Community-Led Circular Economy Initiatives in Colombia: A Study of Multiple Value Creation

MSc Industrial Ecology

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Executive Summary

World Bank data from 2023 indicates that approximately 75% of the global population resides in middle-income countries, primarily located in the Global South. Although these regions generate less waste than the Global North, improved living standards in emerging economies have led to increased consumption and heightened environmental impacts. These impacts include ecosystem degradation through excessive pollution, land use changes, and resource over-extraction, as highlighted by Agbede et al. (2021) and WHO (n.d.). Notable environmental issues like the clothes landfill in the Atacama Desert and the Great Pacific Garbage Patch serve as stark reminders of the consequences of inadequate waste management.

Despite being recognized for its biodiversity, Colombia heavily relies on landfilling for waste management (DNP, 2016), with recycling rates ranging from 12.9% (CEMPRE, 2019) to 17% (Núñez et al., 2016). With a projected population of 57 million by 2050 (World Bank, n.d.), the strain on its 62 official regional landfills will intensify. Thus, finding sustainable waste management pathways is crucial to protect Colombia's unique environments.

Previous research in Colombia has primarily focused on the social aspects of informal waste collection, such as the demographics of waste pickers in Bogotá and legislative efforts to formalize their work. However, there is a notable absence of studies investigating multiple value creation or initiatives primarily designed and led by women. Furthermore, the implications of local circular economy initiatives, especially within Colombia’s Pacific region, remain underexplored. This study aims to fill these gaps by examining community-led circular economy initiatives, particularly through the "Guardianas del Manglar" (GdM) project on the Pacific coast.

Using the Circular Value Flower (CVF) framework, this research employs an explanatory strategy to uncover and understand the values generated through the initiative. The CVF framework is chosen for its ability to provide a systemic analysis and visual representation of resource cycle closures, incorporating intangible outcomes like aesthetic and cultural values. The qualitative multi-methods approach includes semi-structured interviews and workshops to gather comprehensive data from relevant stakeholders.

The GdM initiative, a collaboration between Carvajal Empaques, Fundación Carvajal, and ASOGESAMPA, involves 133 women collecting recycled materials from the mangroves near Buenaventura, amounting to approximately 4000 kg of waste per month (Diario El Pais, 2023). The initiative demonstrates significant multiple value creation:

- **Environmental Values:** The reduction of pollution, increased recycling rates in coastal areas, and the protection of the mangrove ecosystem.
- **Economic Values:** Additional income for the participants, primarily women from vulnerable communities.
- **Cultural Values:** Preservation and integration of traditional Afro-Colombian knowledge with new practices.

- **Aesthetic Values:** Improvement of public areas and enhancements to participants' households.
- **Social Values:** Community empowerment, access to education and knowledge, and increased social cohesion.

The case study's high contextual dependence required several methodological adaptations to fit the realities of Buenaventura. These changes do not diminish the usability of the CVF framework; rather, they validate its flexibility and adaptability across different contexts. The proposed methodology, including contextual investigation, participant recruitment, interviews, workshops, data gathering, and analysis, can guide similar research efforts in other regions, though careful consideration is needed for each unique context.

Moreover, this study highlights the necessity of flexible methodologies when working with vulnerable communities, emphasizing the importance of co-creation and respect for local knowledge and culture. Such an approach fosters a pluriverse of worldviews and acknowledges the experiences of those whose narratives have often been overlooked (Escobar, 2016).

Companies like Organización Carvajal play a crucial role in improving the integration and perception of informal waste pickers. By aligning compliance with Extended Producer Responsibility (EPR) laws, they bridge the gap between informal collectors and the industrial sector, promoting social responsibility and circular economy strategies. Holistic interventions support the health, education, and economic stability of waste pickers, fostering essential community trust. Regulatory frameworks such as the EPR law and Law 2232 of 2022 are vital for expanding waste collection and driving innovation in recyclable materials. Initiatives like "The Chemistry of Recycling" highlight new technologies' potential to increase recycling rates.

However, challenges persist, including outdated waste management plans, logistical issues, and the social stigmatization of recyclers. Addressing these issues, particularly in regions like Buenaventura, requires updated infrastructure, enhanced environmental education, and consistent support for informal recyclers to make recycling more competitive against virgin materials.

In conclusion, this study underscores the potential of community-led circular economy initiatives in driving sustainable practices with significant social components. It validates the CVF framework's adaptability and emphasizes the importance of context-sensitive, participatory research methodologies in fostering sustainable development in the Global South.

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List of Abbreviations

ANRI: Alianza Nacional para el Reciclaje Inclusivo (National Alliance for Inclusive Recycling)
ASOGESAMPA: Asociación de gestores ambientales del pacífico (Association of environmental agents -or managers- of the Pacific)
CE: Circular Economy
CEI: Circular Initiatives
CVF: Circular Value Flower
ECA: Estación de Clasificación y Aprovechamiento (Sorting and Utilization Station)
EbA: Ecosystem-based Adaptation projects
ENEC: Estrategia Nacional de Economía Circular (National Strategy to achieve a circular economy)
FC: Fundación Carvajal
GdM : Guardianas del Manglar
Ha: Hectare
ICC: International Coastal Clean-up
IE: Industrial Ecology
ILO: International Labour Organization
IWC: Inforal Waste Collectors
MLP: Multi-level Perspective
REP: Responsabilidad Extendida del Productor (Extended Producer Responsibility)
SDG: Sustainable Development Goals
SML: Surface macro-litter
SUI: Sistema Unico de Información (Unique Information System)
PAR: Participatory action research
PET: Polyethylene Terephthalate
PGIRS: Plan de Gestion Integral de Residuos Sólidos (Plan of Integral Management of Solid Waste)
POP: Persistent Organic Pollutants
PP: Polypropylene
PE: Polyethylene
UN: United Nations

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List of Concepts

- **Circular Economy**: The concept of the circular economy gained prominence in policy discussions roughly a decade ago, becoming closely linked with the broader concept of 'sustainability' (Geissdoerfer et al., 2017). With increased attention and political influence, various definitions of the circular economy have emerged in recent years. For the sake of coherence, this study adopts the definition put forth by the Ellen MacArthur Foundation, which describes the circular economy as 'an industrial economy that is restorative by intention; aims to rely on renewable energy; minimizes, tracks, and eliminates the use of toxic chemicals; and eradicates waste through careful design' (Ellen MacArthur Foundation, 2013).

- **Circular Economy Initiative**: According to the Cambridge Dictionary, an 'initiative' refers to 'a new plan or process to achieve something or solve a problem' (Cambridge Dictionary, n.d.). Therefore, a circular economy initiative entails a specific plan or action aimed at advancing the principles of the circular economy. In other words, it involves strategies that minimize resource input, waste, emissions, and energy leakage by promoting the slowing, closing, and narrowing of material and energy loops (Geissdoerfer et al., 2017). The focus of the present study is on examining circular economy initiatives in the Global South, with a particular emphasis on Colombia.

- **Waste management systems**: These systems encompass the methods by which solid waste is correctly disposed of. In Colombia, the primary method of solid waste disposal is landfilling.

- **Assessment Frameworks**: These frameworks represent various research methodologies implemented in the evaluation of similar projects in the Global South.

- **Mangrove forests**: A mangrove forest is an ecosystem comprised of mangrove trees and associated fauna and flora that coexist within the ecosystem.

- ***"Community"***: In the context of this study, the term "community" primarily refers to the Guardianas del Manglar, consisting of the 133 women engaged in mangrove cleaning efforts in Buenaventura.

1. Introduction

The World Bank's data from 2023 reveals that around 75% of the world's population resides in middle-income countries (The World Bank, 2023). This majority world primarily corresponds to what is now known as the Global South. Despite lower waste generation compared to the Global North, the increased consumption resulting from improved living standards in emerging economies, as noted by Fuhr (2021), has led to heightened environmental impacts. This surge in consumption has adversely affected ecosystems, contributing to their declining quality and health through excess pollution, land use changes, and resource over-extraction (Agbede et al., 2021; WHO, n.d.). The striking presence of a clothes landfill in the Atacama Desert, visible from space (Rodgers, 2023), or the existence of the Great Pacific Garbage Patch (National Geographic, 2023a), serve as a stark testament to our collective actions as a society, underscoring the collective impact of unchecked disposal, prompting critical questions about effective waste management and its repercussions on ecosystems.

The emerging field of the circular economy (CE) assumes a pivotal role in addressing waste management challenges. Defined as "a system where materials never become waste, and nature is regenerated"(The Ellen MacArthur Foundation, 2020), the CE aims to prolong the life of products within the economy, emphasizing the optimization of production processes to reintegrate consumed goods back into the product cycle. This disruptive approach is considered instrumental in addressing key drivers of biodiversity loss (CE Stakeholder EU, n.d.). This emphasis on the CE is underscored by its inclusion in the United Nations' Sustainable Development Goal (SDG) number 12, "Responsible Consumption and production", and its prominent place in the European Union's Green Deal, embodied in the Circular Economy Action Plan (European Commission, 2023).

Despite being recognized as the most biodiverse country in the world per square kilometer and home to 10% of the world's biodiversity (National Geographic, 2023b), Colombia heavily relies on landfilling for waste management (DNP, 2016). With a recycling rate between 12.9% (CEMPRE, 2019) and 17% (Núñez et al., 2016) and an expected population total of 57 million by 2050 (World Bank, n.d.) the strain on the 62 official regional landfills is evident. Finding pathways to maintain resources within the system is crucial to protect the country's pristine and unique environments.

Compounding the challenge, Colombia's waste management system heavily relies on informal waste workers as the primary actors responsible for recovering recyclable materials from waste and diverting them from landfills (DNP, 2016). This dependence aligns with the broader statistic indicating that approximately 20 million informal workers in the Global South sustain their livelihoods by collecting waste from garbage (Gutberlet, 2023). As part of Colombia's commitment to the circular economy, concerted efforts have been made to map and document informal waste pickers, aiming to facilitate their organization and provide training (DNP, 2016). These initiatives not only aim to enhance the livelihoods of informal waste workers but also recognize the valuable service they provide. Colombia stands out as a pioneer in Latin America and globally for acknowledging the significance of informal waste collectors in the country's waste

management system (Ocampo Cadena, 2021). This acknowledgment is exemplified by the Constitutional Court's official recognition of the participation of informal waste collectors within the recycling supply chain since 2003 (Díaz-Cano, 2017). Therefore, to fully realize Colombia's Circular Economy Strategy, it is imperative to consider the vital role of informal waste collectors.

This study aims to explore community-led circular economy initiatives focused on waste management in Colombia, particularly through the study and exploration of an ongoing project in the Pacific coast region. With a focus on participatory action research (PAR), a bottom-up approach is taken, prioritizing the experiential knowledge of the local system and continuous dialogues (Cornish et al., 2023) to map the multiple benefits that arise from the initiative.

1.1. Research Gap

Circular economy-oriented studies in Colombia have predominantly concentrated on business models and the generation of alternative materials and energy sources from various processes. These studies, mainly quantitative, aim to propose new business ventures or alternatives to reduce the environmental impact of the country's exported commodity staples. For instance, as far back as 2010, Rodríguez Valencia & Zambrano Franco examined the use of by-products from coffee grain production. Gutierrez-Franco et al. (2021) optimized the supply chain for biofuels derived from forest waste in Colombia, while Márquez-Fontalvo (2021) evaluated the potential use of food waste from food banks. Additionally, Grilli et al. (2024) and Aguilar et al. (2022) focused on legislation aimed at promoting a transition to a bioeconomy in Colombia.

When examining the case of informal waste collection, most studies have addressed the social aspects. Sarmiento et al. (2011) conducted a census of informal waste pickers in Bogotá, detailing their sociodemographic characteristics. Díaz-Cano (2017) analyzed the legislation and efforts to formalize and integrate these workers into the formal waste management economy. Moreno Rodríguez (2018) quantified the market generated and driven by informal waste collectors in Bogotá.

Regarding projects outside major urban areas, Richerzhagen et al. (2019) proposed a framework to assess Ecosystem-Based Adaptation (EbA) projects, which was tested at two different sites in Colombia with varying timespans and maturity levels. Although EbA projects have specific considerations, the framework also evaluated the social, economic, and cultural benefits for local communities. However, the projects assessed were in the Andean region near Bogotá and the Caribbean region in Cartagena. These initiatives were mature projects developed through international cooperation involving diverse actors, exclusively focused on EbA.

Previous research has explored vulnerable communities by focusing on understanding poverty and its roots through participatory research (Arboleda et al., 2004), as well as examining the implications of extractive industries, particularly mining, in rural areas (Zárate-Rueda et al., 2022). Despite this, there is a notable absence of studies that investigate multiple value creation or initiatives that are primarily designed and led by women. Furthermore, there is a lack of research that delves into the implications of local

initiatives based on circular economy principles, particularly within the Pacific region of the country. Finally, no studies have evaluated these initiatives using the Circular Value Flower (CVF) principles, highlighting a significant gap in the current literature.

1.2. Relevance of the study

In the realm of system-oriented disciplines, industrial ecology stands as a multifaceted scientific field dedicated to addressing sustainability challenges through a comprehensive systemic perspective. Within industrial ecology (IE), scrutinizing a circular initiative originating in the majority world not only contributes to enhancing our existing understanding of the circular economy but also elucidates alternative approaches to circular economic principles beyond extensively studied domains such as critical raw materials. This, in turn, enriches the discourse on sustainable development practices. Furthermore, studies in the EU show that plastic packaging waste per capita has increased by 18% (EUROSTAT, 2023), while in the US it is estimated that around 30% of total waste corresponds to plastic packaging (EESI, 2020). Additionally, plastic remains the most frequent pollutant in oceans in South America, affecting both the Caribbean and the Pacific (UNEP, 2018).

The present study has a particular focus on post-consumer waste management in vulnerable communities as studies in Colombia show that the main source of ecosystem pollution is due to poor waste management infrastructure (Bolívar-Anillo et al., 2023). Given that the Global South has an astounding percentage of landfilling at 54% (Kaza et al., 2018), and Colombia's rate of landfilling amounts to 83%(DNP, 2016), mapping and understanding initiatives that contribute to maintaining materials within the economy is fundamental to reducing the impact that these materials have on the environment.

Moreover, the significance of this study extends to societal implications, as its findings and recommendations can serve as a blueprint for actor alignment that fosters an environment of multiple value creation in vulnerable communities through the enhancement and support of community-led, local circular initiatives.

1.3. Research objective and research questions

The primary objective of this master's thesis is to conduct an in-depth investigation into community-led, circular initiatives in Colombia, through the examination of a case study in the Pacific region of the country. The research aims to map the diverse stakeholders involved in these initiatives and their impacts on the project itself. Moreover, the study endeavours to provide valuable insights into the sustainability of these initiatives by analysing the implications on both the community and the surrounding ecosystem.

1.3.1. Research questions

With what was previously described as the objective of the study, the present study aims to answer the following question: ***"What are the different values enhanced by community-led initiatives in Colombia focused on circular economy?"***

To answer this, a comprehensive set of sub-research questions has been developed:

1. What are opportunities, impossibilities, and limitations of the system in which the initiative takes place?

2. What are the social effects of the initiative within the community?
3. What are the economic implications of the initiative within the community?
4. How does the initiative contribute to the creation of environmental values?

1.4. Research approach

The research approach for this master thesis employs an explanatory strategy using the Circular Value Flower (CVF) principles to uncover and understand the values generated through the initiative, thereby fulfilling the research objective.

This project utilizes a qualitative multi-methods approach, incorporating both semi-structured interviews and workshops to gather information from relevant stakeholders. This decision has three main advantages. Firstly, the specific knowledge provided by experts and members of the initiative offers a comprehensive understanding of the initiative, its context, and the values generated, as perceived by those directly involved. Secondly, by using interviews and workshops, the information gathered is current and updated, avoiding the delays that other methods might involve between data collection and availability. Thirdly, the final visualization of the methodology facilitates communication efforts and the result-sharing event with all members of the initiative in an easily accessible manner.

However, the approach also has three main disadvantages. Firstly, interviews and workshops are time-consuming, which limits the ability to contact and establish spaces with all relevant stakeholders, potentially leading to uneven representation of actors. Secondly, the research is influenced by the interests, perceptions, and biases of those interviewed. Finally, the specific knowledge and context of the research make it difficult to generalize the results.

1.5. Structure of the Thesis Report

The thesis report follows the structure outlined below:

Chapter Two: Background
This chapter provides an overview of the research project's context. It is divided into five subsections covering the main dimensions of sustainability analysis (economic, environmental, and social), the overarching concepts guiding the research, and a detailed description and actor mapping of the case study.

Chapter Three: Methodology and Data Collection
This chapter details the methodology used and describes the data collection methods. The first subsection focuses on the qualitative aspects of data collection and its sources, while the second subsection outlines the content analysis method.

Chapter Four: Findings
This chapter presents the overall findings, categorized into subsections aligned with the different values identified related to the initiative, including social, environmental, economic, and other values. Additionally, it evaluates the overall system, highlighting opportunities and barriers.

Chapter Five: Discussion and limitations
Based on the findings and the literature review, this chapter maps the implications of the findings as well as their interpretation, and discusses the limitations of the research

Chapter Six: Recommendations
This chapter provides recommendations based on the findings of the study.

Chapter Seven: Personal Reflection
This chapter includes the personal outcomes that resulted from the research project, both in working with communities and in developing research in the Global South.

Chapter Eight: Conclusions
The final chapter includes the conclusions drawn from the research and summarizes the recommendations made in Chapter Seven.

Additional information can be found in the appendices at the end of the document.

2. Background

The study's focus on communities located far from urban centres yet close to key ecosystems necessitates the organization of existing knowledge into main areas to effectively map the fields interacting within the studied project. Sociometabolic research (SMR) posits that defined social systems interact with surrounding biophysical resources, establishing a direct relationship between the socioeconomic system and the environment (Haberl et al., 2019). Therefore, to accurately understand and map the circular initiative, attention must be given to diverse pillars embedded within both dimensions. Figure 1 illustrates each dimension and its interaction.

Firstly, central to the environment are the ecosystem's use and the resulting ecosystem pollution and loss. Regarding the mangrove, direct uses include fishing and utilizing the wood of mangrove forests for house construction. However, other ecosystem services such as flood and extreme weather protection (Dabalà et al., 2023), as well as acting as a carbon sink (Sanderman et al., 2018), are less known to the local population. All these benefits play an important role in shaping the communities, their culture, and their relationship with the mangrove (Galindo Orrego, 2021).

On the other hand, within the socioeconomic system, social aspects include the culture and community settlements around and within the mangrove, as well as the level of environmental awareness. Most of the rural areas in the district of Buenaventura are within protected areas and national natural parks. Additionally, waste management infrastructure significantly influences the level and extent of pollution within the mangrove. Adopting a systemic approach, the figure includes bidirectional arrows to represent the reinforcing relationships between the different aspects mentioned above.

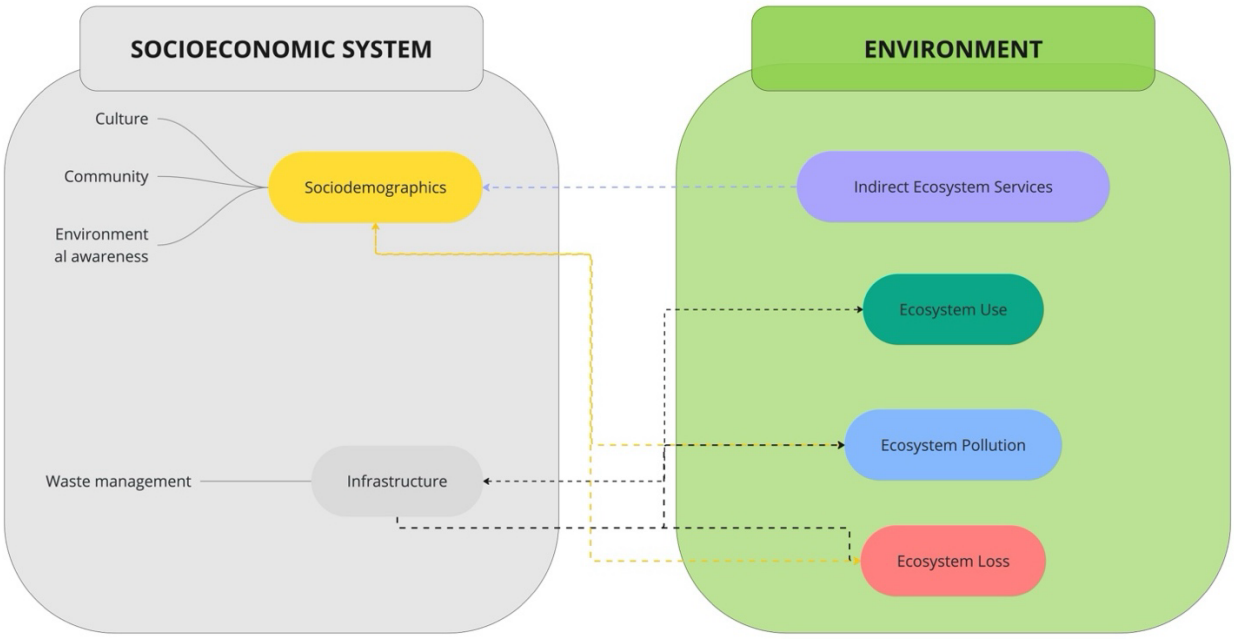

Figure 1. Conceptual interactions between the socioeconomic system and the environment of the case study, developed by the author for the present study.

Thus, in line with the multidimensional characteristics of circular economy initiatives (CEI), the literature review for the present study will follow the structure of the impacts that will be assessed. The present chapter includes a division based on the three-pillar model of sustainability, that is economic, social, and environmental, used to structure the review on the context surrounding the initiative.

2.1. Environmental

2.1.1. Marine litter and ocean debris

Over the past three decades, there has been extensive literature on marine litter and ocean debris, reflecting the growing concern within the scientific community about ocean pollution (Schneider et al., 2018). Marine litter is defined as "any persistent solid material, manufactured or processed, that is directly or indirectly, intentionally or unintentionally, disposed of or discarded into the marine environment" (Peña-Rodriguez et al., 2021). Figure 2 provides a comprehensive illustration of this definition, encompassing waste found in coastal areas, ecosystems, and extending to the seabed (Bellou et al., 2021). Plastics have been the primary focus of many studies, given their consistently prominent presence, with researchers settling on a contribution that oscillates between 60 to 90% (Kumartasli & Avinc, 2020; Murshed et al., 2022; Veksha et al., 2022).

