting mangroves and its potential advantages, most participants indicated that the primary reason for planting mangroves is to protect rice fields from environmental threats, particularly the impact of saltwater. The three main reasons are connected to rice production; thus, it means that they mostly plant mangroves with provisioning ecosystem services in mind (see Figure 21).

Villages with project interventions often associated questions about planting mangroves with the project. When asked if they planted mangroves outside project initiatives, most participants responded negatively. In Bissassema, three participants mentioned waiting for IBAP to intervene and referred to N'tchudé as an example of planting efforts, while others reported no planting activity. However, in Foia, one man noted voluntarily planting mangroves to protect rice fields from salty water, explaining: "We plant them because it benefits us. We collect seeds of Avicennia that have already grown a bit, take them, and plant them in places where there are no mangroves. It only takes two months to see improvements."

Perception of project

This section will highlight the differing perceptions during interviews of the restoration project across villages, serving as a comparison between those that have received the project's intervention (N'tchudé and Djabada) and those that have not (Foia and Bissassema).

In N'tchudé the responses were almost all positive when asked about the impression of the IBAP project in their village. Overall, participants were satisfied and positive about the future mangrove cover in their village. However, some participants mentioned that in the first years of the project, IBAP were employing techniques that were neither efficient, nor good for the mangrove's growth, as they were uprooting juvenile mangroves instead of foraging for propagules on trees, as described by one man from N'tchudé: "The first year, they did not grow very much because we took mangroves that already had some roots, which caused many to die. But in the second year, they came, and we took some propagules instead to plant them, and they grew well, so they stopped dying.".

By contrast, participants from Djabada were much more pessimistic about the future mangrove cover in their village and of the positive contribution of IBAP. It appeared that the slow growth rate and high mortality rate of mangroves planted by the participants in collaboration with IBAP were feeding into the fears linked to sea level rise damaging rice fields and potentially the village in a few years as explained by one participant: "Given Djabada's location on the coast, mangroves are crucial for the village as they protect us from the wind, preventing damage to our houses."

Two farmers from Djabada (participants 58) further discussed how "IBAP only has projects for the island, not for our rice fields.". They described, with disappointment, how the project already came six times, yet the mangroves are not growing and continue falling, and that IBAP want farmers to let go of some rice fields on the island to do restoration. However, the farmers are worried about rice food security as one of them explained: "They told us to give up 100 metres [on the island]. The problem is that then the rice fields left wouldn't be sufficient for our large population." After discussions with IBAP, they decided to give 50 meters away for mangrove restoration through planting. One issue raised by these men were that IBAP asks them to give away rice fields on the island, when their more immediate concerns are about restoring mangroves closer to the village shore, to protect the rice fields next to the village, and hence the village itself from sea level rise.

However, it appears difficult to plant anything at the edge of the sea in Djabada, with participants mentioning: […] You plant, and it does not evolve; it just gets damaged. It grows, then it gets damaged." Both men acknowledged the importance of restoring these mangroves and credited IBAP for the project, recognising its benefits and how it enables them to return to the rice fields on the island. They explained that the project emphasised how planting benefits both the project and the village and clarified that the project's role is to offer guidance rather than remain permanently. Nonetheless, they seemed frustrated with IBAP's technique in doing so, as one of them explained: "But the land we use for food, our rice fields, it is vital. You know that if someone has land for growing food, they will do everything they can to maintain it. However, despite us saying this, they still took our land. They came and took my field as well. That's how they operate—planting in one area and expanding into the surrounding lands.".

Overall, participants from both Djabada and N'tchudé mentioned that the project explained to people who participated in the planting initiative that they need to stop cutting mangroves and explained techniques for planting mangroves. An overall satisfaction was felt, although many participants still asked us to explain the importance of mangroves or how to plant them. Hence, it appeared that only people helping IBAP got hold of the knowledge, whereas the rest of the village did not.

In Bissassema and Foia, no mangrove restoration project took place, and hence, a lot of participants asked us to share our knowledge about the ecology and importance of mangroves. A few participants mentioned planting mangroves voluntarily close to their rice field to protect them. As the village of Foia and N'tchudé are close to each other (less than two kilometers), some participants from Foia mentioned a probable increase in mangrove cover as the neighbouring village is planting them. In Bissassema, an elderly man mentioned how the IBAP project promised to come, however, they are still waiting for them – whereas another participant from the same village said they came already, which is not the case according to the project's database.

Sustainable use and awareness of mangrove ecological processes

Despite recognising the impact of mangrove swamp rice, people across all villages consistently acknowledged the importance of harvesting mangrove wood sustainably, evidenced both in interviews and questionnaires. This includes practices like cutting in different areas to reduce pressure on a single spot, and not cutting down mangroves with propagules such as explained by a man in Foia: "[…] The ones that I leave alone are those that have propagules on them, because

they will bring some new mangroves. That's why I go to different places." In Bissassema, one man highlighted the elders' practice of leaving mangroves untouched for regrowth and preserving certain areas for protection and sustainability, as reflected in his statement: "We, the elders, have left the mangroves alone since 1990. We haven't worked there since, but this year we want to return. We won't use the entire area; we'll leave half of it for the mangroves so they can protect our dykes. If we destroy the mangroves, it won't help us. We only cut down the mangroves inside our rice fields."

When asked about mangrove wood harvesting practices (see Figure 22), participants explained that women cut in different places, either to follow the pattern of newly opened rice fields (hence to gather the mangrove wood they cut to open a new rice field): "Every year, they cut the mangroves in one rice field, then the next year in another.", or that they do it to follow a pattern to prevent running out of wood. Recently, as the effects of mangrove decline have become more pronounced, many people have shifted to cutting only dry, fallen wood instead of green and wet wood.

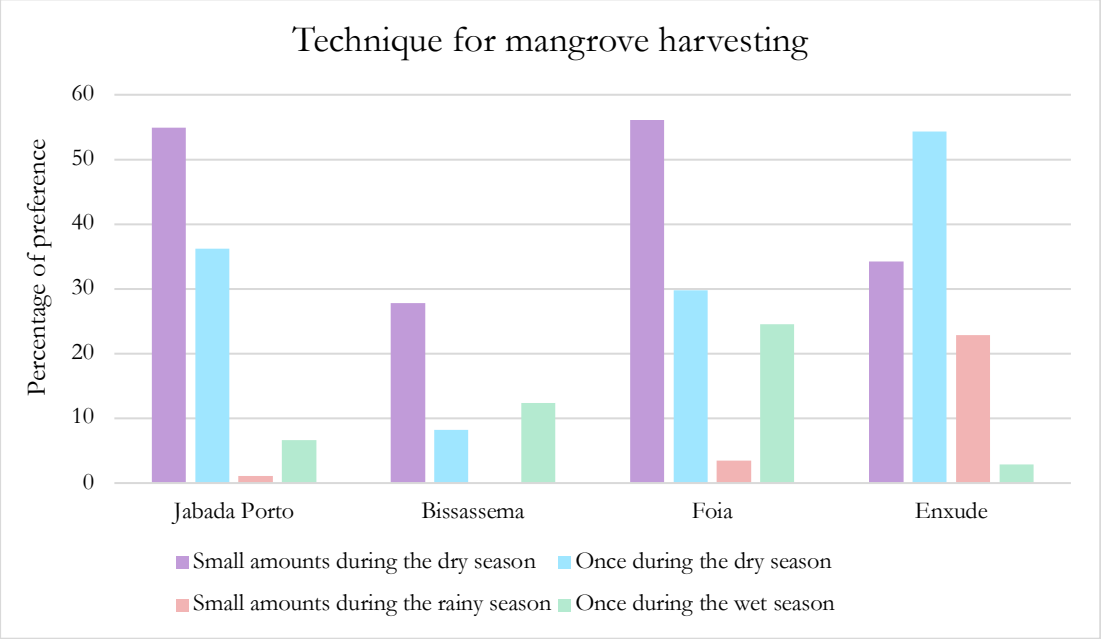


Figure 22 - Preferred techniques for mangrove wood harvesting by village

The method for cutting mangroves varies across villages, although there is a general preference for harvesting small amounts of mangrove wood during the dry season, with 42% of households reporting this practice in questionnaires. Overall, the dry season appears to be the selected time for cutting. This is consistent with other responses from questionnaires, regarding whether the

wood is collected wet, dry, or exclusively dry, where most households across all villages indicated that dry wood is mostly collected (see Figure 23).

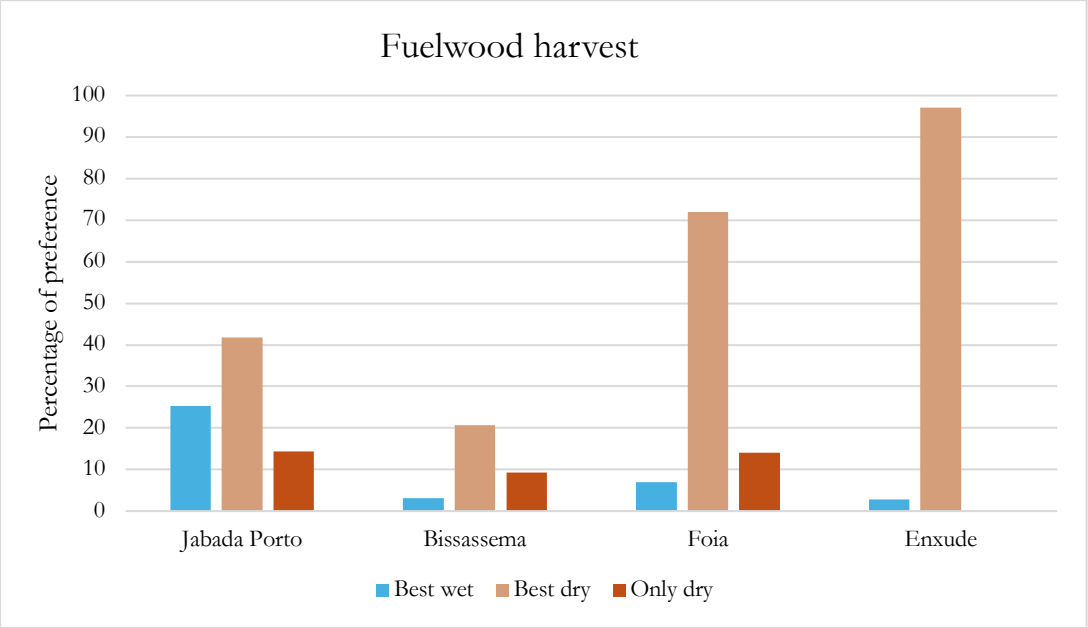


Figure 23 - Preferred condition of mangrove wood for fuelwood by village

There was also a strong understanding of mangrove ecological processes during interviews, particularly in the villages of N'tchudé and Djabada, where the project had been implemented. However, even in villages without project involvement, people, primarily men, demonstrated considerable local knowledge, explaining processes related to fertile soil, erosion, sedimentation, and tides. This reflected an understanding of mangrove ecological processes across communities as provided through these statements: "Mangroves are important because they reduce the force of the tides damaging our dikes, which prevents mud from escaping, thereby elevating the soil. In areas where there is visible erosion, if mangroves start growing there, the area can be restored because they retain the mud in place and create stability. They are important for the village because they protect our houses from the wind." (Participant 49 – Man – N'tchudé), and: "Mangroves are very important for us because they provide wood, protect the dikes against salty water, and contribute to fertile soil in our new rice fields, which increases rice production.' (Participant 22 - Man – Foia)

To conclude, a statement from one participant in N'tchudé serves to emphasise the communities' awareness of the numerous benefits that mangroves provide, including protection and resources. It also highlights their recognition of the positive impact that human efforts, such as replanting,

can have on mangroves, while acknowledging the negative effects that livelihood activities can have on these ecosystems: "Mangroves are important because we cut them for poles to make houses, they are also where fish reproduce, and they protect our rice fields. If you remove all the mangroves, it will be much easier for water to enter the rice fields. The roots of the mangroves protect a lot because they hold the mud close to the main dikes, preventing water from washing away the mud. Mangroves also provide good fertile soil. Overall, we can summarise in two ways: a positive one is that we plant mangroves to protect our rice fields, and a negative one is that we cut them down to create new rice fields."

