

Eliciting plural values behind restoration efforts in the Tudor Creek mangrove forest in Kenya: What is measured and what matters?

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Abstract

Mangroves are crucial tropical and subtropical coastal ecosystems in decline. In Kenya, 20% have been lost with degradation reaching nearly 90% in Mombasa's Tudor Creek mangrove forest, mainly due to logging for livelihoods. Despite ongoing restoration efforts, plural values of mangroves and their representation in monitoring are insufficiently understood. Drawing on the IPBES typology of nature's diverse values and measurement theory, this qualitative case study uncovers to what extent plural values are captured in restoration and monitoring practices through semi-structured key informant interviews. The results reveal a dominance of instrumental values, indicating a local dependence on mangroves. Monitoring is shaped by external funding requirements and focuses on quantifiable indicators, highlighting a gap between what is measured and what matters to the community. Therefore, a context-sensitive monitoring approach is imperative to improve restoration outcomes. This requires integrating locally meaningful values, applying feasible monitoring methods, providing external support, and maintaining reflexivity.

Keywords: Ecosystem restoration, mangroves, plural valuation, diverse values of nature, monitoring, measurement theory

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Figure 1. Restoration site at the Tudor Creek mangrove forest in Junda, Mombasa (own photo).

1 Introduction

Mangroves are social-ecological forest systems in tropical and subtropical regions with unique properties that are as important to the local communities living where they occur as to planetary processes (Dahdouh-Guebas et al., 2022; Macera et al., 2024). Mangrove forests provide a range of ecosystem services, such as coastal protection, medicinal value, timber, fuelwood, fish productivity, and erosion reduction (Dahdouh-Guebas et al., 2022; Mohamed et al., 2016; Spalding et al., 2014). Beyond these material benefits to people, mangroves are also associated with context-specific cultural and spiritual values. Globally, these forest ecosystems contribute significantly to a stable climate as crucial carbon sinks (Gress et al., 2017). Due to their complex root systems and thick, submerged mud soils underneath, mangroves absorb three to four times more CO₂ as compared to terrestrial trees (Donato et al., 2011; Gress et al., 2017; Howard et al., 2017). This is why mangroves are becoming increasingly prominent in the face of the climate crisis.

1.1 Mangrove Degradation and Restoration

Although mangrove forests are now considered among the most valuable ecosystems on Earth, 35% have been lost since 1980 (Macera et al., 2024). Eleven of the 70 identified mangrove species have already been declared threatened by the IUCN (FAO, 2023). Since 2000, the annual net loss has declined, but mangrove degradation continues globally. Before the entire loss of a mangrove forest, a process of degradation often leads to the long-term decline of biodiversity and disruption of the ecosystem's structure, composition, and functionality due to human disturbances (Society for Ecological Restoration, n.d.).

Globally, the primary causes of mangrove degradation include aquaculture expansion, conversion to agricultural land, coastal development, as well as the use of timber, which is a particularly strong driver in Africa (FAO, 2023; Howard et al., 2017; Mohamed et al., 2009). It appears that especially the mangrove's usefulness for people leads to their exploitation. As a consequence, the unsustainable use of these social-ecological systems and the neglect of the diversity of values that mangroves hold beyond their immediate utility accelerate the degradation process (de Groot et al., 2012; IPBES, 2022). Among multiple losses, mangrove degradation can lead to soil erosion, increased carbon emissions, reduced fisheries, biodiversity decline, coastal vulnerability, tourism decline, and loss of recreational, cultural, and spiritual values (Hamza et al., 2020; Himes-Cornell et al., 2018; Howard et al., 2017).

Although curbing the degradation causes is essential, merely halting the destruction does not suffice to recover the lost integrity and values of an ecosystem (Allison & Murphy, 2017). Therefore, ecological restoration has been championed as the best remedy. According to the Society for Ecological Restoration (n.d.), ecosystem restoration describes the “*process of assisting the recovery of a native ecosystem that has been degraded, damaged, or destroyed.*” Natural rehabilitation of an ecosystem is possible, but in the case of severe degradation, human assistance is necessary to achieve the ultimate goal of a full recovery (Brown, 2017; Society for Ecological Restoration, n.d.). The process of restoration often entails revegetation, reforestation, or rewetting of an area, which commonly takes years to decades until it eventually turns into conservation (Society for Ecological Restoration, n.d.).

Increasingly, numerous actors and organisations see ecosystem restoration as an imperative to reverse ecological destruction and biodiversity loss, as well as mitigate and adapt to the climate crisis (Quintero-Urbe et al., 2022). The United Nations called out the *Decade on Ecosystem Restoration* between 2021 and 2030 with the goal to “*prevent, halt, and reverse the loss of nature*” (United Nations, n.d.). This effort had been refined in the *UN Kunming-Montreal Global Biodiversity Framework*, which set the target of restoring 30% of degraded ecosystems globally by 2030 (UN Environment Programme, 2022). To achieve these objectives, laws and programs combatting ecosystem degradation emerge across sectors and countries.

In Kenya, where mangroves were historically seen as free timber resources, efforts to reduce the overharvesting that caused significant degradation rates were finally formalised in 2017 (Government of Kenya, 2017). After recognising the loss of the valuable ecosystem services of Kenya’s coastal mangrove ecosystems, the Kenyan government formulated the *National Mangrove Ecosystem Management Plan* that ought to improve their sustainable management to support local and national development (Government of Kenya, 2017). In the following years, when ecosystem restoration and climate governance became increasingly important globally, this plan became part of the extended *National Landscape and Ecosystem Restoration Strategy 2023-2032* (Government of Kenya, 2023). Among several goals to restore Kenya’s ecosystems, the policy entails an objective to restore 14,000 hectares of degraded mangrove forests. Despite the growing awareness of their importance, the continued decline of mangroves points to limitations in our understanding and management of them.

1.2 Valuation of Mangroves

Various authors attribute the continuous degradation of mangrove forests partially to an incomplete understanding of the diverse values of these unique ecosystems (Arias-Arévalo et al., 2017; FAO, 2023; Kairo & Mangora, 2020). They argue that an increased awareness of the mangrove's values would lead to heightened restoration efforts and sustainable management. Hereinafter, values are defined as the ways in which people ascribe importance to nature, which depends on their contexts, cultures, and knowledge systems they navigate (Arias-Arévalo et al., 2017; IPBES, 2022). To better understand these values, valuation is a deliberate process that elicits the values, which are associated with a particular ecosystem (IPBES, 2022; Pascual et al., 2023). This knowledge can inform communities and decision-makers about their held values regarding mangroves that guide their management decisions.

Initially, mangrove values had never been considered in economic assessments that would inform markets or political decisions, which is why the first valuations of nature attempted to determine the financial benefits of ecosystem services (Costanza et al., 1997; Huxham et al., 2015). This ought to highlight the losses resulting from ecosystem degradation and therefore prevent it. Back in 1997, the first monetary valuation quantified the benefits of nature to people at 18 trillion USD annually (Costanza et al., 1997). To date, numerous studies have put a price on mangroves, and researchers continue to assess their monetary value (Dahdouh-Guebas et al., 2022; Huxham et al., 2015).

With regard to Kenya's mangroves, the common valuation method was also found to be economic (Government of Kenya, 2017). For the *National Mangrove Ecosystem Management Plan*, the government undertook a national valuation of mangrove ecosystems, estimating their financial value at around KES 269,000 per hectare per year, totaling 2,083,000 USD. It includes a quantification of a range of ecosystem services, including fisheries, fuelwood, and tourism, for instance (Table 1). This valuation approach translates mangrove values into monetary terms, often expressed as annual contributions to the national economy. In this case, their financial benefits for shoreline protection, education & research, and building poles were estimated to be particularly valuable.

Table 1. Monetary valuation of mangrove ecosystems in Kenya (Government of Kenya, 2017).

Product and services	KES ha⁻¹yr⁻¹
Building poles	30,659.5
Fuel wood	4,505.0
Onsite fisheries	9,612.7
Beekeeping	1,249.5
Integrated aquaculture	408.0
Education & Research	65,469.6
Tourism	782.0
Carbon sequestration	21,896.0
Shoreline protection	134,866.1
Total	269,448.3

(Source: KMFRI)

Whereas monetary valuations stress the importance of ecosystems for human well-being and make their benefits to people more graspable from an economic perspective, they prioritise market-based values of nature at the expense of hardly quantifiable values (Dahdouh-Guebas et al., 2022; IPBES, 2022). Because economic valuation continues to be the dominant method across nature assessments, there may be knowledge gaps regarding context-specific values and the complexity of human-nature relationships (Arias-Arévalo et al., 2018; Dahdouh-Guebas et al., 2022). Ecological economists particularly criticise monetary valuations for disregarding the non-substitutability and non-linearity of ecosystems, meaning that beyond a certain degree of degradation, some values of ecosystems are simply not possible to rehabilitate and cannot be economically compensated or replaced.

In response, alternative approaches that aim to capture the diverse ways in which nature is valued are gaining prominence (Jacobs et al., 2020). Plural valuation recognises that people ascribe multiple values to one ecosystem and therefore integrates significant non-measurable values of mangroves that matter, such as providing a sense of place, spiritual practices, and aesthetic value, besides economic values (Arias-Arévalo et al., 2017, 2018). A multiplicity of authors argue that this fuller understanding of the values of an ecosystem ultimately better informs effective, sustainable management decisions, leading to increased restoration efforts (Jacobs et al., 2020; Miller & Tonoto, 2023; Pratson et al., 2023; Zafra-Calvo et al., 2020). A shift towards plural valuation approaches is therefore underway and promises to be more suited to tackling the global sustainability challenges of ecosystem degradation and mangrove loss.

1.3 Monitoring Restoration Progress

Despite the rise of plural valuation approaches, revealing the diverse values associated with mangroves does not necessarily ensure that they are reflected in how restoration is managed and assessed in practice (IPBES, 2022). In fact, monitoring goals and systems can influence what is valued in restoration initiatives (Fukuda-Parr & McNeill, 2019; Merry, 2011). Ultimately, what gets measured shapes which values are considered lost and aimed to be restored. Yet, various restoration projects are either lacking adequate monitoring setups or rely on standardised, measurable indicators (Ellison et al., 2020; Gatt et al., 2024; Poti et al., 2025). This raises the question of whether monitoring systems meaningfully capture the diverse values of these social-ecological systems and help to restore what matters.

Although monitoring is critical for ecosystem restoration success, several case studies found that monitoring efforts in mangrove rehabilitation initiatives were often fragmented or short-term (Ellison et al., 2020; Lhosupasirirat et al., 2023; Macera et al., 2024). Yet, regular and sustained monitoring is essential to thoroughly evaluate restoration progress and provide evidence to funders and scientists, as well as to restore the ecosystem in the way it is meant to (Brown, 2017; Poti et al., 2025). Without it, financial resources and planting efforts may be wasted. Therefore, it is not only essential for restoration initiatives to set up a long-term monitoring system but also to ensure that the restoration objectives are based on the full set of values that the ecosystem holds.

1.4 Bridging Plural Values and Monitoring in Kenya

At the nexus of Kenya's mangroves and restoration monitoring lie multiple knowledge gaps. Valuation studies on mangroves predominantly determine the value through benefit transfer and market price, which neglect non-measurable values (Himes-Cornell et al., 2018). Beyond that, plural valuation approaches are underused in African contexts (IPBES, 2022) and a recent literature review found only one study on the plural values of nature in Kenya and three across the entire African continent (Himes et al., 2024). Therefore, there is little understanding of the diverse values that people ascribe to nature, particularly to marine and coastal ecosystems, which are assessed in only 10% of valuation studies (Pascual et al., 2023). Even less research is conducted on peri-urban ecosystems, such as the Tudor Creek mangrove forest in Mombasa (Mohamed et al., 2016). On the other hand, many restoration initiatives in Kenya are found not to report on their monitoring efforts (Kairo & Mangora, 2020). In combination, there is no comprehensive analysis of monitoring practices in restoration projects and how they may capture or obscure the diverse values of mangrove ecosystems. However, to halt degradation and support restoration outcomes, these interactions are crucial to understand.

