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Land and water use conflicts along the Utinga River Basin in Brazil

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I, Ndidzulafhi Innocent Sinthumule, as supervisor of the student Josefina Paz Besomi Ormazábal, hereby APPROVE the thesis entitled Land and water use conflicts along the Utinga River Basin in Brazil.

Place, Johannesburg, South Africa Date 03 September 2025

Signature______________

Abstract

This research, framed within political ecology, analyzes socio-environmental conflicts over land and water use in the Utinga River Basin. Its specific aims were to: (1) identify the main land and water use activities taking place along the Utinga River Basin; (2) describe how different actors in the Utinga River Basin relate to land and water; (3) assess the social impacts of the conflict on traditional water-related practices of communities inhabiting the Utinga River and their reactions to those impacts; and (4) identify how power relationships between different actors shape the uses of land and water in the Utinga River Basin. The study followed a qualitative and quantitative mixed-method case study design. Qualitative techniques included semi-structured interviews, focus groups, participatory mapping, participant observation, and document analysis. Qualitative data was analysed through thematic content analysis. Quantitative techniques involved a thematic map with proportional symbols and a spatial analysis of satellite imagery from Google Earth Pro. The findings show that the expansion of banana and eucalyptus monocultures has reconfigured access to water. Three main types of knowledge mediate relations with land and water—conventional-modern, traditional, and agroecological—whose use varies across actors. A diversity of valuations and principles also emerged, including water and land as means of life, as spiritual entities, and as elements tied to collective care or economic charging. Social impacts were identified in daily water uses, followed by increased workloads, cultural and spiritual disruptions, and psychological effects. Different types of power shape the conflicts, marked by strong historical asymmetries. The findings of this research indicate that conflicts in the Utinga River Basin arise from the interplay between land and water uses, and power relations, reflecting disputes over the control of means of production and reproduction of life, as well as over valuations, knowledge, and principles of relation with land and water. The conclusions underline that economic power, coupled with its fusion with political authority, plays a decisive role in reproducing inequalities of access to land and water in the basin. Yet, alongside these entrenched asymmetries, the endurance of traditional practices and ongoing agroecological transitions act as forms of resistance. The recommendations highlight the importance of governance arrangements that recognize the plurality of knowledge systems, link land and water management, and reinforce community autonomy to sustain peasant livelihoods in their diversity.

Keywords: Socio-environmental conflicts; Knowledge systems; Power relations; Peasant livelihoods.

Résumé

Cette recherche, inscrite dans le champ de l'écologie politique, analyse les conflits socio-environnementaux liés à l'usage des terres et de l'eau dans le bassin de la rivière Utinga. Ses objectifs sont: (1) identifier les principales activités d'utilisation des terres et de l'eau; (2) décrire comment les acteurs du bassin se rapportent à la terre et à l'eau; (3) évaluer les impacts sociaux du conflit sur les pratiques traditionnelles liées à l'eau et les réponses communautaires; et (4) analyser comment les rapports de pouvoir façonnent ces usages. L'étude adopte une méthodologie mixte, qualitative et quantitative, dans le cadre d'une étude de cas. Les techniques qualitatives comprennent des entretiens semi-directifs, des groupes de discussion, la cartographie participative, l'observation participante et l'analyse documentaire, examinés par analyse thématique. Les techniques quantitatives incluent une carte thématique avec symboles proportionnels et l'analyse spatiale d'images satellites issues de Google Earth Pro. Les résultats montrent que l'expansion des monocultures de banane et d'eucalyptus a reconfiguré l'accès à l'eau. Trois types de savoirs structurent les relations avec la terre et l'eau. Moderne, traditionnel et agroécologique, dont l'usage varie selon les acteurs. Une pluralité de valorisations et de principes est également apparue, terre et l'eau comme bases des moyens de vie, comme entités spirituelles ou comme objets de soin collectif et de tarification. Les impacts sociaux se traduisent par des charges de travail accrues, des perturbations culturelles et spirituelles ainsi que des effets psychologiques. Différents rapports de pouvoir, marqués par de fortes asymétries historiques, structurent ces conflits. Les résultats indiquent que les conflits du bassin de l'Utinga résultent de l'interaction entre usages de la terre et de l'eau et rapports de pouvoir, reflétant disputes autour du contrôle des moyens de production et de reproduction de la vie, et autour des valorisations, savoirs et principes de relation avec la nature. Les conclusions soulignent que le pouvoir économique, associé à sa fusion avec l'autorité politique, joue un rôle décisif dans la reproduction des inégalités d'accès à la terre et à l'eau dans le bassin. Pourtant, à côté de ces asymétries enracinées, la persistance des pratiques traditionnelles et les transitions agroécologiques en cours agissent comme des formes de résistance. Les recommandations soulignent l'importance de dispositifs de gouvernance capables de reconnaître la pluralité des systèmes de savoirs, d'articuler la gestion de la terre et de l'eau et de renforcer l'autonomie communautaire afin de préserver la diversité des moyens de vie paysans.

Mots-clés: Conflits socio-environnementaux; Systèmes de savoirs; Rapports de pouvoir; Moyens de vie paysans.

Contents

Chapter 1: Introduction and Background

This dissertation aims to analyze the current land and water use conflicts that have arisen along the Utinga River, Bahía State, Brazil, in recent years due to water shortages during the driest months of the year. This analysis is set within a broader Latin American context, responding to global economic dynamics that have been particularly prominent in Brazil. The study will examine various dimensions of the conflict to understand the situation of the sub-basin within a larger framework of rural transformation linked to the expansion of agribusiness and changes in the role of the state in this expansion and water governance. The research seeks to deepen the understanding of these conflicts by exploring different aspects, such as the conflicting land and water uses of the different actors along the river, the political dimensions related to power relations that define control over natural resources, and the associated knowledge and practices. Additionally, it will consider the impacts on traditional knowledge and practices resulting from the depletion of these resources. The aim is to understand key elements that shape these conflicts, seeing them not only as part of wider global dynamics but also as processes rooted in this territory, with its own history and characteristics that have long drawn different communities and economic activities.

The Utinga River sub-basin, the area proposed for this dissertation, is part of the Paraguaçu River basin and is situated within the Chapada Diamantina Region in the state of Bahiahh in Brazil. The Utinga River, extending 80 kilometers, has historically served as a crucial water source for various human groups who, at different times in history, have settled in the area to live and/or engage in productive and extractive activities and it has served as a spiritual connection for the Quilombola communities, who perform cultural and spiritual activities along the river (Arrazola & Dourado, 2021). As a result, the river flows provide water to various riverside communities, whose inhabitants are predominantly family farmers and artisanal fishers, considering the river as their only source of water (SIHS, 2021a).

The surroundings of the river were long inhabited by the Payayá Indigenous people, who once moved through the Paraguaçu River basin but suffered severe disruption with Portuguese colonization. In the seventeenth century, as the conquest advanced, the area was transformed into large estates dedicated to agriculture and cattle ranching. These estates were created to supply the extensive sugarcane plantations along the Bahian coast and, later, the mining activities in the Chapada Diamantina region. This transformation was made possible by the forced importation of large numbers of enslaved Africans, who were brought to work in mineral extraction and on the estates. This historical backdrop explains the presence of numerous Quilombola communities in the area today that escaped from this forced work to live in hidden territories. During the 1970s, land disputes intensified as efforts to expel squatters from large estates increased. This was part of the agrarian modernization push by the military regime, which eventually led to the establishment of many agrarian reform settlements in the following decades. Today, the remaining Papayá indigenous people are located at the river's source, on a 50-hectare land granted by the State of Bahia. In the central region, there are 15 agrarian reform settlements inhabited by small-scale family farmers, and towards the river’s end, there are 4 Quilombola communities (Arrazola & Dourado, 2021).

These various human groups that have settled in the region possess different knowledge and practices for water use and management developed over their history in the area (Dourado, 2024). However, over the past 30 years, they have experienced a decline in their autonomy to apply this knowledge, Due to the Master Plan for Water Resources established in 1993 to set up water concessions, the state positioned itself as the controller of the water resource, and the social irrigation technologies of the communities were dismantled (Observatório dos Conflitos Socioambientais da Chapada Diamantina (OCA Chapada Diamantina), 2023). In the last decade, large banana monocultures have begun to spread along both sides of the river, managed by medium-sized farmers. The expansion of this agribusiness has become particularly noticeable since 2016 (Arrazola & Dourado, 2021). Currently, there are 3,500 hectares of irrigated land along the river, where 2.4 million banana plants are cultivated (OCA Chapada Diamantina (OCA), 2023).

Land-use conflicts can be broadly understood as competing claims over present and future uses of land, reflecting struggles for scarce resources (Magsi & Torre, 2013). Water disputes, in turn, are a form of ecological distribution conflict that result from competition over access, allocation, and the impacts of resource use, such as contamination (Rodríguez-Labajos & Martínez-Alier, 2015). These struggles are interconnected, since competition for land is inseparable from the ways water is distributed and managed—whether in terms of quality, quantity, or timing (Hodgson, 2004). Since many water conflicts in Brazil are also linked to land disputes, the two are deeply intertwined (Comissão Pastoral da Terra (CPT), 2023). Conflicts in the Utinga River basin can be categorized as water and land use conflicts, stemming from an intertwining of land and water use that arises because the contentious nature of land use for expanding irrigated areas is tied to its high water consumption. In the Utinga River, the concentration of water rights among a small number of users (OCA Chapada Diamantina, 2023) and the ongoing water crisis (SIHS, 2022) have created open disputes, as upstream irrigation takes water away from local communities who depend on it for daily consumption (OCA, 2023). The limited access to water for some groups complicates certain uses, which can temporarily impede spiritual activities in the river and small-scale agricultural practices depending on their spatial location and relationship with the river (Arrazola and Dourado, 2021). Given the role of the state through regulations and its involvement in water management, it also emerges as a significant actor in these conflicts (OCA, 2023). While several sources mention the emergence of conflicts related to water use linked to periods of lower water availability (OCA Chapada Diamantina, 2023; Secretariat of Water Infrastructure and Sanitation of the State of Bahia (SIHS), 2022; Arrazola & Dourado, 2019), there is generally no reference to the types of actions that constitute these conflicts. However, Arrazola & Dourado (2019) note that in 2018, small producers protested by blocking the BR-242 highway.

Understanding the conflict and its potential escalation requires looking at several factors: resource exploitation that results in land dispossession, divergent views and values about nature among groups, institutional and governance shortcomings, and unequal access to resources (Sánchez, 2022). As Paz (2014, p. 2) states, "the controversy is woven around both the material and symbolic dimensions of the environment". This symbolic dimension guides the course of the conflict, as the degree of confrontation depends on how the contested resources are valued. (Balazote, 2013). This study aims to examine the conflict by analysing some of the above-mentioned elements, starting by identifying the main land and water uses; symbolic aspects like values and meanings associated with land and water by different actors; the socio-political structures contributing to the conflict, and their potential role in its resolution. The study will also examine how the conflict affects the lives of riverine inhabitants, focusing especially on traditional water management knowledge and the ways communities have responded to these changes.

1.1. Problem statement

In the Utinga River basin, a major socio-environmental conflict has emerged around land and water use, which is intensified by the recent expansion of agriculture along the riverbanks. This expansion has reduced water availability, a situation aggravated by declining rainfall in recent years. Conflicts in the Utinga River basin arise from the close link between land and water use under conditions of scarcity. Intensive irrigation demands collide with water rights concentrated in certain areas, creating disputes over access and disturbing both farming practices and spiritual life along the river The conflict involves the State of Bahia, more specifically the Institute of the Environment and Water Resources (INEMA); the Association of Farmers of the Utinga River Basin, which represents the producers of the farthest-reaching monoculture in the basin; and various communities that inhabit the banks of the Utinga River, including the Payayá indigenous people, peasant settlements, and Quilombola communities. Each actor maintains a particular relationship with the river, which produces varied experiences and responses. This diversity makes it especially difficult to reach solutions to the conflict.

1.2. Research objectives

General Objective:

Analyze the socio-environmental land and water use conflicts in the Utinga River Basin in Brazil.

Specific Objectives:

1. To identify the main land and water use activities taking place along the Utinga River Basin.
2. To describe how different actors in the Utinga River Basin relate to land and water.
3. To identify the role of socio-political power structures in shaping the uses of land and water in the Utinga River Basin.
4. To assess the social impacts of the conflict on traditional water-related practices of communities inhabiting the Utinga River and their reactions to those impacts.

1.3. Research questions

1. What are the main land and water use activities along the Utinga River Basin?
2. How do different actors in the Utinga River Basin relate to land and water?

3. What is the role of socio-political power structures in shaping the uses of land and water in the Utinga River Basin?

4. What are the social impacts of the conflict on traditional water-related practices of communities inhabiting the Utinga River, and how have these communities reacted to these impacts?