Table 6 - Data triangulation across themes and data sources

Research questions	Interview	Questionnaires	Field observations	Complimentarities	Discrepancies
Local communities' perception of mangroves and current uses	**Mangroves** are vital for **food security**, through rice production and capture fisheries. Also valued for providing **biomass fuel and timber**. **Mangroves** are recognised as key contributors to water and soil regulation, with 54% of participants acknowledging these **regulatory functions.** **Social conflicts** over **access to resources**, whether mangroves or rice fields, can lead to disputes among farmers and families, this is exacerbated by sea-level rise.	**Inter-village similarities** in the use of mangrove wood as **timber.** **Inter-village difference**s with no discernible patterns in **household fuelwood usage**. **Additional** mangrove **services**, such as charcoal, medicines, and wild food, are utilised **less frequently**.	Use of mangroves vary by **household proximity.** For instance, in Bissassema, households further from mangroves reported fewer mangrove usages outside of rice fields. Use of mangroves as shrines, animist rituals, and as recreational spaces for children.	**Food security** through rice production is consistent across interviews, questionnaires, and field observations. **Mangroves** play a crucial role in **protecting rice fields**, reinforcing their significance to local livelihoods. Selection of wood depends mainly on **proximity-factors.**	Data from questionnaires reveal some inter-village differences in household fuelwood use. However, interviews suggest that participants generally consider mangrove wood to be preferable as fuelwood. **Cultural services** were notably absent in participants' responses, which contrasts with field observations.
Gendered utilisation and perspectives on mangroves	**Gendered division of labour** in activities such as wood cutting, rice cultivation, and fishing. Both genders valued provisioning services; **women** more frequently mentioned **fisheries** (52%), **and biomass fuel** (52%) while **men** more often referred **to crop cultivation** (37%) and **timber** (41%). **Regulating services** are more valued by men. **Water regulation** was mentioned by both groups, whereas **soil quality** and **erosion regulation** were only mentioned by men **Restrictions on woodcutting** impacts women.	93% of women across villages are in charge of cutting down mangroves for fuelwood. Nine women in Djabada and N'tchudé, reported benefiting from **plastic sheets** provided by the project, **reducing** reliance on **mangrove wood**.	**Gender roles** in the household are **evident** and women would redirect most questions to the men household head. IBAP project selects villages based on the extent to which women can benefit, but it remains unclear whether it effectively target the right opportunities to boost women's abilities and to provide equal gender opportunities for both men and women.	Consistent across all data sources, despite a gendered **division of labour** in activities such as wood cutting, rice cultivation, and fishing, all **benefits** ultimately contribute to the **household.** The **consequences** of changes in mangrove cover affect all gender groups, as there are strong gender collaboration and complementarities in villages.	An informal interview with the IBAP project manager highlighted a focus on benefiting women by giving them supports for alternative livelihoods. By providing a focus support to women, men are constrained in their productive activities and compelled to find alternative sources of income to purchase imported rice.
Changes in mangrove cover & restoration efforts	Most participants recognise **mangrove** decline but 60% are confident that cover will **increase.** Participants showed **awareness** of **sustainable mangrove usage practices.** Participants in villages with project interventions had greater **knowledge** of **mangrove ecological processes**. Overall **satisfaction** in the **project** in **N'tchudé**. In contrast, in **Djabada**, 73% of participants believe mangrove will **decrease** as they do not see improvements from the project's initiatives and increasing erosion. Intra-village **conflicting narratives** about who participated in the project and the benefits received.	Main reasons for **planting mangroves** are linked to **rice production**, with most participants planting them for provisioning ecosystem services. 85% of households across all villages reported having to **travel farther** from home to **collect wood.** Participants expect **mangrove cover** to **increase** in the future and are using **sustainable practices** for mangrove usage.	**Mangroves decrease** is now **exacerbated** by **sea-level rise**, with high tides damaging both rice fields and mangroves. **Village selection** for the project was based on **commitment** and **interest** of villagers, and restoration **potential**. **Social conflicts**, including political issues in villages like Djabada, along with reduced mutual help among farmers, have **complicated restoration efforts**. Many participants feel **powerless**, believing that little can be done without **external assistance.**	Awareness of some decline, especially due to environmental changes and importance of sustainable practices is consistent across all data sources. Participants expect **mangrove to increase** in the future, as they are growing back in rice field due to abandon of them. Data demonstrates that communities are **not homogenous**, reflected in differing practices around mangrove cutting and varying levels of awareness of sustainability. The project has raised awareness, but only those who participated benefit from this knowledge, which does not seem to be shared with the broader community.	**Project perception varied across villages**: N'tchudé had overall positive feedback, while Djabada participants were mostly disappointed and pessimistic. Foia showed curiosity about mangroves ecology, and Bissassema prioritised forest wood over rice fields due to distance. **Narratives around mangrove cover changes are conflicting**; questionnaires show that all villages are opening new rice fields. However, 60% of participants believe mangrove cover will increase. This aligns with previous academic research but contrasts with government statements and questionnaire data.

5. Discussion

This research aimed to highlight the dynamics surrounding mangrove use and restoration strategies, employing socio-ecological and gendered perspectives to explore the drivers of change and the interplay between mangrove ecosystems and human activities. This discussion section aims to go a step further and link the results with past and ongoing research around mangrove perceptions and restoration to open up a discussion on better practices around it. The discussion starts by taking a step back and looking at the researcher's ontological perspective on the subject and positionality to engage in a process of reflexivity (section 5.1). Then, the three sub-research questions that were examined in this thesis will be discussed. This addresses research question 1 on communities' reliance on and perceptions of mangrove ecosystem services (section 5.2), research questions 2 on how gendered dynamics influence the utilisation of mangrove services, highlighting the importance of gendered frameworks (5.3), and research question 3 on the influences of restoration initiatives on communities' interactions with mangroves (5.4). This final section also discusses broader aspects, critically reflecting on academic perspectives and approaches taken by development and conservation organisations to rethink the approach to mangrove restoration by examining the root causes of engagement with communities, as well as the socioeconomic and political conflicts of interest surrounding these processes.

5.1. Critical reflection on the research and positionality

This research sought to engage in a process that included critical reflections on positionality, privileges, and dynamics that could influence the research approach, interactions with participants, and the interpretation and discussion of results. This involved shaping questions based on consultations with individuals who have lived in the villages and possess an in-depth understanding of local ontologies and village dynamics, followed by conducting interviews through a trial-and-error process of fostering mutual understanding with participants. Additionally, the research drew on and engaged with the reflective framework outlined in the list of "Questions that won't go away" (see Appendix 1) by Long et al. (2016). This framework includes reflective questions on topics such as community identity, membership issues, researcher's roles, community expectations, accountability, rewards, research sustainability, and power dynamics.

The question, "Who decides who is an 'insider' and 'outsider'?" (Long et al., 2016) was especially insightful to reflect on. The concept of "outsider" is associated with traits and characteristics differing from those of the participants, such as ethnicity, while "insider" was identified through

shared attributes, such as gender. Hence, as a white European woman, the researcher was initially expected to be categorised as an "outsider", however, was able to engage with more people, especially women, compared to students from Bissau's university, due to gender similarities.
The "insider-outsider" positionality was not considered a fixed dichotomy but rather understood as a continuum (Bukamal, 2022). This continuum is multidimensional and shaped by factors including the ability to speak Kriol, living in villages, gender, collaboration with students from Bissau, the duration of eight months spent in the country, being white-European, and prior experience with an NGO. These dynamics were acknowledged to influence the access gained to participants, whether consciously or unconsciously. By recognising these influences, assumptions can be deconstructed, and reflexivity can be fostered. Reflexivity, as defined by Bukamal (2022), is described as the "awareness of how a researcher's background and experiences can largely shape all stages of the research process." Through this awareness, a more critical examination of roles and the impact of researcher identities on interactions and on the research, process was enabled.

The subject of community expectations and "What responsibilities do professional researchers have in helping the community to address or resolve their problems? (…) and in creating these expectations" (Long et al., 2016), was carefully considered through discussions with one of the students and with participants themselves. It was observed that conducting research and inquiring about restoration initiatives, while visibly being a white researcher, led participants to question whether the research was associated with an NGO project and if an initiative would be implemented to support them. This was particularly evident in the two villages that had not yet received a project (Bissassema and Foia). In contrast, participants in N'tchudé and Djabada were more inclined to express their opinions on the ongoing project, often sharing critiques or thanks with the hope of fostering better outcomes in the future. In N'tchudé, especially, as interviews coincided with IBAP's arrival in the village, some participants expressed their gratitude towards us. Clarifications were provided again to distinguish between this research project and IBAP's initiative. These dynamics were carefully considered during the analysis of interviews in N'tchudé, recognising that the researcher's positionality and participants' expectations could influence their responses, particularly in shaping positive narratives about the project.

Expectations or assumptions of participants (and non-participants) were observed at times when rumours circulated that medications were being distributed, prompting individuals to approach the team with such requests. On other occasions, interviews were actively sought by individuals in the village. Additionally, in all villages, most participants questioned what was being offered in

exchange for their time. These observations were reflected upon and discussed with the students, leading to a decision to engage in conversations with participants about the challenges faced by the villages, particularly in relation to damaged rice fields, as well as to give explanations (when prompted) on the ecological importance of mangroves, their benefits, restoration processes, and management practices for sustainable benefits. Explanations were provided by both the researcher and students regarding the importance of creating visibility through academic research to ensure that future initiatives can be made aware of the multidimensional aspects of these issues. It was emphasised that such visibility could promote ecosystem management that considers local perceptions and needs. In this way, the research is intended to contribute to greater visibility of the vulnerabilities of these villages to climate change and the critical role of mangroves for local communities. It is acknowledged that despite good intentions, the promotion of lasting benefits for the community may not always be feasible. However, efforts are carefully undertaken through ongoing discussions, engagement, knowledge sharing, and clarifications to address any assumptions. Research ethics, in this context, is viewed as an ongoing process of daily reflection, with particular attention given to acknowledging and minimising harm.

Some reflections stem from the researcher's prior experience working with an NGO in the country, particularly observing the limited time NGOs often spend engaging with and understanding the diverse perspectives and dynamic issues within a single village. This experience also influenced the researcher's positionality. During the initial interviews, the researcher engaged in a process of 'storying,' sharing details about the previous months spent working for an NGO. However, it soon became apparent that participants often then held overwhelmingly positive narratives about NGO activities. To minimise bias, the researcher chose to omit this information in subsequent conversations, instead framing the 'storying' process around personal interests in mangroves, academic background, and related topics.

While these reflections are significant, they do not address the limitations imposed by time. The short duration spent in each village (approximately one week) and the quick succession of interviews limited opportunities to build trust, encourage participants to fully share their thoughts, engage in long informal conversations, or visit all relevant mangroves and rice field sites. This time constraint hindered a deeper ethnographic approach in each village that could capture a more complete and nuanced understanding of people's lives, realities, and perceptions—the 'unsaid' aspects of their daily interactions with mangroves, the environment, and NGOs. Additionally, time constraints affected the storying process. Many participants were unwilling to engage in lengthy

conversations due to fatigue after returning from the fields, adverse weather conditions (e.g., heavy rain), or other commitments. These factors collectively restricted the depth of interactions and insights that could have been gathered.

5.2. Mangrove ecosystem services

This section examines how the selected local communities rely on mangroves and investigates whether these patterns align with previous findings on the relationship between mangroves and coastal populations that depend heavily on them. It also considers some dynamics of drivers of change that can influence people's relationship with and perception of mangroves.