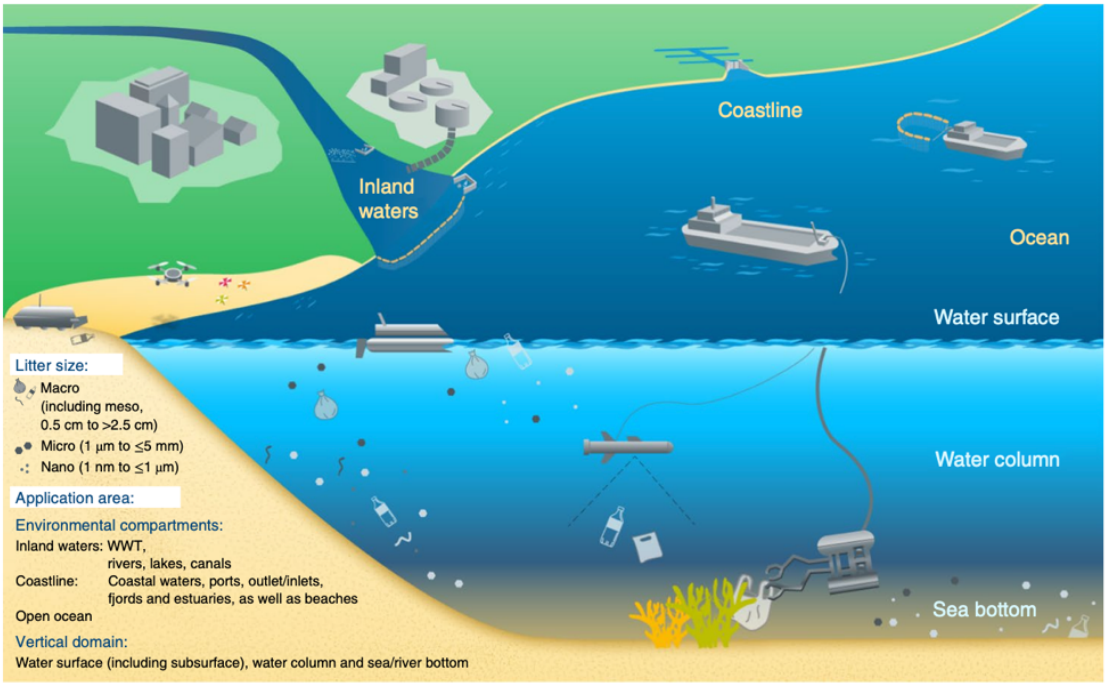

Figure 2. Overview of concepts and areas related to marine litter according to (Bellou et al., 2021).

Marine litter can be categorized into five types according to its source, as standardized by the International Coastal Clean-Up (ICC): ocean/waterway activities, dumping activities, medical/personal hygiene, shoreline and recreational activities, and smoking-related activities (Murshed et al., 2022).

Moore (2008) identified seven main problem areas caused by marine litter, encompassing social, environmental, and economic dimensions. Socially, litter can lead to health issues due to contamination and injuries (Zielinski et al., 2019). Economically, coastal areas heavily reliant on tourism suffer from littered beaches, resulting in reduced visits and adverse effects on sectors dependent on tourism revenue (Peña-Rodriguez et al., 2021). Additionally, municipalities incur increased costs for cleaning brigades and processes, along with expenses related to vessel damage and economic losses in fisheries due to reduced catches (Murshed et al., 2022).

From an environmental perspective, marine litter has numerous negative effects. Animals are prone to entanglement in ghost nets, while ingestion of debris poses a significant threat. Research indicates that 44% of all seabird species consume plastics, and 267 marine organisms are affected by plastic waste (Kumartasli & Avinc, 2020). Plastic pellets, due to their high surface area, absorb persistent organic pollutants (POPs) and other chemicals (Moore, 2008). The low biodegradability of plastic litter makes them substrates for invasive species dispersal, and when sunk to the ocean floor, they impact gas exchange, hinder CO2 sequestration, and destroy nursery habitats, affecting the reproduction of countless species (Moore, 2008).

While the detrimental effects of marine litter on marine life are well-documented, some of the aforementioned effects are less understood, necessitating further research to fully comprehend the environmental impact of marine litter and its global extent.

2.1.2. What happens next?

Although there are consistent efforts to identify the main sources of marine litter (Figure 3) and its effects on ecosystems, there remains a significant gap in the management of litter once it has been collected (Bellou et al., 2021). Furthermore, while most protocols for clean-ups focus on beaches and are associated with certification schemes for tourist destinations (Zielinski et al., 2019), studies have evaluated various beach-cleaning methods and intensities, ranging from volunteer-led efforts to machine-intensive cleaning associated with certifications. These studies examine potential impacts on beaches and prioritize retaining their attractiveness for tourism, as many beaches rely heavily on visitor revenue (Zielinski et al., 2019). Thus, from the four actions identified to tackle waste management problems: prevention, mitigation, removal and behaviour-changing, there is a disparity in the literature on each found (Bellou et al., 2021) but there is also a noticeable gap on defining what to do with the collected litter.

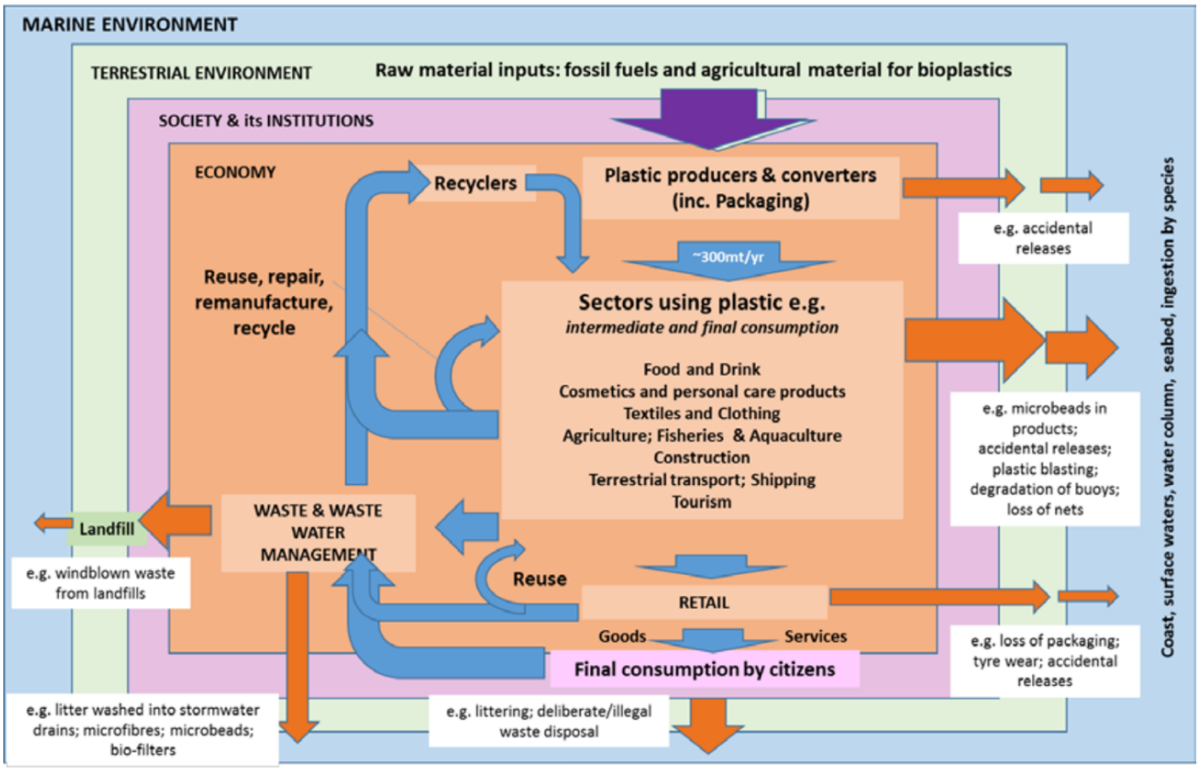

Figure 3. Identification of sources of litter and their leak into the marine environment (ten Brink et al., 2018).

Marine litter poses three main challenges that complicate its recycling or processing back into the economy. Firstly, degradation resulting from exposure to UV light, wind, friction, etc., reduces the quality of the material once it has been recovered (Peña-Rodriguez et al., 2021). Secondly, the recovered material can be contaminated with persistent organic pollutants (POPs), biofilm, natural debris, and other contaminants, further diminishing its qualities or complicating the recycling process (Kumartasli & Avinc, 2020). Thirdly, collected litter is difficult to effectively separate due to the diversity of polymers present, making integration into recycling cycles challenging as it can decrease the overall quality and material properties of the mix (Veksha et al., 2022).

In the case of plastics, three main management methods aside from traditional disposal exist: mechanical recycling, chemical recycling, and energy recovery (Cañete-Vela, 2017). The choice of the best method to process the collected marine litter is also determined by the physical and chemical composition of the mix, for which information is often lacking (Schneider et al., 2018). Nevertheless, efforts have been made to incorporate recovered marine litter into products. For instance, Adidas and Parley recover plastic bottles and create yarn to make their sneakers, Nylon produces ECONYL from recovered nets, and Norton manufactures eyewear from recovered HDPE (Kumartasli & Avinc, 2020). It is important to note that these products consist of a mixture of recovered material and virgin polymers, with a 25% limit accepted to ensure that the mechanical and material properties of the mix remain unchanged (Peña-Rodriguez et al., 2021).

2.1.3. Mangroves

The literature surrounding mangroves is extensive, as mangroves are widely known for being one of the most carbon-dense ecosystems in the world (Sanderman et al., 2018). The delicate state of this ecosystem, present in over 120 countries in the world, was discussed as early as 2006 when a rate of loss was defined at 1-2% per year (Duke et al., 2007). Today, most of the mangrove habitat loss is attributed to Indonesia, Malaysia, and Myanmar (Sanderman et al., 2018). Worldwide, mangrove forests are considered vulnerable ecosystems due to the anthropogenic pressures on them as well as the effects of climate change (Perea-Ardila et al., 2019). Furthermore, they are considered estuarine wetlands of high importance within the RAMSAR convention, of which Colombia belongs since 1980 with 11 identified RAMSAR sites to date (RAMSAR, n.d.).

Colombia is home to 379954Ha of mangroves in both the Caribbean and Pacific coasts (Bolívar-Anillo et al., 2023), with 77% of them located on the Pacific, making it the most extensive area of mangroves in northwestern South America (West, 1956) . On the other hand, the Colombian Pacific is considered one of the rainiest places on Earth, populated by macrotidal mangrove swamps (Riascos et al., 2019). In both the Pacific and the Caribbean, mangroves play a fundamental role in terms of coastal protection, a source of food and income for fisher communities, carbon sequestration, amongst others (Hills et al., 2020).

According to Global Mangrove Watch (n.d.), as of 2020, 56.14% of the coastline of Colombia was covered in mangroves, with 12 species of mangrove trees, four of which are considered threatened by the IUCN. Figure 4 shows the main causes of mangrove loss in the country, with the predominant one being erosion. Manzolli et al. (2024) conducted a study in Barranquilla, in the Caribbean coast, where highway construction along with other climate change-induced dynamics, influenced the coastal dynamics causing high erosion rates.

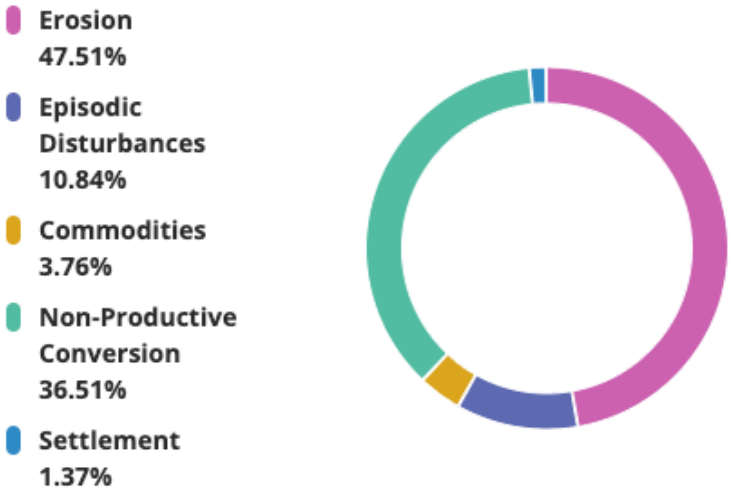

Figure 4. Drivers of mangrove loss in Colombia 2000-2016 (Global Mangrove Watch, n.d.).

In the Pacific coast particularly, there are reports of 8 species of mangroves (Perea-Ardila et al., 2019). These mangrove forests are classified as humid tropical forests due to the

high precipitation levels that occur in the region (3000mm on average) as well as the high temperatures that average 24C (Perea-Ardila et al., 2019). Figure 5 shows the spatial distribution of tree cover and mangrove forest in the district of Buenaventura (GFW, n.d.).

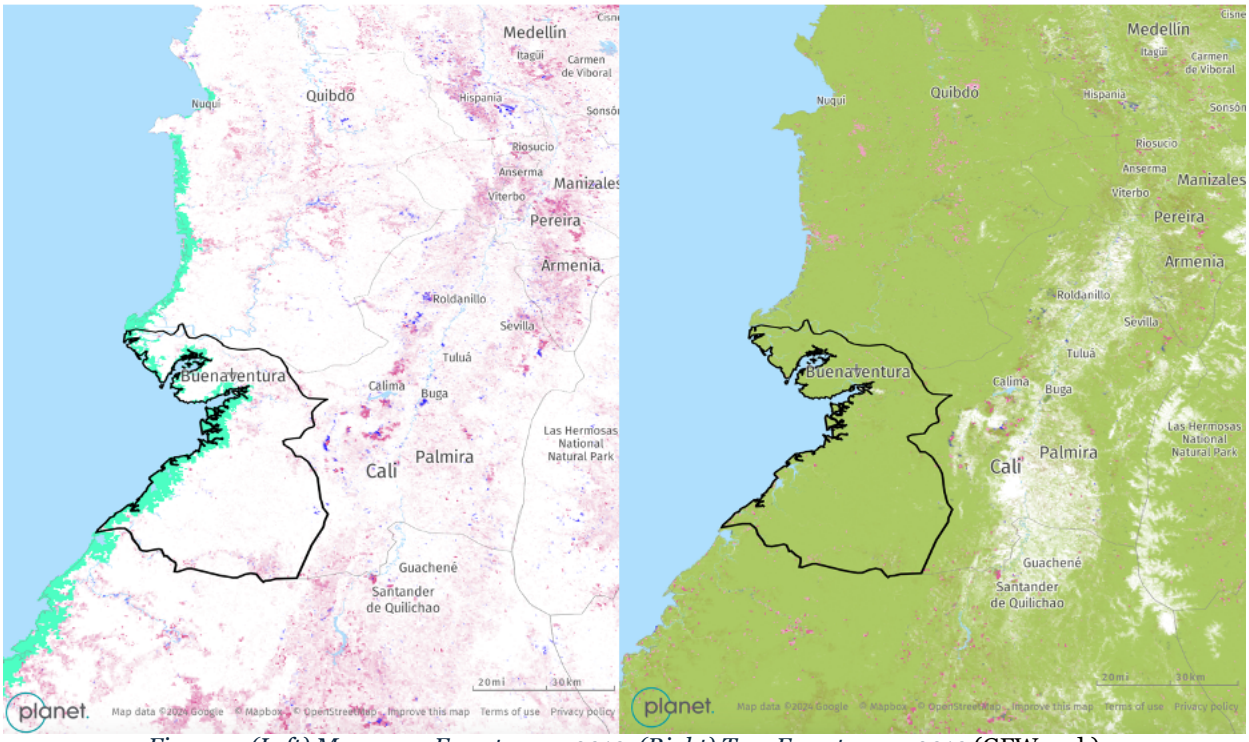

Figure 5. (Left) Mangrove Forest cover 2010. (Right) Tree Forest cover 2010 (GFW, n.d.).

2.1.4. Effects of litter on mangroves

Notably, an alarming 6 to 10% of annual global plastic pollution finds its way into marine environments (Bolívar-Anillo et al., 2023). While marine debris studies have been conducted, they tend to focus on sandy beaches (Luo et al., 2021). However, estuaries are identified as traps for anthropogenic debris, as evidenced by studies such as Riascos et al. (2019), which underscore the susceptibility of mangrove forests to accumulating substantial amounts of litter.

Some of the most documented effects of macro-litter on mangroves include entanglement with mangrove trees, blocking pneumatophores, depriving trees of oxygen, hindering saplings from reaching sediment, reducing space for growth, disrupting migratory bird habitats, disturbing species interactions, and creating anaerobic conditions in sediment that affect crabs and other species (Kesavan et al., 2021). van Bijsterveldt et al. (2021) also state that plastic waste changes the dynamics of growth inducing high aerial root growth and even causing the death of the tree due to smothering (Figure 6).

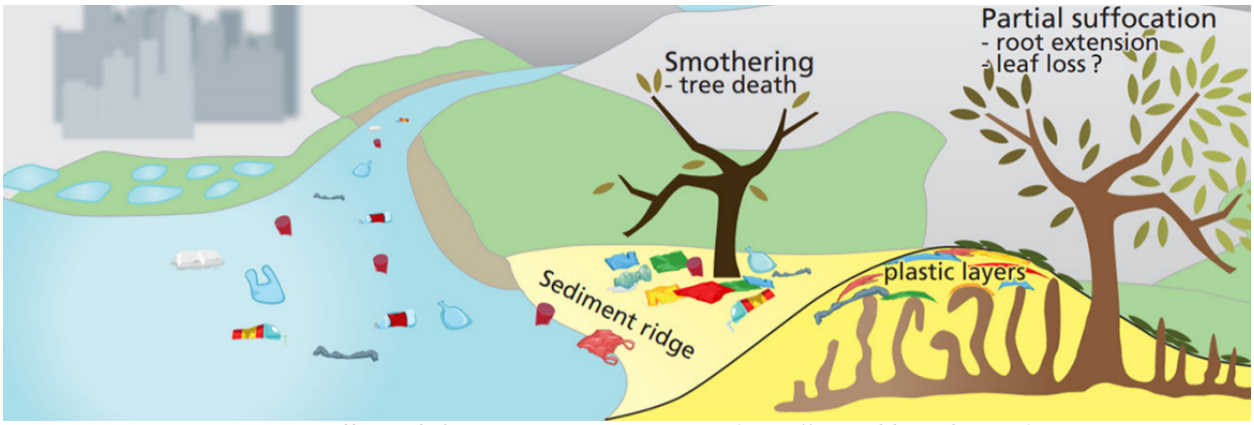

Figure 6. Effects of plastic waste on mangroves (van Bijsterveldt et al., 2021)

Unfortunately, there are significant knowledge gaps in evaluating the general ecological risks of microplastics, and the specificities of the mangrove ecosystem are no exception. Studies by Garcés-Ordóñez et al. (2019) in Colombia, Li et al. (2020) in China, van Bijsterveldt et al. (2021) in Indonesia, and others demonstrate high quantities of both micro and macro plastics in mangrove forests. However, the effects of these plastics on the ecosystem remain unknown.

In Colombia, about 65% of solid waste in coastal areas is inadequately managed, disposed of in illegal dumpsites or natural water bodies (Garcés-Ordóñez et al., 2019), increasing the volume of possible waste that can reach marine ecosystems. Existing research in the country predominantly focuses on the more urbanized and populated Caribbean coast, investigating the influence of the Magdalena River on garbage in nearby beaches and mangroves (Bolívar-Anillo et al., 2023).

Riascos et al. (2019) found that surface macro-litter (SML) in mangroves near Buenaventura, the largest marine port in Colombia, reaches densities ranging from 2 to 314 g*m^-2, rendering them among the most polluted areas globally. Furthermore, the study by Bolívar-Anillo identified packaging such as bags, plastic cups, food wrappers, and drinks, to comprise around 35% of the total characterized litter found in the mangrove.

Bolívar-Anillo et al. (2023) also emphasize the imperative of adopting a holistic approach on the Pacific Coast, particularly in characterizing litter because of inadequate waste management systems, with a focus on the Tumaco region near Ecuador. This underscores the critical necessity of engaging with communities to ensure proper waste disposal practices, thereby mitigating the adverse impact on mangroves. While the referenced research was conducted in a distinct geographical area from the current study, it provides valuable insights into prevalent issues in the majority world, where inadequate or severely stressed waste management systems are common due to escalating demand and population growth (Kaza et al., 2018).

2.2. Economic

2.2.1. Circular Economy in Colombia

In 2019, the Ministry of Environment and Sustainable development published the "Estrategia Nacional de Economía Circular" (ENEC), in English, the National Strategy to achieve a circular economy. As the first country in Latin America to launch a comprehensive strategy to work towards the CE, the ENEC is based Ellen MacArthur definition of the CE (Gobierno de la República de Colombia, 2019).

The ENEC was built through different methods of participatory design that included workshops, debates, and discussions, which led to the final strategy which was signed by representatives of major areas (Figure 7). The Valle del Cauca department, to which the city of Buenaventura belongs, ratified the ENEC through the signing of a regional accord on april 2019 (Ministerio de Ambiente, n.d.).

Figure 7. Structure of the National Circular Economy Strategy. Developed by the author based on (Gobierno de la República de Colombia, 2019).

This strategy is centered on the optimization of the productive systems and a focus on new business models through collaborative and participatory actions (Gobierno de la República de Colombia, 2019). Furthermore, the ENEC builds upon previous initiatives to tackle waste and environmental performance in Colombia, with the aim of complementing them. According to the Colombia's climate and development report (CCRD) published in 2023 by the World Bank, the ENEC, along with the National climate change policy, the green growth policy, and the low carbon development strategy, are examples of the institutional framework that posits Colombia as a regional leader on climate change setting targets above the average in the region (World Bank, 2023).

Overall, there are six main pillars in which the strategy revolves. This includes the flux of industrial materials and mass consumption products, flux of packaging materials, sources, and fluxes of energy, among others. In addition, the compromise of the strategy centers on six mechanisms that aim to encourage the transition towards a circular economy (Gobierno de la República de Colombia, 2019). Figure 8 summarizes the pillars and the actions. Within the realm of CEI that is the focus of the present study, the biggest focus comprises the strengthening of the supply chains, a key indicator from the material fluxes pillars, which include the informal waste pickers as the main actors that close the loop of postconsumer material in the country.