1.5 Aim and Research questions

This thesis in the field of sustainability science examines the case of a mangrove restoration initiative in Tudor Creek, Kenya, through a plural valuation lens and evaluates to what degree the diverse values of the forest are reflected in restoration objectives and monitoring practices. Concretely, it aims to elicit the plural values of the mangrove forest held by the restoration community, identify their current monitoring practices, and determine whether the values are aligned with their monitoring practices and perception of restoration progress. I aspire to shed light on what values are measured and what values matter in this case and generate new insights for mangrove restoration practitioners, funders, policymakers, and researchers.

To reach the research aim, this inquiry is guided by the following research questions (RQs):

- RQ1** *Which plural values does the Tudor Creek restoration community associate with the mangrove forest?*
- RQ2** *How is restoration progress measured and shaped by monitoring practices in the Tudor Creek mangrove restoration initiative?*
- RQ3** *To what extent are the plural values of the Tudor Creek mangrove forest captured in current monitoring practices?*

The questions were answered based on semi-structured key informant interviews with the restoration community of the Tudor Creek mangrove forest. The case study is informed by measurement theory and draws on the Plural Values of Nature typology by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2022) for the analysis.

2 Case Description

2.1 Kenya

Africa hosts the second-largest area of mangroves on any continent, with 2.82 million hectares or 19% of the global mangrove cover (FAO, 2023). A large number of these mangrove forests occur in the East African country Kenya, where they are common coastal ecosystems, predominantly in deltas, creeks, and rivers (Fig. 2) (Abuodha & Kairo, 2001).

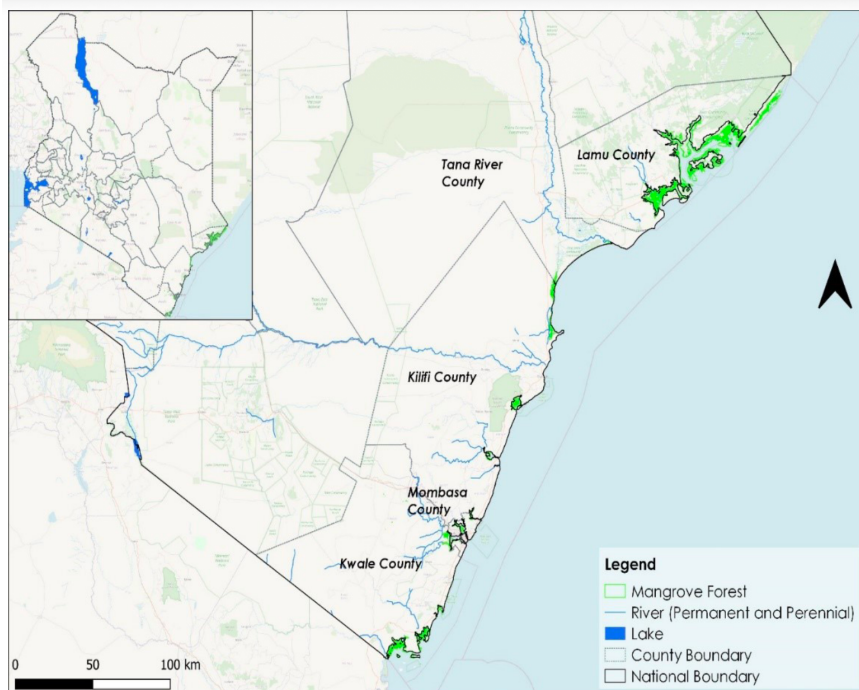


Figure 2. Distribution of Kenya's mangrove forests (Government of Kenya, 2023).

However, between 1985 and 2010, 20% of Kenya's mangroves have been lost (Bosire et al., 2014). Coastal populations regarded mangroves as a free and effective natural resource for various purposes, including firewood, charcoal, and building material (Government of Kenya, 2017; Mohamed et al., 2009). The Government of Kenya (2017) describes particularly the mangrove's usefulness for a variety of purposes as one of the main drivers of degradation, which is compounded by population increase, high poverty levels, lack of alternative livelihoods, and weak management plans. Additionally, extreme weather during strong phases of the El Niño Southern Oscillation (ENSO) induced soil erosion and mangrove dieback across East African countries, including Kenya (Bosire et al., 2014; Dahdouh-Guebas et al., 2022).

2.2 Mombasa

Being Kenya's second-largest city and hosting East Africa's largest port, Mombasa's mangroves have faced strong anthropogenic pressures for decades (Mohamed et al., 2009). Throughout the years, the peri-urban mangrove ecosystems in this coastal metropolis have largely degraded due to consistent firewood demand and housing encroachment, as well as occasional industrial pollution such as oil spills (Government of Kenya, 2017; Mohamed et al., 2009). Regeneration is slowly happening but requires active restoration and the reduction of degradation drivers, which is particularly challenging in peri-urban forests (Bosire et al., 2014).

2.3 Tudor Creek mangrove forest

Mangroves in Mombasa County occur along the Mwache Creek and Tudor Creek, but this study focuses on the mangrove restoration site in Junda at the Tudor Creek (Fig. 3). This forest area was chosen due to the presence of an active restoration initiative at the site led by the Kenyan NGO *Brain Youth Group*, as well as the significantly high rate of mangrove loss. Between 1992 and 2009, Tudor's mangroves disappeared by 87% (Bosire et al., 2014). Part of it was caused by the heavy rains during the El Niño Southern Oscillation (ENSO). In addition, its peri-urban setting makes the mangrove forest particularly vulnerable to uncontrolled harvesting for firewood and construction material, as the surrounding communities largely depend on its timber as an energy source. Extreme weather events caused by the climate crisis and pollution due to a lack of waste treatment facilities and nearby industries only add to these pressures (Mohamed et al., 2016).

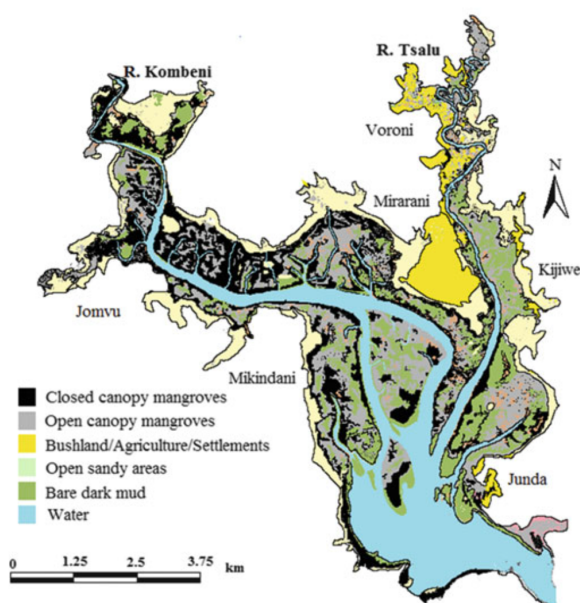


Figure 3. Map of Tudor Creek in Mombasa (Mohamed et al., 2016).

As a response to the disappearance of Tudor Creek's mangroves, the Brain Youth Group established an initiative to restore the forest area nearby Junda in 2011 (Ecosystem Restoration Communities, n.d.). In the following 15 years of engagement, the NGO has built a close cooperation with the surrounding villages, established trust with the local fishermen, and employs especially youth and women. Their work entails the planting of mangroves, as well as regular awareness campaigns to raise the residents' understanding of the mangrove forest's importance.

3 Theoretical Frameworks

Serving as the theoretical ground, measurement theory provides the entry point to this inquiry on the valuation of mangroves and the monitoring of restoration efforts. The Plural Values of Nature typology by the IPBES provides the analytical lens and coding scheme to answer the research questions.

3.1 Measurement Theory

Measurement theory provides a useful lens for exploring how complex, multidimensional phenomena, such as the values people attribute to ecosystems, are translated into comparable indicators (Merry, 2011; Michell, 1999). In Sustainability Science, many aspects of human-nature relationships are '*latent constructs*' that cannot be directly measured but must be represented through proxies that attempt to reflect their essence (El-Den et al., 2020). Examples of these are attitudes, feelings, or values. Thus, indicators reflect latent constructs and make them measurable to facilitate comparisons among units over time (Kelley & Simmons, 2015). The process of operationalising these necessarily involves simplification, as it requires translating complex and context-specific meanings into standardised, measurable, and comparable variables (El-Den et al., 2020; Merry, 2011; Turnhout et al., 2007). Consequently, there is a risk that what is monitored in an ecosystem may not reflect the full spectrum of what matters, but what can be feasibly and meaningfully measured within a system.

According to measurement theory, monitoring frameworks are not neutral representations of reality, but they are shaped by management choices, assumptions, and practical constraints (Merry, 2011). In return, the choice of indicators may shape how ecosystems are valued and understood, prioritising measurable values over others. This perspective is particularly relevant for this study, as it allows for a systematic examination of how plural values of the Tudor Creek mangrove forest are translated in both current and standardised monitoring practices. By adopting measurement theory as the theoretical entry point for this research, the dynamics of monitoring and their implications for human-nature relationships can be critically examined.

3.2 IPBES Values Typology

In this study, the IPBES typology of nature's values serves as the analytical lens. It recognises the diversity of worldviews and knowledge systems that influence how people value nature and aims to incorporate this plurality in value assessments (IPBES, 2022). It originated from the understanding that a common lack of integration and neglect of the diverse values of nature lies at the core of widespread mismanagement and destruction of natural systems. According to the IPBES (2022), basing decisions on the plurality of nature's values leads to more just and sustainable future pathways.

This thesis uses the specific values of the IPBES typology as an analytical group. They refer to the judgments regarding the importance of nature for particular contexts or ecosystems (IPBES, 2022). Concretely, the specific values of nature can be categorised as either *instrumental*, *intrinsic*, or *relational* (Fig. 4), and multiple of these can be held simultaneously (Arias-Arévalo et al., 2017). In this case study, the specific values are used to assess the diverse values that the restoration community associates with the Tudor Creek mangrove forest and how these values are represented in monitored objectives. 'Plural values' and 'diverse values' are used interchangeably in this thesis, as is common in plural valuation literature.

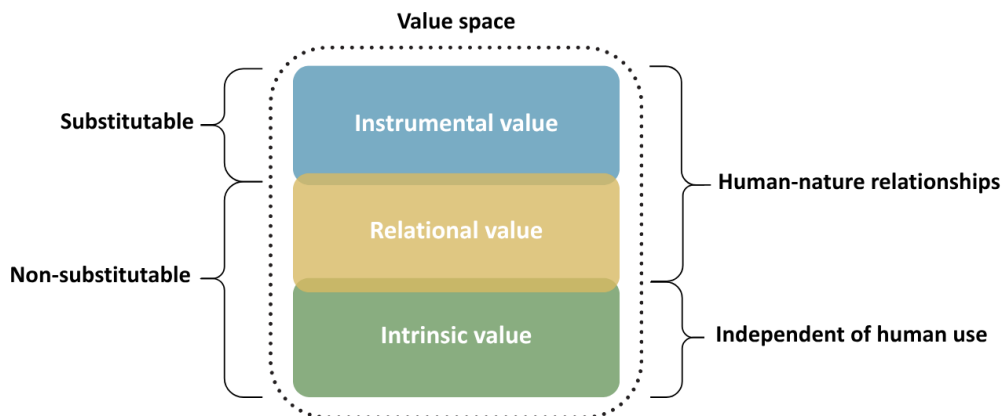


Figure 4. Distinction between instrumental, relational, and intrinsic values of nature (own visualisation, adapted from Himes & Muraca, 2018).