5.2.1. Reliance and perceptions of mangroves

Past insights into the perceived value of mangrove ecosystem services by local users differ across studies. Some researchers have found that provisioning and cultural services were considered by respondents as most valuable for their livelihoods (Afonso et al., 2022; Merven et al., 2023; Mohamed et al., 2024), while others found that all the CICES categories were valued (Damastuti et al., 2019; Mukherjee et al., 2014; Ruslan et al., 2022). In a study of communities' perceptions in Tanzania (Nyangoko et al., 2021) it was found that provisioning services were most acknowledged, while other MA categories were less frequently recognised. The findings of the present study tend to confirm this multiplicity of understandings around ecosystem services and their value. Indeed, in the context of Guinea-Bissau, it was found that local communities in the selected villages of the Quinara region place significant emphasis on both provisioning and regulating services. However, in contrast to other studies, cultural services were absent in participants' responses, although field observations indicates that mangroves are being used for shrines, rituals and as recreational spaces for children. These findings are elaborated hereunder.

Firstly, this research found that communities in the selected villages of the Quinara region relate mostly to mangroves through their provisioning services. The high mention of this category (97% of interview respondents) shows that mangroves are seen as a vital ecosystem for meeting basic livelihood needs such as fisheries, timber and rice production. This study's findings on the high value placed on mangrove swamp rice align with previous research highlighting the cultural significance of rice fields in Guinea-Bissau (Sousa, 2023; Temudo, 2011). Indeed, rice has strong cultural ties and remains an essential element in food traditions (Temudo, 2011). The dominance

of rice cultivation as a relevant aspect of mangrove services and people's livelihoods is undeniably the most important relation that coastal communities have with mangroves.

This research further found that geographical isolation, durability of wood, and limited resources frequently compel communities to rely on the most accessible resources. For example, fuelwood is collected from both mangroves and upland forests, with villages further away from mangroves using more forest products (and wood from fruit trees' pruning, such as mango and cashews) and villages closer to mangroves extracting more of them. Besides, N'tchudé is in closer proximity to mangroves; hence, although forest wood might be preferred for certain uses, such as smoking fish, mangrove wood is predominantly used. This resonates with a study of mangrove fuelwood usages in Guinea, where it was found that proximity to mangroves was one of the factors of mangroves being used exclusively for cooking (Balde et al., 2020). Additionally, the open access nature of mangroves (Nyangoko et al., 2022) outside village territory boundaries, unlike cashew or mango-planted forests, influences the extraction of mangrove for timber and biomass fuel and complicates sustainable management.

However, proximity-factors or lack of mangroves surrounding villages cannot explain all usages and relational patterns. This study's results indicate that there was a strong preference for forest wood over mangrove wood for fish smoking. This contrasts with previous findings underlying that mangrove wood is typically preferred for this purpose in West and Central Africa due to its availability and ability to burn efficiently (Feka & Ajonina, 2011). In addition, studies have reported the use of mangrove wood for charcoal (Numbere, 2020) other findings show that mangrove wood is considered poor-quality charcoal material in Guinea-Bissau (Temudo et al., 2017). This study indeed found no evidence of mangrove charcoal production in Guinea-Bissau. Overall, patterns observed in our study suggest that proximity, durability and accessibility are key determinants of resource use. However, the use of mangroves does not follow a straightforward pattern; it is influenced by multiple dynamics (sociopolitical, economic, gender, etc) such as will be described in following sections (5.2.2, 5.2.3 and 5.3.1). These dynamics, in turn, appear to influence the use of different services provided by mangroves and, consequently, the relationship with them.

Secondly, coastal erosion continues to threaten coastal communities, which are often the first to recognise and experience its impacts. Aligning with previous studies (Damastuti et al., 2019; Temudo et al., 2022), this research found that in all villages, local communities are worried about coastal erosion, especially in Djabada, where restoration efforts have been doomed due to high

tides and erosion. Coastal erosion and food insecurity are significant concerns in those areas, and the importance placed on regulating services seems to reflect the livelihood challenges these communities face and their need for coastal security as a constituent of well-being. Increased wind and higher tides, as highlighted in previous studies (Ruslan et al., 2022), are particularly concerning, where these changes damage rice fields and mangroves, threatening food security for local communities in Quinara. Climate change effects in the region (high tides, coastal erosion, changes in rainfall patterns, etc), was recognised by local communities in this research as both threats to their livelihood and to the mangroves. Participants emphasised the importance of mangrove regulating services for buffering high tide events and maintaining fertile soil. This aligns with previous findings on the role of regulating services in supporting coastal communities (Damastuti et al., 2019; Sarkar et al., 2014) and of community awareness on climate threats and regulating aspects of the ecosystem (Teka et al., 2019).

Lastly, perceptions of the importance of ecosystem services vary depending on the region in Guinea-Bissau and between ethnic groups. For example, there is a lack of mentions of cultural services in these selected Balanta communities, despite observations of shrines and stories about mangroves used in rituals in other villages (e.g., among the Diola ethnic groups (Damerim, 2024)). The methodology used for interviews and questionnaires might explain why these services were not mentioned. Such conversations might have emerged if questions about cultural services had been asked directly. However, it also suggests that provisioning and regulating services are the most important to them and that they believed expressing this importance was expected of them. This highlights the importance, and strength, of data triangulation in gaining more complete insights into the uses of ecosystem services, and discrepancies such as those between interview narratives and field observations.

A final observation is that no obvious disservices were associated with mangroves in this study. This means that, in this case study, looking at the heavy reliance on mangroves by local communities, the benefits of mangroves outweigh potential disservices such as hard physical labour, smells, and mosquitoes. This research shows that in cases of high dependence on an ecosystem and its services, disservices are not discussed by communities. Moreover, negative perceptions, like mangroves being dark and dangerous, are often rooted in colonial mindsets (Friess et al., 2020). Disservices are shaped by the 'specific economic, cultural, and political context' (Vaz et al., 2017); hence it is important to include the local communities' perceptions of local communities potential disservices in the framework to avoid generalisations based on pre-

conceived and colonial perceptions. Research aimed at holistically integrating disservices into frameworks should cautiously address the dynamics that lead particular stakeholders to define a disservice.

5.2.2. Sociopolitical and economic drivers

One of the aims of conducting this research was to grasp an understanding of local communities' perceptions of mangroves and what dynamics influence their reliance on mangroves, aiming to move away from the tendency to place blame solely on the easy-to-target protagonists of environmental degradation, and to attempt to increase visibility and "amplify" the voices of people most affected by climate change (Temudo et al., 2022).

The main argument taken in this section is that it is not a matter of unawareness of degradation, or the risks posed by climate change, but rather the degradation of mangroves is due to a lack of viable economic alternatives (Mangora, 2011). Vulnerability is produced by "on-the-ground social inequality; unequal access to resources; poverty; poor infrastructure; lack of representation; and inadequate systems of social security, early warning, and planning" (Ribot, 2010:48). The poverty trap, a lack of economic alternatives leading to the overexploitation of resources (Afonso et al., 2022), was evident in this study. For example, some participants continued to cut down mangrove wood or open new rice fields to ensure household food security, despite the risks posed by high tides and rising water levels to other rice fields and the village. This can be attributed to the 'day-to-day living' of economically disadvantaged communities, where livelihood needs take priority over the conservation of mangrove resources (Mangora, 2011). Mukherjee and colleagues (2014) warned about the exhaustibility of mangrove provisioning services, noting how this depletion puts at threat dependent populations by reducing regulating services, which, in turn, diminishes provisioning capacities.

While there is a tendency to blame individuals for these actions, these phenomena are often the result of, and perpetuated by, poor policies, weak governance, and limited economic opportunities (Feka & Ajonina, 2011). In this research it was found that the lack of rice fields maintenance is driven by insufficient economic resources. This, combined with the proximity of rice fields to the coastline, often exacerbates threats such as sea-level rise, high tides, and coastal erosion. These challenges negatively affect rice fields and surrounding mangroves, leading to issues like increased salinity and acidification. As shown by previous studies, farmers often abandon degraded land due to a lack of resources to repair it and open new rice fields, a pattern observed in both Guinea-

Bissau and Guinea Conakry (Balde et al., 2020). These effects could be mitigated if better infrastructure were implemented, such as PVC tubes for water management in mangrove swamp rice fields (Leunda et al., 2024; Temudo & Cabral, 2017). This could reduce the risk of losing plots due to the destruction of dikes by tides and decrease the need to open new fields in the mangroves. Moreover, the cutting of mangrove for timber or biomass fuel by local communities typically imposes minimal stress on mangrove ecosystems as compared to other high scale deforestation practices (Atheull et al., 2009). Although in Guinea-Bissau, mangroves are less affected by urban infrastructure, such as ports, factories, and shrimp farming, than in other regions (Temudo et al., 2017), illegal or informal activities along the coast, such as sand mining (Temudo et al., 2017), can place significant stress on mangroves. This aligns with findings that highlight mangrove degradation caused by urban infrastructure development (Jadin & Rousseau, 2022; Mukherjee et al., 2014) and sand mining (Atheull et al., 2009). Mangora (2011) further outlines that blaming individuals who are heavily reliant on these resources due to a lack of economic opportunities is discriminatory against them and overlooks national and international elites who profit from and degrade these very same resources. Hence, this raises questions about the root causes of mangrove degradation in Guinea-Bissau and the need for further investigation into the broader drivers of this degradation to develop comprehensive and fair restoration strategies. These views also overlook the mutual benefits that nature and people share, as well as the preservation of resources by those who depend on them (Mangora, 2011).

5.2.3. Mangrove cover changes & sustainable practices

This section explores participants' perceptions of mangrove cover changes and highlights the sustainable practices already in use in villages to manage the reliance on mangroves.

While some studies (Jadin & Rousseau., 2022) have shown that most respondents perceive mangroves as being under threat and anticipate further decline, others (Afonso et al., 2022) report that a high percentage of respondents perceive mangroves as not under threat, even in ecologically degraded areas. Consistent with the latter findings, this study reveals that participants often described mangroves as increasing and expressed confidence that "mangroves can never really disappear." These perceptions were linked to participants' direct observations of mangroves regenerating in rice fields or recolonising previously cleared areas. Despite governmental claims about the national decrease of mangroves, respondents' assertion that mangroves are increasing aligns with the findings of Temudo and Cabral (2017). They demonstrated that during the eleven years of the anti-colonial war, the area devoted to mangrove swamp rice fields decreased about

14% (Kohnert 1988: 168), allowing mangrove regeneration in some places (Temudo & Cabral, 2017).

The abandonment of older rice fields creates opportunities for mangroves to regenerate, and if needed this can be supported by methods such as assisted natural regeneration. Concomitantly, the provision of PVC tubes can improve water management in the low-lying fields and eventually help reduce the risks associated with dike ruptures and plot abandonment (Garbanzo et al, 2023). It can also increase the fertility of abandoned upper lying fields to allow the cultivation of upland rice through agroforestry with legume trees (Garbanzo et al, 2023). In this research, farmers acknowledged that to restore the soil layer in a formerly abandoned rice plot, mangroves must be allowed to grow, as their roots are able to retain soil particles and facilitate its accumulation. Another research also shows that farmers from other ethnic group actively planted mangroves (Temudo, et al., 2022).

This research found a strong interest in mangrove ecology among participants, as evident from the discussions following the semi-structured interviews, during which participants actively sought information on minimising their impact and improving their practices to benefit the mangroves. Although many participants expressed the need for external interventions to restore mangroves and advocated for restoration initiatives in their villages, they were often already engaging in sustainable practices, demonstrating a capacity to balance immediate needs with sustainable practices. This supports Afonso and colleagues' (2022) results, highlighting that individuals who are highly dependent on mangrove resources tend to be more motivated to preserve them.

Existing sustainable practices identified in this study, such as the collection of dead mangroves by local communities, leaving areas of mangroves untouched, and planting, along with those found in other studies, such as the prevention of oyster harvesting for up to 10 months a year (Temudo et al., 2022; Keleman et al. 2024), demonstrate the potential for harmonising livelihoods with conservation. However, achieving long-term solutions requires addressing the unsustainable practices driven by social, economic and political constraints (Ribot, 2010) and providing support for improved practices for mangrove swamp rice farming to sustain the livelihoods of mangrove-dependent communities.