1.4. Justification of research project

In the last few decades, the advance of agribusiness has profoundly altered the Latin American countryside, largely through the continuous expansion of the agricultural frontier (Ceroni, 2018). The logic behind agribusiness expansion is tied to the commodification of agricultural activity, focusing on securing profits throughout the capitalist production and circulation process. This transformation is tied to a global production system dominated by oligopolies and oriented toward international consumers at the expense of local ones. It entails growing land grabbing and concentration in the Global South, together with large-scale monocultures that demand intensive use of energy, water, soil, and agrochemicals, and generate an unprecedented circulation of energy and materials (Panez, Mansilla Quiñones & Moreira-Muñoz, 2018). For this expansion of agribusiness to occur, the state has played a central role in what is understood as the neoliberal advance: the privatization of strategic resources such as water and land; deregulation of economic and environmental policies to encourage foreign capital investment in resource-intensive extraction and production activities; and territorial reorganization through infrastructure projects that direct capital investment into strategic sectors. In water management, it is possible to see the encroachment of the private sector into areas previously controlled by the state (Ávila-García, 2016). Following the neoliberal reforms of the 1980s, the state once again took on a central role in rule-making under the banner of 'good governance.' In practice, this meant a strengthening of state control in favor of transnational interests, through new norms and legal procedures that defined water rights and promoted institutions aimed at its 'efficient' and 'rational' use. (Roth, Boelens, & Zwarteveen, 2015).

In Latin America, the neoliberalization of water has led to the dismantling of the water–soil–forest matrix that was central to pre-colonial worldviews. This rupture has ignored the social and cultural dimensions of territory and facilitated the destruction of common goods, most visibly through the expansion of commercial agriculture for export. This expansion has caused the overexploitation of aquifers in some regions and the dispossession of lands inhabited by Indigenous and peasant communities. Such dispossession has deepened with privatization and the creation of markets for water and land rights, reducing them to mere economic commodities. Furthermore, people have faced restricted access to water for economic reasons, a situation that infringes upon the human right to water. These regional dynamics have triggered conflicts with Indigenous and peasant communities. (Ávila-García, 2016). The Comissão Pastoral da Terra has found that the increase in recorded rural conflicts in recent years in Brazil can largely be explained by the advancement of the hegemony of export sectors of primary goods, agribusiness, and mining, in conjunction with what they have termed a counter-reform in land policy that favors these sectors while abandoning policies of land redistribution and recognition, as well as support for rural workers (Centro de Documentação Dom Tomás Balduino – CPT, 2023).

The sub-basin of the Utinga River is situated within the Paraguaçu River Basin and the Chapada Diamantina region in the State of Bahia, Brazil. In Chapada Diamantina, Arrazola (2024) examines several factors that have facilitated the expansion of agribusiness linked to the emergence of conflicts in the area: the prominent role of the state as a facilitator and the increase in irrigated land in the Chapada Diamantina region as companies rapidly acquire water rights. Dourado (2024) analyzes conflicts in five communities afected by the expansion of monocultures that has encroached on the springs, wich are vital for them. The study points to a clear disconnect between public water management, local values, ancestral worldviews, and the state's practices in allocating water rights. In the Paraguaçu Basin, Dantas de Ávila et al. (2020) highlight the presence of a dominant block of water users in the basin's governance, with little effective opposition and isolated civil society forces. Similarly, Arrazola and Dourado (2019) link the expansion of agribusiness to a lack of transparency in water rights allocations and to power asymmetries within governance structures. They note the resulting impacts on local communities, including threats to their survival and to their territorial rights.

Specifically, regarding the Utinga River, Arrazola and Dourado (2021) explore the perceptions of communities living along the Utinga River concerning the water-related conflicts that have emerged because of the expansion of banana monocultures, examining how these perceptions are tied to their diverse settlement histories. This dissertation aims to build upon this foundation by deepening the analysis of certain elements that are part of the results but not treated in detail, such as the diversity and location of different land and water uses in the Utinga River. It seeks to systematically explore the values, meanings, and knowledge of various stakeholders related to land and water, as well as to examine the consequences of this water crisis on that knowledge. Additionally, it aims to incorporate other components into the analysis related to the socio-political structures within the sub-basin that shape current land and water uses. This research seeks to investigate legal norms, institutions, and governance mechanisms of the Paraguaçu Basin that have been analyzed in previous studies, while specifically addressing the power dynamics among actors in the Utinga sub-basin. Finally, it aims to complement the findings by incorporating new sources of information and perspectives from other stakeholders, such as INEMA. A deeper understanding of the conflict is essential for shaping responses that both uphold human rights and recognize the cultural diversity of the territory.

1.5. The study area

The following section provides a description of the study area. The research will focus on the communities and productive activities along the Utinga River, from its source to its confluence with the Santo Antonio River. Therefore, the Utinga River sub-basin will be described as the study area.

The Utinga River sub-basin is located in the eastern part of the Chapada Diamantina region, in the central-northern area of the State of Bahia, Brazil, and covers an area of 2,906 km^2. The river is 80 km long, and the rivers Lajinha, Bonito, Mocambo, and Cachoeirinha are its main tributaries. The Utinga River originates near the locality of Cabeceira do Rio, from where it continues in a south-southwest direction and flows into the Santo Antônio River. Thus, the Utinga River sub-basin is part of the Paraguaçu River basin on its western side (Figure 1.1), which is of fundamental importance to the State of Bahia (SIHS, 2021a). The Chapada Diamantina region features a diverse mountainous terrain. In the eastern portion, where the study area is located, the terrain is less irregular than in the western portion, though quartz rocks are predominant, and the soils in the valleys are deep (de Lima & Nolasco, 2015). The Utinga River sub-basin has a semi-humid climate within the broader tropical regime that characterizes the Paraguaçu River (Santo & Carelli, 2016). Average annual rainfall is 667 mm, but a downward trend has been observed in the ten-year moving average, with precipitation falling to a minimum of 455.1 mm (SIHS, 2021).

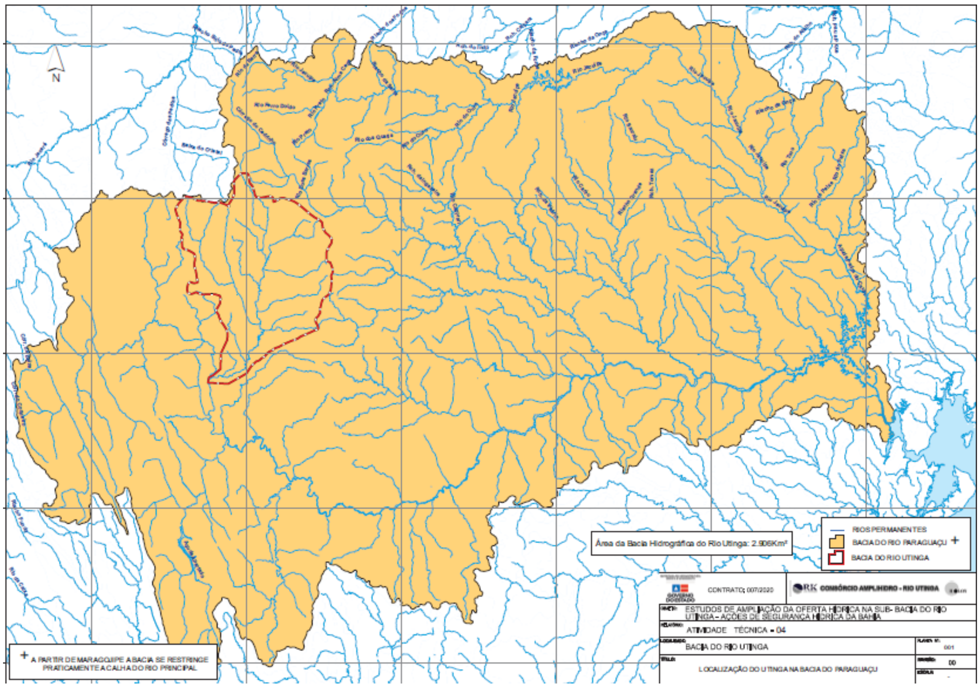

Figure 1.1. *Utinga River Sub-Basin in the Paraguaçu River Basin.* Source: SIHS, 2021a.

As part of the Paraguaçu basin, the Utinga River sub-basin belongs to the Water Management Planning Region – RPGA X-Rio Paraguaçu (SIHS, 2021a). In terms of governance, the Utinga River sub-basin is included in the water governance structure through the Hydrographic Committee of the Paraguaçu Basin (INEMA, n/d). The Utinga River sub-basin comprises eleven municipalities, which are fully or partially located within the sub-basin and are affected by the water security of this territory to varying degrees. SIHS (2021b) reports the areas of the municipalities that are mostly within the sub-basin boundaries and are primarily supplied by the basin's waters, including rural populations. These municipalities are Wagner, Bonito, Utinga, and Lajedinho (Table 1.1).

Table 1.1. *Areas of Municipalities and Areas within the Utinga River Sub-Basin.* Source: SIHS (2021).

Municipality	Area of the municipality (km2) (a)	Area in the basin (Km2) (b)	% (b)/(a)
Utinga	633,76	549,03	86,6
Bonito	791,28	504,91	63,8
Wagner	522,37	421,25	80,6
Lajedinho	846,73	380,22	44,9
Total	2.794,13	1.855,41	

Following the criteria of the Secretariat for Water Infrastructure and Sanitation of the State of Bahia (2021) to estimate the sub-basin's population based on the populations of municipalities mostly within the basin limits, according to the 2022 census data, the estimated population of the study area is 45,151 people (Brazilian Institute of Geography and Statistics (IBGE), 2024). Data from 2017 show that public administration accounted for 39% of the GDP of these municipalities, services and commerce for 36%, industry for 15%, and agriculture for 10% (SIHS, 2021). Agriculture and fish farming are carried out mostly on a small scale for subsistence, although some crops such as banana, coffee, papaya, cassava, and passion fruit are produced on a larger scale. Banana is the basin's dominant crop and has grown significantly between 2010 and 2022 throughout the Utinga River Basin (IBGE, 2024). By 2021, there were 3,500 hectares of irrigated area along the Utinga River, cultivating 2.4 million banana plants (SIHS, 2021). Specifically, for the population living along and in the vicinity of the Utinga River, the focus of this research, Arrazola & Dourado (2021) identified and mapped the communities that inhabit the Utinga River valley and which are experiencing water-related conflicts. Additionally, the distribution of banana monocultures near the river is identified (Figure 1.2). Given the water crisis that the river is experiencing, the Secretariat of Water Infrastructure and Sanitation of the State of Bahia (SIHS, 2022) proposed infrastructure to increase regional water availability. This plan includes nine dams along the river's 80 kilometers, with identified potential sites (SIHS, 2022) (Figure 1.3).

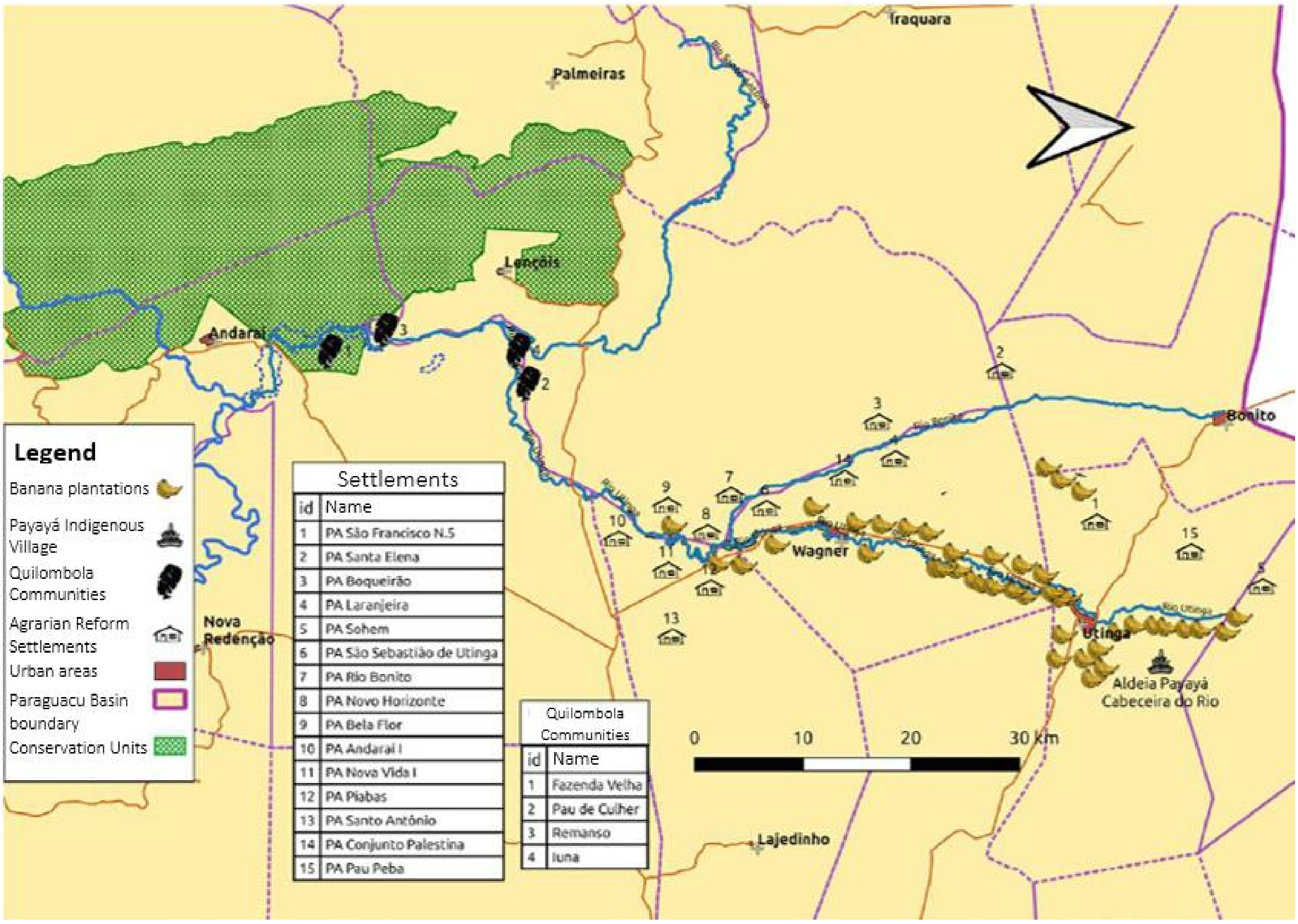

Figure 1.2. *Location of the communities affected by the conflicts in the Utinga River valley*. Source: Arrazola & Dourado, 2022