One of the three specific values in the IPBES typology for diverse values is instrumental values, which ascribe to nature the value of being a means to a particular end (IPBES, 2022). They describe the benefits of nature to people in the form of ecosystem services, which are commonly measured with monetary valuation approaches (Arias-Arévalo et al., 2018). Compared to the other two specific value categories, instrumental values of nature are distinct based on their theoretical substitutability (Chan et al., 2018). If a value of nature can be substituted in another form and continue to provide the same benefit to people, it is considered instrumental.

The inherent value of nature independent of its utility to people is described as an intrinsic value (Arias-Arévalo et al., 2017; IPBES, 2022). It correlates with the right of nature to exist for its own sake, which aligns with various Indigenous ontologies of relating to nature. In recent years, the intrinsic value of ecosystems has been further highlighted by the *Rights of Nature* movement, which advocates for assigning legal rights to natural entities under national law, such as in Ecuador, India, and New Zealand (Knauß, 2018). Intrinsic values are not substitutable (Himes & Muraca, 2018).

Relational values of nature are defined as the meaningfulness of the connection between humans and nature, which are neither intrinsic nor instrumental but relate to a particular ecosystem or context (Chan et al., 2018; IPBES, 2022). Examples of relational values are a sense of place, spiritual fulfillment, reciprocity, and kinship. Although they describe a certain purpose of nature for humans, relational values are distinct from instrumental values insofar as they are not substitutable (Chan et al., 2018; Himes & Muraca, 2018). Thus, this value category incorporates non-Western and Indigenous understandings of nature, such as *Buen Vivir* in South America or *Ubuntu* in Sub-Saharan Africa, which have historically been neglected in nature valuation approaches, despite their importance to human well-being (Chan et al., 2018; Moore et al., 2022; Pascual et al., 2023).

4 Methodology

The research aim is achieved based on a qualitative case study and the methods were chosen according to sustainability science practices and numerous conversations with the restoration coordinator of the Brain Youth Group to assess their feasibility, suitability, and ethics.

4.1 Epistemology

This study is embedded in a constructivist epistemological perspective, which regards knowledge about the world not as objectively discovered but socially constructed through interaction and interpretation by people (Bryman, 2012). This implies that the values attributed to ecosystems are not universal properties but shaped by their context, which is precisely the epistemological stance that the IPBES typology of nature's diverse values is built on (IPBES, 2022). Constructivist research often examines values and perceptions of reality and seeks to understand how these are shaped by contextual human-nature relationships, rather than discovering an objective truth (Avelino & Rotmans, 2011). This epistemological viewpoint also aligns with the use of measurement theory as a central lens. Monitoring indicators are not seen as neutral representations of reality but understood as outcomes of selection, interpretation, and operationalization processes (Merry, 2011).

4.1 Research Design

The research design is shaped by measurement theory as a theoretical lens and the IPBES typology as the analytical framework, in which the three research questions (RQs) are embedded (Fig. 5). To answer these, the Tudor Creek mangrove forest was chosen as a case study, from which insights and conclusions for other ecosystem restoration cases can be derived, albeit not generalised. The data collection was conducted in the form of semi-structured key informant interviews with members of the restoration community and monitoring team. The last research question was answered through a comparative analysis of the results of RQ1 and RQ2.

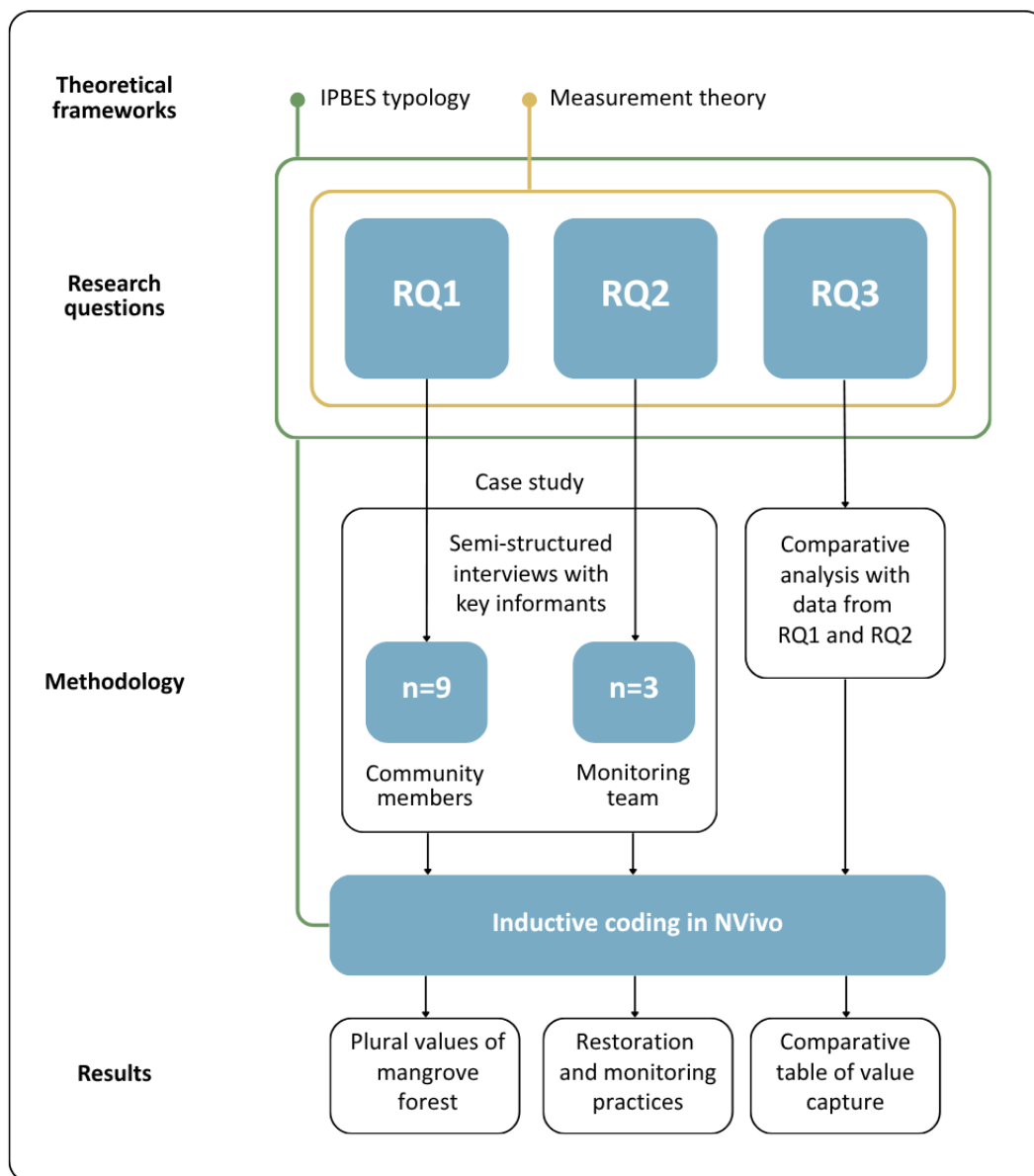


Figure 5. The research design (own visualisation).

4.1.1 Semi-structured Key informant interviews

Semi-structured interviews were deemed suitable for this case study, as it is a form of statement-based valuation, which helps to uncover the importance of nature to people, as well as their underlying reasoning (IPBES, 2022). In this type of interview, an interview guide (Appendix A) was used to direct the conversation towards particular topics to answer the research questions, but flexibility was given for unexpected turns and follow-up questions (Bryman, 2012). In the context of plural valuation in Kenya, semi-structured interviews also allow to create a relaxed and informal environment in which the participants hopefully felt comfortable to share their values and stories (Carmenta et al., 2023).

To get in-depth insights into a specific context, such as the diverse values of the Tudor Creek mangrove forest, key informant interviews are a highly valuable method (Bryman, 2012; Kumar, 1989). In essence, key informants are carefully selected research participants who are especially knowledgeable about a particular topic, which is why a small number of interviewees suffices to answer the research questions. Sampling together with members of the NGO, I chose those restoration practitioners that had been consistently active in the project for at least five years, and most of them grew up in Junda, experiencing the changing forest from degradation to restoration.

Key informants were chosen using a purposive sampling strategy, targeting active members of the restoration community in Junda for RQ1 (n=9) and members of the NGO's monitoring team for RQ2 (n=3) (Fig. 5). In total, the entire community includes approximately 30 members, and the monitoring team includes four persons. Most participants were proficient in English, but for five community members that preferred Kiswahili, an NGO member translated their answers to English. Interviews were carried out until theoretical saturation for every research question was reached, meaning that no new insights emerged from the data (Bryman, 2012). The twelve semi-structured key informant interviews were conducted in March 2026 and lasted between 10 and 46 minutes (Appendix B). Minor edits to the transcripts and removal of names ensured readability and anonymity of the participants.

4.1.2 Coding and Analysis

The transcripts answering RQ1 were coded using a hybrid (abductive) approach, combining deductive and inductive coding, informed by Braun & Clarke's (2006) framework on thematic analysis. After transcribing the interviews and familiarising myself with the data, the material was set up in *NVivo*. Since the IPBES typology serves as the analytical lens for this study, the pre-defined value domains of *instrumental*, *intrinsic*, and *relational* values were used deductively as overarching parent codes.

Next, I developed the child codes inductively from the data and categorised them into one of the three parent groups. This was an iterative process of identification, definition, and refinement of values in relation to the mangrove forest, derived from the data and supported by existing plural valuation literature (Arias-Arévalo et al., 2017; Himes et al., 2024; Himes & Muraca, 2018). After the first version of child codes was finalised, I reviewed each segment and merged or split the codes accordingly. Some segments were coded multiple times, as the boundaries between diverse values can be fuzzy at times (Himes et al., 2024). Finally, it is crucial to note that the absence of certain values in the coding does not imply their absence among the participants but rather reflects what is articulated, recognised, and measurable in this case study. Once the value definitions and coding (Appendix C) were final, the data were visualised and analysed.

For RQ2, the codes emerged inductively from the data based on patterns and themes. Thus, this coding strategy did not follow a pre-existing framework, but the five parent codes of *restoration objectives*, *restoration progress*, *monitoring practices*, *monitoring decisions*, and *monitoring challenges* were developed directly from the data and iteratively refined through repeated comparison across the interview transcripts. Child codes within each category were then identified, defined, and adjusted through multiple rounds of coding, ensuring clarity and consistency. The data were subsequently synthesised and presented in five tables with illustrative quotes for each child code.

4.1.3 Comparative Analysis

The comparative analysis assessed the extent to which the diverse values elicited in RQ1 are captured in the restoration objectives, restoration progress, and monitoring practices of Brain Youth Group identified in RQ2. Here, the instrumental, intrinsic, and relational values associated with the mangrove forest from RQ1 were systematically compared with coded data on current restoration and monitoring structures from RQ2. In line with measurement theory, the degree of capture of each value was classified as *full*, *partial*, or *none*, based on whether and how clearly the value was reflected in monitoring. The results were synthesised in a comparative matrix table, enabling a structured evaluation of alignment and discrepancies between the values that the restoration community considers important and those that are monitored.

4.2 Transdisciplinarity

The field of sustainability science is characterised by its solution-oriented approach, methodological pluralism, integration of non-scientific knowledges, and interdisciplinarity aiming for transdisciplinarity (Spangenberg, 2011). Transdisciplinary research entails the active inclusion of non-academic actors and knowledges in the research process (Avelino & Rotmans, 2011). Concretely, it is characterised by rooting the inquiry in a societal problem, fostering active collaboration between researchers and practitioners, maintaining critical self-reflexivity, and integrating scientific and non-scientific insights (Jahn et al., 2012; Lang et al., 2012).