5.3. Gender-dynamics in mangrove ecosystem

This study sought to identify gendered dynamics and understand the underlying factors and drivers impacting the reliance of different gender groups on ecosystem services. To achieve this, the theoretical framework incorporated gendered drivers of change - such as the division of labour, access to resources, opportunities and abilities, and decision-making power - exploring how these factors influence interactions with the environment and are, in turn, shaped by broader direct and indirect drivers of change. Through the second sub-research question of this study, men and women's utilisations and perceptions of mangrove ecosystem services was explored, leaving substantive questions on this aspect, and showing corresponding findings with previous research attempting to shed light on the links between gender and ecosystem services. The following discussion seeks to underline and question those aspects by outlining gender-specific mangrove interactions, expanding on the how this influences the social construction of ecosystem services, and framing a path toward 'gender-responsive' approaches.

5.3.1. Gender-specific interactions with mangroves

Firstly, this study identified that the harvesting of mangrove wood is gendered, which aligns with the observations of a study review on the drivers of mangrove decline in West-Central Africa (Feka & Ajonina, 2011; Ingram et al., 2016). This study reported that wood harvesting for biomass fuel is an activity conducted by women, whereas men harvest wood for timber purposes. Similarly, past studies have identified the same gendered roles in wood harvesting and further reveal that the year-round collection of wood by men for structural purposes places more strain on the forest than the harvesting of firewood by women (Feka & Ajonina, 2011; Nyangoko et al., 2022). This heavier strain is only observed in Guinea-Bissau if the opening of new rice fields by men is included in the evaluation. Indeed, in Balanta villages, women have a greater impact on mangroves due to smoking large quantities of fish and producing significant amounts of salt, whereas men's use of mangrove wood for structural purposes is occasional. Indeed, in Guinea-Bissau, women play a central role in harvesting mangrove fuelwood (UNDP, 2021), which is supported by this research's findings. Biomass fuel is essential for these local communities as they are entirely depending on mangrove wood due to a lack of alternative. This reliance was found to be the case in Guinea-Bissau and in other areas of the world (De Faria et al., 2014). In the present research, wood-harvesting practices by women are thought to sometimes help mangrove growth by creating gaps. This aligns with Njisuh and colleagues (2011), who highlight that controlled deadwood collection supports improved growth conditions for mangroves, provided that excessive harvesting does not deplete essential decomposing nutrients or propagule sources.

Secondly, this study observed that men's prohibitions on cutting mangroves have increased women's workload, forcing them to travel greater distances to collect wood and rely on men for transportation (e.g., rowing canoe). This increases their labour, limits their autonomy and reduces their opportunities to generate income through wood sales in Bissau. This was found to be masked by gendered social and cultural preferences in Rasquinha's (2024) study of dynamics in mangrove fuelwood reliance. However, this study found that, despite some disadvantages of these restrictions for women, many respondents, both men and women, acknowledged that restrictions to protect rice fields contribute to food security for the entire household and are therefore beneficial for everyone. Thus, although the restrictions increase women's workloads in some cases, they recognise the importance of halting these practices in order to protect rice fields and thereby ensure household food security. Indeed, in contrast to studies claiming that only women recognise men-related activities (Fortnam et al., 2019), the present study observed that both genders recognise and value other activities they do not typically engage in as important contributions to the overall household. Moreover, mangroves were valued by all gender groups and both women and men participated in planting mangroves for the benefits of everyone, depending on time and health attributes. These findings support narratives that emphasise the need to move away from victimising women's positions in environmental and food security contexts, and from gender studies that focus solely on women, advocating instead for an approach that examines all gender dynamics (Doss et al., 2018).

5.3.2. The importance of gender in understanding mangrove dynamics

Studies on the gendered dimensions of ecological services have reported that the perception of the importance of ecosystem services differ between genders, where men are more likely to recognise provisioning services, while women tend to value regulating services (Martin López et al., 2012, as cited in Fortnam et al., 2019). In a similar way, studies have shown that gendered roles can influence data collection. For example, in their research on local communities' perceptions of mangrove ecosystem services, Afonso and colleagues (2022) observed that men predominantly participated in questionnaires around mangrove services, which has then been associated to culturally defined gender roles. Indeed, men are often in charge of decision-making and have better access to education, hence being considered (mainly during resources management) as most influential for restoration strategies (Teka et al., 2019). Similarly, research by Mponela et al. (2022) highlighted different perspectives of restoration projects depending on gender. Women tended to adopt management-focused views on human-induced drivers of change, whereas men were often

more pessimistic, attributing changes to external and uncontrollable factors (Mponela et al., 2022). Hence, the use of mangroves and their importance might mean different things to different gender depending on the division of labour – because rice provision to the family and house building is a male responsibility, and cooking, smoking fish and producing salt are women's duties. This underlines the need to integrate the multiplicity of uses and preferences when implementing restoration solutions, to reflect gendered differentiation in mangrove use (Rasquinha, 2024).

The perceived importance of ecosystem services was found to be gendered in this research. This aligns with Fortnam and colleagues (2019), arguing that the concept of ecosystem services is constructed through gender roles, which are determined by broader drivers such as sociopolitical, economic, and cultural factors. The present study found that both gender groups valued regulating and provisioning services, with men more frequently emphasising regulating services linked to protecting rice fields, whereas women more often highlighted biomass fuel and fisheries. As such, this underscores how the value attributed to specific services is closely associated with gendered roles within households. What is more, this study seems to confirm the findings of the 2022 study by Afonso and colleagues, where it was found that men often participated more frequently in studies related to ecosystem services. In a similar way, while collecting data for this research, it was apparent that questionnaires were often conducted with male household heads, and women frequently redirected interview questions to their husbands. Men were thus more likely to participate and show interest in the research, while women seemed less willing to participate or give their opinions regarding the topic of research. The study of Afonso et al. (2022) underlined that such difference was attributed to women's lack of confidence or trust in expressing their opinions - a finding also reflected in this study.

Despite sharing similarities in the need for some constituents of well-being, such as basic material for a good life (i.e., sufficient food, shelter, etc.) and security (i.e., from disasters, from access to resources, etc.), mangrove ecological knowledge and resource management views differ between men and women, as they use the space and services differently (Fortnam et al., 2019). This study highlights that women and men experience and interact with mangroves differently, and this influences their perceptions of the benefits of mangroves. Hence, gender-inclusive frameworks should be incorporated and reflected upon in the way restoration initiatives are produced, configured, and applied, so that gender inclusivity is addressed at all levels, rather than merely questioning household dynamics based on binary assumptions. These frameworks do not account for gender relations, collaboration, and complementarities within households (Leach et al., 1995).

Doing so will shift the focus away from solely addressing women's needs and instead consider gender relations and household needs (Doss et al., 2018).

Overall, these findings underscore the influence of cultural, social, and traditional gender roles on the perception of, and reliance on, ecosystem services (Fortnam et al., 2019). The loss of ecosystems affects gender groups differently, reinforcing the importance of gender-sensitive and inclusive frameworks in academic research and restoration initiatives. Incorporating a gender-sensitive framework into such approaches aims to inform institutional and (non))governmental mangrove restoration initiatives, both present and future, making them more responsive to local demands and more attuned to the diverse actors who are both impacted by and influence mangrove ecosystems.

5.4. Mangrove restoration initiatives' influence

In this research, through interviews (e.g. participant 58), informal discussions and field observations, it was found that restoration initiatives have not succeeded as intended, which increases grievances by poor people dependent on mangroves whose access is being restricted. Attempts to protect additional mangrove areas through national laws or other policy measures, while beneficial for the mangroves, have not adequately addressed the realities of local communities' dependence on these ecosystems and may exacerbate existing socio-ecological challenges. The emphasis on highlighting the alleged decline of mangroves, raises questions about who benefits from these claims and what drives initiatives to undertake mangrove restoration. This study found that the local mangrove restoration initiative led by IBAP restrains local communities' use of mangroves by negotiating rice field space for mangrove restoration. IBAP aims to address unsustainable mangrove uses (e.g., the use of Rhizophora sp. for oyster harvesting or salt production) by introducing alternative livelihoods, such as solar salt production in these villages, as well as providing rice milling machines or horticultural support for women in the villages (IBAP, 2021). However, the restoration of mangroves is conducted without fully:

(i) addressing the critical concerns related to food security and environmental hazards,
(ii) acknowledging the realities of local communities' dependence on mangroves
(iii) addressing the needs and concerns of all gender groups and of household dynamics.

Firstly, this can be seen in the village of Djabada, where interviews with farmers revealed their discontent with the project because mangrove restoration is being conducted far from the village,

on the island, despite the urgency for rice field restoration near the villages. In this case, it seems that the organisation may have opted for an easier solution, as coastal erosion and high tides were carrying away the propagules when planted near the shore. This raises concerns about whether the villagers' need for food security is being sufficiently considered. This is especially so as simple, natural, and low-cost solutions exist to help mangroves grow in high-wave energy coastlines (Lanjouw, 2022). These solutions could be implemented to address community needs and enhance project feasibility and sustainability and emphasises the importance of involving local communities' knowledge in all stages of the project (Damastuti et al., 2019).

Secondly, project intent does not always reflect the tangible benefits for community and ecosystem in the long term. This study observed that restoration projects fail due to a rushed implementation of the project without consulting previous studies. A situation that is exacerbated by a lack of progress monitoring. This latter statement was acknowledged by the IBAP project coordinator. This is not an isolated case, as a review of the benefits of livelihood alternatives in conservation projects found a significant lack of reporting on project outcomes (Roe et al., 2015). Indeed, projects often do not have appropriate funds to evaluate restoration progress after the project's implementation (Roe et al., 2015). This can lead to a misunderstanding of why mangroves fail to regenerate, both ecologically and socially. It also creates a lack of depth in understanding the benefits for local communities, not only in terms of mangrove regeneration but also regarding the alternative livelihoods provided. It is essential not only to conduct pre-assessments for project implementation to meet donors' demands but also to carry out post-assessments. Implementing policy measures for mangrove protection that consider communities' dependence on mangroves and adopt participatory approaches throughout the project implementation is necessary.

Moreover, the results of interviews and field observations revealed that local communities often doubted whether they can give their opinions to IBAP about better practices. Communities' opinions should be taken into account, as they often have a deeper understanding of mangroves due to their proximity and reliance on these ecosystems (Damastuti et al., 2019). Indeed, participants often criticised IBAP for the inadequate site-selection (i.e., far from the village) and mangrove species selection (i.e., leading to high mangrove mortality rate). Communities expressed a sense of hopelessness regarding mangrove degradation, as well as the exacerbation of the situation as a result of high tides, erosion, and loss of services, feeling that these problems cannot be resolved without external help such as IBAP's interventions. In the context of limited alternative economic opportunities and high dependence on mangroves, people lack the sources

of income to both make ends meet and to invest in coastal protection. Hence the use of mangrove ecosystem services requires careful management, ensuring that local needs and knowledge are integrated throughout the entire restoration project. For example, introducing improved stoves or ovens, as suggested by studies from other regions (Teioli et al., 2018; Balde et al., 2020), could reduce pressure on mangroves while recognising and supporting communities' needs. Other NGOs, such as Wetlands International, also promote assisted natural regeneration for abandoned rice fields and finance alternative livelihoods to alleviate the pressures on mangroves. These approaches can more fully balance mangrove restoration with community needs.

Finally, in the case of the IBAP project, milling machines, oyster production tools, vegetable garden fences, and plastic for salt production were provided to villages, to benefit women-focused activities (IBAP, 2021). In contrast, men were supported with some PVC tubes for rice fields only if they also provided plots for mangrove planting. In summary, only men were constrained in their productive activities and compelled to find alternative sources of income to purchase imported rice. Colfer et al. (2016) argued for 'gender-responsive' processes in restoration, a perspective echoed in this research. For all gender groups to genuinely benefit from these initiatives, restoration projects must provide equal opportunities for men and women to derive social and economic benefits. This entails addressing the concerns and needs of all gender groups throughout project implementation and sustainability phases, rather than confining women to tokenistic or marginal roles. Without such considerations, projects risk benefiting only a subset of the population (Fortnam et al., 2019).