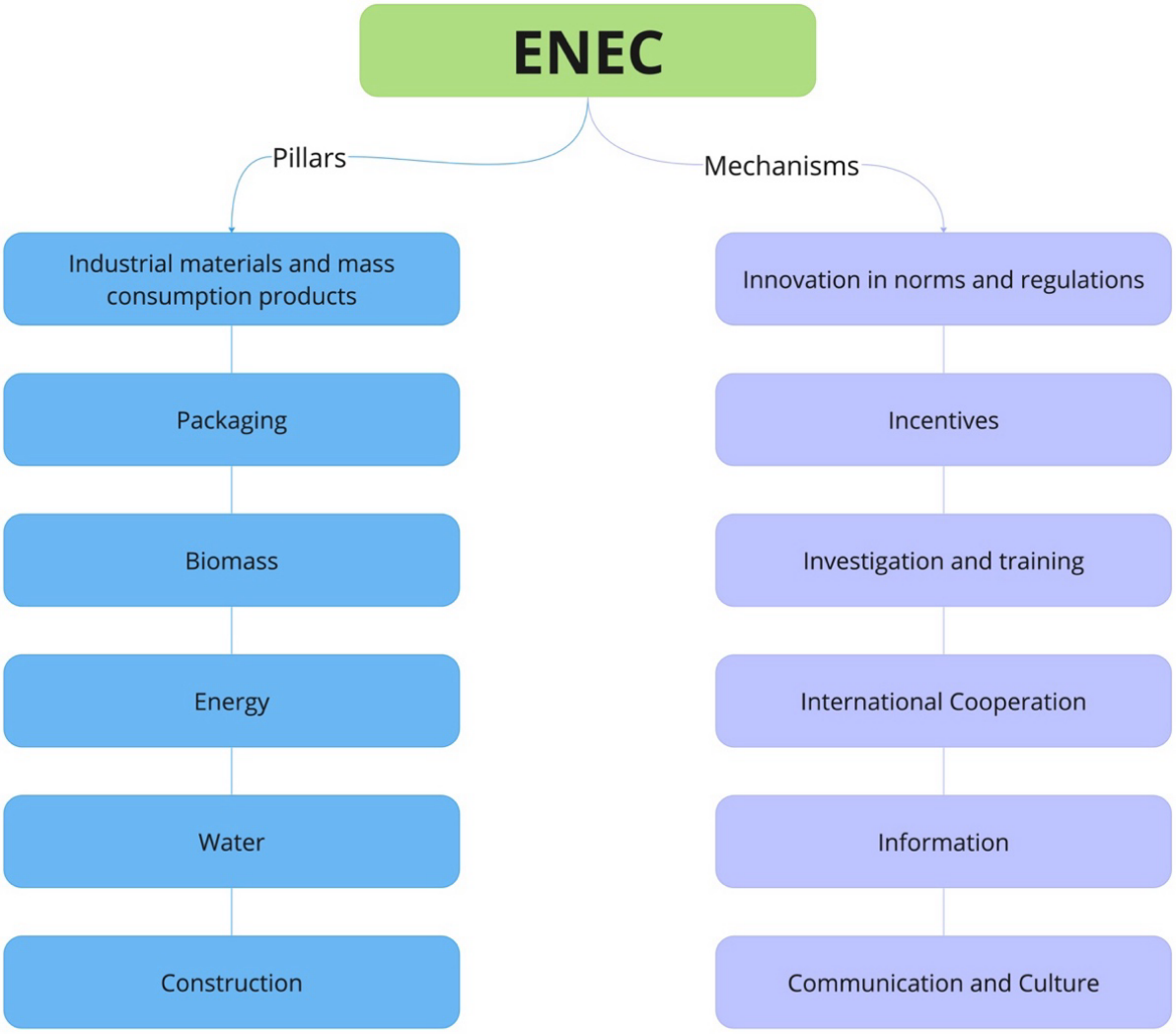

Figure 8. Pillars and mechanisms of the ENEC. Developed by the author based on (Gobierno de la República de Colombia, 2019).

2.2.2. Green jobs and informal waste collectors

The International Labour Organization (ILO) defines green jobs as "direct employment created in different sectors of the economy that reduces the environmental impact of those sectors" (Jarvis et al., 2011). Indeed, in a case study conducted in Chile, the ILO recognizes the importance of informal waste pickers in the country's informal economy, as well as the potential of this sector as a source of green jobs in the developing world (ILO, 2013).

In Colombia, increasing efforts have been made to integrate waste collectors into waste management systems and formalize their work. These efforts include conducting a census of waste collectors within local territorial entities and formalizing waste collector associations as integral parts of the country's waste management system (DNP, 2016). Consequently, the 300,000 estimated waste collectors of the country (Gutberlet, 2023) are recognized as fundamental to ensuring that the country's circular economy strategy and targets are on track.

While most waste collector associations are in Bogota, accounting for the capital district of the country, which generates more than 6,000 tons of waste per day (Minvivienda, n.d.), all municipalities are required to have updated comprehensive waste management plans in accordance with the initiative "National Alliance for Inclusive Recycling" (ANRI) (Marín Lopez et al., 2015). The latest Integrated Solid Waste Management Plan (PGIRS) of the city of Buenaventura, from 2014, reports seven formalized waste collector organizations as well as 39 independent waste collectors in the city (Alcaldía Distrital de Buenaventura, 2014). Traditionally, waste collectors come from vulnerable communities, with poor pay conditions (Gutberlet, 2023). Thus, the evaluation of circular initiatives in the global south involves interaction with these communities in one way or another.

Furthermore, to understand the initiatives, it is important to comprehend the structure of the informal economy in which they are embedded. Gregson & Crang (2015), Awino & Apitz (2024), and Sasaki & Araki (2013) recognize the complexity of the informal waste collection systems in different parts of the world where their studies have been conducted. The informal economy includes several intermediate actors and interactions, the number of which varies greatly depending on the site of study (Sasaki & Araki, 2013). In Colombia, the recycling value chain has four main actors and is divided into three main stages (Moreno Rodríguez, 2018): the generators, informal waste collectors (IWC), the collectors or aggregators, and the transformers (See Figure 9).

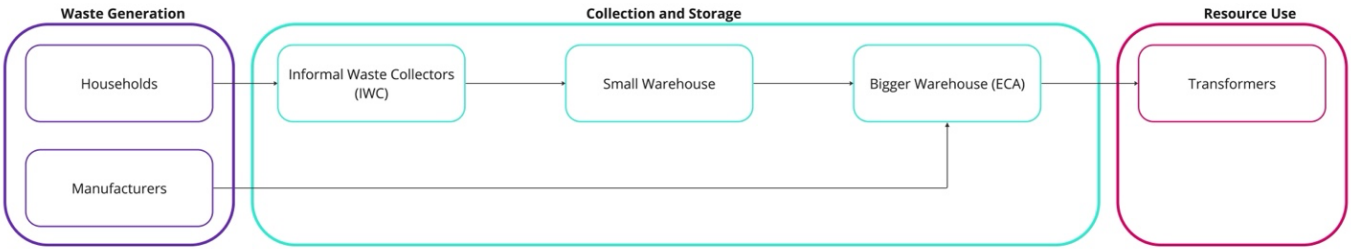

Figure 9. Recycling Value Chain in Colombia, developed by the author for the present study.

The first stage, corresponding to the generators includes households and manufacturers of goods and services that create the waste. The second stage comprises the informal waste collectors who, as their name suggests, act as primary collectors and separators, mainly from households, and sell the material to warehouses called *Estaciones de Clasificación y Aprovechamiento (ECAs)*, who further aggregate and store the material to be sold. which further aggregate and store the material to be sold. The legislation recognizes different sizes of warehouses, thus there can be up to three different warehouses involved in this stage (Moreno Rodríguez, 2018). Finally, the ECAs sell to the transformers, who are usually the industries that use the recycled material as input for their processes (Sarmiento et al., 2011).

2.2.3. Extended Producer Responsibility in Colombia

Extended Producer Responsibility (EPR) is a set of environmental policies designed to extend the responsibility of producers to cover the entire life cycle of their products, including post-consumer aspects. This approach aims to encourage producers to take

greater responsibility for the environmental impact of their products throughout their lifecycle (OECD, 2001).

Colombia has been at the forefront of implementing EPR programs in Latin America (Park et al., 2018). The country initiated its EPR journey by focusing on hazardous residues and waste, such as pesticide containers in 2007, followed by medicines in 2009, and electronics in 2010 (Park et al., 2018). These early initiatives laid the foundation for Colombia's commitment to sustainable waste management practices.

In 2018, Colombia introduced Resolution 1407, a pivotal step in expanding its Extended Producer Responsibility (EPR) program. This resolution was further refined in 2020 with the introduction of Resolution 1342, both of which directly targeted mass consumption packaging items. Notably, these resolutions reflect an incremental approach in both the volume of waste processed and their geographical reach (Ministerio de Ambiente y Desarrollo Sostenible, n.d.-b). They signify a gradual expansion into municipalities situated beyond major urban centers, including Bogotá, Cali, Barranquilla, and Medellín. This geographical aspect highlights the significance of effective waste management practices across the entirety of Colombia's territory.

Moreover, these resolutions evaluate the performance of associations of companies, or individual companies themselves, based on a scoring system that considers the number of municipalities they cover (Ministerio de Ambiente y Desarrollo Sostenible, n.d.-b). Each municipality is classified from 1 to 6, with additional points awarded for the inclusion of municipalities with higher classifications. The total geographical score is calculated as the weighted average of the number of municipalities covered in the company's extended producer responsibility plan and the number of municipalities in each category (Ministerio de Ambiente y Desarrollo Sostenible, n.d.-b). Consequently, companies are incentivized to achieve national coverage rather than confining their efforts to a specific area of influence. This approach encourages companies to adopt a comprehensive approach to waste management that encompasses the entire country.

2.3. Social

2.3.1. The environment and its people

The Pacific coast of Colombia is acknowledged as a biodiversity hotspot (Myers et al., 2000), corresponding to the Chocó/Darién/Western Ecuador hotspot, considered a biogeographic region of high ecosystem importance mainly because of its high biodiversity (Gallego Perez & Selvaraj, 2019).

The Pacific also has a high population density in the coastal area, thus, recognising the complex systems that interact and interrelate within coastal communities is fundamental to understand the processes and activities that take place in the region (Gallego Perez & Selvaraj, 2019).

When discussing the relation of the community with the environment, García et al. (2014) underscore the efficacy of bottom-up approaches in mangrove management, particularly for Afro-Colombian communities heavily reliant on mangroves for their livelihoods. This

underscores the critical role of community involvement in fostering sustainable mangrove management practices. Additionally, roca-Servat & Cifuentes (2020) recognize gender-specific roles in traditional activities, such as mollusk fishing performed by women and open-sea fishing conducted by men, designating mangroves as a traditional "feminine" territory. A comprehensive understanding of community dynamics, traditional fishing practices, and their perspectives on environmental conservation is imperative for ensuring the long-term sustainability of CEI.

Furthermore, drawing from Aguirre & Turbay (2016) study in the Caribbean, it becomes evident that the sustainable management of resources must be tailored to the specificities of each community to prevent stereotyping inhabitants as the sole "guardians of nature". This emphasizes the need for a nuanced and culturally sensitive approach to resource management to avoid oversimplified perceptions and to ensure the successful integration of conservation efforts within diverse communities, as well as recognizing the vulnerability of marginalized and indigenous communities to environmental degradation (Kothari et al., 2019).

2.3.2. Characteristics of Buenaventura

Surrounded by breathtaking natural landscapes and a confluence of diverse cultures, languages, and environments, the district of Buenaventura, situated within the Valle del Cauca department, stands as the largest territory in the region, spanning an area of 6785 square kilometers (Valencia & Sinisterra-Ossa, 2019). It serves as the most densely populated urban center along Colombia's Pacific coast, boasting a population of 423,924 residents (Lombard et al., 2023), among whom 86.7% identify as Afro-Colombian, *Mulato*, or of Afro-descendant heritage (DANE, 2018).

The district possesses the biggest maritime port in the country, handling 51% of port-related activities in the country, making it a hub for imports and exports and a high dependence on the port for the local economic activities, as well as subject to security issues due to the presence of gangs and armed groups (Valencia & Sinisterra-Ossa, 2019). Furthermore, it is a region that has high level of inequalities and social problems. A survey conducted reported that 36% of the inhabitants feels that they have at least one unsatisfied basic need (Valencia & Sinisterra-Ossa, 2019), as well as other alarming figures like 80% of the population in poverty, 17% of analfabetism, and 50% identify themselves as victims of the armed conflict in Colombia (Jaramillo Marín et al., 2019). These issues are exacerbated by geographical barriers, including limited connectivity and challenges in supplying basic necessities to areas inaccessible by land, highlighting the multifaceted challenges facing the region.

Despite this, the Global Atlas of Environmental Justice does not report any case for the coastal area of the district of Buenaventura as of the time this document was written (EJ Atlas, n.d.).

2.3.3. Waste management systems in Colombia

Colombia’s National Planning Department reported that 83% of the total household solid waste generated in the country is disposed of in the 62 official regional landfills serving most municipalities (DNP, 2016). Waste that doesn't reach these regulated landfills often

ends up in illegal dumpsites. By 2018, a total of 10.3 million tons of solid waste were disposed of in both authorized and unauthorized sites (DNP, 2016). However, with a projected 16 million tons of solid waste generated by 2024 and landfills reaching capacity in less than 10 years, the government acknowledges the deficit in landfill capacity for proper waste disposal. Additionally, there's a significant disparity in waste collection between urban and rural areas, with collection rates reaching 97.9% in cities but only 21.9% in rural areas as of 2013 (DNP, 2016).

The statistics on the amount of waste recovered by informal waste pickers vary, ranging from 12.9% to 17% (CEMPRE, 2019; DNP, 2016). This variability highlights the challenges Colombia faces in effectively managing waste systems nationwide. Characterization of household waste reveals that approximately 30% consists of materials with high potential for recycling, such as plastic, paper, glass, or textiles, while 62% consists of organic waste (DNP, 2016). According to the abovementioned projections, this statistic translates to 4.8 million tons of recyclable materials being lost in landfills. Furthermore, the 62 official landfills are insufficient to cover all municipalities. In the Pacific Region, Cauca and Chocó have the highest number of rural areas with inadequate waste disposal facilities, with 17 and 10 respectively, ranking among the top 4 in the entire country (DNP, 2016).

The city of Buenaventura is grappling with the prevailing trend of landfilling that characterizes waste management systems in Colombia. According to data from the unique information system (SUI), in 2021, Buenaventura generated 6,700 tons of solid waste per month, equivalent to 21.37 kg per capita, significantly lower than the national average. However, only 6.4% of solid waste in Buenaventura is recovered and recycled (DANE, 2021). Furthermore, with 5,500 tons being deposited in the regional official landfill, the district acknowledges that 87.7% of total solid waste generation is properly disposed of. Nevertheless, there remains approximately 824.1 tons of material inadequately disposed of (DANE, 2021).

2.4. Case Study: Guardianas del Manglar (GdM)

2.4.1. Description

In Colombia, Carvajal Empaques stands out as one of the largest companies specializing in packaging products, with its headquarters located in Cali, the capital of the Valle del Cauca department. Founded in 1904, the company has expanded its operations into various business fields (EMIS, 2024). In 2019, Carvajal Empaques launched the Plataforma Pacífico as part of its commitment to addressing the multidimensional issues faced by Buenaventura. The platform focuses on the proper management and disposal of waste, as well as the economic benefits derived from value extraction through correct segregation and separation for recycling purposes (Carvajal Empaques, 2019).

Carvajal Empaques and Fundación Carvajal (FC) collaborated with ASOGESAMPA, to establish the "Guardianas del Manglar" (GdM) initiative within the Plataforma Pacífico framework. Situated near Buenaventura on the Pacific Coast of Colombia, GdM comprises 133 women who collect recycled materials from the mangroves, amounting to approximately 4000kg of waste per month (Diario El Pais, 2023).

Therefore, the project entails collaboration among seasoned actors in territorial interventions and expertise in the circular economy, the company (Carvajal Empaques) serving as the primary funder along with its foundation (FC), the association of informal waste collectors in Buenaventura called ASOGESAMPA, and the community, both within the broader Plataforma Pacífico and the more specific group of fisherwomen that are directly involved in the initiative (Diario El Pais, 2023).

2.4.2. Actor Mapping

Drawing from media coverage and conversations with representatives from both Carvajal and ASOGESAMPA, Figure 10 illustrates the various stakeholders involved in the GdM initiative. The stakeholders are categorized into four main actors, each of whom and their relation to the initiative will be explained below.

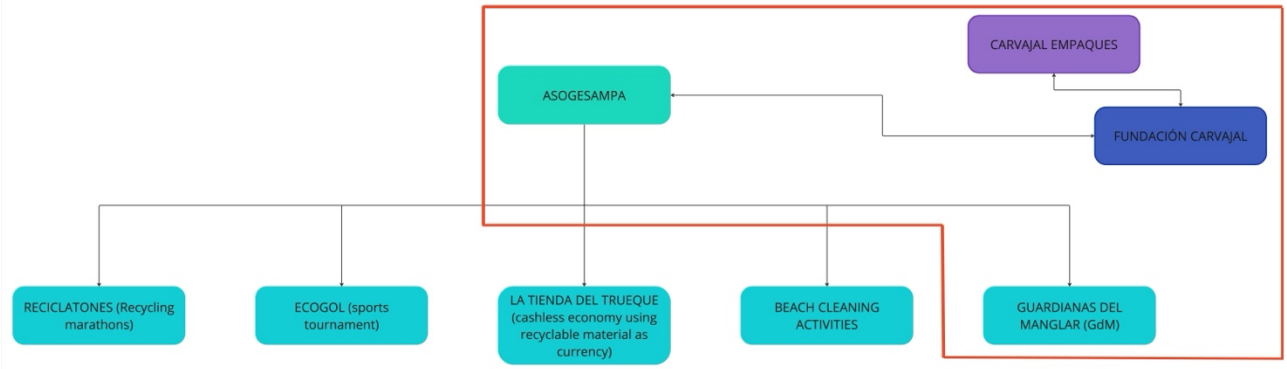

Figure 10. GdM Stakeholder Map (developed by the author for the present study).

Firstly, Fundación Carvajal acts as the executor of the initiative on behalf of Carvajal Empaques and directly engages with GdM on-site. They maintain constant communication with all the GdM and the team develops activities to empower and strengthen the women. These activities include health brigades, empowerment workshops, and educational workshops for both the women and their children (Fundación Carvajal, 2023). Carvajal Empaques serves as the funding agent through their program focused on circular economy, as part of their sustainability strategy (Organización Carvajal, 2024).

Secondly, ASOGESAMPA is the association of recyclers that operates directly within the community. They undertake several ongoing projects to raise awareness and educate the community on proper recycling practices. As an ECA (see section 2.3), they purchase materials from informal waste collectors, aggregate them, and then sell them to transformers.

Lastly, there are the 133 women who are part of the GdM initiative. They are organized into smaller groups, with a designated leader appointed to ensure effective communication between ASOGESAMPA and all participants.

3. Methods and Data Collection

To address the main and sub research questions a qualitative multi-methods approach comprised of both semi structured interviews and workshops using the circular value flower framework (CVF) as the guiding methodology was employed. Figure 11 shows the research flow diagram that highlights the approach taken for the present study.

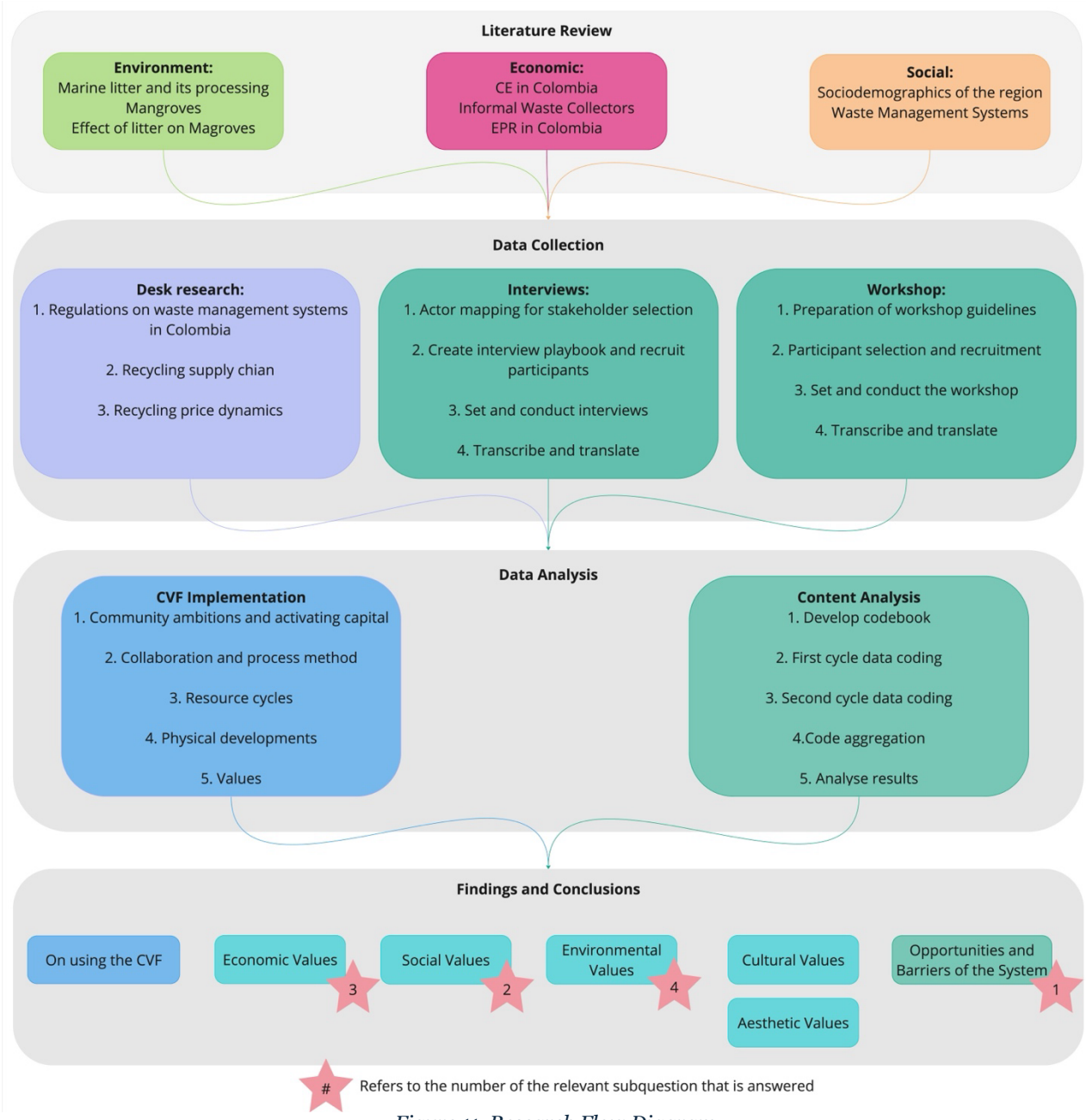

Figure 11. Research Flow Diagram

Moreover, utilizing the CVF enables the assessment of overarching circularity principles, thereby aiding in the identification of additional potential loop-closing activities and, consequently, further contributing to the reduction of the environmental impact of plastic packaging waste.

The general framework, illustrated in Figure 12, maps and emphasizes the interconnections of the initiatives.