As a fully transdisciplinary research project would require a research team consisting of scientists and practitioners (Lang et al., 2012), this thesis is transdisciplinary-informed. First, I took the societal challenge of mangrove degradation, particularly in the Tudor Creek forest, as the starting point of this inquiry, ensuring that the research provides societal value. Second, I maintained close collaboration with the Brain Youth Group throughout the research process and continually adjusted the research design according to conversations with the NGO coordinator. Third, I practiced reflexivity daily and critically examined how my preceding biases, assumptions, and socialisation influence the research.

4.3 Positionality

Reflexivity also requires careful consideration of the researcher's positionality (Spangenberg, 2011). As I embodied the role of a researcher towards the restoration community, my actions and approaches would leave an impression of academia as a whole. Besides ethical practices, it is therefore crucial to conduct the research in a reflexive, respectful, and open-minded manner with the participants. I noticed how several interviewees expected me to teach them instead of me learning from them. Thus, it was particularly important to emphasise the importance of their local knowledge for the research.

Additionally, I came into the field as an outsider. Before visiting the Tudor Creek mangrove forest in February 2026, I had never even seen a mangrove tree in person before. As a European, I was an outsider simply due to my ethnicity. *Mzungu* is what I was frequently referred to as by Kenyans, a Kiswahili descriptive term used to point out 'white people' or Europeans, which is derived from the words 'to go around' or 'wander' (Spitzer, 2019). As a *mzungu*, I was immediately perceived as different and less knowledgeable about the daily life and dynamics in Kenya. Therefore, I depended on the hospitality and friendliness of the Kenyans to explain to me not only how to navigate the country but also to understand important perspectives related to mangrove degradation and restoration.

On the other hand, being European and a university student comes with generous privilege and power. I had direct access to travel grants, databases, insurance, digital devices, and a passport that most locals do not. I thus want to emphasise that significant injustices and power differences between the researcher and participants exist, impacting how this study was designed, conducted, and interpreted.

4.4 Ethics and Anticolonial science

Coming as an outsider, a *mzungu*, and a privileged master student to Kenya, I placed importance on practicing not only ethical but also anticolonial science. Colonial science entails conducting research without consent, assuming access to Indigenous land, extracting knowledge without giving back, and causing pollution or harm (Liboiron, 2021). On the contrary, anticolonial science demands reflecting upon how the research is conducted, assessing one's positionality, acknowledging the subjectivity of the researcher, preventing the appropriation of local knowledges, championing place-based research over universalism, practicing good relations with participants, and including them in a meaningful way.

I fostered the principles of anticolonial science through frequent reflection regarding my methods and biases and discussing them with the NGO coordinator and asking every participant for their free, prior, and informed consent stated in a written ethical consent form (Appendix D), avoiding non-consensual appropriation of their experiences. Furthermore, I actively supported the seedling planting efforts for several days in March 2026 (Fig. 6). My intention was to practice good relations with the land and the people, as well as to give value back to the community in return for their time and insights. Lastly, I shared the thesis with the restoration community and discussed the key findings in an online meeting.



Figure 6. Preparing for planting with NGO members (own photo).



Figure 7. Tudor Creek forest (own photo).

4.5 Limitations

This research project faced numerous limitations. Generally, the success of key informant interviews is highly dependent on the right selection of interviewees (Kumar, 1989). Although I trust that I chose suitable key informants and achieved saturation, I may have missed relevant actors in the restoration community due to time constraints or limited familiarity with the context. Additionally, the interviews with the community members were assisted by a translator from the NGO, which has likely influenced the outcomes. The meaning of the original responses may have been altered through the translation from Kiswahili to English, or the translator may have adjusted the responses based on their own views and biases.

In plural valuation studies based on the IPBES framework, the boundaries between *instrumental*, *intrinsic*, and *relational* values can be ambiguous, which influences the research results (Himes et al., 2024). Sometimes, the three value domains overlapped, or the same segment was coded twice, because it could imply multiple meanings. Although I followed a structured iterative coding process informed by Braun & Clarke (2006) and plural valuation scholars, coding choices are always subject to the researcher's epistemology and preconceptions.

Further, the IPBES (2022) and several authors in the field of nature valuation stress the importance of integrating the research findings in decision-making (Pascual et al., 2023; Zafra-Calvo et al., 2020). They highlight the common implementation gap of insightful valuation studies into policies, which I was not able to address in this thesis. Although engaging with Kenyan decision-makers, such as the *Kenya Forest Service*, could have increased the impact of this research, I instead focused on my collaboration with the Brain Youth Group, with which I later shared research results and discussed to what extent they could be considered in their management and monitoring decisions.

The short duration of my fieldwork in Mombasa further limited my ability to practice anticolonial science, insofar as I could not conduct a community peer review. Ideally, a community peer review at the end of the research process entails a presentation of the research findings to the participants and provides a constructive space for them to respond to the outcomes (Liboiron, 2021). The purpose is returning the knowledge that was synthesised from the community and making it available for scrutiny, rather than merely extracting and presenting it in academic spaces. Likewise, transdisciplinary research requires the integration of knowledge, meaning the discussion of different knowledges with various research stakeholders (Jahn et al., 2012). Therefore, this thesis is merely anticolonial- and transdisciplinary-informed.

5 Results

5.1 Plural Values Elicitation

The interviews with nine key informants of the Tudor Creek restoration community revealed a variety of diverse values associated with the mangrove forest, of which 12 were identified as instrumental, four as intrinsic, and six as relational (Fig. 8). It should be noted that most values are directly linked to the existence of the mangrove forest itself, whereas several others stem from the restoration efforts, which provide *work opportunities* and *international opportunities*, for instance.

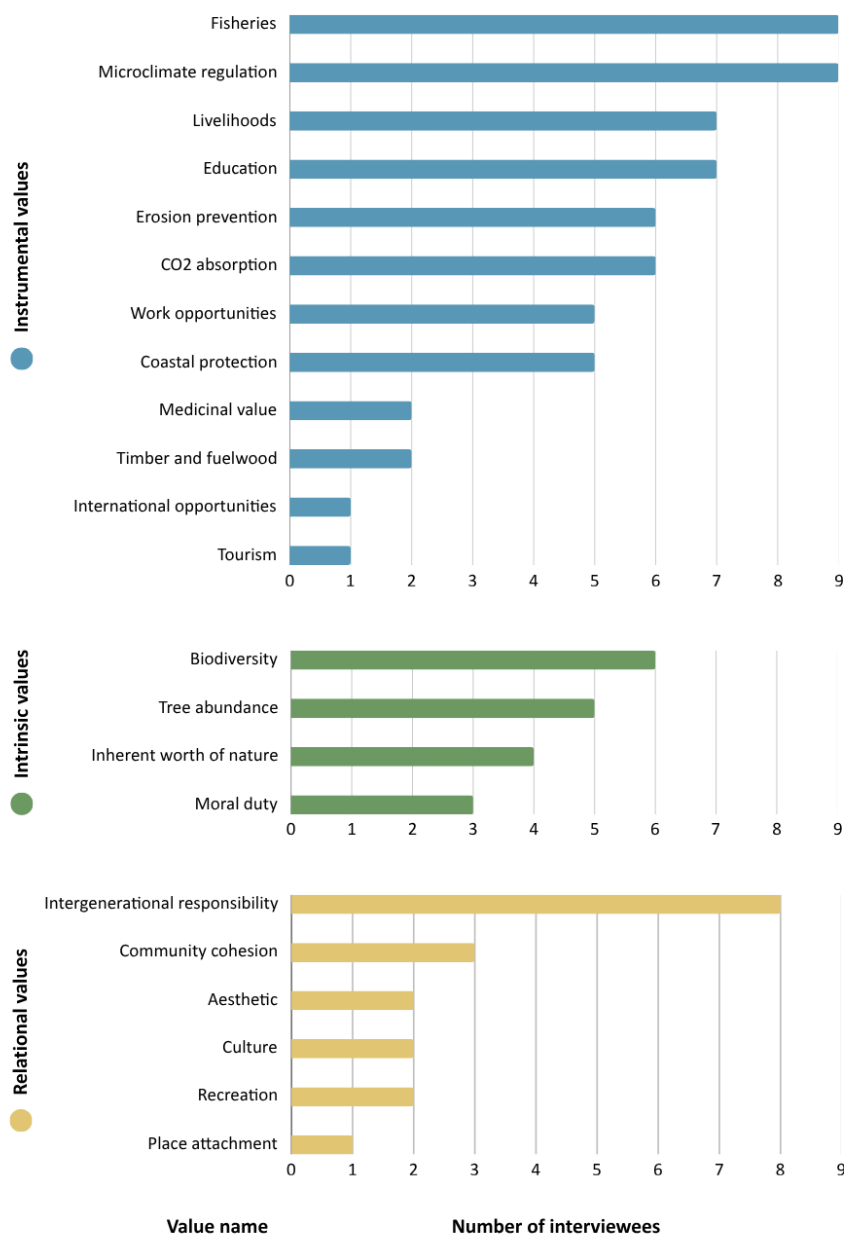


Figure 8. Elicited plural values associated with the Tudor Creek mangrove forest, distinguished between the three specific value domains (*instrumental*, *intrinsic*, *relational*), ranked according to the number of interviewees that expressed a value and, if they are equal, by the number of times a value was mentioned.

Among the three specific value domains, the majority of values connected to the Tudor Creek mangrove forest were found to be instrumental (Fig. 8). This becomes clear not only from the number of interviewees that mentioned instrumental values but also from the number of values that emerged from the data. Primarily, all nine key informants recognised the mangroves' positive effect on *fisheries* and their ability for *microclimate regulation* as core values. The community noted that a healthy mangrove ecosystem increases overall fish abundance, and one restoration practitioner explained that "*Now when we restore the mangroves, the fishermen also get a lot of fish because the mangroves are the breeding grounds of the fish*" (RQ1-NGO1). The value category of *microclimate regulation* included sub-values such as *cool temperature*, *breeze*, *fresh air*, *rainfall*, and *shade provision*, which the community recognises as essential values of the forest.

As expressed by eight key informants, *intergenerational responsibility* clearly stands out as the third most-mentioned value and the dominant one among the relational values (Fig. 8). One community member stressed, "*Our future generations will benefit from this forest because we have done sensitisation, (...) they know the importance of the forest, and they will go on taking care of the forest*" (RQ1-COM3). The results demonstrate the community's determination to maintain both the health of the mangrove forest and the restoration project long-term. Except for *intergenerational responsibility*, other relational values were mentioned only a few times.

Intrinsic values of the Tudor Creek mangrove forest were not held by all key informants and visibly less prominent as compared to instrumental values (Fig. 8). Among the four identified values, *biodiversity* mattered the most. Six interviewees explained the importance of mangroves for *biodiversity*, as highlighted here: "*We have made a lot of homes for very many creatures in the sea. It's more of an ecosystem again*" (RQ1-NGO3). Similar to the relational values, intrinsic values were expressed more sparingly than instrumental ones.

Although nearly every key informant held instrumental, intrinsic, and relational values in relation to the Tudor Creek mangrove forest, the instrumental values clearly outweigh the other two (Fig. 8). The results suggest a strong awareness of the ecosystem services and benefits that the forest provides, such as *fisheries* support and *microclimate regulation*. In addition, the data point to a clear sentiment for *intergenerational responsibility* and a motivation to preserve the forest and its plural values for future generations.

5.2 Monitoring Restoration in Practice

The five main themes regarding monitoring in the restoration initiative by the Brain Youth Group that emerged from the research are (1) *restoration objectives*, (2) *restoration progress*, (3) *monitoring practices*, (4) *monitoring decisions*, and (5) *monitoring challenges*. Presented in the following tables, they provide relevant insights into the goals, dynamics, and limitations of monitoring in ecosystem restoration work.