6. Conclusion

Mangrove ecosystem services are recognised as vital for many coastal communities around the world, supporting local livelihoods through provisioning, regulating, and cultural services. Exploring people's perceptions of these services can help clarify the socio-ecological dynamics surrounding mangroves, as well as how these dynamics affect community well-being and influence restoration incentives. In Guinea-Bissau, home to one of the largest mangrove areas in Africa, there has been increased international and local interest in protecting these ecosystems. However, changes in mangrove cover due to sea-level rise, coastal erosion, alterations in rainfall patterns, and economic and socio-political challenges continue to pose significant threats to both livelihoods and mangrove cover. This vulnerability underscores the need strategies to be implemented in countries like Guinea-Bissau that are focused on sustaining ecosystem services, considering all drivers of change, and ensuring benefits for both communities and the environment.

This research acknowledges that there are no simple solutions for achieving inclusive and holistic mangrove restoration in Guinea-Bissau, as the drivers of change are numerous and complex, and the scope of this study limits a deeper exploration of these factors. However, this research has attempted to shed light on the perceptions and relationships of selected coastal communities in the Quinara region to mangrove ecosystem services. Such attempts aim to shed light on some opportunities for new pathways towards mangrove restoration initiatives that not only make space for local communities to be involved in the whole process but are also responsive to the multiple underlying layers of interactions, uses, and experiences surrounding mangroves. By incorporating a gender dimension into the ecosystem services framework, this study aimed to contribute to research gaps in understanding how ecosystem services are constructed and perceived by different gender groups and how this impacts the reliance on mangroves. A deeper analysis of socio-ecological and gender dynamics, as well as a fuller understanding of the drivers of mangrove changes, can help inform restoration initiatives in ways that ensure better implementation and a deeper understanding between local communities, mangroves, and broader drivers. This approach seeks to ensure that mangrove management benefits everyone, particularly those who depend on the services the most.

Through a mixed methodology for data collection, along with ethnographic, comparative, and statistical data analysis, this research has revealed that:

(1) The heavy reliance on mangroves for provisioning and regulating services is driven by economic and social vulnerabilities. The importance placed on ecosystem services depends

on the immediate needs that constitute people's well-being, strongly aligning with the vulnerability of populations to changes in ecosystem services linked to economic inequality. The multiplicity of understandings of mangrove ecosystem services in Guinea-Bissau, highlights the need for deeper research that includes dimensions such as gender, age, regions, and ethnic groups.

(2) Gendered drivers influence the use of mangroves, depending on the attributes of gender roles. However, the reliance on mangrove ecosystem services does not impact gender groups differently in these selected Balanta communities, due to household complementarities and strong collaboration. This stresses the importance for ecosystem services frameworks to include gendered drivers.

(3) Local initiatives influence communities' interactions with mangroves by inadequately addressing the realities of communities and failing to implement long-term monitoring of project, while restraining the use of mangroves, ultimately increasing the grievances of communities dependent on mangroves. These projects would be more beneficial if drivers of change beyond local mangrove use are addressed, providing a holistic understanding of the situation at hand. Long-term solutions that benefit both mangroves and communities should also address the socio-economic and political drivers of mangrove degradation in Guinea-Bissau.

Overall, this research underscores the importance of knowledge-sharing, dialogue, and collaboration between local communities, academic institutions and (non)-governmental organisations (Balde et al., 2020). Such partnerships are essential for developing restoration strategies that are informed by an understanding of local communities' needs (including gender differences) and designed to ensure the long-term sustainability of mangroves in the country. There is a need for better practices in mangrove restoration, where the gap between (non) governmental institutions and academics could be bridged, for example by having monitoring and evaluation of projects done by local students to ensure post-initiative sustainability (Feka & Ajonina, 2011). Furthermore, educational programmes that inform communities about project progress and outcomes, as suggested by Stone et al. (2008), could enhance community involvement and support for restoration initiatives. This would foster an environment of collaboration among all actors, prioritising the voices of marginalised groups in pursuit of environmental justice.

References

Afonso, F., Felix, P. M., Chainho, P., Heumüller, J. A., De Lima, R. F., Ribeiro, F., & Brito, A. C. (2021). Assessing ecosystem services in mangroves: insights from São Tomé Island (Central Africa). *Frontiers in Environmental Science*, *9*, 501673.

Afonso, F., Félix, P. M., Chainho, P., Heumüller, J. A., de Lima, R. F., Ribeiro, F., & Brito, A. C. (2022). Community perceptions about mangrove ecosystem services and threats. *Regional Studies in Marine Science*, *49*, 102114.

Alongi, D. M. (2022). Climate change and mangroves. In *Mangroves: Biodiversity, Livelihoods and Conservation*. Singapore: Springer Nature Singapore.

Amorim-Maia, A. T., Anguelovski, I., Chu, E., & Connolly, J. (2022). Intersectional climate justice: A conceptual pathway for bridging adaptation planning, transformative action, and social equity. *Urban climate*, *41*, 101053.

Anu, K., Sneha, V. K., Busheera, P., Muhammed, J., & Augustine, A. (2024). Mangroves in environmental engineering: Harnessing the multifunctional potential of Nature's coastal architects for sustainable ecosystem management. *Results in Engineering*, 101765.

Armitage, D., Mbatha, P., Muhl, E. K., Rice, W., & Sowman, M. (2020). Governance principles for community-centered conservation in the post-2020 global biodiversity framework. *Conservation Science and Practice*, *2*(2), e160.

Atheull, A. N., Din, N., Longonje, S. N., Koedam, N., & Dahdouh-Guebas, F. (2009). Commercial activities and subsistence utilization of mangrove forests around the Wouri estuary and the Douala-Edea reserve (Cameroon). *Journal of Ethnobiology and Ethnomedicine*, 5, 1-14.

Audu, S. I. (2022). Perceptions of mangrove ecosystem services and conservation priorities by decision-makers and key stakeholders in Nigeria.

Balde, B. S., Karanja, A., Kobayashi, H., & Gasparatos, A. (2020). Linking rural livelihoods and fuelwood demand from mangroves and upland forests in the coastal region of Guinea. *Sustainability Challenges in Sub-Saharan Africa I: Continental Perspectives and Insights from Western and Central Africa*, 221-244.

Beeston, M., Cameron, C., Hagger, V., Howard, J., Lovelock, C., Sippo, J., Tonneijk, F., van Bijsterveldt, C. and van Eijk, P. (Editors) (2023). Best practice guidelines for mangrove restoration.

Bertelsmann Stiftung. (2022). Country Report — Guinea-Bissau. Gütersloh: Bertelsmann Stiftung.

Bioguinea. (n.d.) Biodiversity in Guinea Bissau. Retrieved from: https://www.bioguinea.org/biodiversity-in-guinea-bissau/

Bordonaro, L. I. (2009). Introduction: Guinea-Bissau today—The irrelevance of the state and the permanence of change. *African Studies Review*, *52*(2), 35-46.

Borrini, G., & Jaireth, H. (2007). *Sharing power: learning-by-doing in co-management of natural resources throughout the world*. Earthscan.

Bukamal, H. (2022). Deconstructing insider–outsider researcher positionality. *British Journal of Special Education*, *49*(3), 327-349.

Bronstein, L. (2023). Establishing a Mangrove Restoration Strategy in Guinea-Bissau. Panorama.

Catarino, L., Menezes, Y., & Sardinha, R. (2015). Cashew cultivation in Guinea-Bissau–risks and challenges of the success of a cash crop. *Scientia Agricola*, *72*(5), 459-467.

Cifuentes-Espinosa, J. A., Feintrenie, L., Gutiérrez-Montes, I., & Sibelet, N. (2021). Ecosystem services and gender in rural areas of Nicaragua: Different perceptions about the landscape. *Ecosystem Services*, *50*, 101294.

Convention on Biological Diversity. (2014). *Fifth National Report to the Convention on Biological Diversity, Guinea-Bissau*. Retrieved from: https://www.cbd.int/doc/world/gw/gw-nr-05-en.pdf

Costa, S., Casanova, C., & Lee, P. (2017). What does conservation mean for women? The case of the Cantanhez Forest National Park. *Conservation and Society*, *15*(2), 168-178.

Costanza, R., De Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., ... & Grasso, M. (2017). Twenty years of ecosystem services: How far have we come and how far do we still need to go?. *Ecosystem services*, *28*, 1-16.

Cormier-Salem, M. C. (1999). The mangrove: an area to be cleared... for social scientists. *Hydrobiologia*, *413*(0), 135-142.

Cormier-Salem, M. C., Bernatets, C., & Sarr, O. (2010). Mangrove system sustainability: public incentives and local strategies in West Africa. In *Tropical deltas and coastal zones: Food production, communities and environment at the land and water interface*, Wallingford UK: CABI, 409-421.

Cross, H. (2016). Displacement, disempowerment and corruption: challenges at the interface of fisheries, management and conservation in the Bijagós Archipelago, Guinea-Bissau. *Oryx*, 50(4), 693-701.

Cummings, A. R., & Shah, M. (2018). Mangroves in the global climate and environmental mix. *Geography Compass*, *12*(1).

Czúcz, B., Arany, I., Potschin-Young, M., Bereczki, K., Kertész, M., Kiss, M., ... & Haines-Young, R. (2018). Where concepts meet the real world: A systematic review of ecosystem service indicators and their classification using CICES. *Ecosystem Services*, *29*, 145-157.

Damastuti, E., and de Groot, R. (2019). Participatory ecosystem service mapping to enhance community-based mangrove rehabilitation and management in Demak, Indonesia. *Regional Environmental Change*, *19*, 65-78.

Damerim, F.A. (2024). Serviços de provisao do ecossistema de mangal em diferentes aldeais da Guiné-Bissau – (Elia e Quibil) (Master thesis). Universidade Lusófona.

De Faria, M. L., Ferreira, P. M., Melo, J. B., & Vasconcelos, M. J. (2014). A social assessment of forest degradation in the "Cacheu mangroves natural park", Guinea-Bissau. *Forests*, *5*(12), 3327-3343.

De Vries, L. (2023, December 4). Session 16 Ethics, slide 7 [Course presentation], Wageningen University & Research.

Dias, G.A.; Vasconcelos, M.J., and Catarino, L. (2022). Examining the socioeconomic benefits of oysters: A provisioning ecosystem service from the mangroves of Guinea-Bissau, West Africa. *Journal of Coastal Research,* 38(2), 355–360.

Diop, E. S., Gordon, C., Semesi, A. K., Soumaré, A., Diallo, N., Guissé, A., ... & Ayivor, J. S. (2002). Mangroves of Africa. In *Mangrove ecosystems: Function and management*, Berlin, Heidelberg: Springer Berlin Heidelberg, 63-121.

Doss, C., Meinzen-Dick, R., Quisumbing, A., & Theis, S. (2018). Women in agriculture: Four myths. *Global food security*, *16*, 69-7.

Écoutin, J.-M., Barry, M., Boujou, S., Charles-Dominique, E., Journet, O., Penot, E., Rue̸, O., Souaré, D., and Sow, M. (1999). Aménagement technique du milieu. In Cormier-Salem, M.-C. (ed.), Rivières du Sud: societes et mangroves ouest- africaines, vol. I. IRD, Paris, pp. 209–268.

Elmhirst, R. (2022). Intersectional inequalities to consider in action to address environmental degradation.

Embalo, B. (2021). *UNDP GUINEA-BISSAU GENDER ANALYSIS* [Doctoral dissertation]. https://www.undp.org/sites/g/files/zskgke326/files/migration/gw/Gender-Analysis-Final-01.03.2021.pdf

FAO, & ICRISAT. (2019). *Climate-smart agriculture in Guinea-Bissau*. CSA Country Profiles for Africa Series. International Center for Tropical Agriculture (CIAT), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), & Food and Agriculture Organization of the United Nations (FAO). Rome, Italy. 23.

Farvar, T., Borrini-Feyerabend, G., Campese, J., Jaeger, T., Jonas, H., & Stevens, S. (2018). Whose 'Inclusive' Conservation? Policy Brief of the ICCA Consortium.