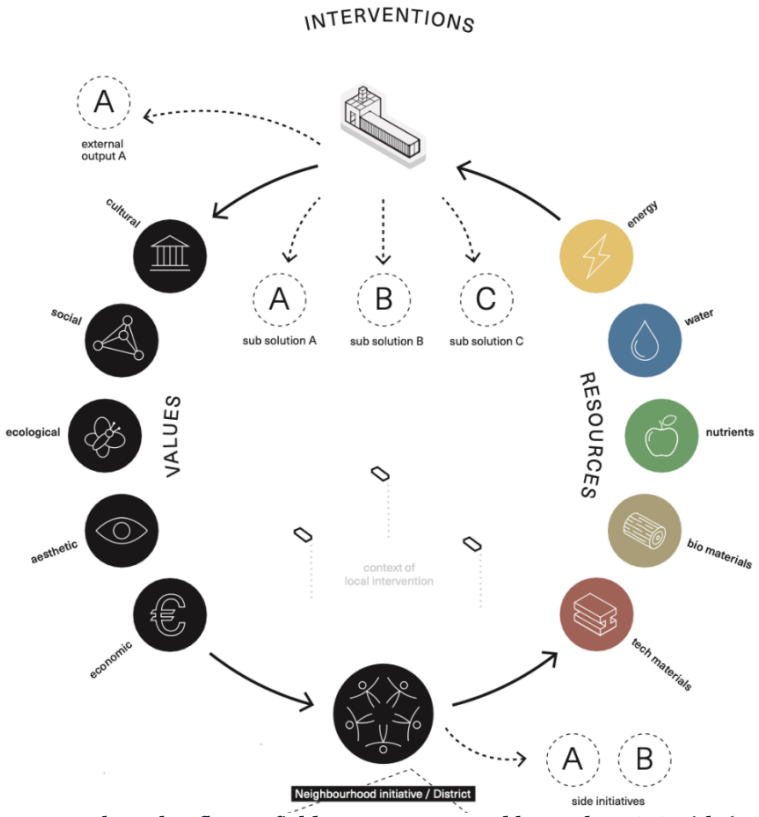

Figure 12. The value flower field map as proposed by Leclerq & Smith (2023)

The CVF method, as proposed by Leclercq & Smit (2023), involves three distinct stages. First is the recruitment of participants and the customization of the CVF layers to match the initiative. Second is a collaborative analysis that includes both researchers and participants, guided by the CVF canvas. Finally, the findings are translated into visual elements and the value flower map (Martellotto, 2023). The CVF was initially designed to explore potential activities to close the loop and enable multiple value creation at the neighborhood and district levels in Rotterdam, Netherlands (Leclercq & Smit, 2023). However, for the present study, several adaptations were necessary to apply the CVF in the context of Buenaventura, Colombia.

Due to the varied locations of the experts identified through grey literature and academic papers, it was not feasible to organize a collaborative workshop with all stakeholders present. Furthermore, Buenaventura is classified as a red zone by the Dutch Foreign Affairs Ministry, which prohibits travel to the city (Ministerie van Buitenlandse Zaken, 2023). Additionally, the educational level, background, and daily activities of the

initiative's participants suggested that they might not have the necessary tools or time to participate in a lengthy online workshop.

Consequently, the proposed workshop setup was modified to gather the required information through interviews and an adapted version of the workshop. The following sections describe the process undertaken for both approaches.

3.1. Data Collection

As mentioned above, the CVF method served as the guiding principle for the present study, both in the interviews and the workshop. Given the nature of the study, the entire research process was submitted to, verified by, and approved by the Ethics Committee of Delft Technical University to ensure there were no risks and to safeguard the participants.

In both cases, informed consent forms were sent in advance to all participants to inform them of the nature of the study, the methodology followed, the duration, the steps taken to ensure privacy and confidentiality, as well as the contact details of the main researcher in case further clarification was required (University of Connecticut, 2023). All the consent forms were signed, and the English versions are available in Appendix 3: Interview Consent Form and Appendix 4: Workshop Consent Form.

3.1.1. Interviews

Interviews are the most popular method of data collection for case research as they provide a personalized approach in which the interviewer works directly with the respondent to ask questions and record responses. This method allows for clarification of issues as well as asking follow-up or probing questions (Bhattacherjee, 2012). For the present study, semi-structured interviews were chosen due to the flexibility they offer in dropping or changing questions that fail to connect with the interviewee, ensuring the required information is obtained (DiCicco-Bloom & Crabtree, 2006).

To collect data using interviews, a five-step process was undertaken: stakeholder mapping to select relevant interviewees, preparation of the interview guidelines, recruitment of the participants, conducting the interviews, and preparation of the interview data for analysis. Each of these steps will be described below.

3.1.1.1. Interviewee Selection

As section 2.2.2 points out, the recycling value chain in Colombia is composed of different actors. Including stakeholders from each link of the value chain was considered of utmost importance to ensure balance in the data collected, reduce bias, and provide an accurate description and understanding of the system within the peculiarities of the context in which the initiative takes place. Further actor mapping of those directly involved in the initiative (see section 2.4.2) allowed for determining the scope of the interviewed participants.

To answer the research questions, a diverse group of actors with different knowledge systems and areas of expertise was included. Through gaps identified within the literature review and background research, the profile of the interviewees was determined, and an initial pool of candidates was drafted.

Considering that time availability and willingness to participate are inherent limitations in every study, there was no fixed number of interviewees. Instead, an ample selection was made to account for possible reduced responses.

3.1.1.2. Preparation of interview guidelines

Given the diverse backgrounds of the stakeholders mapped, flexible interview guidelines were created. These guidelines aimed to fill data and knowledge gaps, as well as to ensure a clear understanding of the system while considering the stakeholders' different areas of expertise.

The selection of questions was based on the CVF principles, with the environmental aspect guided by the Ecosystem-Based Adaptation (EbA) questionnaire developed by UNEP and IUCN (Reid et al., 2017). Thus, the questions were designed to gain a deep understanding of the four main components determined by the CVF as valuable for mapping a community-led circular initiative: community ambitions and activating capital, collaboration and process methods, physical developments, and values.

Finally, the questions and guidelines needed to allow for a certain level of debate and openness as proposed by the CVF. This meant that the guidelines could not be too rigid or structured but rather serve as a common thread to cover the necessary topics. As a result, the final interview guidelines were reviewed and adjusted after each interview based on interactions with the interviewees. The final version of the interview guidelines can be found in Appendix 1: Interview Guides.

3.1.1.3. Recruitment of participants

The recruitment of participants aimed to balance the time constraints of the study with an accurate and full representation of the system. The recruitment process was conducted through personalized emails sent to the mapped stakeholders mentioned above. The email included an overview of the research, its purpose, and a question to redirect in case they were unable to participate. Through this mapping and referral process, all participants were successfully recruited.

3.1.1.4. The interview itself

A total of 10 interviews were conducted by the end of the data collection process. The interviews were planned to last approximately one hour, although the length varied from 45 minutes to 1 hour and 15 minutes. All interviews were conducted in Spanish, as it was the native language of both the interviewees and myself. Codes were assigned to each interviewee to ensure privacy and confidentiality while allowing for clustering of insights and comparison during the analysis, as well as correctly mapping within the CVF the perspectives of the different stakeholders considered. Table 1 includes the description and codes of the interviewees, as well as the number of interviewees per established category, while Figure 13 positions them in the context of the initiative.

Table 1. Interviewed actors' description

Code	Stakeholder Type	Background	Role	Number of interviewees
Type I	Transformer	Industry	Founder	1

Type 2	External Expert	Academia	Researchers	3
Type 3	External Expert	Foundations	Project Coordinators	2
Type 4	Collectors	Industry (ECA)	Founder	2
Type 5	Generators	Industry	Environmental and sustainability specialists	2

The interviews were carried out either online, using Microsoft Teams or Zoom, as preferred by the interviewee, or in person. In both cases, the interviews were recorded and transcribed using the software's voice-to-text functionality.

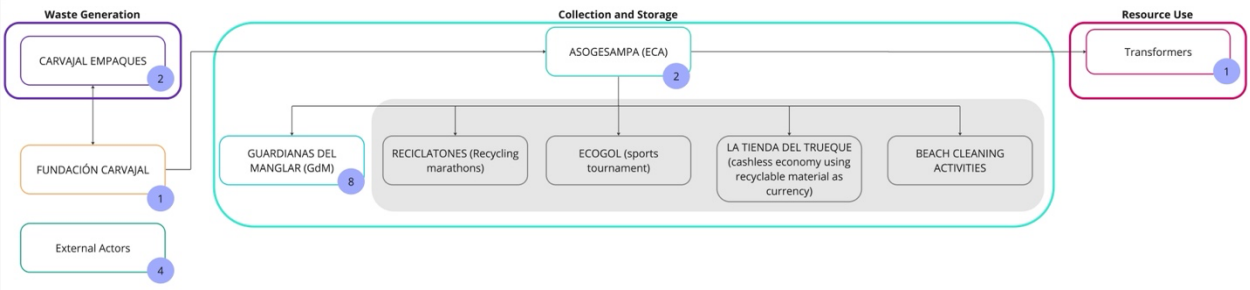

Figure 13. Overview of the interviews in the context of the initiative

When the interview was recorded using the recording app on a smartphone, it was done in airplane mode to avoid storing the data in the cloud. The recordings were then transferred to the university's OneDrive for secure storage. Afterwards, they were deleted from the app and the phone. For the online interviews, the recording was set to expire as soon as the transcription was completed.

3.1.1.5. Preparation of the interviews for data analysis

After conducting the interviews, the recorded audio was compared to the transcript generated by the meeting software used. The transcripts were carefully checked and corrected against the recordings and then translated into English. During this process, all information that could identify the interviewee was removed to ensure anonymization. Subsequently, the recordings were deleted to further protect the participants' identities.

The final transcripts were analysed using content analysis, with Atlas.ti serving as the primary software for this step. The detailed process of this analysis will be explained in section 3.2.

3.1.2. Workshop

As the interviews were the primary method for gathering information from experts and formal actors in the recycling value chain, the workshop was developed to gather insights from the GdM, the informal waste collectors.

A workshop is defined as "a meeting in which a group of people learn, acquire new knowledge, perform creative problem-solving, or innovate in relation to a domain-specific issue" (Ørngreen & Levinsen, 2017). The main purpose of the workshop was to learn from the GdM participants and conduct a participatory brainstorming exercise to

understand the multiple value creation that the initiative enhances, as suggested by Leclercq & Smit (2023). Participatory impact assessment has identified that it is imperative to include local communities in impact measurement, as they are central to measuring indicators and the outcomes of initiatives (Miller et al., 2020).

3.1.2.1. Preparation of workshop guidelines and participants recruitment

For the GdM participants, the foundation's team based in Buenaventura assisted in setting up the workshop space. They highlighted the time constraints faced by the participants due to their demanding fishing activities. During the data collection period, what they traditionally call "good" water was occurring, meaning they were fishing for mollusks every day. Additionally, the presence of gangs in the city created invisible barriers (Valencia & Sinisterra-Ossa, 2019), requiring careful planning to ensure participant safety, appropriate workshop duration, and suitable locations.

The primary consideration when designing the workshop was the time restrictions due to these factors and the local team's constraints. After careful consideration, the local team set a date, time, and central location to assist with setup and logistics. Given the limited timeframe, the entire CVF workshop as suggested by Leclercq could not be conducted. Instead, the focus was on gathering information about the specific activities they conduct, their perceived relationship with the community, neighborhood, and space, and the values generated by the initiative.

The workshop had three phases, each targeting different information. The first phase covered their day-to-day activities: what they do, how they do it, and why they do it (activating capital, process methods, physical developments). The second phase explored their relationship with their space, community, and networks (community ambitions and collaboration). The final phase focused on mapping the different values identified.

After finalizing the workshop guidelines (see Appendix 2: Workshop Guidelines), the local team contacted the GdM and invited them to participate.

3.1.2.2. The workshop itself

Considering the travel restrictions, the workshop was conducted in a hybrid mode with the local team on-site. Eight participants attended the entire workshop, which lasted for 2.5 hours, including planned breaks.

The workshop was conducted in Spanish and recorded using Microsoft Teams. As with the interviews, the recording was set to expire and was deleted from the University's SharePoint once the transcription was finished.

3.1.2.3. Preparation of the workshop for data analysis

After the workshop, and just like the interviews, the recorded audio was compared to the transcript generated by the meeting software used. There was also a correction against the recordings and further translation into English. Again, all information that could identify the participants was removed to ensure anonymization. Subsequently, the recording was deleted to further protect the participants' identities.

The final transcript was also analysed using content analysis using Atlas.ti. The detailed process of this analysis will be explained in the following section.

3.2. Content Analysis

Content Analysis is a systematic way to derive meaning from qualitative material (Schreier, 2012). It is a widely used tool as it can be applied to a wide range of data sources and formats and is particularly helpful when there are rich data sources that require interpretation (Schreier, 2012).

Content Analysis (QCA) links codes to portions of the data to classify and group it, thereby identifying concepts related to the researcher's interest (Bhattacherjee, 2012). There are many different coding methods and processes depending on the interest and the nature of the information that one wishes to extract from the data (Saldaña, 2016). This study employs both deductive and inductive approaches to the coding process. The former involves defining concept-driven categories from theory and using them to construct the coding frame prior to the coding process (Schreier, 2012). The latter involves determining coding categories and structures as the researcher codes the data (Saldaña, 2016).

The deductive approach used the CVF principles and structure to define a primary baseline for the coding frame, extracting from the data the information related to the construction of the CVF for the studied initiative. The inductive approach was used to complement the set coding frame, allowing for additional categories to be added and acknowledging an open approach as a deeper understanding of the system was gathered. Nevertheless, it is worth noting that both the inductive and deductive approaches follow the CVF narrative, aiming to search and find the multiple value creation instances and examples throughout the different levels and the different actors involved in the initiative and the data collection method.

The mixed approach implies that the coding process is iterative, with first-cycle coding used to classify the information into the prescribed CVF categories and subsequent coding cycles used to refine the codes and categories. Finally, complying with the recommendations of Bazeley (n.d.), the coding groups were kept to a minimum to avoid losing perspective and having disorganized categories that did not add to the analysis phase, as well as having issues in accurately using them and classifying the information, and the recommendations of Saldaña (2016) that suggest not going overboard with unique codes in a project of moderate complexity. The total number of unique codes for this study amounts to 109. The complete table can be found in Appendix 5: Complete Codebook (Table 3).

Table 2 includes the code categories and subcategories derived from the content analysis phase. Finally, complying with the recommendations of Bazeley (n.d.), the coding groups were kept to a minimum to avoid losing perspective and having disorganized categories that did not add to the analysis phase, as well as having issues in accurately using them and classifying the information, and the recommendations of Saldaña (2016) that suggest not going overboard with unique codes in a project of moderate complexity. The total number of unique codes for this study amounts to 109. The complete table can be found in Appendix 5: Complete Codebook (Table 3).

Table 2. Coding frame used during content analysis.

Group Number	Code group	Code Categories
1	Understanding the system	Waste management practices (official)
		Waste management practices (unofficial)
		Actors and roles
		GdM Activities (fishing)
		GdM Activities (recycling)
		Spaces
		Plastic Pollution
		Social context
2	Barriers	Pertaining the Supply Chain
		Pertaining gubernmental actions
		Pertaining the social sphere
		Pertaining the market
3	Opportunities	Pertaining the market
		Pertaning the Supply Chain
		Pertaining gubernmental actions
		Pertaining the social sphere
		Pertaining the mangrove
4	Enabling Capital	Environmental Responsibility
		Social Responsibility
		GdM Motivation
		Aspirations
5	Values	Aesthetic
		Cultural
		Economic
		Social
		Environmental

Code families 1, 4 and 5 correspond to the CVF method, including the process method, community ambitions, physical developments and values, related to subresearch questions 2, 3, and 4 (See section 1.3). Code families 1, 2 and 3, are focused on subresearch question 1 that aims to understand the system, the barriers and opportunities related to it.

4. Findings

4.1. Opportunities and limitations in closing the loop

To gain insight into the waste management challenges addressed by the case study, a simplified diagram illustrating the flows of solid waste is provided in Figure 14. These flows are based on data published by the National Department of Statistics for the district of Buenaventura (DANE, 2021), as well as monthly collection reports from the GdM initiative (Diario El Pais, 2023). The diagram, modeled after what ten Brink et al. (2018) reported (Figure 3), aligns with the aim of the study by focusing primarily on the consumption and disposal of waste, excluding the production and transformation of plastic in various sectors and retail activities.

The section in gray represents the input of material and its subsequent transformation into products and services, which are then sold and consumed by the population in the district of Buenaventura. After the products reach the end of their lifespan, their disposal can occur either through official or unofficial means. Official means include disposal in the official landfill by the local waste management provider and/or recycling through informal waste pickers and the recycling value chain (in the figure represented by the box "informal waste pickers"), as described in section 2.2.2. Unofficial waste disposal primarily occurs in areas not covered by local waste management services. Informal disposal methods include dropping waste directly into water bodies, dumping in illegal landfills, burning waste at home or on beaches, and burying waste.

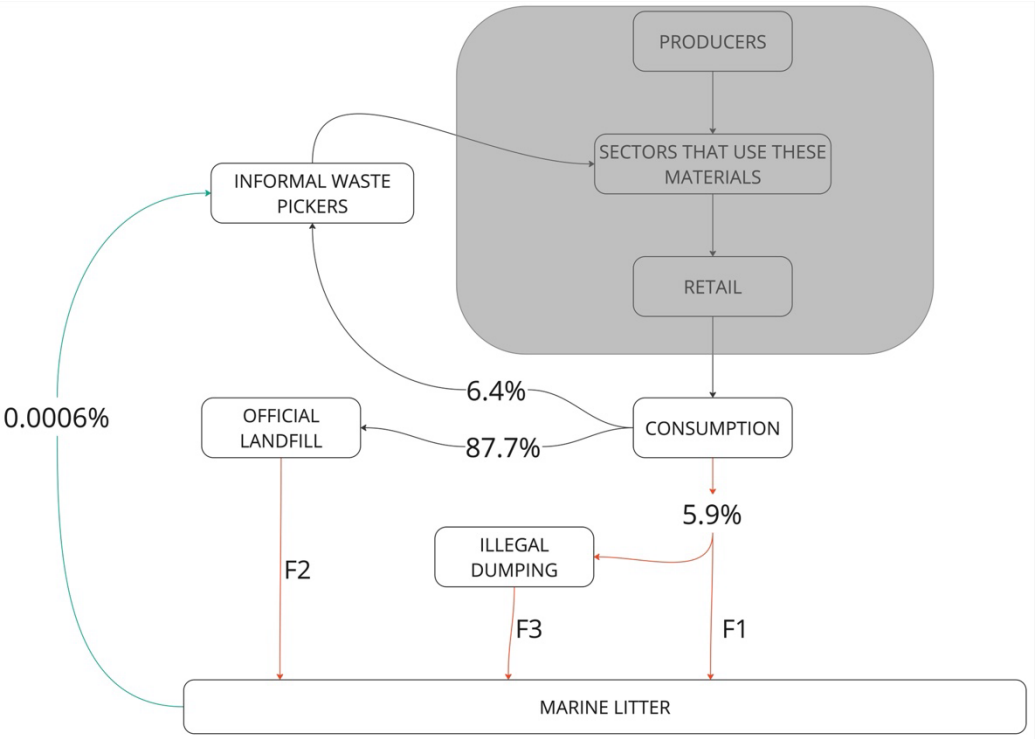

Figure 14. Simplified Percentages of Mass Flows of solid waste in the district of Buenaventura.

The primary uncertainties revolve around the pathways through which litter enters the marine environment. This may occur through direct disposal (flow 1), escape from the regional official landfill (flow 2), or illegal dumping sites (flow 3).

While GdM focuses on cleaning waste reaching coastal ecosystems (including beaches, estuaries and mangroves), existing literature highlights the significance of source segregation to maximize waste valorization potential. Nevertheless, flows 1 to 3 underscore the critical role of strategies focused on the consumption stage in reducing overall waste reaching marine environments (and terrestrial environments, considering land-based illegal dumping sites).

Furthermore, although GdM collects approximately 4 tons of material per month, Figure 14 implies that 100% of the collected material can be reintroduced into the system. As the research indicates (refer to What happens next?), most of the collected material cannot be reintroduced into the system and is subsequently transported to the official landfill.

During the workshop, special attention was brought to the expected difference between collected material and recyclable material. Initially, participants responded that when they started, they took material that could not be sold to the waste collection point so that it could be landfilled. However, nowadays most of the material can still be collected and sold, as their experience allows them to differentiate the material that cannot be recycled. They mentioned that non-recyclable material is usually "toasted," so once they pick it up, it breaks into small pieces, making manual collection very hard and time-consuming. Thus, GdM are aware of the material that cannot be recycled and that it is left in the ecosystem.

However, ASOGESAMPA mentions that when they conduct sensitization activities like beach cleanings, they clean the entire beach of both recyclable and non-recyclable material and ensure the correct disposal of the non-recyclable material. This further educates the participants on the importance of recycling and correctly managing waste at home, while also showcasing the effect of degraded material and the loss of potentially recyclable material.

The following sections describe the main identified opportunities and barriers of the system.

4.1.1. Opportunities to close the loop

The main opportunities identified can be divided into three broad categories: social, technical, and regulatory. An overview can be found in Figure 15.

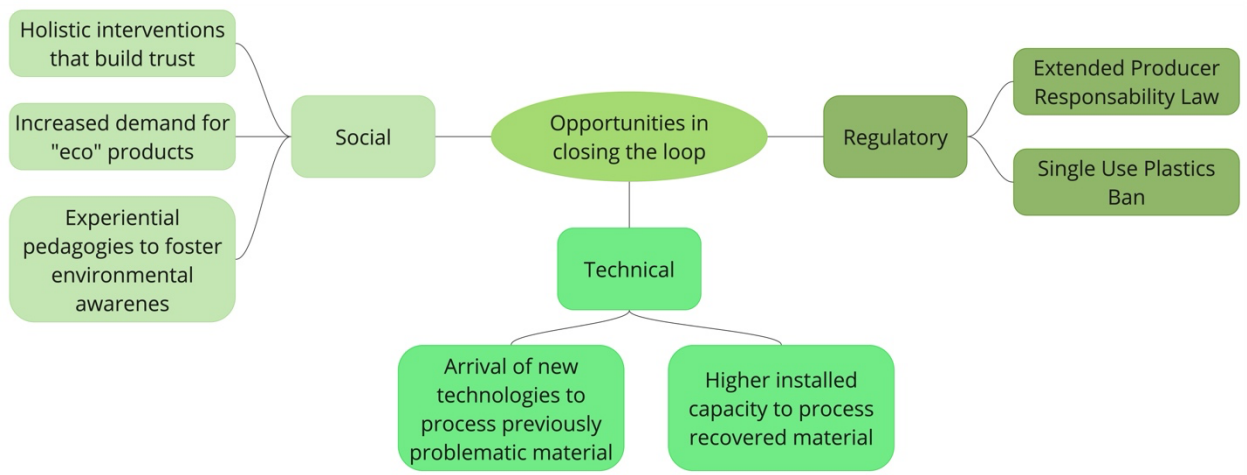

Figure 15. Overview of the opportunities in closing the loop.