According to the three key informants of the NGO's monitoring team, the overarching restoration objective is the restoration of the *full canopy cover* across the Tudor Creek mangrove forest (Table 2). They emphasise that their aim is to not only rehabilitate the site in Junda but the entire forest, in collaboration with other local communities (RQ2-NGO1, RQ2-NGO5). Second to this target, two informants expressed the importance of *livelihood improvement* through the restoration initiative (RQ2-NGO1, RQ2-NGO5) and improved *microclimate regulation* through the forest's capacities, such as clean air (RQ2-NGO5, RQ2-NGO6). Half of the identified restoration objectives were only raised by one informant (Table 2). Other than that, it is noticeable that every restoration goal refers to an instrumental value. Thus, restoration objectives refer to utilitarian goals, and merely one of the six is agreed-upon by all participants.

Table 2. Restoration objectives in the Tudor Creek mangrove forest restoration initiative, ranked according to the number of interviewees that mentioned a value (*participants*) and, if they are equal, by the number of times a value was mentioned (*references*).

Restoration objectives	Participants	References	Illustrative quote
Full canopy cover	3	7	"The goal is to make sure the Tudor Creek degraded areas are fully restored to achieve the state the forest was previously, until it comes back to that." (RQ2-NGO6)
Livelihood improvement	2	4	"The mangroves, they have created a connection or a bridge for me to reach the people who can provide what is needed on the ground." (RQ2-NGO1)
Microclimate regulation	2	2	"And ensuring that the air we breathe is okay, is clean." (RQ2-NGO6)
CO2 absorption	1	1	"Our goal is to reduce the carbon emissions. That's our goal." (RQ2-NGO6)
Fisheries support	1	1	"And then again, to make sure they will increase fish production, which will lead to income generation." (RQ2-NGO6)
International opportunities	1	1	"So it's also to create more opportunities for the international students that are interested to come to Kenya and participate in mangrove restoration." (RQ2-NGO1)

Similar to the restoration objectives, the progress in filling the forest's *canopy cover* is pointed out as the main achievement of the restoration project and the only one that was shared by all (Table 3). However, comparing across the three key informants, a discrepancy regarding how much of the forest has been restored emerged. NGO1 declared that the NGO has restored 75% of the forest, whereas NGO5 claimed 60%, and NGO6 referred to 85% (RQ2-NGO1, RQ2-NGO5, RQ2-NGO6). This large misalignment in restoration progress may be due to the lack of monitoring of the restored hectares between 2011 and 2022, when only the number of planted seedlings was accurately calculated, but not the progression of the forest's canopy cover (Table 3). Secondly, the participants highlighted *community mobilization* as an indicator of progress, referring to the planting efforts and sensitisation programs that have increased awareness of the importance of mangroves across the community and contributed to a reduction in their use for timber and fuelwood. As in Table 2, only one person pointed out additional indicators of restoration progress, but these were not expressed by the other monitoring team members.

Table 3. Restoration progress in the Tudor Creek mangrove forest restoration initiative, ranked according to the number of interviewees that mentioned a value (*participants*) and, if they are equal, by the number of times a value was mentioned (*references*).

Restoration progress	Participants	References	Illustrative quote
Canopy cover	3	12	"And I can say that almost 420 hectares we have managed to restore. So there is a small amount of hectares that is still open." (RQ2-NGO1)
Community mobilization	2	3	"Everybody when he sees any big tree, they'll come and cut them, but now we have educated them, and they know the importance of the mangrove." (RQ2-NGO6)
Biodiversity	1	4	"You can see all the flowers. The bees are doing so well." (RQ2-NGO6)
Microclimate regulation	1	2	"So right now, you can see when you sit here, you can see the breeze." (RQ2-NGO6)
Fisheries	1	1	"Because the fish are coming now." (RQ2-NGO6)
Erosion reduction	1	1	"The tides are coming and they are stopped right from the other end. (...) There is no erosion anymore." (RQ2-NGO6)
Livelihoods	1	1	"We can now start getting something from the honey we sell." (RQ2-NGO6)

The results provide a thorough understanding of the NGO's monitoring practices, of which half were confirmed by all key informants (Table 4). Their common practice includes the regular evaluation of the seedlings' growth and survival rates in three-month intervals. By checking each seedling in a sample site, the practitioners calculate the percentages and replace the dead and weak seedlings with new ones. Usually, the entire restoration community participates in this task until the restoration target is reached. Despite the NGO's founding in 2011, a monitoring structure was only established in 2022 during a funding opportunity. Since then, the practitioners have relied on external support to acquire monitoring expertise and access to tools. Interestingly, some monitoring is done through observation, by getting a feeling for the forest and comparing it with previous states (RQ2-NGO6). Therefore, the monitoring practices of the Brain Youth Group can be deemed adaptive, recent, and done by everyone.

Table 4. Monitoring practices in the Tudor Creek mangrove forest restoration initiative, ranked according to the number of interviewees that mentioned a value (*participants*) and, if they are equal, by the number of times a value was mentioned (*references*).

Monitoring practices	Participants	References	Illustrative quote
Seedling growth and survival rate	3	29	"So what you measure is the amount of surviving trees, thriving trees. And the diameter, the thickness of the tree." (RQ2-NGO5)
External support	3	15	"There are people who are coming here to teach us how to monitor mangroves. They come with their tools and measurements." (RQ2-NGO6)
Replacement of dead seedlings	3	11	"If there are some dead seedlings which have been planted, we'll have to replant them to replace them to make sure the target which was aimed at is achieved." (RQ2-NGO5)
Monitoring frequency	3	8	"After planting, we come after three months. Then after three months, we come again. And then comes the time when it's after six months, after one year." (RQ2-NGO5)
Start of monitoring in 2022	3	7	"But, since 2022, when we had the opportunity to plant 750,000 mangrove seedlings, then we started being serious." (RQ2-NGO1)
Community participation	3	5	"Most of the time, all the members are involved." (RQ2-NGO5)
Observation-based monitoring	2	11	"If the birds are coming, you can see. You will check the legs. You calculate how many birds are there. You look at the footsteps." (RQ2-NGO6)
Number of planted trees	2	6	"When you plant seedlings, you count the amount that you plant." (RQ2-NGO5)
Data recording	1	6	"But for us, [NGO member] is the one who records all the seedlings we planted, how we have replaced the seedlings. She has the records." (RQ2-NGO6)
Zonation	1	6	"There's zonation. (...) So I choose where the Ceriops are available. You can't go to where Rhizophora are." (RQ2-NGO6)
Biodiversity	1	4	"You can see the animals, which are on that portion. You have to calculate the crabs inside there." (RQ2-NGO6)
Reporting and visibility	1	3	"Later we are going to take some pictures to post them on social media, so people can see what is happening on the ground and so we can mention the company that has supported us." (RQ2-NGO1)

According to the data, the primary reason why the NGO began to monitor their restoration activities in 2022 is that a particular funding organisation requested them to monitor the success rate of the seedlings in order to receive the funding (RQ2-NGO1). The restoration practitioners have realised that the monitoring activities have increased the willingness of funders to support their project, which is one reason why they have continued since starting in 2022 (RQ2-NGO5). This motivation to monitor is accompanied by a general curiosity to learn more about mangrove ecosystem restoration and improve the project (Table 5). Generally, the results show that external stakeholders, individuals within the organisation, and sometimes community needs are involved in decision-making processes. Although there is a dedicated monitoring team of four, the decisions seem to be taken by various persons for different reasons.

Table 5. Monitoring decisions in the Tudor Creek mangrove forest restoration initiative, ranked according to the number of interviewees that mentioned a value (*participants*) and, if they are equal, by the number of times a value was mentioned (*references*).

Monitoring decisions	Participants	References	Illustrative quote
Requirement from funders	3	8	"If we do a project with a certain organization, we do the monitoring." (RQ2-NGO5)
Openness to learn	3	5	"Because the more you are interacting with different people, you learn new things, and you also decide: I can do this to my project and you learn all the time." (RQ2-NGO1)
External decisions	2	5	"And, after he moved around with his team, they saw a place where there is high demand for us to replace the dead and weak seedlings, and they tell us." (RQ2-NGO1)
Individual decisions	2	5	"I just have to find the site first before anyone is going there so that I can see it has a growth rate of how many percentages (...)." (RQ2-NGO6)
Simplicity	2	5	"Because if it is too technical, our people here, when it comes to mathematics, you cannot tell them how to calculate. So you do that one. It's so easy for them to understand how to do the monitoring." (RQ2-NGO6)
Low prioritization	2	5	"Previously, we did not see any need for us to do the monitoring. We were just planting and growing." (RQ2-NGO1)
Community-informed decisions	1	3	"I have picked the ideas from different people. What they are praying for." (RQ2-NGO1)

Regarding the challenges to monitoring, the lack of equipment was stressed as the main reason why certain indicators are not measured (Table 6). As the NGO does not have the financial resources to purchase the necessary monitoring equipment, they depend on external tutors to provide it to them, making consistent measurement hardly feasible. Linked to this challenge is the lack of technical knowledge, specifically the expertise to use the tools and correctly record the data. Thus, it becomes clear how the NGO is restricted to monitoring only a few indicators because they do not have the tools, knowledge, or even permits required to measure a more diverse set of restoration objectives.

Table 6. Monitoring challenges in the Tudor Creek mangrove forest restoration initiative, ranked according to the number of interviewees that mentioned a value (*participants*) and, if they are equal, by the number of times a value was mentioned (*references*).

Monitoring challenges	Participants	References	Illustrative quote
Lack of equipment	3	8	"Most of the time, we depend on the tutor's equipment, but us at Brain Youth Group, we don't have it. And when we don't have them, we just go and we count." (RQ2-NGO5)
Lack of technical knowledge	2	3	"We need a lot of people who are experts on doing those things to come and teach us how we can handle those areas, or how we can operate those things, like the equipment that is being used for checking the salinity." (RQ2-NGO1)
Regulatory barriers	1	5	"There are people who came to do the carbon, but they didn't get the contract because the government has not given us the framework to do the carbon." (RQ2-NGO6)
Biophysical constraints	1	4	"When it comes to where the place is so dry, you can walk and use ropes. But here, you can see you can't use ropes because there's a lot of mud." (RQ2-NGO6)
Financial constraints	1	2	"It's too expensive because you have to bring other guys and the gadgets to measure all the things." (RQ2-NGO6)

5.3 Plural Values Alignment in Monitoring

This comparative analysis shows to what extent the elicited plural values associated with the Tudor Creek mangrove forest depicted in section 5.1 are captured in the restoration objectives, restoration progress, and monitoring practices that were presented in section 5.2. Here, the extent of capture is divided into the following three categories: (1) the value is clearly recognised, improved, or monitored (*full*); (2) the value is partially recognised, improved, or monitored (*partially*); (3) the value is not recognised, improved, or monitored (*none*).

Evidently, only a minority of values are captured fully or partially in the objectives, progress, and practices (Table 7). In total, 13 of the 22 elicited diverse values of the Tudor Creek mangrove forest were entirely left out of restoration and monitoring considerations. Moreover, none of the relational values were recognised. This aligns with RQ1 results, in which relational values were found to be the least prominent value domain for the community, except for *intergenerational responsibility* (Fig. 8).

The specific values that are captured the most are instrumental (Table 7). For both objectives and progress, four instrumental values are fully reflected, and one is partially reflected, albeit different ones. The two values that are measured are *fisheries* and *microclimate regulation*, which have the highest importance for the community. However, these are only monitored partially through observation and check-ins, in which the NGO members occasionally talk to the fishermen and the community to get a feeling for the changes related to the forest, on which they base their perception of restoration progress (RQ2-NGO6). *Microclimate regulation* is captured partially in all three categories, because only the *cool temperature*, *clean air*, and *breeze* were mentioned (RQ2-NGO5, RQ2-NGO6), although the community members value the *shade provision* and *rainfall*, as well (RQ1-NGO3, RQ1-NGO4). In terms of monitoring, it is noticeable that the five values, *livelihoods*, *education*, *erosion prevention*, *CO₂ absorption*, and *international opportunities*, were all recorded as either restoration objectives or progress, although none of these were operationalised into a monitoring structure (Table 7). Findings presented in Table 6 explain that a lack of equipment, lack of technical knowledge, and other constraints may play a role in this gap.