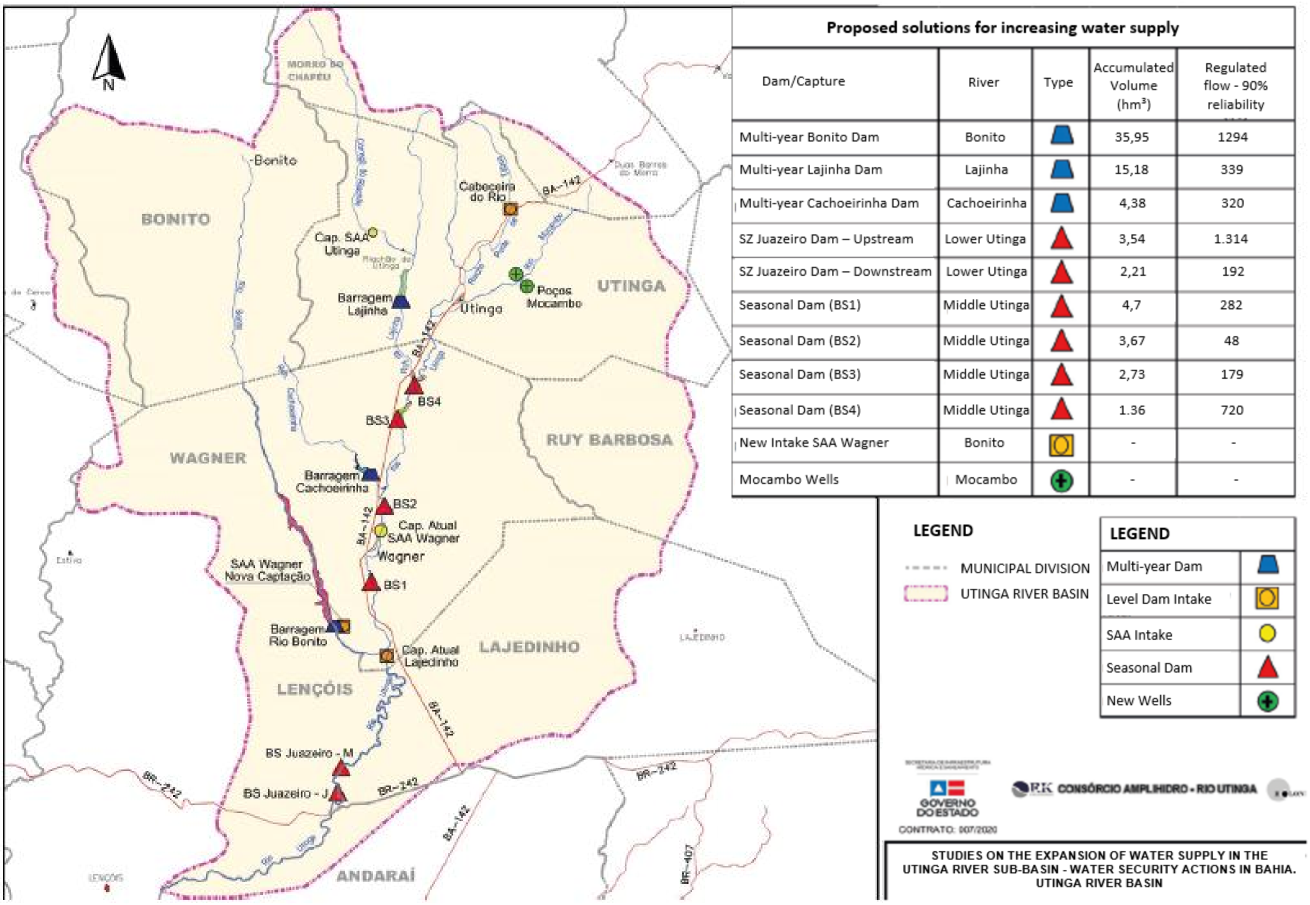

Figure 1.3. *Map of solutions for increasing water supply*. Source: SIHS, 2022

1.6. Guide to chapters

This thesis is structured in six chapters to progressively build an analysis of land and water use conflicts along the Utinga River Basin, moving from theoretical and empirical foundations to methodological choices, empirical findings, discussions, conclusions, and recommendations for addressing the conflicts identified.

Chapter 2 presents the literature review, situating the study within the political ecology approach and ecological distribution conflicts. It reviews theoretical and empirical debates on land and water use conflicts, introducing the concept of hydrosocial territories to understand them as interconnected processes. The chapter examines how such conflicts are shaped by power relations, knowledge systems, and valuation languages, and highlights their impacts on local populations, establishing the conceptual framework for the analysis.

Chapter 3 describes the methodology, outlining the mixed-method case study design that combines qualitative and quantitative approaches. It explains the use of semi-structured interviews, focus groups, participant observation, participatory mapping, document review, and spatial analysis, with thematic analysis as the main interpretive tool. It also explains the choice of purposeful and snowball sampling to access information-rich perspectives from communities, agribusiness actors, state institutions, and civil society organizations. The chapter also presents an analysis of the ethical considerations and practical limitations faced during the research.

Chapter 4 presents the results, organized around key themes. First, it examines land and water uses in the basin, and the transformations driven by banana and eucalyptus expansion, which resulted in increased water consumption and the allocation of water rights in the middle and upper sections of the Utinga River. Second, it explores the different ways in which actors involved in the conflicts relate to land and water, identifying diverse knowledge systems, values, and principles at play. Third, it highlights the social impacts derived from the ecological impacts of these conflicts on affected communities. Finally, it analyzes the power relations sustained by different actors, considering both their historical and contemporary dimensions, the arenas where these relations unfold, and how they are shaped by material and symbolic dimensions in a dialectical relationship.

Chapter 5 develops the discussion, interpreting the results in dialogue with the theoretical debates reviewed earlier. It analyzes upstream–downstream relations and their influence on the configuration of conflicts, the predominance of economic valuation in state policies, and the marginalization of community knowledge and practices. The analysis contrasts these findings with existing literature and comparable cases, underscoring both common patterns and the particular dynamics of the Utinga Basin.

Chapter 6 concludes the thesis with a synthesis of the main contributions, showing how water-intensive monocultures and governance asymmetries reinforce inequalities in access to land and water. It stresses the risks these dynamics pose to peasant livelihoods, autonomy, and cultural practices. Finally, the chapter offers recommendations to strengthen governance. These include recognizing diverse valuation and knowledge systems, and integrating land and water management into preventive measures with the aim of allowing the reproduction of the diverse peasant ways of life present in the Utinga River Basin.

Chapter 2. Literature Review

2.1. Political ecology approach

Political ecology examines the links between power relations, environmental change, and social structures. It shows how power distribution influences the use of natural resources, both among human groups and in the interactions between humans and other species (Rodríguez-Labajos & Martínez-Alier, 2015). It focuses on the unequal distribution of the benefits and costs of environmental change processes, which is sustained by the exclusion and lack of recognition of marginalized groups (Magsi & Torre, 2013; Scheidel et al., 2018). This perspective underscores that conflicts over natural resources are driven less by scarcity and more by power dynamics, valuation, and distribution dynamics. Leff (2015) defines political ecology as

> "the study of power relations and political conflict over ecological distribution and the social struggles for the appropriation of nature; it is the field of controversies on the ways of understanding the relations between humanity and nature, the history of exploitation of nature and the submission of cultures, of their subsumption to capitalism and to the rationality of the global world-system; of power strategies within the geopolitics of sustainable development and for the construction of an environmental rationality" (p.33).

Political ecology has its roots in human geography, cultural ecology, and ethnobiology, disciplines that examine the power relations embedded in human interactions with the environment. It looks at ecological distribution conflicts, focusing on historical exploitation and the socio-political struggles around the appropriation of nature (Leff, 2015). Political ecology covers a range of perspectives. Porto-Gonçalves and Leff (2015) point out that northern political ecology often concentrates on agrarian contexts in the Global South, focusing on Indigenous practices and their resistance to external pressures. Meanwhile, in the Global South, it arises from cultural and ecological conditions specific to these regions, emphasizing decolonization, territorial reinvention, and the re-appropriation of nature. Another important distinction is between materialist and post-structuralist perspectives (Tetreault, 2017). Materialist approaches, grounded in Marxist political economy, focus on the social metabolism of energy and materials, showing how the material basis of society underpins resource conflicts and environmental injustices (Martínez-Alier, 2007, 2011). From this perspective, political ecology shows how metabolic profiles link economic systems, power relations, and ecological sustainability across scales, grounding the analysis in the physical flows of energy and matter. In contrast, post-structuralist approaches see environmental problems as socially constructed and examine how narratives and epistemologies shape knowledge and conflict (Tetreault, 2017). These perspectives are not necessarily incompatible, and a dialectical or eclectic integration can offer an alternative to the extremes of each framework (Tetreault, 2017). This is especially important for understanding the cultural dimensions of conflict, since, as Escobar (2006) notes, differences in power between knowledge systems and cultural practices are central to many environmental disputes. From this standpoint, discourse analysis contributes to revealing the "languages of valuation" that mediate such disputes (Tetreault, 2017), while Rodríguez-Labajos and Martínez-Alier (2015) remind us that conflicts over resources are always also struggles over meanings.

Political ecology offers a complex view of socio-environmental conflicts, rejecting the idea that environmental degradation is simply the result of poverty or hunger. Rather, it explains degradation through power dynamics, in which certain groups exert control over environmental conflicts. This approach helps understand the different scales of socio-territorial issues and reveals the networks of actors involved. It identifies various actors and their discourses on socio-territorial problems while highlighting the economic and political forces impacting local resource degradation (Calderón-Contreras, 2013). In sum, political ecology sheds light on how power, culture, and environment are intertwined and offers a critical perspective for addressing the challenges of ecological and social justice.

2.2. Definitions and Categorization of Socio-Environmental Conflicts

There are various ways to name and define conflicts related to the environment and natural resources. In the field of political ecology, environmental conflicts refer to social disputes over the usage of the environment and natural resources (Robbins, 2012). Environmental conflicts are essentially social conflicts that arise from power dynamics in public disputes over the use of nature and land. Conflicts of this nature are dynamic processes that are impacted by human conduct. They expose deeper personal relationships and experiences, despite the fact that they often harm the environment (Sánchez, 2022). Socio-environmental conflicts are the intricate issues that arise between different social groupings as a result of their different approaches to interacting with the environment. These disputes are frequently a reflection of people's differing views about the environment and the use of resources (Little, 2006). The analysis of these conflicts goes beyond the behavior of natural resources and seeks to answer questions such as: who uses the resources? When? For what reasons? At what cost? With what impacts? (Little, 2006). Socio-environmental conflicts are those related to access and control over natural goods and territory, where the actors involved have divergent interests and values regarding those, within a scenario of significant power asymmetry. These conflicts reflect different conceptions of territory, nature, and the environment (Svampa, 2013). Environmental conflicts can also be addressed from the perspective of environmental injustices, which include the unequal distribution of environmental benefits and burdens, exclusion from decision-making processes, and the lack of recognition of the values, worldviews, and material and cultural relationships that various social groups maintain with the natural environment (Scheidel, 2023). When local populations' beliefs about nature diverge from those of outsider projects, environmental disputes frequently result. This is due to the fact that residents' opinions and voices are regularly ignored, which makes them feel excluded and irritated (Balazote, 2013).