Companies like Organización Carvajal are working to solidify and demystify the perception of informal waste pickers in the region, paving the way for a promising start. By combining the need to comply with regulations with a long-lasting social impact, they help bridge the gap between informal waste collectors and the industrial sector. Their social responsibility strategy and circular economy strategy are interlinked. Recognizing that informal waste pickers are often vulnerable populations with low incomes, they aim to comply with Extended Producer Responsibility (EPR) laws while adding a social strengthening and empowerment dimension. Some interventions, such as GdM, adopt a holistic approach that includes health brigades, workshops, information on higher education options for their children, and donations. These interventions, led by Fundación Carvajal, build trust with the communities, which Organización Carvajal recognizes as fundamental for developing successful initiatives.

In terms of regulation, the EPR law (refer to section 2.2.3) not only requires the collection and certification of tons of transformed material but also mandates extending the collection to areas outside the major urban centers of the country. The original resolution from 2018 does not include Buenaventura in the mandatory territories. However, this geographical component opens up the discussion on the importance of ensuring proper waste management services in areas outside urban centers. Furthermore, the yearly increase in material certification can make smaller cities such as Buenaventura attractive for companies aiming to comply with the EPR law.

Another significant regulatory step toward facilitating closing the loop is Law 2232 of 2022, which bans and regulates single-use plastics (SUIN, 2022). Since most single-use plastics cannot be processed in mechanical recycling facilities, such regulations drive the development of new materials that can replace single-use plastics considering end-of-life management of the product.

During this research project, Carvajal, in alliance with several other companies, launched an initiative called “The Chemistry of Recycling.” This initiative involves recovering material that cannot typically be recycled through mechanical methods and using chemical recycling to convert it into pyrolytic oil, which can be further processed and used

as raw material for new products (Gomez, 2024). Thus, the development of new technologies and the increase in the installed capacity of industries to transform material into new products is one of the biggest opportunities for increasing the recycling rate in the system.

Additionally, an increased demand for conscious products and products made of recycled materials opens the door to raising citizen awareness and increasing recycling in households. Small national businesses like BohioPlaya, Kowu and Paréntesis convert recycled PET into clothing. Pachas uses discarded tires to make shoe soles, and The Loop Concept transforms recycled plastics into unique furniture. This increased awareness also allows for new business models to emerge. For instance, Plastico Precioso Uramba offers an environmentally conscious tourism model that includes recycling workshops, whale watching, and ecosystem cleaning activities in Ladrilleros, part of the district of Buenaventura.

ASOGESAMPA carries out several initiatives aimed at tackling consumption bottlenecks in different areas of the population. These include “La Tienda del Trueque,” which exchanges basic necessities for recyclable material; “EcoGol,” which organizes football tournaments in vulnerable areas where registration, uniforms, and penalties are all paid with a fixed amount of recycled materials; and the beach cleanings previously mentioned.

These opportunities have a direct impact on the GdM initiative. On the one hand, the GdM also act as local leaders in recycling, conducting sensitization efforts in their neighborhoods. They report that their neighbors ask questions about recycling and start leaving recyclable materials at their doorsteps for collection. Overall, these activities and conscious steps increase district-wide awareness and facilitate the job of informal waste collectors, who receive correctly segregated and clean material that can be taken to the ECAs. On the other hand, the technical and regulatory aspects described above have a direct impact on the support that the initiative attracts. The technical improvements mean that the GdM can diversify and collect more types of material in a wider variety of states, which increases the total amount of material they take to the ECAs and their remuneration. The regulatory aspects increase the attention to the initiative and the interest of a wider variety of stakeholders covered by the regulation, which can translate to higher support for the activities of the GdM and the strengthening of the initiative.

4.1.2. Barriers in the system

The barriers identified can be divided into five categories: related to the district, volume, barriers within the transformation and the recycling of collected material, lack of environmental education and discrimination, and price. An overview can be found in Figure 16.

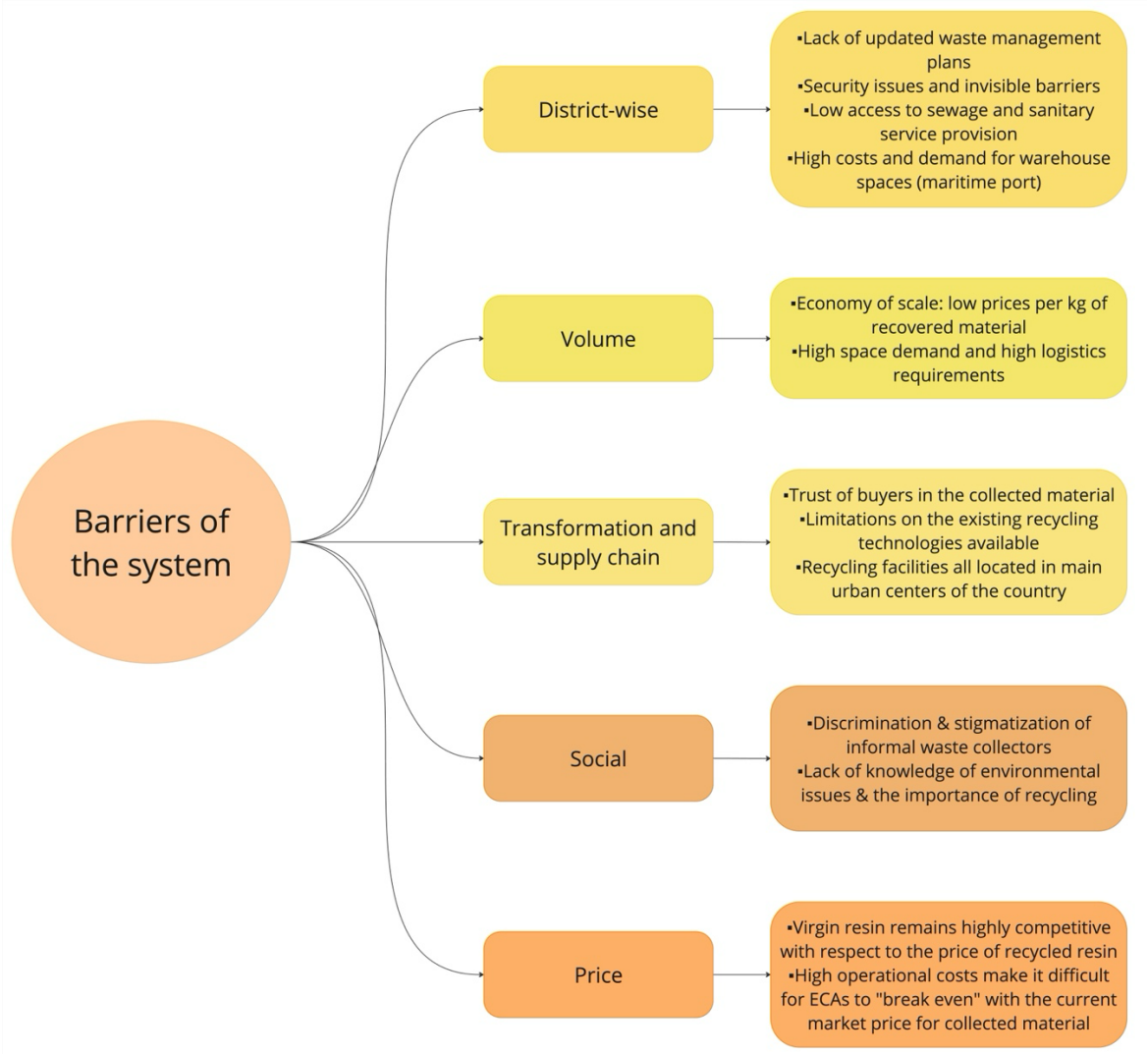

Figure 16. Overview of the barriers in the system.

In the district

Firstly, there is a lack of updated waste management plans. For instance, the Integral Management Plan for Solid Waste (PGIRS) has not been updated since 2014 and does not include areas with low communication and difficult access, particularly coastal regions. Some experts reported attending meetings to discuss the PGIRS, opening the discussion to include several actors who understand the local realities of the waste management system. This hopefully translates into a more realistic and inclusive management plan, which, at the time of this research project, had yet to be updated.

Also, Law 70 of 1993 decrees that the afrocolombian communities of the pacific coast that have traditionally occupied need to be recognized and involved in all projects that might be developed in their territories (Congreso de Colombia, 1993). Therefore, the participation and engagement of local councils are essential to strengthen the interaction between consumers and informal waste pickers, increase the amount of recyclable material that reaches them, and prevent diversion into alternative waste disposal methods. Considering the security issues and invisible barriers in Buenaventura (Valencia

& Sinisterra-Ossa, 2019), reaching local councils and establishing a trusting relationship with them can be difficult. This hinders the access of informal waste pickers into neighborhoods and, without sensitization, results in receiving material that has not been correctly separated.

Furthermore, the “palafitos” (houses built above the sea) cannot be accessed by waste trucks, so they are not covered by the formal waste management company of the district, this causes the communities living in this types of houses to either burn or throw into the ocean the waste they produce. Thus the local waste management service does not cover the entire population of the city, much less the district. And most of these “palafitos” do not have access to sewage and other santary infrastructure with some having to walk several blocks to the closest place where the waste truck collects waste further reinforcing the need to burn or throw the waste.

Additionally, there is a lack of infrastructure for the ECAs. For them to be functional, they require warehouse space, and in Buenaventura, as a port city, these spaces are expensive. Since recycling requires an economy of scale to "break even," this poses a limitation for the logistics of the value chain and creates bottlenecks. The limited space hinders the processing of a higher quantity of material, which needs to be further separated, compacted, and stored until there is enough to be taken to the respective transformer. This process also requires operational costs of the active members of the association as well as a constant cash flow to pay the occassional sellers (such as the GdM) once the material is weighted. All of this expenses imply cost increases along the value chain, making the collected material unable to compete with virgin resin.

Volume

The main barrier for recyclable material is its volume. The recycling chain depends on the quantities collected, which are weighed at the time of delivery, and their value is defined by kilogram. However, many recyclable materials, like plastic, have a very low weight, requiring large quantities to generate a decent income for informal recyclers. For this reason, informal recyclers prefer heavier materials (like scrap metal) and/or those with higher prices. This causes a disproportion in material recovery, allowing potentially recyclable materials to leak into the environment or be disposed of traditionally, where they cannot be recovered.

Volume also generates logistical problems. Firstly, storage is needed to keep the material until enough quantity is gathered to be transported or sold to a client who will process it. Although materials are separated and compacted in ECAs, the space demand remains high. Additionally, transportation costs increase if there are no nearby processing plants. ASOGESAMPA mentions transporting materials to urban centers like Cali or Medellín, where large quantities of material must be collected because trucks charge by the vehicle's tonnage, not by the material's weight. This increases the pressure on the capacity to collect, separate, and process large volumes of a single material to ensure delivery without an exponential increase in logistical costs. According to De Man (2023), collecting all recyclable materials implies a significant increase in transportation and handling costs, often ignored in discussions about the circular economy.

Transformation and Recycling of Collected Material

Another barrier is the trust of buyers in the received material. There is a kind of "discrimination" as they demand that the material be separated, clean, compacted, and in good condition. Material collected from the environment, such as in mangroves and beaches, may be degraded and rejected by recycling facilities. Without a secure buyer, it is difficult to sustain the business, limiting collection to materials with assured sale to cover operational costs. This adds to the inherent difficulties of the complex supply chain, where several interviewees recognize the difficulty of ensuring the arrival of a certain amount of material within a timeframe due to the high informality of recyclers, as well as managing all recyclable materials.

Despite new technologies that expand the spectrum of recyclable materials, they also present limitations (for example, chemical recycling does not process PVC), impacting the amount of material that can be collected.

Moreover, these circumstances hinder the stability of customers, as processing industries in urban centers receive materials from all over the country. With limited processing capacity, material may not be received or may be bought at a lower price, creating difficulties for the ECAs. Although the issue of price will be discussed later, it is important to mention that ECAs in remote areas have a competitive disadvantage compared to those in urban centers due to logistical costs, making their material inherently more expensive than that collected in areas close to processing industries.

Lack of environmental education and Discrimination

The most notable social barriers in Buenaventura's recycling system include the lack of environmental education, as well as discrimination against waste managers, such as informal recyclers.

Firstly, several participants mentioned the negative attitudes of people when they see them recycling. Discrimination and stigmatization of professional recyclers are common in both the Global North (Porras Bulla et al., 2021) and South (Gómez-Maldonado et al., 2023; Maldonado, 2019). Although most participants mention that the attitude of their neighbors has changed, many still face difficulties in performing their work due to the rejection from some individuals.

On the other hand, the lack of knowledge about environmental issues is evident in the stories of the guardians, who state that before ASOGESAMPA approached them with the proposal to recycle, they were unaware of the potential for resource recovery from waste or the negative consequences of disposing of it in the ocean or burning it. This lack of knowledge is also observed in their neighbors and the surprise of people who attend ASOGESAMPA's training and awareness activities, realizing the negative implications of improper solid waste management for the environment.

Since a considerable fraction of the waste generated in Buenaventura comes from the domestic sector, the aforementioned barriers hinder the collection of post-consumer material in the city, creating bottlenecks in the collection activity when segregated material is not found. This decreases collection efficiency by requiring additional

separation steps for the recycler and limits recycling potential to families that conduct the process, significantly reducing the amount of material that can be accessed.

Price

The previous barriers converge on the price of the kilogram of recycled material, generating two main and related problems. First, the prices of virgin plastic resins depend on oil prices, which have decreased in recent years. This makes virgin resin cheaper than recycled resin. For example, in the United States, the price of virgin PET is $943 per ton, while recycled PET costs around $1,631 per ton (Ambiente Plastico, 2024). This 73% increase in costs cannot be passed on to consumers by producers without losing market competitiveness. This situation makes it difficult to maintain a constant demand for recycled resins, increasing the intermittency in transformation and, therefore, the uncertainty for the ECAs in securing constant customers for the sale of collected material.

Additionally, the operational costs of the ECAs are high. According to Buenaventura's 2014 PGIRS, the purchase price of a kilogram of plastic was 0.11 euros (Alcaldía Distrital de Buenaventura, 2014). In 2020, the newspaper La República reported a value of 0.17 euros per kilogram (Rodríguez, 2022). Using this latter value as a reference, and considering that a truck with a capacity of 5.5 tons makes a weekly trip from Buenaventura to Cali to deliver material to a processor, it would be necessary to collect 22 tons of material per month, which would be paid to recyclers at 3,774[1] euros. To this, transportation costs (1,500 euros) must be added (Ministerio de Transporte, 2014), as well as the rental of the warehouse where the material is stored (1,405 euros) (Finca Raiz, 2024), and the fixed costs for the ECA staff (1,216 euros) (Domínguez Coral, 2024), totaling approximately 8,000 euros in fixed costs. This would mean that the ECA would need to sell the kilogram of material at 0.36 euros (111% more expensive than what it was bought from the recycler) to break even. Furthermore, since the 133 guardians collect 4 tons of material per month, four times more recyclers would be needed to reach the necessary monthly volume. These costs reinforce the high value of recycled material and reduce its competitiveness compared to virgin resin. This difference is even more notable with materials such as glass (0.03 euros per kilogram) or cardboard (0.086 euros per kilogram) (Rodríguez, 2022).

It is important to clarify that this exercise does not include all costs or materials, and the values used are approximate. Although they do not fully reflect the reality of the ECAs' operation, they provide an idea of the implications of current prices in the recycling value chain.

4.2. Values identified

Throughout the following sections, the different values created and enhanced by the initiative, as proposed by Leclercq & Smit (2023), will be explored. Figure 17 provides an overview of the main takeaways from the workshop conducted with the GdM participants, serving as the primary source of information on local multiple value creation, as experienced by the main actors of the initiative.

[1] All the prices use the exchange rate 1EURO = 4273 COP.

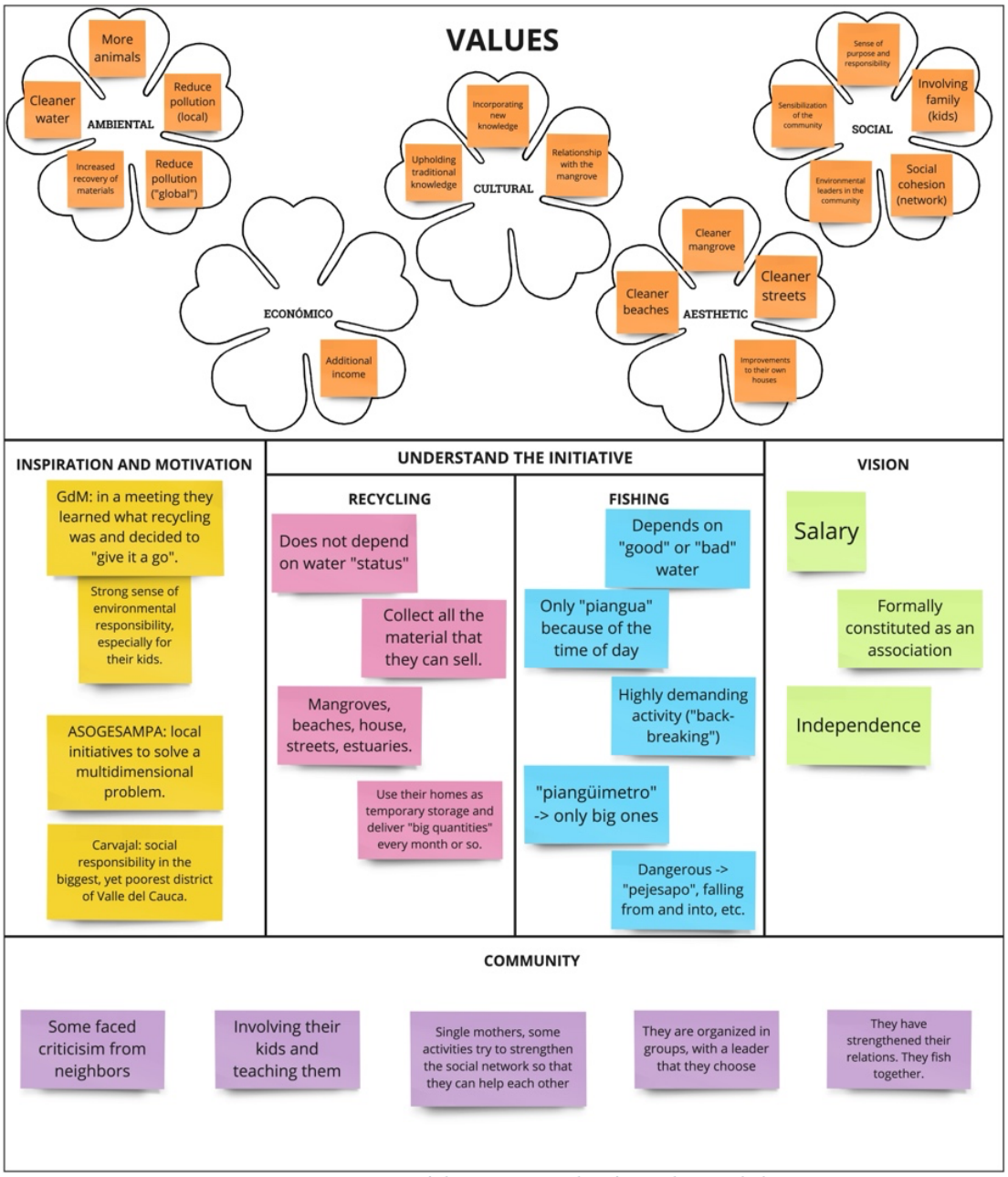

Figure 17. Overview of the main insights from the workshop.

4.2.1. Social Value

The initiative boasts a high social impact, as perceived by both the participants and the interviewees. First and foremost, the strengthening of the social network is recognized by the GdM as well as multiple interviewees. The GdM mention their interactions while conducting both fishing and recycling activities, which are traditionally group activities, and getting to know each other through the different activities and workshops in which they participate. This is also strengthened by the way the participants are organized, which consists of groups of women that live close by and choose a leader who directly communicates with ASOGESAMPA. This means that the smaller groups need to be in close connection to effectively comply with the goals they have in terms of volume of

material collected. Roca-Servat and Cifuentes, in their investigation of the amphibious culture of Bahia Malaga, mention the mangroves and the activities conducted within as a "permanent channel of communication and connection" (roca-Servat & Cifuentes, 2020).

Furthermore, the workshops and activities carried out by Fundación Carvajal aim to help foster this connection so that the social network extends beyond the activities in the mangrove and enables them to rely on each other. As most of their families rely solely on their work as the main income, the solidarity of the group is fundamental. Roca-Servat and Cifuentes again mention the amphibious culture of Bahia Malaga and the activities conducted by the women, comprising a social gear based on the group (or community), their camaraderie, and the commons comprising the ecosystems on which their living depends (roca-Servat & Cifuentes, 2020).

Connected to the above, the strengthening of family ties through the teaching and involvement of their children in their activities acts as a way to connect with them. Most of the GdM mention the environmental awareness of their children and their commitment at kindergarten or school to bring material back from their snacks and lunch bags so that it can be adequately recycled. Beyond the time spent with their children, the influence of family in developing behaviors that enable recycling is clear (Fabris et al., 2010). Furthermore, Fabris et al. (2010) also mention the positive correlation they found between the behavior of peers and their positive influence on recycling behaviors, which in turn might translate into a broader impact in the context of children at school influencing their peers to develop more environmentally-conscious behaviors.

Additionally, their desire to constitute themselves into a formal association with a legal constitution and their own governance bodies demonstrates that they recognize the value of the group and have a long-term vision for their activities. This is supported by several studies that show cooperative participation is fundamental for increased income (Angermayr et al., 2023) and sustaining the initiative over time (Miller et al., 2020).

Another value recognized is their becoming environmental leaders in their neighborhoods and acting as anchors for changing the behaviors of their neighbors. The GdM are adamant in expressing the difficulties that arose with their neighbors and the general population when they started picking recyclable materials. Although some of them mention how at the beginning they were questioned about their recycling, and now they are referents, being called when neighbors have material that can be recycled and even having bags of material left at their doorstep, others continue to express their disappointment with the way some people treat them once they realize they are "waste picking." Unfortunately, this is not an isolated case. The literature review conducted by Morais et al. (2022) showcases that more than half the studies include stigma, poverty, and vulnerability as themes related to informal waste pickers around the world. Despite these differences in the participants' perception of how they are viewed by neighbors and residents, most agree on their empowerment and the clear motivation for why they are recycling as a powerful tool to garner the attention of their neighbors and influence them to adopt recycling practices.