Tree abundance is the only value that is consistently captured across restoration objectives, restoration progress, and monitoring practices (Table 7). Although it is classified as an intrinsic value in the IPBES typology (Fig. 8), it is operationalised differently. Here, it is measured through indicators such as the number of planted seedlings, survival rate, growth rate, and canopy cover (RQ2-NGO1, RQ2-NGO5, RQ2-NGO6), which serve as proxies for restoration success rather than reflecting the intrinsic value of mangroves. This may be shaped by external decisions and funding requirements (Table 7). Besides *tree abundance*, the only additional intrinsic value of the mangrove forest that is captured is *biodiversity*. The restoration practitioners did not highlight it as an objective but described how the animals now thrive in the forest, which they determine by observation-based monitoring (RQ2-NGO6).

The comparative analysis reveals that most plural values of the mangrove forest are not captured in the restoration objectives, indicators of progress, and monitoring practices. While relational values are absent and intrinsic values are partially represented, instrumental values dominate. The intrinsic value of *tree abundance* is the only fully measured value and is operationalised as the main indicator for restoration progress.

Table 7. Extent to which the elicited plural values of the Tudor Creek mangrove forest are captured in restoration objectives, restoration progress, and monitoring practices (*full, partial, or none*), ranked according to the number of participants that mentioned a value (*importance*).

Specific value	Value name	Importance (participants)	Extent of capture in restoration objectives	Extent of capture in restoration progress	Extent of capture in monitoring practices
Instrumental	Fisheries	9	Full	Full	Partial
	Microclimate regulation	9	Partial	Partial	Partial
	Livelihoods	7	Full	Full	None
	Education	7	None	Full	None
	Erosion prevention	6	None	Full	None
	CO2 absorption	6	Full	None	None
	Work opportunities	5	None	None	None
	Coastal protection	5	None	None	None
	Medicinal value	2	None	None	None
	Timber and fuelwood	2	None	None	None
	International opportunities	1	Full	None	None
	Tourism	1	None	None	None
Intrinsic	Biodiversity	6	None	Full	Partial
	Tree abundance	5	Full	Full	Full
	Inherent worth of nature	4	None	None	None
	Moral duty	3	None	None	None
Relational	Intergenerational responsibility	8	None	None	None
	Community cohesion	3	None	None	None
	Aesthetic	2	None	None	None
	Culture	2	None	None	None
	Recreation	2	None	None	None
	Place attachment	1	None	None	None

6 Discussion

6.1 Instrumental Perspectives on Mangroves

The results clearly highlight that instrumental values are predominantly articulated, prioritised, and embedded in the Tudor Creek mangrove restoration initiative. The restoration community particularly values the mangroves' positive effect on fisheries and the microclimate, which directly benefits the residents. However, throughout the findings, it is not always evident whether the key informants associate these values with the forest itself or with the restoration initiative that aims to restore these values. One NGO member, for instance, sees the mangrove forest as a *“connection or a bridge for me to reach the people who can provide what is needed on the ground”* (RQ2-NGO1). According to the IPBES (2022) definition, instrumental values are substitutable, and the same value could be provided by a different ecosystem. This seems to be the case in the Tudor Creek mangrove forest, which is not only valued for the crucial ecosystem services that the local communities cherish but also for the benefits that the restoration project brings.

The dominance of instrumental values can thus be explained by the challenging socio-economic and peri-urban context of residents in Junda, where mangrove restoration is directly associated with tangible benefits and income opportunities. In coastal Kenya, mangroves provide free wood resources that can be used as construction material, timber, or charcoal (Bosire et al., 2014). The residents' reason to cut the trees is not making large profits but sustaining their livelihoods and providing for their families. It can therefore be argued that the main driver of mangrove degradation in Kenya is a symptom of chronic poverty. Scholars found that logging can generate three to five times more income than selling products from sustainably managed mangroves or voluntary restoration projects (Miller & Tonoto, 2023; Su et al., 2021). In Kenya, the complete ban of mangrove harvesting, enforced in 1997, especially impacted low-income and mangrove-dependent communities (Rönnbäck et al., 2007).

That is why, to succeed in rehabilitating mangrove forests, creating alternative income sources for locals is imperative. In contexts similar to this case study, restoration projects that prohibit logging, threaten livelihoods, and rely on volunteer labor are likely to fail (Su et al., 2021). Those communities are already vulnerable, and restoration leaders must carefully navigate the dependency on mangroves. Alternative income sources may come from aquaculture, carbon credits, beekeeping, or financial compensation for planting efforts. These should be adapted to the socio-economic context and the conditions of the mangrove forest (Afonso et al., 2022; Cadier et al., 2020; Su et al., 2021). In the Brain Youth Group initiative, a mix of beekeeping, aquaculture, and planting compensation ensures that restoration does not compromise local livelihoods (RQ2-NGO1, RQ2-NGO6).

The importance of instrumental values is not unique to Tudor Creek but reflects a broader trend in mangrove valuation literature. Existing studies in Kenya have predominantly approached mangrove values through an ecosystem services lens and economic valuation approaches (Huxham et al., 2015; Owuor et al., 2019; Rönnbäck et al., 2007), with no study explicitly applying a plural valuation method such as the IPBES framework.

Rönnbäck et al. (2007) identified a wide range of ecosystem services that the residents deem most important, including the provision of fish, firewood, charcoal, poles, timber, flood protection, erosion control, habitat and nursery ground, link to other marine systems, and recreation and tourism. Similar to my results, their research demonstrates a high prioritisation of instrumental values among coastal communities. However, the findings differ regarding the use of firewood and charcoal. The Tudor Creek restoration community does not consider the forest a source of timber (RQ1-NGO2). On one hand, this could reflect a shift in norms and practices in Kenya since Rönnbäck et al.'s (2007) study was published in 2007. On the other, fuelwood may not appear strongly in this study because the key informants are actively restoring the forest and thus opposed to logging. Hence, although instrumental values remain dominant in mangrove forest communities, their particular values may differ.

This instrumental framing is reinforced by economic valuation studies such as those from Huxham et al. (2015) that pre-structure the data collection with the ecosystem service framework. Although that research draws on thorough socio-economic data, only those values that could be quantified in economic metrics were ultimately included in the final valuation. The results thereby claim that Kenya's coastal communities particularly value erosion prevention, carbon sequestration, and timber products from mangrove forests. Yet, the research design biases the outcomes towards monetisable indicators, sidelining relational and intrinsic values. By contrast, results from the Tudor Creek restoration community reveal that, whereas instrumental values are indeed dominant, they are embedded in a diversity of values beyond measurable ecosystem services.

Owuor et al. (2019) examined the perception of mangroves' values among coastal communities in Kenya, combining the ecosystem services framework with the '*willingness to pay*' method. Participants of their study ranked provisioning services, which can be classified as instrumental values under the IPBES typology, the highest. Among these, the mangroves' values related to fish, education and research, and biodiversity were perceived as most significant. Again, although these findings are largely consistent with this Tudor Creek case study, it must be noted that Owuor et al.'s (2019) research relied on a set of pre-defined values that limited which value expressions were considered. As these were predominantly instrumental, the researchers' choice marginalised relational and intrinsic values that may have emerged through alternative valuation approaches.

Comparing previous valuation studies on mangroves in Kenya highlights the importance of fisheries for mangrove-dependent communities. Both Rönnbäck et al. (2007) and Owuor et al. (2019) found fisheries support to be one of the essential benefits that mangroves provide to people. Other African mangrove valuation studies identified the same pattern (Afonso et al., 2022; Merven et al., 2025). In Mauritius, for example, mangroves are not only crucial to support livelihoods but are also tightly linked to identity and cultural practices (Merven et al., 2025). These findings align with further research on the relevance of mangrove ecosystems for small-scale fisheries and food security, particularly in coastal regions with high poverty levels (zu Ermgassen et al., 2020). Conclusively, this comparison suggests that the dominance of instrumental values closely relates to a dependence on mangroves for coastal livelihoods, as well as the choice of valuation methods.

6.2 Limits to Measuring Plural Values

Although present throughout the data, relational and intrinsic values are articulated to a lesser extent than instrumental ones, except for *intergenerational responsibility*. However, none of the previous mangrove valuation studies focusing on Kenya identified responsibility to future generations as a value held by coastal communities (Huxham et al., 2015; Owuor et al., 2019; Rönnbäck et al., 2007). This discrepancy does not necessarily reflect the absence of the value but methodological differences. *Intergenerational responsibility* may have been more prominent in this study because the IPBES typology specifically includes such value categories (IPBES, 2022), whereas the methods of comparative studies relied on economic and ecosystem services assessments. This stresses how analytical frameworks shape the outcomes of valuation approaches.

Moreover, the interview guide included a question on the meaning of the forest for future generations (Appendix A), which likely contributed to the prominence of *intergenerational responsibility* in the data. Without it, the results would have probably differed. This highlights wider challenges of plural values elicitation: values may be held but not articulated by interviewees, not captured by the researcher, differently interpreted, or even prompted by certain questions. For example, a mangrove valuation study in India categorised '*livelihood security*' as a relational value (Rasquinha et al., 2026), whereas it was interpreted as instrumental in this study. Ultimately, such differences demonstrate that methodological choices, interview questions, and coding strategy alter how values are defined and elicited.

Relational values of mangrove ecosystems were found to be highly diverse across contexts. In Panama, relational connections between mangroves and coastal communities were closely tied to mental health and spirituality expressions (Scott et al., 2024). A study on a West African island found aesthetic value to be the most significant relational value (Afonso et al., 2022). In Mauritius, Merven et al. (2025) identified cultural heritage, local-ecological knowledge maintenance, linguistic diversity, matrilineal knowledge transmission, and coastal socio-cultural activities as core relational values associated with mangroves. Initially, the researchers identified mainly instrumental values through the '*free listings*' methodology and later revealed various relational values through participant observation. Hence, certain values may not be articulated but embodied and therefore not elicited through statement-based valuation. This comparison stresses the influence of method and context in plural valuations. Especially intrinsic and relational values relate to a specific ecosystem, which is why they cannot be generalised (Himes & Muraca, 2018; Scott et al., 2024). Therefore, context-specific management and research are critical to fully understand the diverse values underpinning an ecosystem.

6.3 What is measured is not what matters

According to the results, the forest's values that matter to the community are not always those that are formally measured in monitoring. In this case study with the Brain Youth Group, relational values were entirely neglected, whereas the intrinsic value *tree abundance* is operationalised as an ecological metric measuring *canopy cover*, upon which restoration success is defined. The findings reveal that what matters most to the restoration community are instrumental values, such as *fisheries* support and *microclimate regulation* (Fig. 8). Progress regarding these values is assessed through observation and check-ins with the community members (Table 4). On the other hand, relational values of the Tudor Creek mangrove forest are absent among the restoration objectives and progress. This case suggests that monitoring systems systematically prioritise certain values over others.

In a systematic literature review, Cadier et al. (2020) found that restoration monitoring focuses on ecological indicators such as survival rates and neglects socio-cultural metrics related to intrinsic and relational values. Most studies evaluating restoration success in coastal ecosystems apply indicators relating to structural diversity of an ecosystem. Although short-term survival of seedlings is claimed not to be ideal to determine whether the ecosystem is recovering long-term, survival rates continue to be prioritised in monitoring. This can be explained by widespread data shortcomings on restoration monitoring and challenges in quantifying cultural and socioeconomic indicators (Cadier et al., 2020; Dahdouh-Guebas et al., 2022; Gatt et al., 2022).

Both the results and restoration literature point to a substantial gap in monitoring reporting (Table 7), which directly limits restoration success and the ability to evaluate progress (Gatt et al., 2022). As seen in the comparative matrix, only one value is fully captured in monitoring practices, and three are partially measured through observation (Table 7). This aligns with findings from restoration scholars highlighting that only two-thirds of restoration initiatives have an established monitoring structure, which is usually not consistently pursued long-term (Gatt et al., 2022).