Martínez-Alier (1999) introduced ecological distribution conflicts, which draw attention to the disparities in how humans use natural resources. When people or communities react to environmental injustices and the detrimental effects of resource exploitation, these conflicts frequently result (Scheidel et al., 2020). This concept emphasizes the link between environmental sustainability and social justice. This conceptualization's central tenet is the connection between the rise in environmental problems and the growing social metabolism brought on by expanding economies and population demands (Rodríguez-Labajos & Martínez-Alier, 2015). Social metabolism is a key idea that explores how societies use and manage energy and materials, from the extraction, changing them into something useful, and ultimately disposing of what we no longer need. This concept sheds light on the conflicts that can arise from these interactions (Haberl et al., 2019). A persistent development of resource extraction frontiers, such as oil, gas, mining, eucalyptus for pulp plantations, genetically modified soy, and biofuels, has been fueled by the demand for consumer products and raw materials from industrialized nations. The way local communities operate has been profoundly changed by this process, which has also had a big impact on global economies. But it has also presented significant obstacles to the environmental well-being and social cohesion of different ecosystems and areas (Svampa & Viale, 2014). Harvey's (2007) theory of "accumulation by dispossession," according to which neoliberal policies create new opportunities for capital accumulation, is consistent with this dynamic. This has become an extractivist development paradigm in Latin America due to the "commodity consensus," which promotes vertical appropriation and exploitation of community goods, often at the expense of local residents (Svampa & Viale, 2014).

With indigenous and peasant organizations spearheading opposition activities, Svampa (2013) claims that this paradigm has increased socioenvironmental conflicts and seriously harmed the environment. This tendency is best shown by agribusiness, which has changed the spatial arrangement of rural Latin America by enlarging agricultural borders and stepping up the extraction of natural resources (Ceroni, 2018). While Martínez-Alier (2009) emphasizes that rising social metabolism due to population and economic growth inevitably triggers ecological distribution conflicts, Muradian et al. (2012) argue that a variety of mediating factors shape the manifestation of these conflicts. There are three main ways that conflict results from socio-metabolic growth: the closeness of the impacted groups to these harmful effects, the extraction of environmentally harmful materials, and the perception of an imminent threat (Scheidel, 2023). Scheidel highlights how the dynamics of these conflicts are significantly shaped by historical, ecological, technological, and societal elements, as well as ideas of justice and corporate behavior (2023). The biophysical world, the human world, and the dynamic and interdependent relationship between the two are the three interconnected dimensions that make up the socio-environmental notion. Considering these interactions, conflicts can be divided into at least three categories: those related to the control of natural resources, the environmental and social impacts arising from human and natural actions, as well as conflicts related to the use of environmental knowledge (Reis & Zanic, 2015). From the perspective of social metabolism, ecological conflicts are classified based on the points in the production chain where they occur: conflicts over the extraction of materials and energy, conflicts related to transportation, and those linked to waste and pollution (Martínez-Alier, 2007).

2.2.1. Land use conflicts

A significant difference between approaches that define disputes as the outcome of incompatible land uses and those that frame them as the consequence of conflicting demands can be seen in the literature on land use conflicts. Although they both deal with conflicts over land use and access, they draw attention to distinct underlying dynamics. On one hand, some authors, such as Magsi and Torre (2013), define land use conflicts as "competitive demands for present and future uses of land", which implies that the main driver of the conflicts is the competition for limited resources. Land use changes are being driven by the growing demand for agricultural products, which is creating competition for access to these resources. When building new infrastructure, like reservoirs for irrigation or electricity generation, it is normal practice to expropriate homes, farms, and other productive resources. Large-scale land purchases are therefore both a cause and an effect of land competition (Bruns et al., 2026). In this way, conflicts arise due to pressure on resources and the competition to accumulate land.

However, some writers approach land use disputes from the standpoint of conflicts of interest. These are viewed as conflicts resulting from divergent interests, values, and ideas about land use in addition to competing for scarce resources. For example, Buchanan (2013) discusses how severe disputes arise in developing countries between those promoting traditional land uses, such as agriculture, forestry, and conservation, and those promoting industrial extractive uses, such as mining. Since the extraction of mineral resources necessitates the removal and irreversible alteration of the surface, which impacts not only natural resources but also human settlements and activities that depend on these surface resources, these conflicts are a reflection of the incompatibility of land uses (Buchanan, 2013).

Escobar (2006) emphasizes how Colombian violence has been largely caused by the unequal distribution of land, especially because of tensions brought on by the concentration of land in the hands of a few number of people, which makes social inequality worse. In conflict-affected regions such as Colombia, Del Río Duque (2022) aimed to understand land use dynamics in two territories in Colombia, Caquetá and Cesar, and tried to connect the findings with land use conflicts at the regional level applying a methodology based on system thinking. The study demonstrates how land use conflicts are closely tied to land tenure systems, armed conflict, and socio-political factors. These conflicts go beyond territorial disputes and involve economic, environmental, and historical dimensions. On the other hand, Fernandes (2019) analyzes the territorial policies that favor agro-extractivism and their impact on agrarian conflicts in Brazil. Through the paradigmatic debate method, specific cases are examined to understand the disputes between agribusiness and peasant movements. The results show the hegemony of agrarian capitalism in the neoliberal and post-neoliberal phases as a key factor in the intensification of conflicts and how peasant actions seek to resist and advance against the latifundio-agribusiness binomial.

In line with the concept of land use conflict as an incompatibility of uses, Pineda (2014) has studied land use conflicts between private landowners and Mapuche communities in Chile from a historical perspective using document analysis. The research shows that, despite periods of lower intensity, this historical conflict remains alive and that one of its key aspects is the opposing models of life and land use. On one hand, the State promotes capitalist and privatizing development policies, private landowners use the land claimed by the Mapuche for forestry monoculture businesses, while Mapuche communities view land as a means of subsistence, essential to their identity and existence as a people, highlighting the contrasting visions of the territory (Pineda, 2014). Furthermore, Martínez and Acosta (2014) investigated using documental analysis how changes in land use have led to conflicts in Ecuador, especially due to the intensification of structural adjustment programs promoted by neoliberal policies since 1992. They identified that these reforms, which favored large landowners and opened the door to large-scale mining projects, triggered an indigenous uprising in 1994. This case demonstrates how land use changes, especially those motivated by economic interests and policies, can greatly increase social tensions and spark conflicts, especially when those changes disregard or jeopardize the interests of the local population, as claimed by Martínez and Acosta (2014).

2.2.2. Water use conflicts

The goal of water management systems has always been to alter the flow of water in river basins. In order to ensure that there is clean water, they have constructed facilities that convert salt water into fresh water as well as tanks for collecting rainfall. Depending on the actor, these changes may be valued differently. The power dynamics of the parties involved and the languages of valuation used can be used to examine the socio-environmental conflicts that frequently arise from these divergent perspectives (Rodríguez-Labajos & Martínez-Alier, 2015). Societies, or individuals and interest groups, constantly reshape river basin waterscapes in ways that reflect not only the technology available but also their conceptions of nature, the labor or capital they can mobilize, and the distribution of power and agency that determines who can make decisions on how to control, use, and share water (Molle, 2007).

According to Rodríguez-Labajos and Martínez-Alier (2015), water conflicts are a subset of ecological distribution conflicts that occur when disagreements are over the distribution and use of natural resources, such as water, or the cost of environmental effects like pollution. Phelps (2007) points out that conflict is not solely caused by drought but by the unequal distribution of resources in times of scarcity, indicating that societies tend to accept a fair division of water resources. Conflicts often arise from disagreements over how water is shared equitably among various sectors, like agriculture and industry, as well as ecological requirements. The author argues that conflicts are fueled by water shortages and the competing interests of sectors such as agriculture and industry, alongside environmental needs (Phelps, 2007). When it comes to water consumption in farming practices, it frequently conflicts with needs that focus on maintaining a healthy environment. Drought and the push of social and economic growth add further pressure (Munda, 2008; Mengyao Jiang et al., 2020). Many conflicts come from competition over scarce water, a problem made worse by population growth and rising demand. It becomes most acute when river basins are stretched to their limits and shortages occur more often and with greater intensity (Molle, 2007).

In addition to conflicts based on competition, interventions in water systems, such as large-scale infrastructure projects, can also give rise to new social tensions. Rodríguez-Labajos and Martínez-Alier (2015) point out that centralized water management and the privatization of water resources often make these tensions worse, especially when projects are designed to maximize economic gains rather than meet local needs, including those of Indigenous communities and small-scale farmers. In many situations water is prioritized for large scale projects or industry use over agriculture and local communities which can lead to conflicts regarding water rights and access. Furthermore, interventions in hydro/ecological systems by different stakeholders, each with varying political, decision-making, and discursive power, tend to distribute the costs, benefits, and risks unevenly across spatial, temporal, and social scales (Molle et al., 2007). In this context, the role that the state plays in water management are crucial. Sneddon (2010) shows that the state plays a contradictory role. While it tries to balance economic growth with ecological management, it often ends up aggravating resource conflicts and helping to sustain water-related disputes.

Because water is a shared resource, conflicts over it are deeply tied to the interconnected nature of hydrological systems, which cross political boundaries and bring different social groups into contact (Bruns et al., 2016). For instance, conflicts often arise between upstream and downstream users, as water use in one area can reduce availability for those below who depend on the same source. This stems from the interconnected hydrologic cycle that links all users to a single resource. Furthermore, basin interconnectedness also has a socio-political side, since people and groups within the same basin do not have equal power in decision-making or equal access to water resources (Molle et al., 2007). Unlike land, which is fixed in one location, water is a fluid resource, part of a cyclical process of renewal. As a flow, water connects different places (upstream/downstream), transcending political boundaries of any scale. Due to its fluid nature, conflicts over the appropriation or allocation of water have the potential to affect entire river basins (Bruns et al., 2016; Molle et al., 2007).

Conflicts over water use have been the subject of a variety of studies. In Mexico, in the Ñäñho community of Santiago Mexquititlán, a study was conducted based on the Participatory Action Research methodology to analyze the conflict related to the control of the community's water well. The research looks at how water management in the community is grounded in its traditions and culture, the cultural and social effects of losing control over water, and the resistance that has emerged in response (Flores González et al., 2024). On the other hand, in the Amazon region, Novoa Garzon et al. (2020) studied conflicts arising from the implementation of large hydroelectric projects. The study examines the practical and symbolic measures used to push this process forward, which, it argues, turn territories into functional spaces subjected to a form of 'social cleansing,' shaped by dominant ideas of 'modernity' and 'development´. The study also highlights the resistance to this advance in defense of autonomy, based on cultural repertoires that do not align with these development proposals. Finally, research explored how Latin American Andean countries' legal systems address the region's diverse local water rights and the implications of official policies aimed at recognizing these rights. It discusses how these policies often result in subtle forms of codification, confinement, and disciplining, which attempt to bring local water systems, seen as unruly, into alignment with state and market demands (Boelens, 2009). The paper examines strategies that blend local and official legal systems without challenging the existing power structures. The argument is that post-colonial recognition policies go beyond responding to demands for autonomy; they also function as tools to control and absorb local water rights into neoliberal market frameworks, even in the face of community resistance (Boelens, 2009).

2.2.3. Synthesis of land and water use conflicts

Water and land systems are almost always studied independently from each other (Bruns, et al., 2016). However, land and water are intimately linked (Hodgson, 2004). Water can either enable or constrain land-based activities, which, in turn, may affect both water quantity and quality (Bruns, et al., 2016). Current struggles over land are connected to water—and other resources—and as such, land competition is directly linked to how we use and allocate water in terms of quality, quantity, and timing (Hodgson, 2004). It has been observed that land use in the upper basin of a watershed determines water availability for downstream areas (Leite et al., 2010). Additionally, land grabbing is not only a rush for land but also for the freshwater resources available in those lands (Bruns, et al., 2016). Significant changes often occur when large infrastructural projects, such as dams, are constructed. These land use changes frequently generate conflicts by increasing pressure on land.

The concepts of the hydrosocial cycle and hydrosocial territory represent an attempt to promote an integrated understanding of these interactions by considering the various dimensions involved. Hydrosocial territories can be understood through three interrelated concepts: hydropower, hydrosocial cycle, and territory (Boelens et al., 2016). Starting with the classical hydrological cycle is one way to approach land–water linkages in the hydrosocial cycle. Precipitation, storage, discharge, and evaporation or transpiration are all influenced by climate, land use, and soil conditions (Ward & Trimble, 2004). Within this framework, land-based activities are connected either by shared rivers, lakes, reservoirs, or aquifers or because they lie within the same watershed. However, what the classical hydrological cycle fails to capture are the social dimensions of land–water couplings. This gap has prompted members of the water science community to adopt the concept of the hydrosocial cycle (Bruns, et al., 2016). Hydraulic environments are socio-physical constructions, actively and historically produced in terms of both their social content and physical-environmental qualities. Consequently, socio-environmental change is never socially or ecologically neutral, as certain trajectories can undermine the stability of some social groups while enhancing the sustainability of others (Swyngedouw, 2009). The hydrosocial cycle refers to the continuous interaction between the hydrological cycle and social dynamics: the complex, historical ways in which human action—and the inherent power structures—reconfigure the natural cycle of water and vice versa (Damonte-Valencia, 2015).