Additionally, access to education in the form of workshops and activities, as well as knowledge of the different educational offers of the institutions in the district, fosters capacity building. The GdM mention the importance of the information they receive from the different institutions. For instance, the fact that they attended training on the fishing limitations of the piangua and now strive to fish only those that reach a certain size shows their openness to receive new knowledge and their desire to do things in the best manner possible. Last year, some of the activities involved showing the offspring of the GdM the different higher education opportunities available in the district. The interviewees mention that two kids who graduated from high school last year are already enrolled in higher education. This dimension of the social value of the initiative catalyzes change and opens the door for better future prospects.

Finally, some interviewees mention the sense of purpose and motivation given to the participants, as well as the opportunity to have an additional income in a vulnerable population. Usually, the formal job market excludes vulnerable communities, and through these sorts of initiatives, they can earn their daily living. Combined with the empowerment, the motivation and the job create a sense of purpose and a desire for betterment.

4.2.2. Economic Value

The added income from selling the collected material stands out as the main economic value generated by the initiative. This, coupled with the workshops on financial matters and the increased experience and dexterity of the GdMs in selecting recyclable materials, enhances the amount of money they can earn from the collection activities.

The GdM members express their aspiration for a stable salary, rather than relying on day-to-day earnings. Although they strongly recognize the importance of recycling for environmental purposes, they acknowledge that the economic aspect is fundamental for their sustenance. Further development of business models that formalize informal waste pickers like the GdMs is crucial to ensure they have a stable monthly income and to strengthen the economic value of the initiative for the GdM.

It is worth noting that the price difference between various materials creates a clash between the environmental and economic aspects of the initiative. The GdM tends to prioritize materials with a higher price per kilogram or higher weight per unit to compensate for lower prices. Since they reach the mangrove in groups using canoes and return with both recycled materials and mollusks, and considering that recycled materials occupy a lot of space, they prioritize materials accordingly. Consequently, some materials are left in the environment because they cannot be sold for various reasons.

Recognizing this disparity in material collection, the EPR law requires compliance for every material reported, so companies offer incentives to boost the collection of less attractive materials in terms of price per kilogram. However, this incentive is sporadic, leading to “seasons” where the demand for certain materials is higher than others.

4.2.3. Environmental Value

The environmental values recognized by the GdM can be divided into four main groups. Firstly, they report an increased presence of animals, both due to the cleaner mangrove and the use of tools provided by the environmental authorities to control the size of the mollusks that are fished. The GdM mention they expect higher populations of mollusks and that they make a conscious effort to abide by the regulations of collecting only individuals of a certain size (thus ensuring that most of the population reaches reproductive maturity (Delgado et al., 2010)), knowing that the next month they will come back to the mangrove to find it replenished and with a good quantity of "pianguas."

Secondly, they mentioned cleaner water. The GdM noted the effects on water quality due to the reduction of pollution in the mangrove. In addition, they understand the broader implications of pianguas inhabiting this environment, recognizing the potential health impact of consuming such animals when they live in polluted water.

Thirdly, they consider there has been a reduction in the pollution of marine ecosystems. During the workshop, they reported that the mangrove was in better condition than when they started over five years ago. Nowadays, they collect less material from the mangrove and more from other areas such as the beaches and their own neighborhoods. Furthermore, they mentioned the interconnectedness of ecosystems, noting that while they clean the beaches, the three rivers passing through the district bring waste from distant areas that accumulates on the beach, and tides bring trash from the ocean. This means that every time they visit, the beach still has a high density of trash. Thus, they recognize that the initiative contributes to the reduction of both local and global pollution.

Lastly, they highlighted the increased recovery of materials and their transformation, while the different interviewees emphasized the importance of this initiative in reducing the pressures on the official landfill and the need for the local population to burn or dispose of their waste in illegal landfills.

In addition to these four elements, the interviewees noted the increased environmental awareness that the initiative generates, which further strengthens the motivation of the GdM members and positions them as environmental leaders in their neighborhoods. They act as anchors of good segregation and disposal practices in their immediate surroundings.

4.2.4. Aesthetic and Cultural Values

Cleaner spaces stand out as the main aesthetic value resulting from the initiative. GdM participants report seeing the mangrove in better condition in terms of trash, with them collecting less from the mangrove and more from other areas such as beaches. Although they mention that the beaches have not improved due to tides and rivers bringing in trash, it is worth noting that the interviewees mention the change in citizens' perceptions when beach cleaning activities are over and they see the beach in pristine conditions.

A second aesthetic value corresponds to improvements in the GdM participants' own homes. Some members report saving the money they earn from recycling and using it to

improve their living conditions. In both cases, this has a positive correlation with well-being, as studies support that poorly managed environments are not conducive to well-being (Tuhkanen et al., 2022).

In terms of cultural values, upholding traditional knowledge and practices from Afro-Colombian communities is driven by the initiative. GdM members mention that their relationship with the mangrove is not only to find sustenance but also to connect, reflect, and meditate, arriving home with a different mindset. They also mention singing, talking, and sharing while they are in the mangrove, as it is an activity done in groups, further passing on and maintaining their traditional songs. roca-Servat & Cifuentes (2020) calls this their traditional relationship with the mangroves and estuaries as "amphibious populations". A second value that arises from this initiative corresponds to the incorporation of new knowledge and how it is balanced with their traditional knowledge in their day-to-day activities. The new knowledge is brought by the various workshops and activities they attend, such as understanding the importance of not fishing mollusks beyond a certain size or bringing back materials that previously would not have been recycled, now that they are aware of new technologies and markets for these materials. They integrate what they learn and think towards the future while maintaining their traditions.

4.3. Circular Value Flower of GdM initiative

This section includes the full development of the Circular Value Flower criteria and the resulting infographic. Each of the components is summarized below, with the infographic included at the end.

4.3.1. Community ambitions and activating capital

The GdM initiative is one of many initiatives carried out by ASOGESAMPA to tackle the waste issues present in the district of Buenaventura. It started over five years ago with the founders of ASOGESAMPA conducting recycling workshops in the neighborhoods where the GdM lived and inviting them to recycle. In 2023, Carvajal Empaques and Fundación Carvajal stepped in, helping to solidify the group. Consequently, there are three levels of motivation and aspirations that enable this initiative to thrive.

On one level, ASOGESAMPA aims to be a reference for best waste management practices in the region, contributing to the construction of a clean and livable city while also addressing social aspects by helping communities in vulnerable neighborhoods of the district.

Carvajal Empaques and Fundación Carvajal have a clear social responsibility motivation, driven by the desire to help the environment and the people in their area of influence. This is a key element of their sustainability and circular economy strategy. Moreover, maintaining a positive reputation for the organization is of utmost importance.

Finally, the GdM themselves report a strong motivation to help the environment, reduce pollution, and clean the city. Their primary motivation is the future of their children and the values they instill in them, such as hard work, environmental awareness, and the desire for improvement and betterment.

4.3.2. Collaboration and process method

The GdM initiative began with ASOGESAMPA and the neighborhoods where the fisherwomen live. Currently, there are 133 women organized into groups, each with a self-appointed leader who cascades communications and invitations to various activities to ensure all members are kept informed.

ASOGESAMPA connects with organizations such as Carvajal Empaques and Fundación Carvajal, which help strengthen the initiative. Last year, Fundación Carvajal collaborated with other specialized foundations to donate canoes to the GdM groups and provided workshops on topics such as empowerment, finances, strengthening family and community ties, and health brigades. They also supported the GdM's children by showcasing higher education opportunities available in the district (Fundación Carvajal, 2023). Other actors involved include community councils, neighborhood leaders, and local government representatives, who participate in various initiatives or contribute to local environmental policy regulation.

The process method, which is interlinked with the resources will be described in the subsequent section.

4.3.3. Resource cycles

The mangrove is considered primarily a female territory. While men go fishing, women collect "piangua" (*Anadara tuberculosa* and *Anadara similis*) from the mangrove. This mollusk is a staple of traditional Afro-Colombian cuisine in the Pacific region and serves as a source of income, as it is sold in local markets for consumption or exported to Ecuador (roca-Servat & Cifuentes, 2020).

The women leave Buenaventura in canoes in groups only when the tides are "good" and the roots of the trees are exposed, allowing them to find the mollusk. They describe the activity as very demanding and back-breaking, occurring for around 4 to 6 hours each day that the tide allows it. Because the mollusk grows in the mud between the roots of the mangrove, they have to hunch over the trees deep in the mud, avoiding the painful stings of the "pejesapo" (*Oligoplites altus*) and injuries that can occur from falling or slipping on this unstable ground.

While conducting this activity, they sing and share stories. As they move along the mangrove, they also collect materials that have reached the ecosystem and can be recycled. This includes glass, cardboard, composites, PVC, PET, flexible and other types of plastics, aluminum, metal scraps, and more. They each return with both the dozens of mollusks and the recyclable materials to store until they have enough quantity to get a good sum of money. When the water is not "good" for piangua collection, they recycle in other areas. They go to nearby beaches or look for materials in their neighborhoods. On average, they collect over 4 tons of material per month, which includes waste found in mangroves, beaches, estuaries, their neighborhoods, and their homes. In this way, the initiative addresses both nutrients and technical materials.

4.3.4. Physical developments

Although the initiative does not currently involve the design and construction of infrastructure, there is a significant physical component in the form of public spaces and their transformation after the GdM's efforts. They report cleaner mangroves and reduced litter in the area, as well as a continuous effort to clean up the district's beaches. Despite the challenges posed by tides that bring in litter, they mention the increase in awareness by the community when participating in the various beach cleaning activities organized by ASOGESAMPA throughout the year.

4.3.5. Multiple value creation and the CVF infographic

The previous section (4.2) includes a detailed description of each of the values identified. The main ones are as follows: Environmental values include the reduction of pollution, the increase in recycling rates in coastal areas, and the protection of the mangrove ecosystem. Social values encompass community empowerment, access to knowledge and education, and an increase in social cohesion. The main economic value is represented by the additional income that these women perceive. The aesthetic value consists of the improvement of public areas that are cleaned and enhancements to their own households. Finally, cultural values pertain to the upholding of traditional knowledge and practices of Afro-Colombian communities, as well as the openness to receive new knowledge and incorporate it into their daily activities.

All of the components described in this section are summarized in Figure 18, which shows the CVF field map of the initiative, while the full infographic can be found in Appendix 6: CVF Infographic of GdM Initiative.

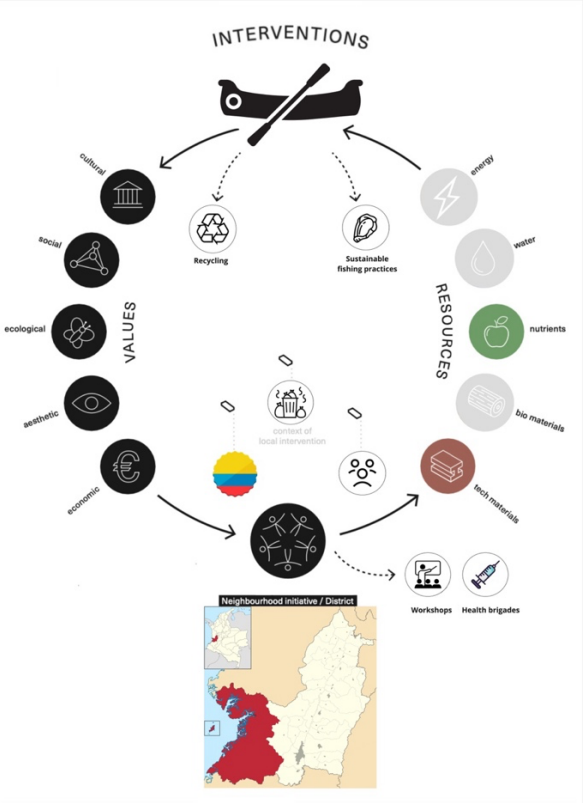

Figure 18. CVF Field Map of the GdM initiative

5. Discussion and limitations

5.1. The system

Market and supply chain

The high logistical requirements of the Circular Economy (CE) have been studied and criticized by (Slaveikova Nikolova & Ness, 2023), De Man (2023) and (Llorach-Massana et al., 2015). It is evident that the reverse logistics involved in post-consumer material collection increases the costs of recycled materials, among other challenges. This, compounded with the highly manual labor that limits the capacity of informal waste collectors to manage large amounts of material, not only reinforces high operational costs but also maintains bottlenecks within the system. Additionally, the quality and condition of the collected material are not necessarily ideal, further constraining the system. Informal waste collectors are forced to pick only materials they know will be accepted, as their daily income depends on this. For consumers, this "discrimination" of materials that can be recycled requires knowledge of recycling, time, and space to segregate materials accordingly, all of which disincentivizes their willingness to recycle (Strydom, 2018).

Thus, the entropic limitations of recycling and closing the loop, compounded with the logistical efforts required to ensure recycling, imply that throughout the entire value chain, the price of the collected material increases. Consequently, the final material, once processed and purified, is significantly more expensive than virgin resin. Furthermore, it is known that there can never be 100% recovery (Boggia et al., 2022), so the recovered material cannot always be transformed back into the same product. In fact, it has been shown that adding recycled material can decrease the mechanical resistance of the final product (Mendoza et al., 2020).

Overall, the competitiveness of recycled material depends on a series of factors embedded throughout the entire production value chain, making it difficult to become competitive without broader support, as Slaveikova Nikolova & Ness (2023) mention.

Policy

As mentioned above, the current price of recycled material is insufficient to make its collection competitive. This issue is even more pronounced in communities that are disconnected or not properly integrated into the national waste management systems. Colombia's waste management system relies on 62 official landfills and waste trucks that collect waste from generation points (households or industries) and transport it to the corresponding landfill . In this system, users pay a determined cost for waste collection and disposal services through their utility bills.

Although Extended Producer Responsibility (EPR) encourages the industry to comply with alternative disposal methods and increase recycling rates, there remains a significant bottleneck in reaching the material from the consumer. To address this, two sets of policy changes are suggested. Firstly, the system should shift from charging per kilogram of material dumped into a landfill to charging companies for the materials actually dumped in a landfill. This change would incentivize service providers to seek alternative business

models and strengthen the recycling value chain, reducing the landfilling of recoverable and recyclable materials, including organic material that makes up 33% of household waste in Colombia (Rodríguez, 2022).

Secondly, public policies should focus on the general population to foster greater environmental commitment in households, thereby increasing the current recycling rate not only in Buenaventura but across Colombia. In the department of Huila, the government launched a program called "Huila Sin Basuras" (Huila Without Garbage) with four action lines focused on raising household awareness about recycling (Gobernación del Huila, 2014). According to the national solid waste management report, the department achieved material recovery rates above 50% for three consecutive years after the program's development, and above 45% in subsequent years (Superintendencia de Servicios Públicos Domiciliarios, 2021)

The initiatives developed by ASOGESAMPA with the population of Buenaventura serve this purpose by establishing collection routes for usable materials. However, these activities need to be complemented with public policies that ensure compliance with source separation regulations to enhance recycling efficiency both in Buenaventura and nationwide. In fact, Mishra et al. (2022), while studying community-led energy initiatives in India, found that initiatives run by local communities require support in the form of regulation to ensure their sustainability and environmental responsibility. Thus, both the social and environmental aspects of the system require broader regulatory support, not only through legislation but also through control measures to ensure the project fulfills its intended purpose.

In the district of Buenaventura, the lack of infrastructure such as roads and the high reliance on water transport necessitate an update to the PGIRS (Plan de Gestión Integral de Residuos Sólidos) to account for the region's specificities, rather than relying solely on traditional methods of waste collection and landfill disposal.

This can be summarized by what Slaveikova Nikolova & Ness (2023) state regarding the circular economy (CE) approach: it can only work as a waste management solution if the CE strategy is embedded within a much broader support system than current strategies provide. This includes integrating goals such as healthcare, childcare, education, economic development, and the inclusion of the communities themselves (Slaveikova Nikolova & Ness, 2023).

Multiple Value Creation

This study demonstrates the ability of local initiatives to create value in the communities where they are implemented. Furthermore, knowledge management and leveraging the capabilities and expertise of various stakeholders are fundamental to the initiative's success. This approach strengthens the notion of holistic interventions with socio-environmental objectives, which are essential for companies to consolidate their post-consumer material chains and comply with extended producer responsibility legislation. In this regard, the values generated by the initiative go beyond social intervention, creating a solid foundation based on trust where participants, the organization, and the ECA interact in a joint effort.

On the other hand, the values found reflect the system's barriers. The participants show great commitment and conviction about the importance of their work in aesthetic, cultural, environmental, and social aspects. However, beyond the monetary incentive, the economic value of the initiative is not as attractive. They recognize the effort involved in collecting all the material but hope to have a fixed salary instead of living day-to-day. This investigation of values offers another perspective on the lack of competitiveness of recycled material: the sale price of the material and the current solid waste management infrastructure hinder the ability to formalize all the actors in the chain. Informality makes their incomes highly variable, complicating the financial stability of the communities and, in a way, keeping them in a vulnerable situation.

In this sense, the study also provides an alternative approach to consider the study of additional dimensions of the circular economy (CE), aside from environmental and economic ones. As Quintelier et al. (2023) demonstrate, at least the social dimension of the CE is a field understudied. In fact, the authors mention a similar occurrence in the Netherlands to what was found in the present research project: the trade-off between economic incentives and the social aspect of the CE. The authors identify the same issue brought to light in this study in the context of a circular initiative in the Netherlands, noting that *"current price mechanisms make virgin resources cheap and labor costly. This contributes to socio-circular organizations being outcompeted in the longer term by competitors that are less circular and create less social value"* (Quintelier et al., 2023). Thus, the inherent trade-off between social and economic values exists in a wide variety of circular initiatives and demonstrates the wider support system required to ensure these initiatives remain competitive in the current market.

5.2. The methodology

The original CVF method, as explained in section 3, consists of a three-step process illustrated in Figure 19. The greatest benefit of this method is that it opens a space for discussion among different stakeholders and allows for brainstorming on topics that are usually not considered due to their difficulty in quantifying them (Leclercq & Smit, 2023). Martellotto (2023) also identifies the capacity of the CVF to guide conversation and encourage reflection on the complexities of a system and the interconnections within it. However, while preparing to use this method in the present studies, I encountered some barriers that prevented me from implementing the original method fully.

First, the simplification of the preparation step. The method suggests the recruitment of participants and the customization of the layers; however, areas with multidimensional poverty and complex security situations, such as Buenaventura, require a longer preparation step and careful mapping of stakeholders who have the tools and capacities to participate.

Second was the high time demand that the workshop required, in contrast with the time availability of the different experts that were mapped. After sending out invitations, the available time slots were typically only 1 to 1.5 hours and varied significantly, making it difficult to develop a workshop that included all stakeholders. Additionally, the workshop method can pose challenges in obtaining input from all participants, as some individuals

are naturally more outgoing and may "overshadow" others. The method, as it stands, does not provide room for one-on-one interactions, at least not during the workshop itself. This issue was compounded by my lack of experience as a qualitative researcher, with my experience in workshops and focus groups limited primarily to participation.

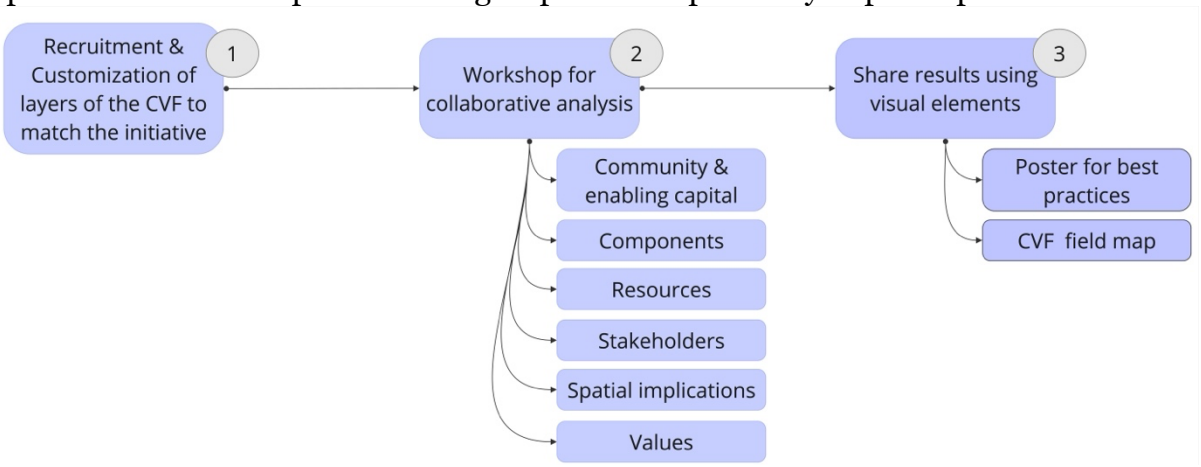

Figure 19. Original CVF methodology overview.

After this first approach to the CVF method and the difficulties outlined above, changes to the original method were applied, as illustrated in Figure 20. The first change includes a deeper, separate investigatory approach with an emphasis on the local context and stakeholder mapping of the initiative. Furthermore, aiming to address the main barriers of time and potential information gaps due to the researcher's lack of experience, the second step was modified to be carried out through interviews instead of workshops to perform the collaborative analysis and gain insights into the six components that comprise the CVF. Thirdly, a separate analysis phase acknowledges the need to gather insights before moving forward with the debrief as the original CVF method suggests.

This version came with its own set of problems, mainly the large amount of information collected per interview and the impossibility of including the six components in depth. This made the interviews too structured and rigid, and the nuances of the interviewees' perceptions on particular topics within their areas of expertise were missed.

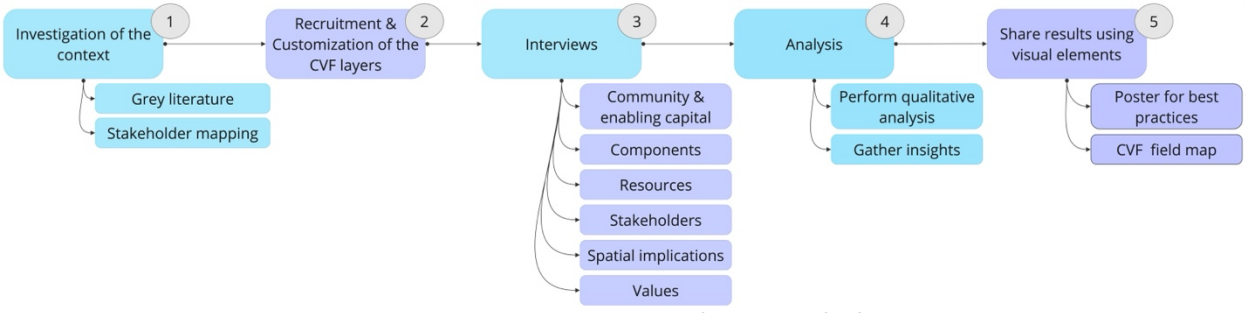

Figure 20. First iteration on the CVF method.