To accelerate global mangrove restoration success and enhance comparability across projects, scholars argue for a common base of indicators and long-term monitoring programs (Cadier et al., 2020; Gatt et al., 2022; Shaham, 2024). Among various standardised measurement tools, the most prominent and recent monitoring framework is the Mangrove Restoration Tracker Tool (MRTT) (Gatt et al., 2024). It is a free, open-access database that is supposed to be simple and intuitive for restoration practitioners to use. However, the initial setup requires a large data set, including the causes of decline, pre-restoration assessment, and ecological status, among numerous others. This raises the question as to whether such monitoring frameworks are truly designed to aid communities in improving restoration success or to facilitate global comparisons.

Although restoration literature emphasises the importance of coherent, long-term monitoring systems for successful mangrove rehabilitation (Cadier et al., 2020; Shaham, 2024), their feasibility is restricted in practical contexts. This discrepancy highlights the tension between scholarly expectations and local realities. The findings revealed that local resource constraints are leading to these monitoring gaps and inconsistencies (Table 6). Interviewees particularly highlighted the lack of equipment and technical knowledge as dominant barriers to improving their monitoring practices. Consistently monitoring a variety of relevant indicators over the long time required for ecosystem restoration demands steady technical, financial, and scientific assistance that many bottom-up restoration initiatives do not have access to (Su et al., 2021). Therefore, monitoring tools like the MRTT are not absent because of a lack of interest but a lack of capacity. Consequently, calls for strengthened monitoring activity must consider local restoration contexts and their specific feasibility constraints, which currently remain largely unacknowledged.

6.4 The Politics and Realities behind Monitoring

For the Brain Youth Group at Tudor Creek, monitoring is seen as a strategy to attract financial support for their restoration activities rather than a method to estimate restoration progress (Table 5). The NGO began to monitor in 2022 following a funding opportunity that set regular assessments of seedling growth and survival rates as a partnership requirement. As one restoration practitioner explained, *“Since we started doing the monitoring thing, we've seen our projects go well. If we do a project with a certain organisation, we do the monitoring”* (RQ2-NGO5). Hence, monitoring practices are motivated by funding opportunities, rather than restoring the forest's values. This explains the gap between the elicited plural values from the community and the restoration objectives and monitoring practices. Despite limited data, the community considers the restoration successful based on lived experience and observation of the regeneration. Pointing at the forest, one NGO member said, *“We don't have to tell someone to tell us how good we have done. You can see the success”* (RQ2-NGO6).

Ultimately, the monitored indicators are determined by the funder, not by the values of the restoration community. Based on certain indicators, organisations financing ecosystem restoration projects want to ensure that their intended objectives were achieved and the funding was not wasted (Brown, 2017). In this case, the funder requested regular calculations of the seedling growth and survival rates to assess the success of the project (RQ2-NGO6), turning the value of *tree abundance* into a measurable, ecological indicator for restoration progress (Table 7). In this way, monitoring becomes a tool to increase the NGO's attractiveness for potential funders. Values and indicators that are costly, time-intensive, or not relevant for funders remain excluded (Miller & Tonoto, 2023; Su et al., 2021). As a result, what is monitored reflects not only what is measurable but also what is funded, as the need to secure coastal livelihoods while preventing mangrove degradation necessitates monitoring that is aligned with external requirements.

In turn, the funder's choice of indicators and measurement tools exert influence over which of the forest's values are considered important to restore. Although indicators are perceived as neutral metrics based on technical reasoning, they are the result of assumptions, feasibility considerations, and political decisions that ultimately simplify a complex phenomenon (El-Den et al., 2020; Fukuda-Parr & McNeill, 2019; Merry, 2011). Once they are determined, indicators define what counts as restoration success and packages it as objective truth. As a consequence, funding-driven indicators exercise a type of *‘soft power’* by conveying superior credibility and determining restoration objectives regardless of local values (Avelino & Rotmans, 2011; Kelley & Simmons, 2015).

This is clearly demonstrated in the Tudor Creek case, where restoration was deemed successful even without monitoring, but due to external requirements, restoration practitioners began to introduce monitoring practices. While the regular assessments now help to facilitate comparisons over time and across other restoration initiatives, it may shift local views on restoration goals and success (Fukuda-Parr & McNeill, 2019). As a consequence, the funder, prior choice of indicators, measurement tools, and interpretation of the data ultimately shape how the forest is valued and restored.

6.5 Towards Feasible and Meaningful Monitoring

Alternative monitoring approaches that are feasible and meaningful for all stakeholders do not aim to capture all plural values of an ecosystem but balance what matters, what can be measured, and what can be sustained over time. Undoubtedly, monitoring is an essential element of ecosystem restoration, ensuring compliance, evaluating progress, and enabling comparison across initiatives (Brown, 2017; Gatt et al., 2022; Poti et al., 2025). Nevertheless, existing research often overlooks the influence of funder priorities, measurability of values, and practical constraints faced by restoration communities. To advance towards feasible and meaningful monitoring, this thesis recommends a context-sensitive approach that integrates (1) locally relevant values, (2) feasible monitoring methods, (3) capacity building through external support, and (4) maintains reflexivity (Fig. 9), which are each discussed in the following. Hence, monitoring can be more than a standardised protocol and become a system for social learning, information sharing, and collaboration (Evans et al., 2018).

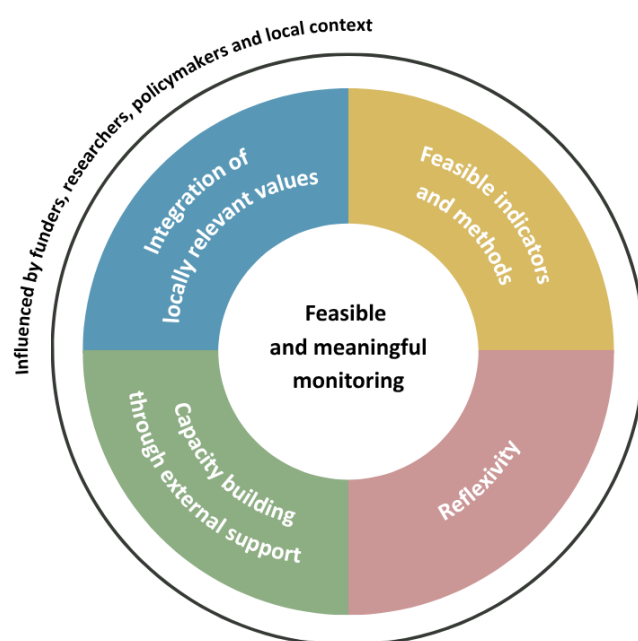


Figure 9. Conceptual framework of a feasible and meaningful monitoring approach for mangrove restoration initiatives (own visualisation).

First, as both the results and comparison with similar studies underline, the objectives and possibilities of restoration projects are highly context-specific, and monitoring should not be entirely generalised but adapted to local realities (Dai et al., 2024; Queiroz et al., 2017; Rasquinha et al., 2026). Integrating the tangible benefits of ecosystem restoration experienced by the community into monitoring structures provides them more visibility. Establishing a combination of globally relevant monitoring indicators and locally important ones in collaboration with the community is ideal (Evans et al., 2018). The consideration and active request from funders to include local priorities and perspectives in monitoring would accelerate their implementation (Olander et al., 2024). Ultimately, an enhanced integration of the values that the community associates with the mangrove forest and aims to restore informs stakeholders on how restoration supports social, cultural, and economic well-being on-site (Olander et al., 2024) and can improve overall restoration outcomes (Dai et al., 2024).

Second, translating realities into monitoring practice entails selecting a set of restoration objectives and indicators that are not only inclusive of local values but also feasible given the context-specific constraints. Following the idea of quality over quantity, choosing a number of restoration targets that can be consistently and reliably monitored for long time periods by the restoration community is recommended over a selection of standardised, poorly monitored ones (Evans et al., 2018). Monitoring must therefore not include all relevant values but represent a combination of what matters to the funding organisation, what matters to the community, and what is realistically feasible. Notably, not all values can be measured through indicators (Fukuda-Parr & McNeill, 2019). Nevertheless, existing practices, such as occasional observation-based monitoring and informal check-ins that already take place in Tudor Creek offer alternative measurement approaches (Table 4). Improving the frequency, structure, and documentation of these observations can capture valuable insights into restoration progress that would otherwise remain invisible (Evans et al., 2018). Acknowledging the local limitations and conditions, monitoring methods should ultimately be simple and possible to be consistently followed for years (Dai et al., 2024; Evans et al., 2018).

Third, the establishment of restoration monitoring systems depends on external support for capacity building. As demonstrated in this case study, bottom-up initiatives like the Brain Youth Group often lack the technical expertise, financial resources, and access to tools needed to create a consistent monitoring structure (Table 6). Certain indicators, such as carbon accounting, are costly and require governmental permits (RQ2-NGO6), in which case the funders should provide the necessary resources. Particularly in the early stages of a restoration project, investments in trainings and tools from governmental agencies, universities, or funding organisations are crucial (Evans et al., 2018; Olander et al., 2024). Eventually, the early support builds the community's capacity to continue the monitoring

activities largely independently and creates credibility to secure the necessary funding to cover any additional costs. However, external support should avoid imposing rigid indicator frameworks, as they risk reinforcing gaps between what matters to the community and what is measured for funders. For the long-term sustainability of a restoration project, continued investment or alternative income sources, including carbon credit schemes or livelihood diversification solutions, are needed to maintain monitoring activities long-term (Su et al., 2021).

Fourth, considering the dynamic and long-term nature of mangrove restoration, an adaptive and reflexive monitoring approach is key (Ellison et al., 2020; Evans et al., 2018). Ecosystem restoration takes years to decades, and as a social-ecological system, a mangrove forest is continually subject to change (Society for Ecological Restoration, n.d.). The surrounding communities and their priorities, the management structure, land tenure, policies, and the forest's ecological conditions influencing the monitoring may change over time. Therefore, a monitoring system should not be seen as permanent but as evolving (Evans et al., 2018). Regular dialogue between restoration practitioners and supporting organisations ensures restoration is progressing towards shared goals, aligned with relevant indicators, and that monitoring is feasible and meaningful. In this way, monitoring goes beyond evaluation and becomes a co-creative process shaping how mangrove restoration is understood and carried out.

6.6 Future Pathways

Looking ahead, this thesis points to multiple next steps for funders, practitioners, policymakers, and researchers engaging in mangrove restoration. As the main actors enabling and executing the rehabilitation of the ecosystem, improved collaboration between the funding organisations and restoration practitioners is integral. At the beginning of a funding agreement with a restoration project, funders must introduce feasible and meaningful monitoring. This includes actively integrating locally relevant values, selecting feasible indicators and monitoring methods, providing support to build initial capacity to monitor, and regularly reviewing and adapting the monitoring strategy together with the restoration community (Fig. 9).

As for the practitioners, the monitoring gaps and inconsistencies that were identified at the Brain Youth Group should be addressed to create internal alignment. Concretely, restoration goals must be routinely discussed, and the progress thoroughly assessed through unified practices. This likely prevents incongruent restoration objectives, progress indicators, and monitoring practices (Table 2, Table 3, Table 4), establishing a coherent and agreed-upon monitoring structure.

Setting the agenda on ecosystem restoration, policymakers play a role not only in determining wider restoration objectives but also putting in place the enabling conditions on the ground. To achieve the aims of the global *UN Kunming-Montreal Global Biodiversity Framework* and *National Landscape and Ecosystem Restoration Strategy 2023-2032* in Kenya, for example, policymakers must establish mechanisms that provide the necessary funding and support to restoration communities. This may include enhancing access to alternative income streams, capacity building programs, and monitoring support.