Boelens et al. (2016) argue that territories, often taken to be natural, are in fact the result of historical processes shaped by the interaction of nature, technology, and society. This is clear in river basin management, where water flows, uses, and hydrological cycles are influenced by governance and human intervention, linking biophysical, technological, social, and political dimensions.The authors conceptualize a hydrosocial territory as

> "the contested imaginary and socio-environmental materialization of a spatially bound multi-scalar network in which humans, water flows, ecological relations, hydraulic infrastructure, financial means, legal-administrative arrangements and cultural institutions and practices are interactively defined, aligned and mobilized through epistemological belief systems, political hierarchies and naturalizing discourses" (p. 2).

These territories, whether imagined, planned, or materialized, carry contested functions, values, and meanings. They influence who is included or excluded, and how benefits and burdens are distributed across different groups (Boelens et al., 2016) To connect the biophysical and social dimensions of land–water couplings, one could argue that water flows not only along hydraulic gradients but also according to power gradients (Swyngedouw, 2009). Water infrastructures play a key role in controlling and managing these flows, determining who receives water, in what quantity, quality, and timing (Bruns, et al., 2016). The concept of hydrosocial territories is useful for examining how socio-natural arrangements and water politics either reinforce or challenge the unequal distribution of resources and decision-making power in water governance. These dynamics are supported by mechanisms, structures, knowledge systems, and discourses (Boelens et al., 2016).

There is a diversity of studies that intersect conflicts involving land and water use. In some, these are addressed as water use conflicts, in others, as land use conflicts, where water and land appear as causal factors of the conflicts or as being impacted by them. In contrast, some studies adopt an integrative approach to these conflicts. Below, some studies conducted in Latin America, Africa, and Asia are presented, focusing on land and water use conflicts according to these different conceptualizations.

A study in Peru explored the links between water, power, and cultural politics in the Andes through an analysis of the hydro-social cycle. It focused on community water control practices in Mollepata, showing that irrigation systems there are not only physical infrastructures connecting the hydrological cycle with agro-productive systems, but also political and cultural constructs. These systems bring together local knowledge, values, property arrangements, power relations, and bonds of belonging. Water control is tied to ancient metaphysical beliefs, where relations among mountain deities, Mother Earth, and humans are seen as guiding water flows. At the same time, these practices emerge from ongoing internal negotiations and conflicts with external actors, shaping local norms and truths within wider, multi-scalar struggles (Boelens, 2014). Also, in Perú, in the Ica Valley, and from the perspective of the concept of hydro-social territory, a study was conducted on how the growth of the agro-export sector has led to transformations in water territories, particularly in the Ica region, through the consolidation of an agro-export political and economic project. The research follows a case study qualitative methodology. The results point out that the process, driven by shifting power dynamics, has redefined hydro social territories and consolidated a discourse of hydrological and productive development. These transformations have resulted in physical changes, such as agricultural expansion, alongside the political and social consolidation of new institutional frameworks (Damonte-Valencia, 2015).

In Colombia, Hernández and Rodríguez (2020) examined the social and environmental changes in the highland regions after the 2016 Peace Agreement between the Revolutionary Armed Forces of Colombia (FARC) and the government. Their study focused on the village of Colombia, which had been under FARC control until the accord was signed. Through ethnographic fieldwork, interviews, and document analysis, the study revealed how the withdrawal of the FARC and the shift to state control reconfigured land distribution and water access, creating new inequalities, especially for landless peasants, which was one of the main causes of the armed conflict in the country. Mena-Vásconez (2020) carried out a study in Ecuador on the relationships between local and external actors from pre-Columbian times to today, focusing on the conflicts generated by irrigation. The work combined historical analysis with a political ecology approach, using documentary sources and case studies. The results show that, over time, local inhabitants have resisted the imposition of external activities, such as floriculture, defending their traditional agricultural practices, although some have adopted this activity in small plots. It was also identified that water conflicts are increasingly intense due to the scarcity of water resources and the competition between large agribusinesses and small producers (Mena-Vásconez, 2020).

Another study in Eastern Amazonia aimed to analyze socio-environmental conflicts related to the increasing interest in natural resources by transnational corporations. Its methodology included document analysis, interviews, and field observations. According to the findings, resistance to de-territorialization and the alteration of traditional communities were linked to land issues, which were at the heart of larger socio-environmental conflicts. The findings indicate that conflicts over land and territory serve as the foundation for the development and expansion of other related disputes

(Pereira, 2020). In México, a study was carried out to analyze a conflict between an open-pit mining company and its opponents in Cerro de San Pedro, using the echelons of rights framework. The study pointed to four main areas of dispute: resources, rules, decision-making power, and discourses. The study revealed that international trade laws supported the mining company's disregard for local land and water rights, with the help of ambiguous regulations and the state. The study suggested that multi-actor, multi-scale alliances could promote environmental and social justice solutions (Ramírez, 2016).

Lastly, studies from Brazil highlight how disputes over water are deeply connected to economic dynamics, as water resources are primarily allocated for agricultural and industrial activities (Leite et al., 2010). In Brazil's semi-arid region, a study examined the environmental and socio-economic impacts of the 2012–2014 drought in the Baixo Jaguaribe area of Ceará, focusing on how local people responded to the crisis through learning, self-organization, and rising conflicts over water access. The methodology combined Landsat-8 and Resource satellite imagery with statistical data and fieldwork, including interviews with local stakeholders. It concludes that conflicts over water and land are exacerbated by agribusiness expansion and irrigation policies, which demand large volumes of water. These policies produce 'green islands' with restricted access in otherwise arid landscapes, which intensifies disputes, especially during long droughts like the one from 2012 to 2014 (Reis & Zanic, 2015). Similarly, in the State of Bahia, a study focused on agribusiness expansion in Chapada Diamantina. The methodology used fieldwork, cartography, secondary data, and interviews. The study finds that agribusiness has expanded with state support, framed by discourses of knowledge, competence, and environmental responsibility. It argues for the need to confront its rentier character and to promote alternative approaches (Arrazola, 2024).

Bekele et al. (2022) studied conflicts among agro-pastoral households in Ethiopia affected by large-scale land investments (LSLIs). The aim was to identify the main drivers of disputes over land and water. Using household and community surveys analyzed with descriptive statistics and a binary logit model, the study found that land conflicts affected over a quarter of communities in the past decade, intensifying after the arrival of LSLIs. Pasture scarcity and insecure tenure were key drivers. State appropriation of communal grazing lands, along with policies favoring large-scale agriculture over pastoralism, reduced resource access, deepened livelihood disruptions, and increased vulnerability to conflict. Another study developed in the Inkomati Water Management Area in South

Africa analyzed water reforms. The aim was to assess how water and land reforms interact in a context shaped by commercial agriculture, forestry, environmental needs, and demands for better access from black populations in former Bantustan areas. The study found that, although land and water reforms are interconnected, they have largely proceeded on separate tracks and remain limited by unresolved tensions. It highlighted how the commodification of land and water in commercial agriculture constrains redistributive reforms for historically dispossessed groups (Woodhouse, 2012).

In Kenya, a study analyzed conflicts over eucalyptus plantations in the Taita Hills. The study used a qualitative approach, drawing on document analysis and interviews to examine power dynamics in environmental resource management. The results showed that local communities perceive eucalyptus plantations as a threat to water resources and as symbols of historical land dispossession, while government agencies support them for commercial forestry. Bureaucratic management structures dismiss local concerns due to a lack of "valid" evidence (Hohenthal et al., 2018). Omodeo (2024) investigated how global capitalist investment plans in Senegal involved reengineering the waterscapes in the Senegal Delta. According to the study, water shortage is socially created by commercial and political interests rather than occurring naturally. The Fula people were displaced and their grazing pastures were reduced as a result of the disruption of water flows caused by large-scale agrofuel production.

Kar (2024) studied the Turga Pumped Storage Hydroelectric Project in Purulia, India, focusing on the socio-ecological conflicts between state-led hydroelectric development and local Indigenous communities. The study shows environmental impacts on ecosystems, including land-use change and soil degradation; social consequences such as displacement, and disruption of livelihoods; and political-economic dynamics shaped by centralized decision-making, corporate influence on government policies, and the repression of local mobilizations. In the Lower Ganges Basin, Lafaye et al. (2018) explored how the interactions between water, sediments, and societies have long been overlooked. Using an environmental historical approach and three case studies from West Bengal, they traced the impacts of colonial interventions, with particular attention to the Farakka Barrage. The findings show that neglecting sediment–water dynamics has harmed riverine livelihoods, creating a land–water divide that disadvantaged local communities. Current community efforts to contest administrative decisions point to the need for integrated management of water, sediment, and social systems.

2.3. Dimensions of Analysis: Land and Water Use, Relationships with Nature, Power Relations and social and environmental impacts.

2.3.1. Land and Water: Uses and Distribution

When analyzing land and water use, it is important to distinguish between land cover and land use, even though the two are closely related. Land cover refers to the physical features of the surface, such as vegetation (trees, shrubs, or herbaceous plants), bodies of water, bare soil, or human-made structures like permanent plantations. It also includes areas occupied by various human activities in a specific region (Cartaya et al., 2018). On the other hand, land use refers to how humans employ these types of cover to meet their needs, whether for productive, recreational, or residential purposes (Instituto Geográfico Agustín Codazzi (IGAC) & Corporación Colombiana de Investigación Agropecuaria (CORPOICA), 2002); Centro Nacional de Memoria Histórica (CNMH), 2016). This distinction is key to understanding how resources are distributed and how different social and economic factors shape their use. Land use can be classified in different ways, depending on the scale and focus of the analysis. A common classification system is based on their purpose, such as agricultural, agroforestry, livestock, forestry, or conservation, with each of these subtypes further broken down according to specific activities (IGAC & CORPOICA, 2002; CNMH, 2016). Land use can be categorized at different scales. We can classify land uses into 'major uses' at the departmental level, while at the municipal level, they can be divided into 'primary uses', where more specific categories can be identified (Castro, 2018). This system helps explain the complexity of land use distribution, reflecting both human needs and socio-economic impacts.

Similarly, water use covers a broad set of needs, from basic consumption to industrial applications including food, fodder, and fuel production in agriculture, as well as hydroelectric generation and industrial cooling (FAO, 2011). Yet these uses can overshadow other essential needs such as drinking water, sanitation, fishing, sustaining ecosystems, and even recreation or tourism (Bruns et al., 2016). This diversity shows both the versatility of water and the need for fair management to meet social and economic demands.

The physical availability of resources explains part of how the benefits and burdens of land and water use are distributed; social, cultural, and political factors also play a decisive role in shaping supply and demand (Swyngedouw, 2009). Water scarcity, for instance, cannot be reduced to the quantity or quality of available water; it is also a matter of how water is valued in cultural and economic terms, who has access to it, the way it is used, and the degree of control exercised over its management and distribution. Thus, water scarcity may be linked to the economic ability to pay for its use, as well as the social structures that determine access to this resource, often favoring some groups over others (Swyngedouw, 2009).

Legal frameworks and governance policies are essential in determining how land and water are used and how they are distributed among various social groups. Legislation can regulate land and water use through instruments such as territorial planning laws and water rights. Yet informal control mechanisms, including violent incursions or illegal land and water grabs, also play a major role (Garvey et al., 2024). These exercises of power connect to processes of accumulation by dispossession (Harvey, 2006) and make clear the tensions between formal legislation and existing power relations. Such tensions are most evident when natural resources are privatized, and access rights are limited or disputed. Similarly, the governance of land and water is deeply influenced by the actors involved in their management, who can be both state and non-state actors. A clear example of how public policy affects access and use of resources can be seen in the research that Castro (2005) conducted with the aim of analyzing neoliberal policies applied to water management in Latin America. The study looked at various case studies from Latin America and Europe. It found that these policies have tended to deepen social inequalities, with private companies reaping more benefits than the state and communities. Despite claims of promoting democratic governance, the outcome has often been the exclusion of vulnerable groups and a violation of the human right to water.

2.3.2. Relationships with Nature

Local and traditional knowledge

Berkes (2018) defines traditional ecological knowledge or local environmental knowledge as an accumulated set of knowledge, practices, and beliefs that evolves through adaptive processes and is transmitted culturally across generations, concerning the relationships among living beings, including humans, and their interactions with the environment. This type of knowledge is characteristic of societies with historical continuity in resources used in a specific territory, implying knowledge and practices transmitted through generations. Traditional knowledge also includes an empirical and local component regarding species and other environmental phenomena, as well as a component of practice related to subsistence activities such as agriculture, fishing, and hunting. Moreover, it involves a component of beliefs concerning people's ethical perceptions of their relationship with ecosystems (Berkes, 2018).