Finally, after this iterative process, the final version used can be found in Figure 21. This version maintains the in-depth investigation preparatory phase while dividing the second stage into two consecutive data collection phases. The first phase is conducted through interviews and the second with a shorter version of the workshop. To ensure greater

flexibility, the six components of the CVF were divided into the technical and contextual components of the system and the experiential and routine components. The former were approached through the interviews and the latter through the workshop. The values were addressed by both the interviews and the workshops, as they are considered the heart of the method. The advantage of conducting the interviews first lies in the ability to refine the workshop guidelines to fill in gaps and validate findings from the interviews with the workshop. The final stages of analysis and debriefing remain unchanged.

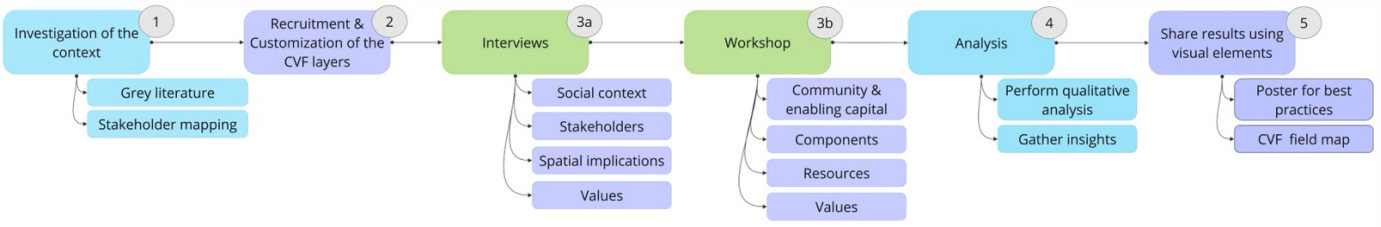

Figure 21. Final iteration on CVF methodology.

The methodological changes described above were intended to adapt the current framework to the realities of Buenaventura and the restrictions on conducting fieldwork there. However, it is essential to recognize that these changes do not necessarily increase the usability of the existing CVF but rather validate its flexibility and adaptability to different contexts while maintaining the essence of the multiple value creation evaluation. The proposed methodology served its intended purpose by allowing for successful data collection in Buenaventura. Thus, the steps outlined above may serve as a guide for conducting research in other areas or facilitating the implementation of the CVF in other contexts, but this needs to be carefully decided by the researcher.

When Martellotto (2023) developed her modifications to the CVF to conduct research in Argentina, she redesigned the CVF and created guidelines specific to circular initiatives in Argentina, even naming it after their famed drink, the “mate”. This further demonstrates the flexibility of the method and the intricacies of local initiatives with their context, highlighting the need for methods that can adapt to that context rather than requiring participants to adapt to a rigid research methodology.

5.3. Limitations on the methodology

Data Collection and analysis

Primary data collection through interviews and workshops was influenced by the researchers' perceptions and the agendas and beliefs of the interviewees, potentially introducing biases into the research (Bhattacherjee, 2012). Time constraints prevented the validation of results with the broader community, allowing only for a meeting with several actors to present the findings. Consequently, there was no opportunity to correct any misconceptions or biases that may have been introduced.

Additionally, the sample collected does not fully represent the entire population, including both direct members of the initiative and the pool of experts interviewed. Some relevant stakeholders, such as local government actors, were challenging to reach, resulting in their underrepresentation due to a lack of response.

In terms of data analysis, the coding process was constrained by translation. Many of the selected codes may not entirely capture the exact message intended by the interviewees. This issue is particularly evident given the experiential storytelling style employed by the GdM, which often includes slang, leading to some loss of meaning during translation. However, it is important to note that since Spanish is the main researcher's native language, special effort and care were taken to select codes that best represented the intended messages.

Finally, my lack of experience as a qualitative researcher influenced the results, especially since coding is inherently an interpretive act (Saldaña, 2016).

Participatory research methods

The changes in the methodology proposed above have several implications for implementing a PAR method. First and foremost, the lack of diversity in terms of stakeholders in the workshop poses a limitation on the discussion. This leaves the researcher with the task of unraveling the different interactions from the responses of the interviewees and workshop participants.

Although the proposed changes to the steps for conducting and using the CVF in the context of Buenaventura allowed for data collection, it should be noted that these changes were prompted not only by the socio-cultural aspects of the region and the context of the initiative but also by the time constraints of the research project. In that sense, allowing for a collaborative workshop would have been very insightful for understanding the perceptions and seeing firsthand the interactions between the different actors.

Furthermore, as will be discussed in depth in the section below, PAR limits the ability to generalize the findings of the present study to all community-led circular initiatives. As such, the methodology itself cannot be generalized, as it is also highly context-dependent. Nevertheless, recognizing and including the preparatory phases and explicitly opening up the method to include this can be useful for future researchers conducting research in areas with a similar context.

In addition, the methodology leaves ample room to interact and increase the participatory approach and engagement with the communities. Travel and time constraints determined the time spent with the community and the possibilities to engage with them. Although the needs and vision of the participants were explored during the workshop, not being able to interact with them and understand their day-to-day activities limits the possibilities to make recommendations that benefit the community rather than those focused on a single narrative of what they might or might not need.

Finally, the changes to the methodology shed light on the realities of some vulnerable communities in the Global South and the need to adapt the methods, largely developed and validated in Global North contexts, to the Global South. As mentioned in the previous section, rather than imposing a rigid research methodology, the involvement of the participants and the flexibility to co-create and adapt to their knowledge and culture is fundamental for fostering a pluriverse of worldviews and acknowledging the experiences and voices of those whose narratives have largely been ignored (Escobar, 2016). The

proposed changes start paving the way for this openness, but it is important to note that further changes are needed, especially considering the reduced time and the controlled space in which the interactions with the community occurred.

5.4. Limitations on generalizability

Local Circular Economy initiatives are highly context-specific, with their nature and evolution dependent on the local community and its specific needs. Therefore, although the findings of the present initiative might resemble those of similar ones, they should not be generalized. The specific narrative of this initiative may serve as inspiration to complement or develop similar projects, but discussions of the values it creates should be conducted with this context in mind.

For example, the Circular Communities Foundation has a project with informal waste pickers in India (Circular Community Foundation, 2022), and the CVF produced there differs from that generated in the present study. The unique social situation of the community and the blend of traditions and knowledge from different cultures that form the Afro-Colombian Pacific region play a central role in the initiative and the values it enhances. Additionally, the political situation of the port, the characteristics of Buenaventura, and the unique environments surrounding the district are key determinants of the processes and decisions that shaped the project. Even national regulations on single-use plastics and extended producer responsibility affect how the initiative unfolded. Thus, the values, enabling capital, actors, spaces, and elements are driven by local context and needs, making it impossible to generalize the effects of community-led circular initiatives based on this unique case study.

Furthermore, as mentioned above, the PAR approach implies focusing on specific aspects of the initiatives. The level of specificity generated by the active participation of the community and the members of the initiative means that the information collected is harder to generalize (Arboleda et al., 2004). Time constraints also limited the number of interviewees and participants, so the findings might not represent the views of the entire community. However, it is worth questioning the value of generalizing the findings of studies like the present one. Simplifying and deconstructing a complex system into concepts that do not necessarily capture the entire system might undermine the research's intent. This research aims to acknowledge and respect the voices of the community, and generalizing their experiences might ignore the voices of other communities in different contexts. Therefore, the only generalization this study seeks to make is the need for research practices that respect, honor, and value local knowledge systems and voices in their entirety, thus conducting research following an inclusive and sensitive framework to uphold those who participate in it.

6. Recommendations

On practical matters

Due to the current regulatory landscape of the country, initiatives such as GdM have a material emphasis, specifically the collection of potentially recyclable materials. However, combining this with other interventions can make a significant difference. Various allies and actors could evaluate adding interventions related to the preservation and conservation of mangroves. This could open the door for voluntary blue carbon reporting, and consequently, additional income for the community. Colombia is already familiar with carbon credits and blue carbon. In 2021, in the departments of Córdoba and Sucre, the Ministry of Environment and Sustainable Development, along with various international actors, launched the project "Vida Manglar" in the Gulf of Morrosquillo. This program protects 7,561 hectares of mangrove on the Caribbean coast as part of the country's carbon-neutrality strategy (Ministerio de Ambiente y Desarrollo Sostenible, 2021).

Furthermore, the Ministry of Environment and Sustainable Development initiated the "Pagos por Servicios Ambientales (PSA)" (Payment for Environmental Services), which has four lines of action aimed at incentivizing the protection of key environments with monetary or tangible compensation agreed upon by the community to uphold and preserve the environmental values recognized in the agreement (Ministerio de Ambiente y Desarrollo Sostenible, n.d.). This could be an additional step to enhance the environmental aspect of the initiative. Increased environmental awareness and understanding of the mangrove ecosystem can also lead communities to value and focus more on its preservation. For instance, some interviewed experts reported that populations in Nuquí or the Gulf of Tribugá take good care of the mangrove because they understand its value in terms of biodiversity and its attractiveness as a tourist destination.

As ASOGESAMPA plans to continue growing, optimizing the supply chain and logistics to address space and transport barriers would significantly reduce business costs. For instance, their plan includes covering rural areas of the district. Establishing smaller satellite warehouses in strategic locations might improve overall logistics costs (Milewski, 2020), considering long-distance transportation occurrences to ensure the material reaches the final processor.

Additionally, incorporating a processing step to add value to the product sold and reduce the number of links in the chain might help offset costs. This requires finding new markets and clients for the processed materials, but overall, valorization occurs once the material is transformed, with recycled pellets selling for 3.7 times the price of the collected material itself (Mendoza et al., 2020).

In terms of the legislative framework, it is necessary to evaluate policies that help strengthen the position of recycling within the overall market. While EPR is a good start, it should be combined with other policies that address system inefficiencies such as the lack of environmental education and recycling knowledge in households, and the reliance

on a waste management strategy focused on landfilling solid waste, as mentioned in section 5.1.

For further research

The present study encountered some methodological barriers in the original CVF for it to be appropriately used in the context of Buenaventura. However, time constraints limited the desired approach. Drawing from Escobar (2016) and Arboleda et al. (2004), one of the most important suggestions when conducting a case study with vulnerable communities is incorporating participatory action research (PAR) methods. This ensures that the research outcomes align with the expectations and needs of the community and benefit the community, rather than following an agenda detached from their realities. Additionally, using a multi-methods approach increases the flexibility of the research itself, allowing for the filling of data gaps with higher adaptability. This method can be tailored according to the needs of the participants, the community, or the experts consulted.

The CVF methodology considers the mapping of the perceptions of system actors regarding values, actions, and consequences of initiatives. Further validation of the perceptions described by the GdM, especially concerning the environmental aspect, could be instrumental in determining the initiative's environmental impact. It is also crucial to consider other factors that may have influenced the environment, unrelated to the initiative but contributing to environmental enhancement. This approach enables the implementation of tailored measures focused on mangrove conservation, informed by the participants' insights.

Furthermore, community-led circular initiatives could benefit from implementing a more quantitative approach that measures the materials collected, the frequency, and the bottlenecks in the system that prevent the district from reaching a higher recyclability rate. Currently, Buenaventura's recyclability rate is 6.4% (DANE, 2018), while the national average is around 17% (Núñez et al., 2016). This could further strengthen the knowledge of the system itself and provide insights into possible optimizations or shed light on quantitative performance indicators of the system.

Finally, the system could benefit from an in-depth study of the legislative framework surrounding the CE and its effects on the entire recycling value chain. Although the present study mentions some aspects, understanding the regulatory context is fundamental to supply public policy recommendations that can further strengthen the effects of circular initiatives in the country.

7. Personal Reflections

7.1. On doing research in the Global South

My main goal when initiating this research project was to establish a bridge between academia and the sustainability initiatives taking place in the most remote regions of Colombia. I aimed to experience firsthand the lives of those who make sustainability their way of life, with the hope of achieving a real and positive impact in my country.

I sought to create a space within sustainability narratives to listen to the voices of individuals who have traditionally been excluded from academia, which has created a gap between theory and reality. Chimamanda Ngozi Adichie, in her TED Talk, "The Danger of the Single Story," mentions “how impressionable and vulnerable we are in the face of a story” (Ngozi Adichie, 2009). The single story that is told of Buenaventura is that it constitutes a red-coded area in which fieldwork cannot be conducted. This further complicates and enlarges the gap between theory and reality. Chimamanda goes on to say, “all I had heard about them was how poor they were, so that it had become impossible for me to see them as anything else but poor. Their poverty was my single story of them” (Ngozi Adichie, 2009). And so, I wonder if the research protocols that are now put in place, of course with a well-founded basis on the safety and wellbeing of the researcher, are not contributing to perpetuating the dilemma of the single story.

While I do not pretend that there are no security issues in Buenaventura, and to be fair, in the entire country, I do question if perhaps the criteria used to assign the color code to each region are based on the stereotypes of the single story of what the Pacific coast of Colombia is, instead of the multifaceted, complex, multidimensional system that is indeed Buenaventura. Growing up facing the stereotypes created by the history of Colombia in the past century, and having to answer and explain multiple times why those stereotypes do not reflect what the country is or who we are, much like Chimamanda had to do with her roommate, I wonder who will explain and correct the stereotypes of the District of Buenaventura and, moreover, how can this thesis be a step in that direction?

Although I understand the reasons behind the university's decision not to allow travel to high-risk areas for research, I find it challenging to reconcile this with my desire to contribute to my country's development and, perhaps, improve the lives of resilient and generous individuals who dedicate themselves to honorable and valuable activities that protect mangroves. In the end, the mangroves act as carbon sinks, benefiting everyone in the world, regardless of the color of the area where they are located.

With that said, I believe this work is a call to action to open up and increase the flexibility of these decisions. It is necessary to establish specific criteria that allow maintaining the researcher's safety without completely shutting the door on these communities and areas. Personally, establishing contact with local organizations and carefully building a relationship of trust and respect allowed me to carry out the entire research process. Beyond the research results, this experience was one of the best of my life as I was able to share with a group of exceptional human beings who, despite adversities, have a strong

desire to progress and contribute to solving environmental problems, despite being the least responsible but the most affected.

7.2. On working with communities

Establishing a relationship of trust and security that allows for dialogue stands out as one of the greatest needs for conducting participatory research. It is important to understand the people who make up these social groups, their needs, expectations, and to discover how they perceive any kind of growth or achievement after participating in research. It is necessary to show consideration and recognition for the time they invest and their effort to participate. It is also essential to be open to recognizing and accepting the experiential knowledge they impart when showing how they carry out their daily activities.

Of course, information, transparency, and honesty cannot be lacking, as they allow for the creation of sufficient trust to overcome biases and find new perspectives, understanding other points of view. On several occasions, previous experiences were mentioned with external agents who requested space, collected information, and left without at least compensating them with documents or results of the joint work, causing a feeling of powerlessness in those interactions.

In my case, we established written commitments to socialize the project, provide information and documentation about what was expected to carry out the fieldwork. The administrative procedures resulting from these commitments took longer than expected, limiting the time to share with the community. This meant that interactions with the daily realities of the guardians were minimal and that the details of the activities they perform were derived from the participants' responses to the workshop held. Although I was clear from the beginning that I would have this space for socialization, these previous experiences meant for me a greater effort to demonstrate to the community that this type of exercise is beneficial for all involved.

Although I understand that all projects have limitations of time and resources, personally and as a reflection for all those interested in working with communities, it is necessary to move away from the extractivist model of academia and work on participatory projects, where the exercise includes the presentation of results. The community's time and knowledge must be recognized to strengthen trust relationships and leave the door open to continue working together. It must be understood without a doubt that it is not a "favor" to the community, but a commutative work where living knowledge enriches research and projects new horizons of teaching and mutual collaboration.

Regarding knowledge, due to internal processes, I focused on researching and preparing interviews and workshops. However, I found that, regardless of the amount of research and preparation, defining a structure that is too rigid for interactions with community participants ends up being counterproductive. In the end, it was in thematic conversations, with open questions, where stories and personal experiences were shared that it was possible to understand the perceptions, motivations, and thoughts of the participants. As a researcher, the main reflection focuses on maintaining adaptability and flexibility when conducting on-site research, but also on keeping an open mind and humility to accept and recognize local knowledge in the way they choose to share it, in my case, the stories and experiences of their daily lives.

8. Conclusions

The present study aimed to explore the multi-value creation capacity of community-led circular initiatives in the Pacific region of Colombia, using a case study approach. The research employed the Circular Value Flower (CVF) as the guiding framework, supported by a qualitative multi-method approach, including interviews and a workshop, to gather the necessary information.

Firstly, given the high context-dependency of local initiatives, efforts were made to understand the intricacies and nuances of the system. Through this study, the waste management system in the district of Buenaventura was analyzed. Several general insights on the system were identified:

- Companies like Organización Carvajal are actively working to improve the perception and integration of informal waste pickers by aligning compliance with Extended Producer Responsibility (EPR) laws with significant social impacts. They bridge the gap between informal collectors and the industrial sector, emphasizing the importance of social responsibility and circular economy strategies. Their efforts include various holistic interventions to support the health, education, and economic stability of waste pickers, fostering community trust essential for initiative success.
- Regulatory frameworks such as the EPR law and Law 2232 of 2022 are crucial for expanding waste collection beyond urban centers and driving innovation in recyclable materials. Initiatives like “The Chemistry of Recycling” highlight the potential of new technologies, such as chemical recycling, to increase recycling rates.
- Increased consumer demand for sustainable products further encourages household recycling, supported by emerging businesses and innovative models that integrate environmental consciousness into their operations.
- Barriers such as outdated waste management plans, logistical challenges, and social stigmatization of recyclers persist. Addressing these issues, particularly in regions like Buenaventura, requires updated infrastructure, enhanced environmental education, and consistent support for informal recyclers to make recycling more competitive against virgin materials.

Secondly, the GdM (Guardians of the Mangrove) initiative proved to be highly promising in terms of multiple value creation:

- Environmental Value: Reduced pollution in coastal ecosystems, conservation of “pianguas” in the mangrove, cleaner water, and increased recycling rates in coastal areas.
- Economic Value: Additional income from recycling activities for GdM participants, mostly women from vulnerable communities.
- Cultural Value: Preservation of traditional Afro-Colombian knowledge and practices, while incorporating new knowledge.

- Aesthetic Value: Improved cleanliness of public spaces in the district of Buenaventura.
- Social Value: Increased social cohesion, access to education through activities and workshops, and community empowerment.

These outcomes underscore the potential of local initiatives in driving sustainable practices with a deep social component.

Thirdly, the study involved the use and validation of an existing framework, originally conceived in the Global North, within a Global South context. This required methodological adaptation to the specific conditions of Buenaventura. The study demonstrated three key points:

- The importance of flexible methodology when conducting research with vulnerable communities.
- The necessity of clear and delineated preparatory stages to understand the context and build trust with the community and local partners, embodying respect, recognition, and humility towards the community's knowledge and contributions.
- The challenge of generalizing findings from a single case study. Community-led initiatives are highly context-dependent, and generalization might be counterproductive. Instead, recognizing the uniqueness of each case study and exploring the adaptability of the methods to diverse contexts is essential to honor the voices of the communities involved in the research.

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Appendix 1: Interview Guides

Purpose

This playbook is designed to provide a standardized procedure for conducting semi-structured interviews with internal and external stakeholders as part of the thesis research project.

Pre-Interview

Arrange meetings with the supervisor to go over the interview questions and expectations. Also, ensure the relevance of the questions to the context of the research and interviewee's knowledge and role.

Interviewer Preparation

Research: Understand the background of the stakeholder to be interviewed, including their role and previous contributions to sustainability if available.

Training: The interview guide is set to ensure familiarity with the questions and the flow of the interview.

Roles

1. Lead Interviewer: leads the interview and discussions with the interviewee. Ensure the interviewee signed the consent form, record the interview.

Interview Structure

1. **Introduction (5 minutes)**

2. **Greeting & introduction of the team**: Begin with a friendly greeting and thank the stakeholder for their time. Briefly introduce the interviewer and the research project, as well as the goal of the research. Contextualize the importance of the research and the interviewee's insights.
    - The interviewer will:
      Overview: Give a concise overview of the research objectives and the significance of the stakeholder's input.
      Consent: Confirm that the interviewee understands that the interview is recorded, notes will be taken, and they will remain anonymous.
      Anonymity and Disclosure: Clarify that while their identity will be kept confidential, their role may be disclosed to give validity to the inputs given.

3. ***Main Interview (45 minutes)***
   The interviewer will go as follows:
    - **Discuss role:** Specifically ask the stakeholder to describe their role and involvement in circular economy initiatives.
    - **Ask the defined, open-end questions:** ask the questions selected for the interviewer. Ask follow-up questions if something is unclear or of further interest.
    - **Ask improvised follow up questions:** If there is time available, ask further questions about related topics or points of interest which are relevant for the research.

4. ***Conclusion (10 minutes)***
   The interviewer will:

- **Wrap-Up:** Conclude the main part of the interview, summarizing key points and thanking the stakeholder for their insights.
- **Last Thoughts**: Give the stakeholder an opportunity to add anything else they believe is relevant.
- **Next Steps**: Explain the next steps in the research process and how their input will be used.
- **Show gratitude**: Close the interview with sincere thanks and appreciation for the interviewee's time and insights.

5. **Post-Interview**
    - **Debrief:** Immediately after the interview, the interviewer should note impressions and take preliminary notes on main insights gained.
    - **Review the playbook:** check if the structure of the interviews is well organized and can be done in the allotted time. Make changes and adjustments if necessary.
    - **Transcription:** Transcribe the interview as soon as possible while the discussion is still fresh in the interviewer' mind. These notes will be added to the central repository for data collection on Teams.
    - **Synthesis:** Analyse and synthesize the interview data, looking for patterns, key themes, and insights related to the research.
    - **Discuss with Supervisors:** Discuss the interview outcomes and any insights that may be relevant to the research.

6. **Additional Considerations**
    - **Punctuality**: Ensure all interviews start and end on time out of respect for the stakeholders' schedules.
    - **Confidentiality**: Maintain the confidentiality of the interviewee's identity.
    - **Data Protection**: Ensure that all notes and data collected are stored securely and are accessible only to the research team**.**
    - **Continuous Improvement**: After a set of interviews, review the process and adjust the playbook as needed for clarity and efficiency.

This playbook is a guide and should be adaptable to specific situations encountered during the interviews.

A1.1. Expert Type 1:

1. What motivated you to create this initiative? How did it all begin?
2. How long have you been doing this?
3. What are the organization's values?
4. What value does Precious Plastics want to bring to the community? In other words, what do you think is the effect of the intervention on the community?
5. Do you have data on the total amount of material collected?
6. How does the collection process work? Who do you work with?
7. What is your network like?
8. Why did you choose that area?
9. Do you work on other beaches? Do you work only on the beach?
10. What types of materials do you collect?
11. What do you do with the materials that cannot be used for your regular production?
12. What are the main problems encountered in the collection process?