Feka, N. Z., & Ajonina, G. N. (2011). Drivers causing decline of mangrove in West-Central Africa: a review. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *7*(3), 217–230.

Folke, C., Cundill, G., & Queiroz, C. (2005). Communities, Ecosystems, and Livelihoods. *Ecosystems and Human Well-being*, 261.

Fortnam, M., Brown, K., Chaigneau, T., Crona, B., Daw, T. M., Gonçalves, D., ... & Schulte-Herbruggen, B. (2019). The gendered nature of ecosystem services. *Ecological economics*, *159*, 312-325.

Garbanzo, G., Cameira, M. D. R., & Paredes, P. (2024). The Mangrove Swamp Rice Production System of Guinea Bissau: Identification of the Main Constraints Associated with Soil Salinity and Rainfall Variability. *Agronomy*, *14*(3), 468.

Gippoliti, S., & Dell'Omo, G. (2003). Primates of Guinea-Bissau, West Africa: distribution and conservation status. Primate Conservation, 19, 73-77.

Global Mangrove Alliance. (2022). *The state of the world's mangroves*. Retrieved from: https://www.wetlands.org/publication/the-state-of-the-worlds-mangroves-2022/

Global Mangrove Watch. (n.d.). Guinea-Bissau Country's Profile. Retrieved from: https://www.globalmangrovewatch.org/country/GNB

Google Earth Pro (2024). Bissau and Quinara Region, 11°50'30.41" N 15°27'56.81" W, elevation 0m.

Gonçalves, Paulo & Leandro, Francisco José (2024). Guinea-Bissau: Avoiding the Reputation of being a Failed State. Janus.net, e-journal of international relations. 15(2), 331-370.

Guttorm, H., Kantonen, L., Kramvig, B., & Pyhälä, A. (2021). Decolonized research-storying: Bringing indigenous ontologies and care into the practices of research writing. In *Indigenous research methodologies in Sámi and Nordic contexts*, 113-143.

Greenchoice (2021), Guinea Bissau Mangroves Restoration. Retrieved from: https://www.greenchoice.nl/media2/dtdbl3wx/20211215_pdd-gb_v10.pdf

Haines-Young, R., & Potschin, M. (2012). Common international classification of ecosystem services (CICES, Version 4.1). *European Environment Agency*, *33*, 107.

Havik, P. J., Monteiro, F., Catarino, S., Correia, A. M., Catarino, L., & Romeiras, M. M. (2018). Agro-economic transitions in Guinea-Bissau (West Africa): Historical trends and current insights. *Sustainability*, *10*(10), 3408.

Ingram, V., Haverhals, M., Petersen, S., Elias, M., Basnett, B. S., & Phosiso, S. (2016). Gender and forest, tree and agroforestry value chains: Evidence from literature. In *Gender and forests* (pp. 221-242). Routledge.

Instituto da Biodiversidade e das Áreas Protegidas (IBAP). (2021). "PIR GEF ID 9521 TRI Guinea-Bissau" (report). Retrieved from: arrozmangal.ibapgbissau.org

Instituto da Biodiversidade e das Áreas Protegidas. (2021). *Protection et restauration des mangroves et des paysages productifs pour renforcer la sécurité alimentaire et atténuer le changement climatique, Guinée Bissau.*

Instituto da Biodiversidade e das Áreas Protegidas. (2024). *Home*. IBAP. Retrieved from: https://ibapgbissau.org/

IUCN. (2020). Where Rice, Mangroves and Dikes connect in Guinea-Bissau. Retrieved from: https://iucn.org/news/forests/202002/where-rice-mangroves-and-dikes-connect-guinea-bissau

Jadin, J., & Rousseau, S. (2022). Local community attitudes towards mangrove forest conservation. *Journal for Nature Conservation*, *68*, 126232.

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.

Jaló, S. (2023). Guinea-Bissau: 30 years of militarized democratization (1991–2021). *Frontiers in Political Science*, *5*, 1078771.

Joshi, D., Monterroso, I., Gallant, B. (2021). A feminist political ecology approach to better manage land, water and forests. *CGIAR GENDER PLATFORM*. Nairobi, Kenya.

Kashwan, P., V. Duffy, R., Massé, F., Asiyanbi, A. P., & Marijnen, E. (2021). From racialized neocolonial global conservation to an inclusive and regenerative conservation. *Environment: science and policy for sustainable development*, *63*(4), 4-19.

Keleman, P. J., Sá, R. M., & Temudo, M. P. (2024). Drifting Away from the Roots: Genderfluidity as Diola's Mangrove Fishing Strategies in Three Island-Villages of Northern Guinea-Bissau. *Human Ecology*, 1-17.

Keleman, P. J., Temudo, M. P., & Sá, R. M. (2023). Rooted in the Mangrove Landscape: Children and their Ethnoichthyological Knowledge as Sentinels for Biodiversity Loss in Northern Guinea-Bissau. *Ethnobiology Letters*, *14*(2), 10-21.

Lanjouw, S. (2022). Testing a Biodegradeble Engineering Product for Mangrove Restoration Along a High Wave-Energy Coastline (Master Thesis). Wageningen University and Research.

Leach, M., Joeks, S., & Green, C. (1995). Gender relations and environmental change.

Leunda, M., M., Céspedes, J., Varanda, M., Merkohasanaj, M., dos Santos, B. A., & Temudo, M. P. (2024). The Role and Drivers of Cooperation in Managing Hydraulic Infrastructures for Sustainable Mangrove Rice Production in Guinea-Bissau. *Sustainability*, *17*(1), 136.

Locatelli B., (2016). Ecosystem Services and Climate Change. In: Routledge Handbook of Ecosystem Services. M. Potschin, R. Haines-Young, R. Fish and R. K. Turner (eds). Routledge, London and New York, pp. 481-490.

Long, J. W., Ballard, H. L., Fisher, L. A., & Belsky, J. M. (2016). Questions that won't go away in participatory research. *Society & Natural Resources*, *29*(2), 250-263.

Lopes, N. D. R., Li, T., Qian, D., Matomela, N., & Sá, R. M. (2022). Factors influencing coastal land cover change and corresponding impact on habitat quality in the North-western Coastline of Guinea-Bissau (NC-GB). *Ocean & Coastal Management*, *224*, 106181.

Lourenço, P., Cabral, A. I. R., Oom, D., Vasconcelos, M. J. P., Catarino, L., & Temudo, M. P. (2009). Re-growth of mangrove forests of Guinea-Bissau. In *33rd International Symposium on Remote Sensing of Environment "Sustaining the Millennium Development Goals". Stresa, Lago Maggiore, Italy*, 4-8.

Madeira, J. (2016). GUINEA-BISSAU: the role of local and international NGOs in environmental preservation and sustainability of the Bijagos Archipelago. *InterEspaço: Revista de Geografia e Interdisciplinaridade*, 1(3), 191–202.

Mahour, K. (2016). Role of women in environment conservation. *Journal of Advanced Laboratory Research in Biology*, *7*(1), 17-26.

Maj, J. (2013). The significance of intersectionality for feminist political theory. *E-International Relations*. Retrieved from : https://www.e-ir.info/2013/11/01/the-significance-of-intersectionality-for-feminist-political-theory/

Malmon-DeSIRA (n.d.). Retrieved from: https://www.malmon-desira.com/

Mangora, M. M. (2011). Poverty and institutional management stand-off: a restoration and conservation dilemma for mangrove forests of Tanzania. *Wetlands Ecology and Management*, *19*, 533-543.

Matarrita-Cascante, D., Sene-Harper, A., & Ruyle, L. (2019). A holistic framework for participatory conservation approaches. *International Journal of Sustainable Development & World Ecology*, *26*(6), 484-494.

McMichael, A., Hefny, M., & Foale, S. (2005). Linking Ecosystem Services and Human Well-being. *Ecosystems and Human Well-being*, 43.

Mendes, O., & Fragoso, M. (2024). Recent changes in climate extremes in Guinea-Bissau. *African Geographical Review*, 1-19.

Merven, R., Appadoo, C., Florens, F. B. V., & Iranah, P. (2023). Dependency on Mangroves Ecosystem Services is Modulated by Socioeconomic Drivers and Socio-Ecological Changes–Insights From a Small Oceanic island. *Human Ecology*, *51*(6), 1141-1156.

Millennium Ecosystem Assessment. (2005). Ecosystems and Human Well-being: Synthesis. *Island Press*, Washington, DC.

Miller, A. E., Davenport, A., Chen, S., Hart, C., Gary, D., Fitzpatrick, B., ... & Sagita, N. (2020). Using a participatory impact assessment framework to evaluate a community-led mangrove and fisheries conservation approach in West Kalimantan, Indonesia. *People and Nature*, *2*(4), 1061-1074.

Mohamed, M. K., Adam, E., & Jackson, C. M. (2024). Assessing the Perception and Contribution of Mangrove Ecosystem Services to the Well-Being of Coastal Communities of Chwaka and Menai Bays, Zanzibar. *Resources*, *13*(1), 7.

Moore, A. C., Hierro, L., Mir, N., & Stewart, T. (2022). Mangrove cultural services and values: Current status and knowledge gaps. *People and Nature*, *4*(5), 1083-1097.

Mponela, P., Aynekulu, E., Ebrahim, M., Abate, T., Abera, W., Zaremba, H., ... & Tamene, L. (2023). Gender gap in perspectives of the impacts of degradation and restoration on ecosystem services in Ethiopia. *Land Degradation & Development*, *34*(15), 4503-4516.

Mukherjee, N., Sutherland, W. J., Dicks, L., Huge, J., Koedam, N., & Dahdouh-Guebas, F. (2014). Ecosystem service valuations of mangrove ecosystems to inform decision making and future valuation exercises. *PloS one*, *9*(9), e107706.

Noble, H., & Heale, R. (2019). Triangulation in research, with examples. *Evidence-based nursing*, *22*(3), 67-68.

Numbere, A. O. (2020). Utilization of the mangrove forest for sustainable renewable energy production. *Progress in Petrochemical Science*, *3*(3), 324-329.

Nyangoko, B. P., Berg, H., Mangora, M. M., Gullström, M., & Shalli, M. S. (2020). Community perceptions of mangrove ecosystem services and their determinants in the Rufiji Delta, Tanzania. *Sustainability*, *13*(1), 63.

Nyangoko, B. P., Shalli, M. S., Mangora, M. M., Gullström, M., & Berg, H. (2022). Socioeconomic determinants of mangrove exploitation and management in the Pangani River Estuary, Tanzania. *Ecology and Society*, 27(2).

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health and mental health services research*, *42*, 533-544.

Rasquinha, D. N. 2024. Manning the mangroves: gender, regional identities, and social history shape mangrove forest dependence and governance. Ecology and Society 29(1):17.

Reggers, A. (2019). Climate change is not gender neutral: gender inequality, rights and vulnerabilities in Bangladesh. In *Confronting climate change in Bangladesh: policy strategies for adaptation and resilience*. Springer International Publishing, 103-118.

Reid, C., Calia, C., Guerra, C., & Grant, L. (2019). Ethical Action in Global Research: A Toolkit. *The University of Edinburgh*.

Rendón, O. R., Garbutt, A., Skov, M., Möller, I., Alexander, M., Ballinger, R., ... & Beaumont, N. (2019). A framework linking ecosystem services and human well-being: Saltmarsh as a case study. *People and nature*, *1*(4), 486-496.

Ribot, J. (2010). Vulnerability does not fall from the sky: Toward mul tiscale, pro-poor climate policy. In R. Mearns & A. Norton (Eds.), Social Dimensions of Climate Change (pp. 47–74). The World Bank.

Ring, J, Stefanova, M. Roebiono, R & Stodulka, K. (2023). Mangrove breakthrough, financial roadmap. Global Mangrove Alliance. Retrieved from: https://www.mangrovealliance.org/resources/mangrove-breakthrough-financial-roadmap-financing-coastal-ecosystems/

Roe, D., Booker, F., Day, M., Zhou, W., Allebone-Webb, S., Hill, N. A., ... & Sunderland, T. C. (2015). Are alternative livelihood projects effective at reducing local threats to specified elements of biodiversity and/or improving or maintaining the conservation status of those elements?. *Environmental Evidence*, *4*, 1-22.