Around the world, many Indigenous and local knowledge systems have achieved long-term management of functional ecosystems, informed scientific efforts to maintain these ecosystems, and prevented the degradation of social-ecological systems (Reyes-García, 2023). Traditional peasant knowledge has been shaped over generations and is therefore finely adapted to the conditions of diverse environments (Altieri, 2002). Farmers' native livestock breeds and crops are not only part of their cultural legacy but are also hardy and climate-adaptable. This characteristic makes them essential for promoting sustainable farming practices capable of withstanding the challenges of the present (López & Guzmán, 2012). This type of knowledge is seen as an alternative to the agricultural sector crisis, which is leading to a transition toward alternative practices that follow similar logics to peasant ones, such as the multifunctionality of agricultural activity, intensive use of labor, endogenous resources, and local knowledge, as well as the relocalization of economies (Ploeg, 2010; López & Guzmán, 2012). Socio-environmental conflicts, as defined by Little (2006), are complex disputes between social groups that emerge from their different forms of interaction with ecosystems. Traditional water management systems, built and maintained over generations, are likewise exposed to these tensions and frequently become sites where such conflicts play out. Conventional approaches often present river basins as rational units, with engineers trying to control erratic hydrological regimes to meet social demands (Little, 2006). When these attempts fail, the causes are usually attributed to limited funding, lack of expertise, weak institutions, or government failures. The usual response is to attempt to correct these deficiencies through capital investment, expert knowledge, and bureaucratic reform (Molle, 2007).

Policies that claim to recognize Indigenous knowledge often operate in paradoxical ways. Only when these forms of knowledge and principles fit official frameworks are validated, while others, referred to as 'unruly rules' or 'disorganized wisdoms', are excluded for failing to conform to dominant policies (Boelens et al., 2019). In doing so, these policies ignore the power and cultural relations embedded in professional science, where experts promote supposedly universal 'best practices' and deny local water users the capacity to reshape and reproduce their own management practices (Boelens et al., 2019). However, in many instances, modern territorialization policies do not attempt to suppress alternative territorialities, but rather to recognize, absorb, and discipline them within the logic of centralized government. This is often done through 'neoliberal multiculturalism,' which selectively validates what is considered 'convenient' while marginalizing what is seen as 'problematic' (Boelens et al., 2016). Sterling et al. (2017) propose that different knowledge systems, along with the indicators that emerge from them, can exist in three possible states: as distinct and separate systems, as interacting systems that remain disconnected but still influence each other, where externally derived sustainability indicators may be culturally inappropriate at local levels, or as integrated, synthesized knowledge systems.

Biocultural approaches explicitly begin with local cultural perspectives, although not all social-ecological frameworks take into account the locally relevant cultural perspectives that are central to biocultural approaches (Sterling et al., 2017). Knowledge co-production processes generate new social interactions among diverse actors with various interests at multiple scales, often professionalizing debates and sometimes distancing civil society from its local realities. However, they also open possibilities to make local actors and their concerns more visible, creating opportunities for both cooperation and resistance (DuPuits et al., 2023). It is important to avoid idealizing Indigenous knowledge. Too often it is simplified and treated as if it were static, ahistorical, and universally valid (Boelens et al., 2019). Traditional knowledge systems are best understood as hybrid and relational, formed through interaction with diverse environments and shaped by power relations both within and beyond their communities. The same applies to so-called 'Western' knowledge. So they should not be reduced to the oppositeof. Particularly for marginalized groups, framing knowledge systems in binary and reified terms and giving preference to one over the other frequently results in misunderstandings and detrimental behaviors (Boelens et al., 2019).

In the highlands of northern Ecuador, Dupuits et al. (2023) conducted a study in the Cayambe region around the creation of the Plurinational Water Fund, using a transdisciplinary methodology that combined interviews, surveys, focus groups, and water quality measurements. The study revealed how Indigenous communities, governments, and private companies interact and contest one another over water services, where local knowledge and demands for justice frequently collide with global technoscientific perspectives. Cámara-Leret and their team (2019) explored how communities impacted by hydropower projects were affected by policies meant to consider local voices. They used qualitative methods to dig into the situation and found that, despite these recognition policies, the traditional knowledge and practices of these communities ended up being marginalized. It shows that even well-intentioned efforts can sometimes overlook the very people they aim to support. This highlights the dangers of epistemic hierarchies in resource governance. Finally, Boelens et al. (2016) explored Andean contexts through the concept of hydrosocial territories, applying a political ecology framework to case studies that combined ethnographic and document analysis, and revealed how conflicts over water are simultaneously material struggles over resources and epistemic struggles over meanings, in which traditional and local knowledge plays a central role.

Languages of valuation

Indigenous and local knowledge systems use diverse languages to convey the many values attached to nature (Munda, 2008; Zografos, 2023). These languages express different ways of understanding the natural world and of valuing its attributes and contributions to human life. Value systems differ among individuals within the same group and across groups, and they shift over time and space (Díaz, 2015). Ecological economics questions the reductionism of monetary valuation, which tends to overlook important dimensions of value, and instead calls for plural approaches that recognize diverse perspectives in ecological decision-making (Zografos, 2023). Research in Ecuador makes this plurality visible, showing how environmental conflicts give rise to multiple ways of valuing nature. These valuations extend beyond economic criteria to include claims for environmental justice, territorial rights, the sacredness of nature, and the defense of cultural heritage. Conflicts become sharper when these valuation languages collide—for example, when ecological or cultural values confront dominant economic and political interests (Avcı et al., 2010). At their core lies the primacy given to monetary valuation and the ongoing struggle to secure recognition of multiple values that cannot be reduced to a single measure. At the heart of these conflicts lies the centrality of monetary value and the struggle for recognition of multiple values that cannot be reduced to a single measure.

Martínez-Alier (2004) argues that the surge of socio-environmental conflicts in Latin America has generated new valuation languages around territory. These languages challenge the binary conceptions of natural resources advanced by corporations and governments and instead frame territory as a space carrying multiple values: cultural, ecological, and social (Svampa, 2013).

Territoriality is being constructed in a complex space where different action logics coexist. While corporations and economic elites operate within an economic logic that turns natural resources into efficient and profitable products, other social actors claims that natural resources are common goods that should be protected and preserved by the community beyond their market value (Svampa & Viale, 2014). In this sense, the notion of common goods not only implies a rejection of the commodification of nature, which is part of what the above-mentioned authors refer to as the "commodities consensus" that emerged at the end of the 20th century, but also a reclaiming of the cultural and ecological values inherent to these territories (Svampa & Viale, 2014).

In terms of natural resource governance mechanisms, the development of criteria and indicators for decision-making becomes fundamental in addressing ecological distribution conflicts. Socio-environmental conflicts can be analyzed through the valuation languages used by the involved actors, and the inclusion of multiple perspectives is crucial for understanding and managing such conflicts (Rodríguez-Labajos & Martínez-Alier, 2015). Discrepancies between value systems arise not only from differences in values but also from the difficulties in measuring the impacts of conflicts. Ecological impacts such as biodiversity loss, harm to territorial rights, and the disruption of Indigenous livelihoods cannot be reduced to monetary terms, as they involve dimensions that escape economic measurement. Cultural and ecological valuations are examples of such dimensions (Falconi & Oleas, 2023). In this regard, ecological economics' critique of reducing nature to monetary values highlights the importance of accepting a plurality of values in environmental decision-making (Zografos, 2023). The acceptance of value incommensurability implies that different value systems should not be hierarchized, because each brings a unique and valid perspective on the relationship between humans and the natural environment (Munda, 2008). Rather than trying to impose a single value, values should be allowed to coexist and be negotiated within a genuinely participatory process that allows all parties involved to express their interests and perspectives.

The economic valuation of natural goods is contested, with some viewing it as a pragmatic tool and others rejecting it for methodological and ethical reasons (Kallis et al., 2013). Some critics contend that ecological, cultural, and social values, such as the intrinsic worth of biodiversity or its significance within landscapes, cannot be reduced to a single monetary measure. To account for this plurality, Munda (2008) introduces Social Multi-Criteria Evaluation (SMCE), a framework that intends to bring together economic, social, and ecological dimensions in sustainability decision-making. This approach has been applied, among others, to water conflicts, demonstrating that its implementation can help to reconcile a diversity of valuation systems (Villamayor-Tomas et al., 2023). Compensation and replacement policies might be useful in some circumstances, but they should be applied carefully when dealing with non-replaceable goods, like biodiversity (Munda, 2008). Overall, research on valuation languages in socio-environmental conflicts underscores the importance of participatory approaches that respect local, Indigenous, and ecological knowledge, and that promote inclusive and equitable governance (Villamayor-Tomas et al., 2023).

Avci (2010) analyzed the environmental conflict around the proposed development of a gold mine at Mount Ida, Turkey. The aim was to examine the different "valuation languages" used by social actors to support or oppose the project. Using a mixed qualitative and quantitative approach, the study found that local communities resisted the mine for diverse reasons and that financial or technical compensation measures could not resolve the disputes. Pro-mining arguments centered on "economic prosperity" and "employment and business opportunities," while opposing actors use the languages of "environmental protection and quality," "community life and livelihood," "public health," and a nationalist discourse resisting foreign projects. In another study, Temper and Martínez-Alier (2013) investigated the contested process of assigning a Net Present Value (NPV) to forests in India. The aim was to trace the environmental and institutional history behind this valuation. They conducted a documentary analysis of policies and official reports. The findings show that both technical and political aspects of price-setting reinforced structural inequalities, created negative distributive effects, and promoted an economic decision-making framework that excluded participation and disregarded cultural diversity and plural values. The authors concluded that NPV calculations neither support conservation nor advance environmental justice.

Kallis et al. (2006) studied water conflicts in three locations in Southern Europe: Naxos Island in Greece, Baixo Guadiana in Portugal, and Costa del Sol in Spain. The aim was to evaluate participatory methods in river basin planning under the Water Framework Directive. The methods included scenario workshops, mediated modelling, and social multicriteria evaluation. Workshops and modelling proved useful in the early stages of planning, as they helped participants clarify goals and strengthen capacities, though they were less effective in addressing long-term conflicts. Social multicriteria evaluation was more successful when comparing alternatives and reconciling divergent perspectives, but it depended heavily on experts and allowed limited participation in defining objectives. The study recommends a combination of methods for participatory water planning. In a different line of inquiry, Martínez-Alier (2009) carried out a documentary analysis of socio-environmental conflicts in various regions, with the aim of examining how environmental degradation affects local communities and how these communities confront corporate and governmental economic interests. His methodology was based on a review of existing case studies. The study found clear contrasts in the ‘valuation languages used by different actors. Corporations framed nature primarily in terms of economic profit, while local communities highlighted its social, cultural, and environmental significance. These opposing perspectives became a source of conflict, deepened by unequal power relations.

2.3.3. Power Relations

A political ecology approach views river basins as political arenas where various actors who use water or are affected by its externalities compete for access, protection, or compensation. These actors use their social or political power to impose or elicit regulations in line with their interests (or a broader conception of the common good) (Molle, 2007). Power is manifested through the ability to control and capture resources at different levels, and at the same time, this control allows power to perpetuate itself (Lebel et al., 2005). Leff (2015) emphasizes the importance of Michel Foucault’s (1980) perspective on the relationship between power and knowledge as a fundamental element of political ecology. Foucault's theory suggests that power is not just about domination and repression but also mobilizes desires for emancipation and the creation of new forms of knowledge. "In Foucault’s views, power is not only a relation of domination and a repressive agency. Power mobilizes desire to emancipate from, and to produce new forms of knowledge" (Leff, 2015, p. 33). In order to provide avenues for survival and sustainable futures, political ecology investigates power relationships and social conflicts. It creates room for different environmental viewpoints by challenging prevailing rationalities. Power dynamics in the hydrosocial cycle dictate which changes take place and how water flows are altered. These power dynamics, carried by social actors, determine who will have access to or control over resources and who will be excluded (Swyngedouw, 2009).

Power exists in various forms: social, economic, political clout, discursive, symbolic, and decisional power. For instance, those who can afford deep wells and powerful pumps can outcompete those relying on shallower wells. Companies are generally characterized by having greater political influence, and due to their level of consumption, they have the capacity to significantly affect other sectors that use water. One of these ways is through the contamination of water bodies (Molle, 2007). Power asymmetries among different groups represent significant obstacles to participation. They also create barriers to overcoming inequities related to variables such as age, gender, and background (Reed, 2008). Swyngedouw (2009) also identifies struggles over social power, material, economic, political, and cultural, often linked to gender, class, ethnicity, and other contextual differences. In addition, the concept of scale politics is used to refer to contestations over spatial boundaries in decision-making processes. Additionally, the politics-of-scale metaphor refers to the contestation of spatial boundaries in decision-making. The "politics of position" concerns the relative positions of actors, such as upstream vs. downstream water users, while the "politics of place" involves power dynamics based on local contexts (Lebel et al., 2005).