13. What are the main barriers you face?
14. Have you considered making more products for sale?
15. Can you explain how the manufacturing process works? (Research shows that collected material loses material strength properties and cannot be added in many processes above a certain proportion, which ends up being very small).
16. What is the logistics like?
17. Have you tried selling the recovered plastic to ECAs or traditional warehouses for traditional transformation?

A1.2. Expert Type 2:

1. How do the characteristics of Buenaventura and the relationship of the people in the area with the mangrove exert pressure on the ecosystem?
2. In general terms, what are the implications of the high garbage density present on the mangroves of the Buenaventura district?
3. Studies discuss the colonization of non-native species from garbage in the mangrove. What could be the implications of this colonization for conservation and ecosystem services?
4. Could you tell me something about the *Piangua* fishing culture on the Pacific coast and how it could be affected by high mangrove pollution?
5. Do you consider it a solution to the garbage problem in ecosystems?
6. What environmental values can such initiatives generate in the short and long term?
7. What environmental indicators could be identified in such initiatives?
8. What do you think are the most urgent steps to ensure mangrove conservation?
9. What other interventions do you consider important to ensure mangrove conservation?
10. Do you have any additional remarks or considerations?

A1.3. Expert Type 3:

1. What are the main pressures and management plans related to coastal ecosystems in the pacific?
2. What values can you name that these initiatives generate?
3. After your work with communities, could you see a difference in their attitudes and perceptions regarding the environment and marine ecosystems?
4. Could you tell me something about the *Piangua* fishing culture on the Pacific coast and how it could be affected by high mangrove pollution?
5. Did you involve the community in the data collection part of your work? In what way was the community involved?
6. What types of indicators did you consider and mapped?
7. What did you do with the collected material?
8. What do you consider fundamental in developing the projects with the community?
9. How was your approach to the community and how did you manage to establish a trusting relationship with them?
10. Do you have any additional remarks or considerations?

A1.4. Expert Type 4:

1. How did the project start?
2. How does the supply chain work?
3. What inspired you to start?
4. What benefits does the initiative bring?
5. What are the biggest challenges you face?
6. Who do you collaborate with?
7. How would you describe your relationships with the different stakeholders mentioned earlier?
8. What else would you like to do? How do you see yourselves in the future?
9. What are the different values you can see are enhanced by the project?
10. Do you have any additional remarks?

A1.4. Expert Type 5:

1. How did the strategy for social and environmental intervention came to be?
2. What is the long-term vision of the strategy?
3. What are the main actors and networks that the company collaborates with?
4. What are the implications of EPR legislation on the company's environmental and social interventions?
5. What are the biggest challenges in fulfilling the strategy?
6. What are the different values you can see are enhanced by the initiatives?
7. Do you have any additional remarks?

Appendix 2: Workshop Guidelines

Purpose

This playbook is designed to describe the detailed preparation of the workshop conducted as part of the thesis research project.

Preparation

1. **Clarify the purpose and outcomes:** articulate the purpose of the workshop and the specific research outcomes that we aim to achieve.
2. **Design the Workshop Structure and Agenda:** First outline the workshop structure and create a detailed agenda. With this, the content and materials that will be used during the workshop can be defined.
3. **Review with supervisors:** Discuss the workshop structure, agenda, and materials with the supervisors to ensure alignment with the research outcomes
4. **Understand participant backgrounds:**
    a. Research and understand the backgrounds of the initiative members.
    b. Review the workshop plans with local partners to ensure clarity and that the setting is considerate of the participants' characteristics.
5. **Send invitations:** Send out invitations to potential participants well in advance
6. **Define venue:** Select and confirm a suitable venue for the workshop.

Workshop design and materials

Acknowledging that each participant might have a different level of comfort in expressing their views in written form, the workshop was designed to cover six major topics, each

with several guiding questions. Sheets of paper and markers were provided for those who preferred to write rather than speak out loud.

The first phase includes four central pillars related to understanding the participants' day-to-day activities, the reasons behind their participation in GdM, their motivations, and their future projections. Figure 22 shows the accompanying material for those who preferred to write. The material is in Spanish, as the workshop was conducted in that language.

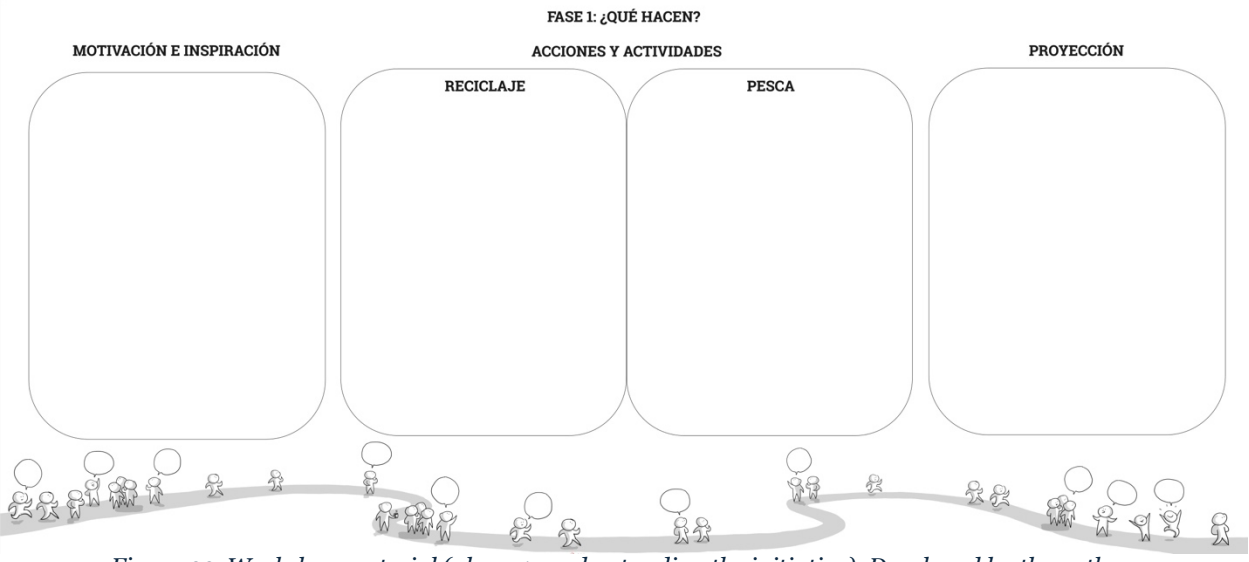


Figure 22. Workshop material (phase 1: understanding the initiative). Developed by the author.

The second phase focuses on the community pillar (see Figure 23). This phase examines participants' immediate relationships, the social network they form and strengthen through their activities, the traditional and external knowledge they apply in their day-to-day tasks, and their relationship with nature and the different spaces they frequently use.

Figure 23. Workshop material (phase 2: understanding the community). Developed by the author

Finally, the third phase involves identifying value creation (Figure 24). This includes exploring the different values proposed by the CVF method and encourages discussion on the various benefits generated and perceived by the members of the initiative.

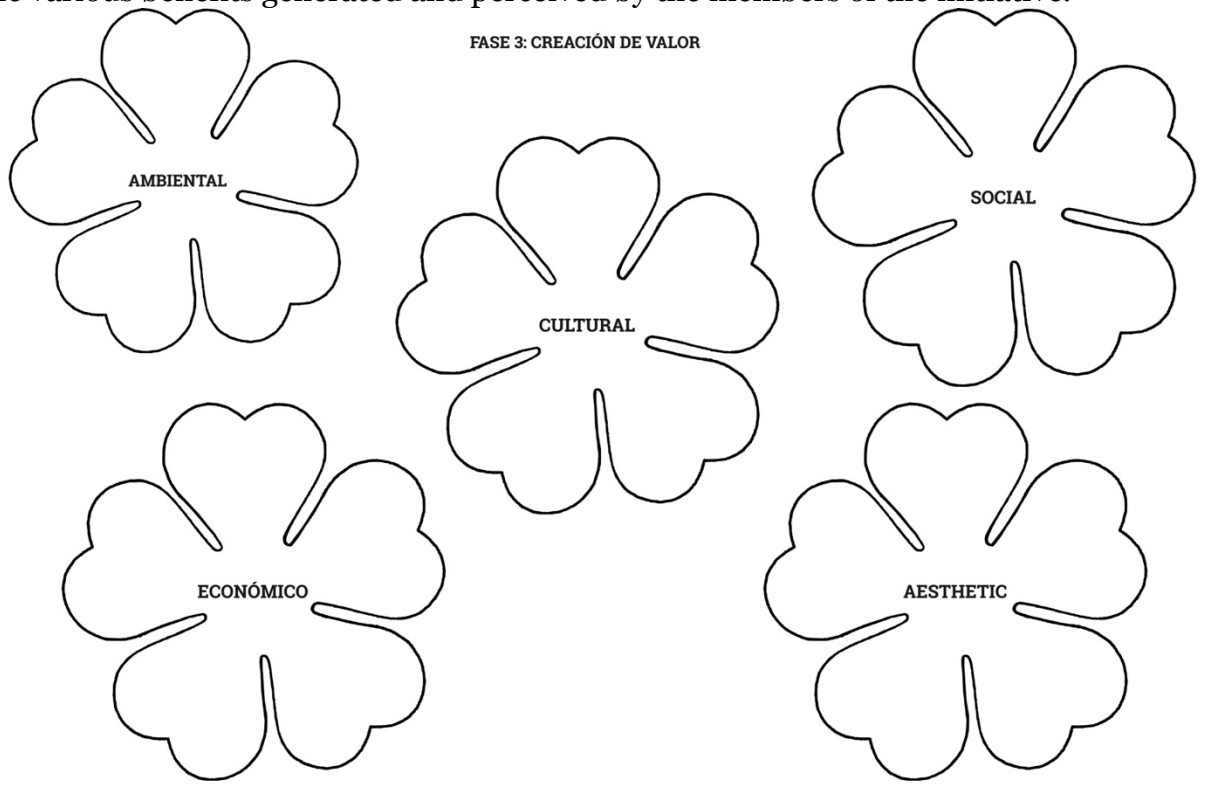


Figure 24. Workshop material (phase 3: value creation). Developed by the author

Workshop structure

1. **Preparation before arrival of participants (15 minutes)**
    - Prepare the space to receive the participants.
    - Set the materials and the amenities available.

2. **Introduction (10 minutes)**
    a. Welcome the participants and thank them for their participation and time.
    b. Introduce yourself as the facilitator and the research project. Mention the goal of the research, the goal of the workshop and the importance of the research.
    c. Distribute the informed consents so that they can read it and that all the participants understand what the workshop entails, that it will be recorded, notes will be taken, and everything will be anonymized.
    d. Collect informed consents and set up the recording devices (two devices in opposite sides of the room to avoid missing any input).
    e. Ask the participants on their preferred method of participation. The workshop is set to allow for written inputs as well as verbal inputs to accommodate the preferences of the participants.

3. ***Phase 1: Understand the Initiative and its vision (40 minutes)***
    a. What motivated you to join the GdM?
        i. How was the experience of learning to collect material and
    b. What do you do as a GdM?

        i. Recycling: What materials do you collect and how much of what you collect can be sold? Do you specialize on a certain material or collect everything you find? Where do you collect material?
        ii. Fishing: How does it work? How do you balance both activities? How are the two activities related?
    c. Fishing: How does that work?
    d. What are the challenges you face as a GdM?
    e. What benefits do you recognize of being part of the GdM?
    f. Do you see yourselves as a part of GdM in the future? What are the long-term goals of you as GdM?
    g. What are the biggest needs?

4. ***Break (5 minutes)***

5. ***Phase 2: Understand the broader community and tradition (40 minutes)***
    a. Traditional knowledge, "good" and "bad" waters, singing, culinary culture, etc.
    b. Fishing: *piangua, jaiba, camaron, etc.*
    c. Community:
        i. Family
        ii. Neighbors
        iii. Between the GdM (their groups)
    d. Spaces:
        i. Mangrove: what pressures do you perceive in the mangrove and how does that affect your work? How does your work help with the pressures on the mangrove?
        ii. Beaches: how do you see the waste issue in the beaches? And compared to the mangrove?
        iii. Houses
        iv. Neighborhood
        v. Streets
    e. How was your learning curve and how did you incorporate external knowledge on your daily activities?

6. ***Snack break (10 minutes)***

7. ***Phase 3: Value creation (40 minutes)***
    a. Social (e.g., cohesion)
    b. Economical (e.g., added income)
    c. Cultural (e.g., upholding traditions)
    d. Environmental (e.g., cleaner water)
    e. Aesthetic (e.g., cleaner spaces)

8. ***Conclusion (10 minutes)***
    a. **Wrap-Up:** Conclude the workshop, summarize key points and thank the participants for their insights.
    b. **Last Thoughts**: Give the participants an opportunity to add anything else they believe is relevant.
    c. **Next Steps**: Explain the next steps in the research process and how their input will be used.
    d. **Show gratitude**: Close the workshop with sincere thanks and appreciation for the participants' time and insights.

e. **Organize** the material used and collect the recording devices.

9. **Post-Workshop:**
    a. **Debrief:** Immediately after, note impressions and take preliminary notes on main insights gained.
    b. **Transcription:** Transcribe the workshop as soon as possible while the discussion is still fresh in the facilitators' mind. These notes will be added to the central repository for data collection.
    c. **Synthesis:** Analyse and synthesize the data, looking for patterns, key themes, and insights related to the research.
    d. **Discuss with Supervisors:** Discuss the interview outcomes and any insights that may be relevant to the research.

This guideline acts as a suggested approach. The researcher should be adaptable and flexible to specific situations encountered during the workshop.

Appendix 3: Interview Consent Form

The following consent form was sent to all participants. The consent form was sent in Spanish as was the language in which the interviews were conducted.

Dear participant,

You are being invited to participate in my master's thesis research project titled *Community-Led Circular Economy Initiatives in Colombia: A Study of Multi-Value Creation*. The interview is expected to last a maximum of 1 hour. After reviewing the main topics and procedures with the respective committees at Delft University, I do not anticipate any risks associated with your participation. Nevertheless, you have the right to stop the interview, omit any questions or withdraw your participation from the research at any time.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by anonymising the translated interview, deleting the recording once the transcription has been conducted and storing everything in the approved channels provided by the university.

The purpose of this research study is to understand the social, environmental, and economic impacts of a circular initiative conducted in the Global South, providing insights and recommendations for the development of future initiatives related to the circular economy. If you decide to participate, you agree to the following:

1. You are voluntarily taking part in this project. You understand that you do not have to take part and can stop the interview at any time.
2. You do not expect to receive any benefit or payment for the participation.
3. The interview will be recorded, and a transcript will be generated.
4. If requested, you will be sent the transcript and given the opportunity to correct any factual errors.
5. Access to the interview transcript will be limited to the researcher, Juanita Sierra Gómez, and academic supervisors and researchers with whom she might collaborate as part of the research process.

6. Any summary of the interview content, or direct quotations from the interview, that can be made available through academic publication or other academic outlets will be anonymised so that the participant can in no way be identified, and care will be taken to ensure that other information in the interview that could identify yourself is not revealed.
7. All or part of the content of the interview may be used in academic papers.
8. The actual recording of the interview and the transcripts will be deleted with the end of this project.
9. You can ask any questions you might have, and you understand that you are free to contact the researcher with any questions that you may have in the future.

_____	_____	_____
Name of participant	Signature	Date

Appendix 4: Workshop Consent Form

The following consent form was distributed to all participants, with translations provided in Spanish, the language of the workshop proceedings.

Dear participant,

You are being invited to participate in my master's thesis research project titled *Community-Led Circular Economy Initiatives in Colombia: A Study of Multi-Value Creation*. The workshop is expected to last a maximum of 4 hours. After reviewing the main topics and procedures with the respective committees at Delft University, I do not anticipate any risks associated with your participation. Nevertheless, you have the right to withdraw your participation from the research at any time.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by anonymising the translated notes, deleting the recording once the transcription has been conducted and storing everything in the approved channels provided by the university.

The purpose of this research study is to understand the social, environmental, and economic impacts of a circular initiative conducted in the Global South, providing insights and recommendations for the development of future initiatives related to the circular economy. If you decide to participate, you agree to the following:

1. You are voluntarily taking part in this project. You understand that you do not have to take part and can stop the interview at any time.
2. You do not expect to receive any benefit or payment for the participation.
3. The workshop will be recorded, and a transcript will be generated.
4. If requested, you will be sent the transcript and given the opportunity to correct any factual errors.

5. Access to the transcript will be limited to the researcher, Juanita Sierra Gómez, and academic supervisors and researchers with whom she might collaborate as part of the research process.
6. Any summary of the workshop content, or direct quotations from it, that can be made available through academic publication or other academic outlets will be anonymised so that the participant can in no way be identified, and care will be taken to ensure that other information that could identify yourself is not revealed.
7. All or part of the content of the workshop may be used in academic papers.
8. The actual recording of the workshop and the transcripts will be deleted with the end of this project.
9. You can ask any questions you might have, and you understand that you are free to contact the researcher with any questions that you may have in the future.

If you would like any further information about the research, now or in the future, you can turn to Juanita Sierra Gómez (e-mail: j.sierragomez@student.tudelft.nl).

_____	_____	_____
Name of participant	Signature	Date

Appendix 5: Complete Codebook

Table 3. Complete coding frame

Group #	Code group	Code Categories	Individual Codes
1	Understanding the system	Waste management practices (official)	Landfilling
			Segregation and Recycling
		Waste management practices (unofficial)	Illegal dumpsites
			waste burial
			Waste burning at home
			Waste burning at the beach
			Volunteers that clean up
			Dumping at sea
		Actors and roles	Donations
			Volunteers that clean up
			NGOs
			Companies
			Associations
			Government
			Community Council
		GdM Activities (fishing)	Restrictions: "good" and "bad" water
			Description: Back-breaking activity
			Description: Risks
			Description: Routine
			Description: Molluscs characteristics
		GdM Activities (recycling)	Description: areas
			Description: material
			Description: process

			Description: routine
		Spaces	Mangroves: current status
			Mangroves: pressures
			Mangroves: biodiversity
			Mangroves: material
			Beaches: current status
			Beaches: material
			Beaches: description
			Estuaries: description
			Estuaries: current status
			Estuaries: biodiversity
		Plastic Pollution	Identified sources
			General description
			Problems: bioaccumulation
			Natural Phenomena driving plastic accumulation
		Social context	Poverty
			Displaced communities
			Vulnerable Communities
			Security issues
2	Barriers	Pertaining the Supply Chain	Complexity
			Difficult traceability
			Inverse logistics challenges
			Bottlenecks to supply material
		Pertaining gubernmental actions	Management Plans not updated
			Lack of local governance structure
			Lack of service provision
			Lack of infrastructure
		Pertaining the social sphere	Discrimination
			Lack of environmental education and awareness
			Lack of actor's alignment
			Citizens behaviour
			No income stability
		Pertaining the market	Lack of trust on material delivered
			Lack of knowledge of the material itself
			Lack of technologies to process the material as it is collected
			Price volatility
			Volume as main driver
			Operational costs
			Limitations to the recycling technologies
			Lack of stable clients
3	Opportunities	Pertaining the market	New technologies
			Bigger installed capacity in recycling facilities
			Demand for recycled products

			New materials
			New business models
		Pertaning the Supply Chain	New collection methods (e.g., plastic as currency)
			Processes optimization
		Pertaining gubernmental actions	Legislation: Single-use plastics
			Legislation: EPR
			Legislation: Conservation
		Pertaining the social sphere	Hollistic interventions
			Groundwork to establish trust with communities
			Environmental education
		Pertaining the mangrove	Carbon markets
			Added value to the ecosystem
4	Enabling Capital	Environmental Responsibility	Contribution to Pollution
			Reputation
		Social Responsibility	Contribution to social development
			Provide sustenance for vulnerable actors
		GdM Motivation	Wellbeing
			Desire to Improve
			Their children and their future
			To reduce pollution, to help the environment
		Aspirations	Leadership
			Reference in the field
			Positive impact
5	Values	Aesthetic	Cleannliness
			Improvement of spaces
		Cultural	Connection with nature
			Upholding traditional Knowledge
			Upholding traditional practices
			Incorporating new knowledge
		Economic	Added income
		Social	Response to local needs
			Access to education
			Breaking the poverty cycle
			Capacity building
			Community empowerment
			Community leadership
			Behavioural changes
		Environmental	Environmental education and awareness
			Reduction of pollution
			Increased water quality
			Animal population recovery
			Increased rate of recycling
			Reduction in poor waste management practices

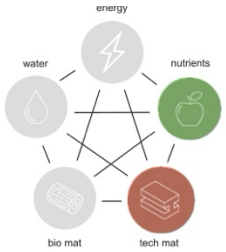
Appendix 6: CVF Infographic of GdM Initiative

Title of Initiative: Guardianas del Manglar

Guardianas del Manglar is an initiative where local fisherwomen who collect mollusks from the mangrove also gather recyclable materials from the environment, including the mangrove, estuaries, and beaches. In collaboration with NGOs and businesses, the women attend workshops on various topics, including finance, empowerment, and health. By participating in this initiative, they increase their income and contribute to the protection of the ecosystems surrounding Buenaventura.

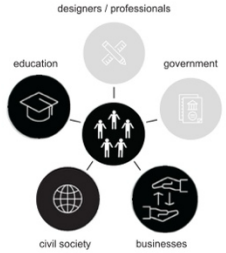
Enablers

The skills, passion, and wisdom from the GdM, ASOGESAMPA, Organización Carvajal, and Carvajal are fundamental to this initiative's success. Furthermore, the network of allies brought together by businesses and foundations, as well as donations in the form of useful tools for the Guardianas' trade, all enable this initiative to succeed.



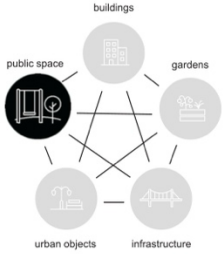
Elements

The initiative addresses nutrient cycles through its deep-rooted tradition of artisanally collecting mollusks that grow in the mangroves. Additionally, it deals with technical materials by recovering recyclable resources from marine environments.



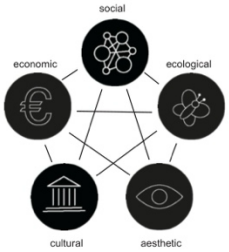
Actors

A variety of actors —namely Guardianas, foundations, NGOs, businesses, and educational sectors—are involved and coordinated in the different activities that comprise this initiative.



Spatial elements

Guardianas del Manglar has a significant impact on the state of public spaces in the coastal area of Buenaventura. By collecting recyclable materials, they help clean and preserve mangroves, beaches, and estuaries.



Values

There is multiple value creation in the different activities of Guardianas del Manglar. Economic values are reflected in the added income, social values in empowerment, access to education, and increased social cohesion. Cultural values are upheld as the initiative preserves Afro-Colombian traditions. Aesthetic values are seen in the impact on public spaces. Environmental values are realized as they aim to preserve the mangroves and reduce pollution in marine environments.