As this study is navigating numerous knowledge gaps and lacking more thorough comparison studies, further research in this field is imperative. Future studies on mangrove restoration should prioritise plural valuation methods, focus on understudied African countries, include larger sample sizes, and inquire into context-sensitive monitoring approaches. Such research can enable comprehensive comparisons across restoration sites and regions, as well as provide insights into improving the monitoring of restoring coastal ecosystems. Above all, researchers ought to be cautious of how their inherent subjectivity influences the research results, particularly when studying people's values.

7 Conclusion

Successfully restoring degraded peri-urban mangrove ecosystems in Tudor Creek, Kenya, and beyond necessitates addressing local realities of restoration communities rather than merely following global goals and indicators. Both the diverse values of mangroves themselves and challenges to monitoring restoration progress are highly contextual and thus require a context-sensitive approach. Yet, what is monitored in this case study is determined by the priorities of funding organisations and not what matters on the ground. Monitoring is therefore considered a means to receive the funding that is crucially needed in Junda for maintaining restoration efforts long-term and protecting local livelihoods while refraining from logging mangroves for timber and firewood.

Yet, to address the monitoring gaps and improve restoration outcomes, a feasible and meaningful monitoring approach is recommended. This requires integrating locally meaningful values, applying feasible monitoring indicators and methods, enabling capacity building through external support, and maintaining continuous reflexivity. As such, rehabilitation initiatives have significant potential to both combat mangrove degradation and support coastal communities.

Ultimately, this thesis demonstrates the importance of plural valuation, as well as the limitations of monitoring in the context of ecosystem restoration. In this way, the research contributes to the field of sustainability science by addressing the societal challenge of mangrove degradation through a case study, examining the diverse values of nature in an understudied area, and involving local practitioners in the research. It further adds to discussions regarding the measurability of nature's values and the politics behind monitoring. Therefore, this thesis points out future pathways for restoration funders, practitioners, researchers, and policymakers to improve the integration of the diverse values of mangrove forests into decision-making and monitoring.

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9 Appendices

9.1 Appendix A: Semi-structured Interview Guides

9.1.1 RQ1 Interview Guide

RQ1: Which plural values does the Tudor Creek restoration community associate with the mangrove forest?		
Interview section	Question	Sub-question
Introduction	What do you do for a living?	For how long have you been doing this?
		Why did you initially get into this field?
	What is your role in this organisation?	For how long have you been in this role?
	What do you like to do outside of your work?	
	Are you from Mombasa?	If yes, how was it growing up in this city?
		If not, when did you move here and why?
	Did you grow up close to mangroves?	If yes, how was your experience?
The mangrove forest today	What feelings or meanings do you associate with mangroves?	
	Do you feel personally connected to the mangrove forest?	If yes, how?
	What values does the Tudor Creek mangrove forest hold, in your perspective?	
Degradation	How have you experienced the degradation of the mangroves in Tudor Creek?	
	Which important values or roles of the mangrove forest have been lost or weakened?	
	Has the loss of mangroves impacted you in any way?	If yes, how?

Restoration	What motivates you to support the restoration of mangroves?	
	What is your organisation's standpoint on mangrove restoration in Tudor Creek and Kenya more broadly?	
	Is the Tudor Creek mangrove forest worth restoring?	If yes, why do you think so?
		If not, why is it not?
	What exactly should be restored?	Can it be restored? Why?
		Who benefits most from the restoration?
Responsibility and beliefs	What role should the mangrove forest play for future generations?	
	Do you feel any responsibility or duty toward restoring the mangroves?	If yes, where does that feeling come from?
	What would your life be like without the existence of mangroves?	What would you miss most?
	Do you think mangroves have value in themselves, regardless of human use?	Why or why not?
	Have your views on the Tudor Creek mangrove forest changed over the years?	If yes, what did you think about them before and how do you view them now?
		If yes, why has your perception changed?

9.1.2 RQ2 Interview Guide

RQ2: *How is restoration progress measured and shaped by monitoring practices in the Tudor Creek mangrove restoration initiative?*

Interview section	Question	Sub-question
Introduction	Why are you interested in participating in this research?	
	For how long have you been active at Brain Youth Group?	Have you been working on any other mangrove restoration project before?
	What is your role at Brain Youth Group?	Tell me about your tasks in this role.
	What do you like to do outside of your work?	How does it link to your engagements with mangroves?
	Are you from Mombasa?	If yes, how was it growing up in this city?
		If not, when did you move here and why?
Restoration objectives	To what extent has the forest been restored so far?	
	What are the objectives of the restoration project?	Why were these objectives chosen?
	Would you say that the restoration is succeeding?	How do you determine this?
Monitoring objectives	How do you currently track the progress of the forest restoration initiative towards these objectives?	What data do you collect regularly?
	Have you thought about using a tool to monitor?	Why or why not?
Monitoring challenges	Is there anything that is difficult to measure or monitor, although it is important for restoration?	

9.2 Appendix B: Interview Overview

Participant ID	Key informant group	Interview language	Interview date	Duration
RQ1-NGO1	NGO member	English	05-03-2026	46 min
RQ1-NGO2	NGO member	English	09-03-2026	44 min
RQ1-NGO3	NGO member	English	09-03-2026	13 min
RQ1-NGO4	NGO member	English	09-03-2026	19 min
RQ1-COM1	Community member	English, Kiswahili	13-03-2026	15 min
RQ1-COM2	Community member	Kiswahili	13-03-2026	11 min
RQ1-COM3	Community member	Kiswahili	13-03-2026	11 min
RQ1-COM4	Community member	Kiswahili	13-03-2026	10 min
RQ1-COM5	Community member	Kiswahili	13-03-2026	12 min
RQ2-NGO1	NGO member	English	05-03-2026	35 min
RQ2-NGO5	NGO member	English	17-03-2026	13 min
RQ2-NGO6	NGO member	English	18-03-2026	36 min

9.3 Appendix C: Value Definitions and Codebook

Specific value	Value name	Definition	Participants	References
Instrumental	CO ₂ absorption	Ability of mangrove to sequester carbon and mitigate climate change.	6	10
	Coastal protection	Protection of coastal settlements from floods, storms, and tsunamis through the forest's buffering function.	5	7
	Education	Opportunities for teaching and learning about the characteristics and importance of mangroves.	7	10
	Erosion prevention	Stabilisation of the coastline and prevention of soil erosion through mangrove root systems.	6	11
	Fisheries	Mangroves functioning as a breeding ground for fish, increasing local fish productivity.	9	28
	International opportunities	Access to international networks, funding, and collaborations through mangrove restoration initiatives.	1	8
	Livelihoods	Income generation and material resources for sustaining everyday life through mangroves and restoration initiatives.	7	19
	Medicinal value	Health benefits obtained from mangroves or products originating from the forest.	2	2
	Microclimate regulation	Capacity of mangroves to regulate the local climate by providing a breeze, cool temperatures, fresh air, rainfall, and shade.	9	20
	Timber and fuelwood	Wooden material used for cooking, construction, and household energy.	2	2
	Tourism	Attraction of tourists to mangrove landscapes and restoration initiatives.	1	1
	Work opportunities	Employment opportunities created by mangrove restoration initiatives.	5	18

Intrinsic	Biodiversity	Richness of species supported by healthy mangrove ecosystems.	6	11
	Inherent worth of nature	Recognition that mangroves are valuable by themselves regardless of human use or perception.	4	4
	Moral duty	Ethical responsibility to preserve, protect, and restore the mangrove forest.	3	6
	Tree abundance	The number and density of mangrove trees within the forest.	5	9
Relational	Aesthetic	Appreciation of the visual appearance of the mangrove forest.	2	3
	Community cohesion	Enhanced collaboration within the community due to the shared mangrove restoration initiative.	3	4
	Culture	Cultural meanings associated with mangroves.	2	3
	Intergenerational responsibility	Determination to restore and protect the mangrove forest for future generations to enjoy and benefit from it.	8	12
	Place attachment	Care for the mangrove forest due to its presence nearby.	1	2
	Recreation	Mangrove forests as spaces to enjoy and spend leisure time.	2	2

9.4 Appendix D: Ethical Consent Form

9.4.1 English Version



Ethical consent form

You are a participant in the master thesis project by Kim Sensener with the title: *Eliciting plural values behind restoration efforts in the Tudor Creek mangrove forest: what is monitored and what matters?* Her research is part of the Master's Program in Environmental Studies and Sustainability Science (LUMES) at the Lund University Centre for Sustainability Studies (LUCSUS) in Sweden.

Kim Sensener shall carry out her master thesis project in accordance with the ethical guidelines, and therefore asks you to be aware of the following:

- The purpose of this research is to investigate the plural values of the Tudor Creek mangrove forest and how these are captured by restoration monitoring.
- Your role is to share your honest experience in relation to the mangrove forest.
- Your participation is voluntary and you can change your mind at any time without consequences.
- The interview will be recorded and all data will be handled anonymously by Kim Sensener alone.
- Your name will not be mentioned anywhere, besides if you explicitly wish so.
- No information will be used to harm you in any way.
- All collected data serves only the purpose of fulfilling the requirements of the master thesis and will be safely stored until it will be deleted after graduation from the studies.
- The master thesis of Kim Sensener will be published in a public catalogue of Lund University.
- You are giving informed, free and prior consent to take part in this research.

Clarify any questions with Kim Sensener before beginning the interview or contact her at any later point at ki2735se-s@student.lu.se. Then, please confirm your consent by signing this form below.

Date: _____ Place: _____ Name: _____

Signature: _____

9.4.2 Kiswahili Version



LUCSUS
CENTRE FOR SUSTAINABILITY
STUDIES

Fomu ya ridhaa ya kimaadili

Wewe ni mshiriki katika mradi wa tasnifu kuu na Kim Sensener wenye kichwa: *Kuomba maadili ya wingi nyuma ya juhudi za urejeshaji katika msitu wa mikoko wa Tudor Creek: ni nini kinachofuatiliwa na ni nini muhimu?* Utafiti wake ni sehemu ya Programu ya Uzamili katika Masomo ya Mazingira na Sayansi Endelevu (LUMES) katika Kituo cha Masomo ya Uendelevu cha Chuo Kikuu cha Lund (LUCSUS) nchini Uswidi.

Kim Sensener atafanya mradi wake wa tasnifu kuu kwa mujibu wa miongozo ya kimaadili, na kwa hivyo anakuomba ujue yafuatayo:

- Madhumuni ya utafiti huu ni kuchunguza maadili ya wingi ya msitu wa mikoko wa Tudor Creek na jinsi haya yanavyonaswa kwa ufuatiliaji wa urejeshaji.
- Jukumu lako ni kushiriki uzoefu wako wa kweli kuhusiana na msitu wa mikoko.
- Ushiriki wako ni wa hiari na unaweza kubadilisha mawazo yako wakati wowote bila matokeo.
- Mahojiano yatarekodiwa na data yote itashughulikiwa bila kujulikana na Kim Sensener pekee.
- Jina lako halitajwa popote, isipokuwa ikiwa unataka waziwazi.
- Hakuna taarifa itakayotumika kukudhuru kwa njia yoyote.
- Data zote zilizokusanywa zinatimiza tu madhumuni ya kutimiza mahitaji ya tasnifu kuu na zitahifadhiwa salama hadi zitakapofutwa baada ya kuhitimu kutoka kwa masomo.
- Tasnifu kuu ya Kim Sensener itachapishwa katika orodha ya umma ya Chuo Kikuu cha Lund.
- Unatoa idhini ya kushiriki katika utafiti huu kwa taarifa, bila malipo na ya awali.

Fafanua maswali yoyote na Kim Sensener kabla ya kuanza mahojiano au wasiliana naye baadaye kwa ki2735se-s@student.lu.se. Kisha, tafadhali thibitisha idhini yako kwa kusaini fomu hii hapa chini.

Tarehe: _____ Mahali: _____ Jina: _____

Saini: _____