Molle (2007) identifies four key strategies in the politics of space: 1. Telling stories. Mechanisms in which actors use narratives to promote their interests. 2. Building alliances. Strategies based on the existence of shared narratives that unite participants and strengthen their impact by linking different management levels. 3. Deliberating alternatives. Collective construction of alternative proposals within platforms involving multiple stakeholders outside traditional bureaucratic systems. 4. Controlling technologies. Whoever controls the technologies of extraction or access to resources has greater control over them (Molle, 2007). Power dynamics play a significant role in shaping our relationship with water and its management. The ‘telling stories’ strategy can be understood as the mechanism by which certain actors define what is considered important. In this way, it is defined how stories about water and its relations are told, making policies appear as unquestionable truths. But this generally means the benefit of some actors over others and the collective good. Since discourses are mediated by different ideologies, interests, and ways of interpreting the world, often in conflict, control over policy discourse becomes fundamental (Boelens, 2014). How we use resources and the resulting impact on the environment and society are deeply influenced by the landscape of a region, the way water flows through it, and the differing levels of political and financial power among the people involved. These dynamics are not fixed; they are always changing and reshaping both the balance of power and the water systems around us (Molle, 2007).

Power dynamics often result in the disqualification of certain knowledge systems, which are seen as inferior or non-compliant with scientific standards, systems that are typically dominated by expert or formal scientific knowledge. Conflicts over knowledge are common in the design and planning of large-scale water systems, particularly between local water user groups or affected communities and engineers or bureaucrats (Boelens et al., 2019). In contrast, struggles for control over territory often go beyond landownership and can also involve a process of "dignification" of local practices and identities, in opposition to other productive systems. These struggles reflect the desire to maintain control over ways of life that are intimately connected to identity and values, particularly regarding relationships with others and with nature (Pineda, 2014). Conflicts over cultural distribution explain how different cultural meanings and practices can shape power dynamics. These struggles are not merely about cultural differences, but about whose norms and practices define social life and regulate relationships with resources, economy, ecology, and identity (Escobar, 2006). There is a growing need to examine how different forms of social power, economic, cultural, and political, interact with water management principles and technology choices (Swyngedouw, 2009).

In Ecuador, Buchanan (2008) analyzed disputes between farming communities and a transnational mining company. The dispute was over land and biodiversity. The study shows how competing discourses on development and conservation shaped decision-making. The study highlights that these debates revealed deeply asymmetrical power relations, where knowledge itself functioned as a tool that reinforced inequalities in socio-environmental governance. Another research conducted in Ecuador examines the role of the state and multinational companies in shaping the mining frontier, exploring the power dynamics between the government, corporations, and local populations. The study emphasizes the importance of local resistance and the politics of knowledge in challenging the imbalances of power that arise from large-scale mining operations (Teijlingen, 2017). Similarly, in Brazil, Megre (2021) studied the conflict between agribusiness and indigenous communities, and the study revealed power imbalances rooted in racial, ethnic, and environmental issues. This conflict has strong roots in Brazil's agrarian history and is amplified by social intolerance and the legacy of colonialism. The study points to the state's role in supporting agribusiness, thus strengthening the power of landowners over indigenous groups fighting for territory demarcation and security. In Peru, Cardinaël & Petit (2019) studied mining conflicts, particularly the Conga case. The findings show that historical and territorial factors, together with the role of the state, intensify existing power asymmetries and reveal how national-level dynamics unfold at the local scale, offering insights into broader socio-environmental conflicts in Peru. The article closes by reflecting on post-extractivism and questions its feasibility in a context where power continues to be unevenly distributed.

2.3.4. Social impacts and reactions

Socio-environmental conflicts arise when different social groups have differentiated ways of accessing, using, and assigning meaning to territory. Discrepancies in their interests and visions cause clashes, and one of the groups sees the continuity of its social practices threatened by undesirable impacts caused by the actions of other groups. These impacts can be both environmental (such as soil, water, air pollution, or disruption of ecosystems) and social, as they affect the way of life of the populations involved. In this context, political ecology and environmental justice aim to denounce the structural inequalities that favor certain groups while destroying the living conditions of others, thus giving rise to socio-environmental conflicts (Souza & Milanez, 2016). Globalization and neo-extractivism in the global periphery increase the demand for new territories and resources, leading to significant impacts on ecosystems and vulnerable populations. This crisis strains social ties, erodes community organization, and threatens traditional ways of life, drawing territories into the global capitalist economy while disregarding local ecosystems, cultures, and worldviews. In this context, environmental injustices emerge, as marginalized populations are the ones who suffer most from the damage brought by development, through displacement, environmental degradation, and in some cases even violence and murder (Porto et al., 2014).

Disputes over water arise from various causes, with three primary activities being the most documented sources of conflict: water transfers, overexploitation, and degradation. Water transfers involve moving water from one basin to another, often leading to social impacts such as forced displacement, and environmental impacts including water pollution and disruptions to local ecosystems (Pedrozo, 2020). Overexploitation refers to using water at a rate faster than it can naturally replenish, contributing to water scarcity. Degradation, on the other hand, is caused by pollution, the introduction of chemicals, heat, radiation, invasive plant species, or the construction of dams and levees that obstruct or alter the natural flow of rivers. The consequences of these activities include displaced communities, aquifer depletion, and direct health impacts on local populations, as well as long-term damage to biodiversity and ecosystems (Pedrozo, 2020). Porto et al. (2014) argues that the socio-environmental crisis presents new challenges and calls for a revision of the theoretical-methodological foundations of public health and the social determinants of health. The above-mentioned authors call for a critique of the hegemonic scientific paradigm in health and advocate for an emancipatory approach, drawing from post-colonial studies, to bridge the gap between scientific knowledge and the knowledge of marginalized communities.

A study in northern Ghana analyzed the health effects of water insecurity on women irrigators. It used interviews, focus groups, participatory drone mapping, and validation workshops. The findings show that women with plots far from canals face greater physical strain. They reported severe pain in their limbs, waist, and hips, as well as anxiety due to difficulties accessing water (Dinko & Nyantakyi-Frimpong, 2023). Another study carried out in Southeast Asia examined socio-ecological conflicts related to land, forests, water, and mining, using an interdisciplinary approach across several countries. The results show ecological impacts such as deforestation, water pollution, and biodiversity loss, as well as social impacts including the displacement of Indigenous and minority groups. In response to these impacts, a range of actions emerged, including protests, lawsuits, participatory mapping, and alliances with NGOs and local governments. Lastly, the authors conclude that conflicts can be seen as opportunities to transform power relations. Yet the risk of cooptation brings with it the possibility of perpetuating asymmetric power relations and domination. Outcomes depend on community organization and external support (Pichler & Brad, 2016). Finally, Gerber (2011) reviewed 58 conflict cases involving industrial monoculture tree plantations. The study applied a literature review of academic sources, NGO reports, and grey literature to compare cases across the Global South. The analysis focused on impacts, actors, and forms of protest. The main impacts of those agricultural activities were deforestation, water shortages, pollution, and loss of local ecosystem uses. Protests included tree uprooting, lawsuits, blockades, and confrontations. Outcomes ranged from repression and compensation to the interruption of projects.

Chapter 3. Methodology

3.1. Introduction

Research methodology refers to the series of processes designed and implemented during the study of a phenomenon to collect and analyze information. The purpose of this chapter is to describe the research methodology used in this study, illustrating the mechanisms and tools applied in data collection and analysis. This, in turn, justifies a methodology aimed at delivering a study focused on trustworthiness. The chapter begins by outlining the research design, distinguishing between quantitative and qualitative methodologies. The chosen methodology for studying the topic of this study is presented, along with ways to assess the degree of trustworthiness. The text first explains the types of information sources, making a distinction between primary and secondary ones. It then identifies which sources were selected for the research and why they are relevant. After that, the discussion turns to the sample and its size, clarifying what sampling means and how it was applied in the study. The understanding of sample size and its role in the research is also addressed, emphasizing that the goal is to identify information-rich sources rather than amass large amounts of data. The sampling selection mechanisms used in the study are described and justified. The methods used to collect data in the study area are also explained. The chapter then presents the method of analysis, which is based on thematic analysis of the collected qualitative data and spatial analysis of quantitative and spatial data. Finally, ethical considerations and the various limitations of the study are discussed.

3.2. Research Design

The research design consists of a set of systematic, critical, and empirical processes carried out during an investigation, that is, when studying a phenomenon or problem (Hernández, Fernández & Baptista, 2014; Neuman, 2014). There are two research design methodologies that represent these processes: on one hand, there is quantitative methodology, and on the other, there is qualitative methodology. The quantitative methodology aims to “rigorously link abstract ideas to measurement procedures that can produce precise information in the form of numbers to relate conceptual definitions of constructs to concrete operations for measuring the constructs” (Newman, 2014, p. 209). Qualitative methodology, in contrast, aims to understand social phenomena from the perspectives of the actors involved, focusing on their experiences and the meanings they assign to their psychosocial realities (Izcara, 2014; Flick, 2004). It can have different approaches, such as ethnography, autoethnography, case study, grounded theory, realism, phenomenology, heuristic inquiry, narrative inquiry, systems theory, and thematic analysis (Patton, 2014), and its design employs data collection techniques that capture experiences, such as interviews, focus groups, and observations. Meanwhile, quantitative research designs in social research utilize tools like questionnaires and surveys, which allow for, among other aspects, data generalization (Hernández-Sampieri, 2014).

The objectives of this study: (1) To identify the main land and water use activities taking place along the Utinga River Basin; (2) To describe how different actors in the Utinga River Basin relate to land and water; (3) To assess the social impacts of the conflict on traditional water-related practices of communities inhabiting the Utinga River and their reactions to those impacts; and (4) To identify how power relationships between different actors shape the uses of land and water in the Utinga River Basin. To meet these objectives, a mixed qualitative and quantitative methodology was adopted. This approach makes it possible to explore the conflict in depth by analyzing the statements, perceptions, and knowledge of different actors, at individual, community, and institutional levels, while also integrating quantitative spatial data.

The way to carry out this mixed design will be through a case study, as the goal is to gain a deeper understanding of the internal aspects of conflicts that occur in the selected case. Case studies vary based on the number of cases examined and the depth of investigation into their characteristics. The key point lies in whether the aim is to understand the characteristics of a single case or to compare across several (Neuman, 2014). Case study research centers on a detailed examination of one or a few cases, looking closely at the multiple dimensions of each and the context in which they unfold. In essence, it considers both the internal dynamics of a case and the broader circumstances that shape it (Neuman, 2014). A case study may refer to a specific instance within a broader population, where the population is made up of social actors, and each case represents one element of that group. Another type of case study can be understood as an example of a wider conceptual category, in which cases share defining characteristics that place them within that category (Abbott, 1992). In this research, the Utinga River basin, focusing on land and water use, will serve as the unit of study, corresponding to this second type of case study described by Abbott (1992).

Case study research can be based on qualitative methods, quantitative methods, or a mixed approach (Neuman, 2014), as in this research, which adopts a mixed approach. Using both perspectives offers valuable insights for examining a socio-environmental conflict. From a qualitative perspective: Since socio-environmental conflicts are fundamentally social conflicts (Sánchez, 2022), which are largely rooted in dynamics of power, valuation, and distribution (Leff, 2015), environmental conflicts over resources are struggles for the interpretation and meaning of these resources (Rodríguez-Labajos & Martínez-Alier, 2015). This study adopts a multimethod design to address three dimensions: power relations, actors' relations with nature, and social impacts. Specifically, the power and valuation dimensions are examined qualitatively through semi-structured interviews, focus groups, participant observation, sketch mapping, and document review, in order to elicit actors' perceptions, beliefs, and experiences and to illuminate cultural ways of relating to land and water and their consequences for riverine livelihoods. In parallel, the distributive dynamics of land and water use are investigated quantitatively using cartographic and georeferencing tools to spatialize variables relevant to the case, with the quantitative analysis informed and supported by document analysis and qualitative insights (Jociles, 2018). These procedures, when used in a complementary way, are useful for triangulation across data sources and methods, providing support for the validity and the interpretive strength of the findings (Bryman, 2006).

3.3. Sources of data

Information sources can take many forms, including books, logbooks, essays, biographies, speeches, photographs, and others. To differentiate them, they are commonly classified as primary or secondary sources. Primary sources provide firsthand data, as the researcher is the first to obtain the information (Hernández-Sampieri, 2014). Secondary sources, by contrast, involve information that has already been collected and documented by other authors or institutions (Oluwatosin, 2023). This means that the data are not originally produced by the researcher, or, if they were previously collected by the same researcher, it was done for different research questions or projects, but they can serve as a shortcut in the research process, helping to identify connections between research needs and relevant databases (Ribeiro, Silva & Carneiro, 2018). Another distinction between these types of sources lies in the temporality of the information: primary sources collect data in real time, whereas secondary sources provide past information. Additional differences include cost and time investment—primary sources generally require a larger budget and more time for data collection, whereas secondary sources are often more cost-effective and require less time to obtain (Oluwatosin, 2023).