Ruslan, N. F. N., Goh, H. C., Hattam, C., Edwards-Jones, A., & Moh, H. H. (2022). Mangrove ecosystem services: Contribution to the well-being of the coastal communities in Klang Islands. *Marine Policy*, *144*, 105222.

Santos, C., & Mourato, J. M. (2022). 'I was born here, I will die here': climate change and migration decisions from coastal and insular Guinea-Bissau. Geografiska Annaler: Series B, Human Geography, 106(2), 137–155.

Sarkar, P., Banerjee, S., Biswas, S., Saha, S., Pal, D., Naskar, M. K., ... & Mukul, S. A. (2024). Contribution of Mangrove Ecosystem Services to Local Livelihoods in the Indian Sundarbans. *Sustainability*, *16*(16), 6804.

Sofian, A., Kusmana, C., Fauzi, A., & Rusdiana, O. (2019). Ecosystem services-based mangrove management strategies in Indonesia: a review.

Sousa, J., Campos, R., Mendes, O., Duarte Lopes, P., Matias, M., Rosa, A. P., ... & Catarino, L. (2023). The (dis) engagement of mangrove forests and mangrove rice in academic and non-academic literature on Guinea-Bissau–a systematic review protocol. *PloS one*, *18*(4).

Start, F. (2015). GUINEA BISSAU.

Sunderland, T., Achdiawan, R., Angelsen, A., Babigumira, R., Ickowitz, A., Paumgarten, F., ... & Shively, G. (2014). Challenging perceptions about men, women, and forest product use: a global comparative study. *World Development*, *64*, S56-S66.

Teioli, H., Van Der Ploeg, J., Schwarz, A. M., Sukulu, M., & Eriksson, H. (2018). Conserving womangroves: Assessing the impacts of improved cooking stoves on resource management in Langalanga Lagoon, Solomon Islands.

Temudo, M. P. (1998). Help farmers winnow tools and partners.

Temudo, M. P. (2011). Planting knowledge, harvesting agro-biodiversity: a case study of Southern Guinea-Bissau rice farming. *Human Ecology*, *39*, 309-321.

Temudo, M. P. (2012). "The White Men Bought the Forests" Conservation and Contestation in Guinea-Bissau, Western Africa. *Conservation and Society*, *10*(4), 354-366.

Temudo, M. P. (2019). Between 'forced marriage' and 'free choice': social transformations and perceptions of and sexuality among the Balanta in Guinea-Bissau. *Africa*, *89*(1), 1-20.

Temudo, M. P., & Abrantes, M. B. (2013). Changing policies, shifting livelihoods: The fate of agriculture in Guinea-Bissau. *Journal of Agrarian Change*, *13*(4), 571-589.

Temudo, M. P., & Cabral, A.I. (2011). The social dynamics of mangrove forests in Guinea-Bissau, West Africa. *Human Ecology* 45, 307-320.

Temudo, M. P., & Cabral, A. I. (2023). Climate change as the last trigger in a long-lasting conflict: the production of vulnerability in northern Guinea-Bissau, West Africa. *The Journal of Peasant Studies*, *50*(1), 315-338.

Temudo, M.P., Cabral, A.I.R. & Reis, P. The Sea Swallowed our Houses and Rice Fields: The Vulnerability to Climate Change of Coastal People in Guinea-Bissau, West Africa. *Hum Ecol* **50**, 835–850 (2022). https://doi.org/10.1007/s10745-022-00352-2

Teka, O., Houessou, L. G., Djossa, B. A., Bachmann, Y., Oumorou, M., & Sinsin, B. (2019). Mangroves in Benin, West Africa: threats, uses and conservation opportunities. *Environment, Development and Sustainability*, *21*, 1153-1169.

The Common International Classification of Ecosystem Services (CICES). (2023). CICES Version 5.2. Common International Classification of Ecosystem Services.

Thurmond, V. A. (2001). The point of triangulation. *Journal of nursing scholarship*, *33*(3), 253-258.

Totino, M., Urdampilleta, C. M., Ithuralde, R. E., Giono, L. A., Cabrera, A. E., Lanzarotti, E., & Quintana, R. D. (2023). A methodological approach for the analysis of ecosystem services from the local communities' perspective. *Ambio*, *52*(4), 786-801.

Uddin, M. M., Abdul Aziz, A., & Lovelock, C. E. (2023). Importance of mangrove plantations for climate change mitigation in Bangladesh. *Global Change Biology*, *29*(12), 3331-3346.

UNIOGBIS. (2016). In Guinea-Bissau women are the bread winners. Retrieved from: https://uniogbis.unmissions.org/en/guinea-bissau-women-are-bread-winners

UNIVER-SEL. (2019). Ancestral know-how and innovative technologies help women producers of salt and rice preserve the mangroves. Retrieved from: https://womengenderclimate.org/gjc_solutions/ancestral-know-how-and-innovative-technologies-help-women-producers-of-salt-and-rice-preserve-the-mangroves/

Vasconcelos, M. J., Cabral, A. I., Melo, J. B., Pearson, T. R., Pereira, H. D. A., Cassamá, V., & Yudelman, T. (2015). Can blue carbon contribute to clean development in West-Africa? The case of Guinea-Bissau. *Mitigation and Adaptation Strategies for Global Change*, *20*, 1361-1383.

Vaz, A. S., Kueffer, C., Kull, C. A., Richardson, D. M., Vicente, J. R., Kühn, I., ... & Honrado, J. P. (2017). Integrating ecosystem services and disservices: insights from plant invasions. *Ecosystem services*, *23*, 94-107.

Vigh, H. (2022). Slow crisis in Bissau and beyond. *Global Discourse*, *12*(3-4), 522-536.

Vo, Q. T., Künzer, C., Vo, Q. M., Moder, F., & Oppelt, N. (2012). Review of valuation methods for mangrove ecosystem services. *Ecological indicators*, *23*, 431-446.

Wetlands International. (2024). Large scale implementation of best practice mangrove restoration in Guinea Bissau. Retrieved from https://www.wetlands.org/case-study/to-plant-or-not-to-plant-guinea-bissau/

World Bank. (2004). *GUINEA-BISSAU - Coastal and Biodiversity Management Project*. Retrieved from: https://documents1.worldbank.org/curated/en/580051468773971068/pdf/30523.pdf

World Bank. (2020). Guinea-Bissau Country Economic Memorandum. World Bank.

World Food Program. (2021). *Guinea-Bissau Annual Country Report*. Retrieved from: https://docs.wfp.org/api/documents/WFP-0000137866/download/

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

Appendix 1 – Questions that won't go away (Long et al., 2016)

Table 1. Questions that won't go away (QTWGAs) have been grouped into clusters and presented to stimulate discussion of ethical issues in PAR

Cluster	Issue	Sample questions
1	Community identity	What are the implications for research if the concept or perception of community is not clearly defined or agreed upon?
	Divided communities	What are the implications for participatory research when the community is divided?
2	Membership issues	How does the research process change when the professional researchers are or are not members of the community? Who decides who is an "insider" and who is an "outsider"?
	Roles of the researcher	What is the professional researcher's principal role in the community?
		What issues are raised when professional researchers assume different roles in the community (e.g., organizer, facilitator, teacher, consultant, supervisor, bringer of money, or provocateur)?
3	Community expectations	What responsibilities do professional researchers have in helping the community to address/resolve their problems?
		What are the professional researchers' responsibilities in creating expectations? What are the community's responsibilities in creating expectations?
	Accountability	How should professional researchers navigate tensions between what members of the community want and what colleagues and members of the academic community want? How can these tensions best be communicated to everyone?
	Rewards	What are appropriate ways to credit and reward community members who work on the research? How might these be different from credit and rewards in academia, and how can these be reconciled?
4	Sustaining the research	How can research be done so that it promotes lasting benefits for the community?
		How can the research be continued after the specific project (thesis, dissertation, grant, etc.) is completed?
5	Power relationships	What are the implications when participatory research affects power relationships in the community, either intentionally or unintentionally?
		What power might the community have over the professional researcher, and what power might the professional researcher have over the community?

Appendix 2 – Semi-Structured Interview

The date, gender, village, and participant name/number will be recorded either in the voice recording file name or in the note's app on a mobile phone.
Interview time: around 10 minutes

Introduction

To begin, I will express my gratitude for their time and then introduce myself, explaining that this interview is part of a university project. I will outline the research aims and ask if they would like to participate in the study. Participant's consent to participate in the study will be sought orally. I will also seek their consent to record the interview for research purposes. I will remind the participant that they are not obligated to answer any questions and can request to end the interview at any time. I will clarify that the results will be used for academic purposes only and offer them the option to receive a summary of the findings in a short video when the project is completed. Finally, I will allow time at the end of the interview for the participant to ask any questions and engage in a dialogue about the project or mangroves.

Mangrove development and management

The aim is to understand how participants relate to the mangroves, their perceptions of the environment and the benefits or difficulties they derive from it, their views on what constitutes a healthy mangrove forest, and how these perceptions might be linked to climate change.

1. In the next ten years, do you think mangroves around your village will increase or decrease?
2. Why do you think they will increase/decrease?
    a. Change in climate
    b. New rice fields
    c. Wood for smoking fish
    d. Wood for cooking salt
    e. Other (specify)
3. If the mangrove decreases, do you think this will come with problems for your life? What type of problem could you see?
4. Do you always cut mangroves in the same place?

5. Do you sometimes avoid cutting certain parts of the mangrove forest to preserve it for the future? Why?
6. When collecting wood from the mangroves, how do you determine the amount to cut?
    a. Based on when you feel too tired.
    b. Based on the money you can afford to pay small kids to help you.
7. Do you think mangroves are important for your village? Why?
8. What do you think of planting mangroves? Does it have benefits?
    a. What type of benefits can you notice?
9. How do you perceive mangrove restoration/conservation initiatives (such as the plantation of mangroves by IBAP next to your village)?
    a. Which advantages do you see with it?
10. Are the mangroves that were planted showing growth, or are they being cut down for wood?

Gender-Specific Questions

The aim is to explore how social and gender-specific factors within the Balanta ethnic group influence the various uses of mangroves.

1. Do women and men use mangroves and benefit from them differently?

2. Do men or women decide where to cut mangroves for wood?

3. Are there areas in the mangroves where you cannot go and cut wood?
    a. If yes, why?

4. What challenges do you currently face, concerning changes in the mangrove forest?

5. Are you involved in mangrove conservation projects/initiatives?
    a. If yes, how and why?

Conclusion

Thank you for being available for this and for your time. Do you have any questions for us? Are there anything you would like to know about our project or mangrove itself?

Appendix 3 – Questionnaire on ecosystem services uses (Malmon- DeSIRA)

Village: **Date** / /2024 **Name of the house owner**:
Household: Nº of men____ Nº of women _____ Nº of boys_____ Nº of girls_____
Nº of small kids (boys and girls who don't yet plough or plant rice) _____

Uses of mangrove species and products	**Avicennia**	**Rhizophora**	**Laguncularia**	**Forest**
Wood for cooking food				
Wood for salt production				
Wood for smoking fish				
Wood for selling				
Wood to produce charcoal				
Wood to build a bridge				
Wood to build a dam				
Wood for reinforcing a dam's dike structure				
Wood for house structure				
Handle of plough				
Wood for house fences				
Wood to make ropes				
Food for hunger times				
Food for kids (Specify which)				
Medicines (for which disease)				

1. Do you collect mangrove honey? YES__ NO__
2. Have you opened new rice field since 7th of June 1998? YES__ NO__
3. Did you intentionally places bee hives in the mangroves? YES__ NO__
4. In your household, yourself or small kids hunt animals in the mangrove? YES__ NO__
5. Have you planted mangroves in mangroves near the village? No__ Yes__ Avicennia __ Rhizophora__
6. What do you think of planting mangroves? _____
7. Does it have benefits? _____

Name of the women in charge of the household (put X for a positive answer):

1. The wood which is best for cooking: Mangrove____ Forest/Cashew/Mango___
2. How and when do you cut mangroves' fuelwood for cooking?
   Little by little during dry season__ in one go during dry season __ Little by little during wet season__ in one go during wet season__
3. Which month do you cut mangroves for the house? Dry season __ Wet season__
4. The fuelwood for the household is harvested: better wet__ better dry__ only dry __
5. Where do you cut the wood? Far __Close __ (from your house)
6. From 7th of June (1998), have you noticed you have to go further to cut mangroves? YES__ NO__
7. Who cuts the wood for smoking fish? Women __ Boys __

Appendix 4 – Field observations & informal conversations

Bissassema de Cima

People who declined interviews:

- One woman did not feel comfortable talking to us
- One household did not want to be recorded

→ Two participants would like the summary

Main theme that emerged from interviews in Bissassema:

1. Mangrove is important to protect the rice field
2. Mangrove will increase because they stop cutting it
3. Mangrove will increase because water enters the bolanha due to high tides, so men abandon the rice fields, hence mangrove come back in these places
    - Some interviews were deemed irrelevant as the participants neither used nor related to mangroves in any way.
    - Interviews lasted an average of 5 minutes instead of the planned 15 minutes, as participants often gave short answers, despite efforts to engage them through the Djumbai process.
    - One participant (Participant 11) associated mangroves solely with the bolanha (rice fields), framing all responses around their work in rice cultivation. Consequently, this interview was excluded.
    - It became apparent that some participants were hesitant to discuss activities like cutting mangroves after I introduced myself as working for an NGO. To address this, I stopped identifying myself in that capacity.
    - Many women had limited proficiency in Kriol, making it challenging to communicate and connect with them. Those who did not speak Kriol were not interviewed.
    - People mentioned that men are unable to work in the rice fields at the moment due to excessive water.

Avicennia wood

Rhizophora

Rhizophora wood

Laguncularia (more solid)

Foia

The village is much smaller than Bissassema, I quickly reached data saturation (after 10 participants), participants, both men and women had very similar answers, compared to Bissassema de Cima – a much larger village, there was a lot of different narratives.

Moreover, in Foia, people were asking a lot of questions after the interview in relation to mangrove and mangrove ecology, asking us to explain how we see the importance of them, how can their *bolanhas* can be protected, how can they have better practices, if it is wrong to cut mangroves, etc. When asked about planting, they often referred to N'tchudé, which is 2km away, relating planting to the IBAP project in the village close by.

→ One participant would like the summary

N'tchudé

We arrived in the village on the same day as the IBAP project coming with around 50 people from Bissau to continue the planting project. Hence, it was a challenge to over explain to each participant that we are not part of the project. Many of them, despite us reinterring that we are not part of IBAP, thanked us at the end of the interview 'for everything we do for the project', and then we had to explain again, that we are independent researchers. This can introduce some bias in the interviews. A lot of conflicting narratives around the project (who went, what did they get in exchange, how many years, days, etc). Moreover, farmers were coming home late, as they must travel to the island by canoe to work in the rice fields, hence it left us little time to conduct interviews before nighttime. A lot of interviews were also conducted with both men and women for time efficiency.

→ There was no request for a summary or project updates.

Djabada

This village is also bigger than the previous ones. There was a warm welcome by the committee, who were happy to discuss their point of view on the project and on mangroves. Overall, the general feeling from this village is that participants were very inclined to share their opinions, there was a shared concern over the *bolanha* getting flooded, and what this means for the village food security and flood security. Participants were less satisfied with the project interventions than participants in N'tchudé. They were happy the project came, but there was a general dissatisfaction of the restoration work, as their village is still being threaten by sea-level rise, and especially their

rice fields. People mentioned that men are unable to work in the rice fields at the moment due to excessive water. This village is a big fishing village, and although they do not have access to Bissau through the boat company (i.e., Consulmar Bissau), there are canoe going to Bissau almost every day, linking this village directly to the capital. It was very easy to engage in interviews.
→ The video summary will be sent to a student, who has relatives there, to show to the village committee on his next visit.

Interview with Rui Andrade, Project Coordinator, Instituto da Biodiversidade e das Areas Protegidas (IBAP) – notes
Questions:
1. How did the project come about? In what way?
2. Why were the villages of N'tchudé and Djabada Porto selected? What criteria were used?
3. How long has the project been running in these two villages?
4. What results have already been achieved? Ecologically and socially?
5. What improvements do you think could be made to achieve better results?
6. Are the restoration sites selected in partnership with the communities?
7. What are the benefits for the communities?
8. Is there a monitoring and evaluation programme?
9. Djabada and community dissatisfaction - how can the selection of mangrove sites and species be improved for better results?

Interview notes:
In the village of Djabada, significant political challenges have complicated the implementation of the project. In Djabada, the island was chosen because the communities were more focused on rehabilitating the bolanhas (rice paddies) than on restoring mangroves.
Young people in the communities have been highly active, IBAP has put into place an education system in schools to teach the importance of mangroves to younger generations.
While other villages were considered for the project, the level of commitment or interest was not always evident. Positive results were achieved in N'tchudé. Nonetheless, the IBAP team is too small to conduct regular monitoring and evaluation, which the project coordinator acknowledges as a major weakness.
Additionally, there is now much less mutual assistance among farmers compared to the past.
The selection of villages also takes into account potential benefits for women. Materials are provided to the village as support, but monetary assistance is never given to individuals.

Appendix 5 – List of disease treated with mangroves

Djabada:

- Rhizophora is used to cure itchy skin, helping to reduce it on the body.
- Two participants mentioned using Avicennia to cure skin diseases and clean the blood.
- Avicennia leaves are used to treat tuberculosis.
- Mangrove leaves, particularly Rhizophora, are boiled to cure itchy skin.
- The milk from Rhizophora roots is used to treat itchy skin.
- Two participants also mentioned using Rhizophora roots to treat stingray stings.

Bissassema:

- Rhizophora tree bark is used to treat haemorrhoids, reduce blood pressure, and treat infections.
- Rhizophora leaves are used to alleviate body pain and cramps.
- Rhizophora leaves are also used to stop itching.
- Avicennia leaves are used to treat black and blue marks.

Foia:

- Avicennia is used to treat anaemia
- Avicennia leaves are used to treat black-and-blue marks
- Avicennia leaves are used to reduce swelling.
- Mangrove leaves are used to lower body temperature.
- Avicennia leaves are also used to reduce body temperature.
- Both leaves and roots of Avicennia are used to treat itchy skin.

N'tchudé: no information

Appendix 6 – Summary of questionnaires data (percentage of preference)

Villages		Djabada	Bissassema	Foia	N'tchudé	Village average
Number of questionnaires		**91**	**97**	**57**	**35**	
Wood for cooking food	Avicennia	55	28	84	89	64
	Rhizophora	62	12	26	51	38
	Laguncularia	11	8	12	26	14
	Mangroves	76	32	93	100	75
	Forest	88	92	39	3	55
Wood for salt production	Avicennia	70	42	74	51	59
	Rhizophora	34	18	21	17	22
	Laguncularia	8	8	14	3	8
	Mangroves	79	46	75	51	63
	Forest	24	66	12	6	27
Wood for smoking fish	Avicennia	15	9	18	69	28
	Rhizophora	11	4	14	29	14
	Laguncularia	4	1	0	6	3
	Mangroves	25	11	30	91	39
	Forest	88	90	75	14	67
Wood for selling	Avicennia	0	0	0	3	1
	Rhizophora	0	2	9	0	3
	Laguncularia	0	1	0	0	0
	Mangroves	0	2	9	3	4
	Forest	0	0	2	0	0
Charcoal	Avicennia	0	0	0	0	0
	Rhizophora	0	0	0	3	1
	Laguncularia	0	0	0	0	0
	Mangroves	0	0	0	3	1
	Forest	49	43	12	3	27
Wood to build a bridge	Avicennia	36	49	28	51	41
	Rhizophora	25	42	74	63	51
	Laguncularia	2	8	2	0	3
	Mangroves	55	88	98	100	85
	Forest	8	3	0	0	3
Wood to build a dam	Avicennia	55	64	37	46	50
	Rhizophora	37	59	68	69	58
	Laguncularia	3	10	0	6	5
	Mangroves	78	94	98	100	93
	Forest	5	1	0	0	2
Wood for reinforcing a dam's dike structure	Avicennia	44	70	70	63	62
	Rhizophora	44	54	33	43	43

Villages		Djabada	Bissassema	Foia	N'tchudé	Village average
	Laguncularia	4	10	2	3	5
	Mangroves	75	96	98	100	92
	Forest	9	2	2	0	3
Wood for house roofing	Avicennia	3	14	19	26	16
	Rhizophora	2	6	2	6	4
	Laguncularia	0	2	0	0	1
	Mangroves	4	21	21	29	19
	Forest	97	82	84	77	85
Wood for house structure	Avicennia	4	29	18	20	18
	Rhizophora	2	16	7	34	15
	Laguncularia	0	8	18	26	13
	Mangroves	5	36	37	51	32
	Forest	97	78	82	71	82
Handle of a plough	Avicennia	0	42	60	66	42
	Rhizophora	0	10	4	6	5
	Laguncularia	0	1	4	49	13
	Mangroves	0	47	65	77	47
	Forest	99	85	67	40	73
Wood for house fences	Avicennia	23	21	46	43	33
	Rhizophora	15	13	16	14	15
	Laguncularia	2	9	42	43	24
	House fences	30	24	61	66	45
	House fences	58	0	2	0	15
Wood to make ropes	Avicennia	0	0	9	6	4
	Rhizophora	4	4	2	0	3
	Laguncularia	0	0	0	0	0
	Mangroves	4	4	11	6	6
	Forest	0	0	0	0	0
Food for hunger times	Avicennia	0	0	0	0	0
	Rhizophora	0	0	0	0	0
	Laguncularia	0	0	0	0	0
	Mangroves	0	0	0	0	0
	Forest	0	0	0	0	0
Food for children	Avicennia	0	0	0	0	0
	Rhizophora	0	0	0	0	0
	Laguncularia	0	0	0	0	0
Medicines	Avicennia	9	7	9	0	6
	Rhizophora	2	0	2	0	1
	Laguncularia	0	0	2	0	0
	Mangroves	11	7	12	0	8

Villages		Djabada	Bissassema	Foia	N'tchudé	Village average
Do you collect mangrove honey?	Yes	42	38	54	71	51
	No	0	1	0	0	0
Have you opened new rice field since 7th June 1998?	Yes	48	57	58	74	59
	No	0	1	0	0	0
Did you intentionally places bee hives in the mangroves?	Yes	3	0	0	0	1
	No	0	0	0	0	0
Do people hunt animals in the mangroves?	Yes	4	2	0	6	3
	No	0	0	0	0	0
How and when do you cut mangroves' fuelwood for cooking ?	Small amounts during the dry season	55	28	56	34	43
	Once during the dry season	36	8	30	54	32
	Small amounts during the rainy season	1	0	4	23	7
	Once during the wet season	7	12	25	3	12
The fuelwood for the household is harvested	Best wet	25	3	7	3	10
	Best dry	42	21	72	97	58
	Only dry	14	9	14	0	9
Which month do you cut down wood	Dry season	100	97	95	89	95
	Wet season	2	4	4	26	9
Where do you cut the wood?	Far	97	81	67	94	85
	Close	7	20	33	6	16
From 7 of June (1998), have you noticed you have to go further to cut mangroves?	Yes	85	71	60	51	67
	No	11	30	40	49	32
You produce salt	Only for the household	60	71	60	40	58
	Household and selling	29	20	21	11	20
Who cuts the wood for smoking fish?	Women	95	93	89	97	93
	Boys	5	9	30	31	19
Have you started planting mangroves in the village?	No	0	73	25	100	49
	Yes	0	25	75	0	25
	Avicennia	0	61	4	54	30
	Rhizophora	0	0	0	94	24