Primary sources of information include, among others, questionnaires, focus groups, case studies, interviews, observations, and surveys, while examples of secondary sources include government publications, websites, books, academic articles, and internal records (Oluwatosin, 2023). Information can be collected from both primary and secondary sources, depending on the research interests. To meet the objectives of this study, the research will rely primarily on primary and secondary sources. For examining land and water use, interviews and observations will provide complementary insights, while the availability of substantial official data offers an essential foundation for the study. Collecting this information firsthand would involve unnecessary time and resource costs. Secondly, for objectives focused on understanding the perspectives of the actors involved in conflicts, where prior research with these specific goals is lacking in this study area, it is important to gather primary data directly from sources. This will enrich the findings with official research or prior data that can provide additional context and expand the understanding of the phenomenon in a broader spatial or temporal context. Thirdly, secondary data can complement and validate the data collected through interviews or questionnaires. For instance, looking over documents can either support field observations or give a clearer understanding of them. On the flip side, new observations can help check, refine, or broaden what previous studies have discovered. Additionally, pulling from a variety of data sources really boosts the reliability of the research, as it helps ensure consistency and reinforces findings with supportive information.

3.4. Sampling design and sampling size

In qualitative research, the goal of sampling design is to select each unit (or case) based on its potential to provide in-depth and detailed information relevant to the research interests (Martínez-Salgado, 2012). This contrasts with quantitative research, which aims to select representative cases of a population to enable data generalization (Hernández-Sampieri, 2014). Sampling is the act of choosing a limited number of cases from a larger group (Walliman, 2011). It is important to distinguish between the concepts of object of analysis (OA) and unit of analysis (UA). Azona, Manzini, and Dorati (2013) defined the UA as the type of object defined by the researcher to be studied. By "type of object," the authors are referring to the idea that any unit of analysis represents a "concept" or a class of entities, rather than a specific or concrete entity found in space and time. The unit of analysis is the type of object from which the entities to be studied are derived. When they mention "delimited", they are talking about the locatable nature of the object, meaning that it can be identified and situated within a specific space and time. On the other hand, the authors explain that, unlike UAs, which are a "concept," OAs always have an observable reference. They represent the population of specific entities that are temporally and spatially defined to support the administration of data collection techniques (Azcona, Manzini, & Dorati, 2013).

In the case of this research, the type of object would be 'socio-environmental conflicts over land and water use,' and the already "delimited" UA would be 'conflicts over land and water use in the Utinga River basin.' Furthermore, the OAs will be the groups of actors that we understand as directly involved in conflicts. These include small farmers, banana producers, and professionals from the Institute for the Environment and Water Resources (INEMA), who can provide rich testimonies relevant to the research objectives, and groups of actors not directly linked to the river but who possess relevant knowledge about local and regional land and water uses or have insights into water uses relations and conflicts, this include representatives from civil society organizations. Now, it is important to always collect data on the lowest level unit possible, given that it is always possible to "aggregate data collected on individuals, but you can never disaggregate data collected on groups" (Bernard, 2006, p. 51). For this reason, for this study, the lowest level OA will be the individuals who form part of these groups of actors, as it is understood that these groups are not homogeneous, which will provide richer information for the analysis.

3.4.1. Sampling size

The sample size is not determined based on probabilistic concerns but rather according to the contribution of new information or novel data, meaning it is established based on data saturation rather than being pre-defined before data collection. In qualitative research, an initial sample can be defined, but as the study unfolds, it may change, with participants being added or excluded. The number of cases to be included usually depends on three main factors: (1) the capacity to collect and analyze data; (2) the point at which categories reach saturation; and (3) the nature of the phenomenon under study (Izcara, 2014). In this case, the research is carried out by a single-person team, with the fieldwork planned for about three to four months. As a result, the capacity to collect and process data is directly tied to the available human resources, which limits the possibility of working with a large volume of sources.. For this study, interviewees will be interviewed until the point of data saturation, that is when the new collected data is not providing new information (Walliman, 2011). With regard to data saturation, the criterion will be guided by the research objectives, seeking saturation for each of them. Otherwise, new participants will continue to be included until data saturation is reached.

As an initial sample, the study will consider interviewees, either due to their role as a representative or leader or their high level of knowledge or experience on the topic, from four communities of the Utinga River Basin (Iuna, Volta do Américo, São Sebastião, Payayá) and from the following actor groups: banana producers, officials from the Institute for the Environment and Water Resources (INEMA), and civil society organizations.

3.4.2. Type of sampling to be used in this study

According to Neuman (2014), there are eight types of non-probability sampling within Purposeful Sampling: Adaptive, Convenience, Deviant Case, Purposive, Quota, Sequential, Snowball, and Theoretical. Considering the research interests and operational capacity, this study employs purposive and snowball sampling. Qualitative research aims to understand social phenomena in all their complexity, which is why purposive sampling is a suitable method for this approach. This type of sampling focuses on selecting information-rich sources that can provide deep insights, rather than gathering data intended for broad generalization (Patton, 2015). In this method, the researcher intentionally selects specific units from the population and maintains control over the selection process. The assumption is that the smaller group chosen will adequately reflect or represent the larger whole (Kothari, 2004). This is considered the most appropriate type of sampling for this study because it allows the researcher to select interviewees or case studies that represent fundamental and diverse perspectives on the use of water and land. Additionally, purposive sampling allows the researcher to focus efforts on the most relevant places and actors, maximizing the information obtained with fewer resources (Duan et al., 2015).

Snowball sampling is a non-probability sampling method that relies on the networks and references of participants. The researcher starts with a small group of participants (seeds), who, after their participation, recruit others based on the interests and needs of the study, forming a chain of interviewees (Parker et al., 2019). Snowball sampling will be used for this study because this approach recognizes that studying a phenomenon reveals relationships between actors, which can help establish further connections with potential participants. It is also useful because people in the field are considered good informants of other relevant actors to interview. Often, information from specialized informants which are the ones that "have particular competence in some cultural domain" (Bernard, 2006, p. 196) that is not publicly available but is part of local knowledge. To establish the first connections with interviewees, the study relies on a key contact from the Comissão Pastoral da Terra (CPT), who will facilitate contact with some of the actors. Subsequently, to expand the sample size, snowball sampling will be employed, selecting cases based on referrals from previous participants.

3.5. Data collection methods

Data collection is guided by the methodology, in this case, mixed, qualitative and quantitative. Qualitative data gathers a wide range of information and can reveal and conceal multiple meanings (Quecedo, 2002). To gather relevant data for the study's objectives, the techniques to be used include semi-structured interviews, focus groups, participant observation, document analysis, spatial analysis with the use of satellite images, and graduated symbol maps.

3.5.1 Interviews

Piza, Amaiquema, and Beltrán (2019) defined interviews as a meeting in which information is exchanged between two individuals, one being the interviewer and the other being the interviewee. Qualitative interviews are flexible and dynamic (Quecedo & Castaño, 2002). Interviews are categorized into structured, semi-structured, and unstructured (Mueller & Segal, 2015). The structured interview relies on predefined open-ended questions asked in the same order to ensure uniformity and consistency in responses. Unstructured interviews, however, are more flexible, with no set questions, allowing the conversation to flow according to the interviewee's responses and aiming for deeper insights. The interviewer's role is to guide the discussion based on emerging topics (Kallio et al., 2016). Semi-structured interviews blend both methods. The interviewer uses a prepared set of open-ended questions, but the order and phrasing can be adapted during the conversation. This flexibility allows the interviewer to explore topics more deeply, clarify responses, and introduce new questions as needed. Semi-structured interviews typically require a larger sample size to ensure data saturation, providing a comprehensive understanding of the topic (Tejero, 2021). In all three types of interviews, questions should be asked from general to specific and should start with less sensitive topics, leaving those that could make participants uncomfortable or sensitive for the end (Piza, Amaiquema & Beltrán, 2019).

Semi-structured interviews will be used across the research objectives and different actors. This technique of data collection was chosen because it allows addressing the specific variables to be investigated, helping to make the information gathering process more efficient compared to what could be an unstructured interview. At the same time, it provides the necessary flexibility for this topic, as the study requires the freedom to ask questions outside of the initially formulated ones when the researcher realizes that it is necessary to delve into certain topics or collect information on research variables that were not contemplated in those initial questions. Regarding the first objective, it is expected to gather insights into land and water uses in the river basin, as well as information that may not be available in official sources, such as ceremonial uses of water. For the second objective, information will be gathered on how different actors relate to land and water both symbolically (e.g., values associated with land and water) and in terms of knowledge and practices including technologies both traditional and/or modern related to land and water use. These interviews will explore symbolic aspects of the relationship between different actors and water, as well as delve into elements of knowledge and practice. Regarding the third objective, interviews will be conducted to access and/or deepen the narratives that different actors have about conflicts over land and water use in the sub-basin, specifically regarding how they define these conflicts, the factors or phenomena they attribute as causes, and the actors they identify as part of the conflicts. Finally, in accordance with the fourth objective, interviews will be conducted to access the perceptions of actors affected by conflicts regarding the impacts on their lives and/or specific activities.

3.5.2. Focus Groups

Focus groups are characterized by group discussions in which participants collectively focus on a topic selected by the researcher, which can be presented through different formats such as films, advertisements, vignettes, games, or a set of specific questions (Wilkinson, 1998). This method brings together individuals based on the researcher's interest in understanding how they formulate a problem or perceive a particular phenomenon. Typically, focus groups consist of around ten participants, although a smaller number may be preferred depending on the topic to be discussed (Krueger & Casey, 2015). Additionally, they provide a space where individuals can share their experiences, emotions, and perceptions about the phenomenon under study (Morgan, 1997). The method also resembles semi-structured interviews, as it follows a thematic guide while allowing for additional questions to be included based on the researcher's interest (Piza, Amaiquema & Beltrán, 2019). What distinguishes this method is not the way data is analyzed but rather how it is collected. A key aspect—often highlighted by scholars—is that focus groups facilitate interactions not only between the participants and the researcher or moderator but also among the participants themselves. It is precisely this kind of interactive data collection that sets focus groups apart from one-on-one interviews (Wilkinson, 1998).

Where it is possible to gather a group of people in the same space and they are interested in participating, focus groups will be developed in the physical space designated by each community. This technique will take place in meetings specifically scheduled for this purpose and will be requested during community assemblies. Community members who wish to participate will attend the activity. If all participants agree, the audio of the session will be recorded, and the researcher will also take notes on the discussions and interactions between the participants. The questions designed for the focus group will address research objectives 1, 2, 3, and 4. For the first objective, questions will focus on identifying local land and water uses. For the second objective, this technique will primarily be used to understand local knowledge and practices related to people's interactions with land and water, as well as the symbolic, collective, and individual meanings and values attributed to them. The third objective will focus on identifying the actors the community considers relevant in water conflicts, along with their positions, interests, and power. Finally, for the fourth objective, questions will aim to collectively discuss the social impacts of water crises or conflicts over land and water use on their lives and the community's responses to these impacts.

The decision to use this method responds to its valuable complement to individual interviews. While individual interviews are often considered the most appropriate unit of observation (UO) because they capture data in its 'purest' form—partly due to their private setting—focus groups allow for the study of individuals within their social context. "Focus groups tap into ordinary social processes and everyday social interchange" (Wilkinson, 1998, p. 120). Additionally, focus group discussions offer a distinctive opportunity to observe how participants collectively construct meanings related to water insecurity, privilege, and access to water resources (Dinko & Nyantakyi-Frimpong, 2023).

3.5.3. Participatory mapping

Participatory mapping is a cartographic process that seeks to make visible the relationship between land and local communities through the commonly understood and recognized language of maps and encompasses various techniques, including ground mapping, sketch mapping, transect mapping, scale mapping, participatory 3-D modeling, GPS mapping, the use of aerial and remote sensing images, multimedia mapping, participatory geographic information system (PGIS), and internet-based mapping (International Fund for Agricultural Development (IFAD), 2009). In this study, sketch mapping will be used, also referred to in the literature as cognitive mapping. The technique seeks to understand human behaviour via people's perceptions of their spatial surroundings and deliberately departs from conventional cartography to depict perceptions, beliefs, and imaginaries (Boschmann & Cubbon, 2013). Sketch maps are usually hand-drawn on large sheets of paper from memory. They represent the territory from an aerial perspective and highlight key features identified by the community. These maps do not follow exact measurements, consistent scales, or georeferencing. Instead, they illustrate the relative size and positioning of the elements (International Fund for Agricultural Development, 2009). Furthermore, cognitive maps are not merely spatial mental structures indicating relative position; they also contain attributive values and meanings (Kitchin, 1994).

Where it is possible to gather a group of people in the same space and they are interested in participating, collective sketch maps will be developed in the physical space designated by each community. These mappings will take place in meetings specifically scheduled for this purpose and will be requested during community assemblies. Community members who wish to participate will attend the activity. If all participants agree, the audio of the session will be recorded, and the researcher will also take notes on the discussions. Depending on the number of participants, a decision will be made whether to remain as a single group or divide into smaller groups. If necessary, assistance will be requested from community members to record and take notes in the other groups. The questions designed for the sketch mapping will address research objectives 1, 2, and 4. For the first objective, questions will focus on identifying local land and water uses. For the second objective, this technique will primarily be used to access the knowledge and practices of the communities inhabiting the territory. Although symbolic aspects may also emerge during these activities, sketch mapping will provide a collective perspective on these themes. Finally, for the fourth objective, questions will aim to graphically locate and collectively discuss the social impacts of water crises or conflicts over land and water use in their lives and the community's responses to these impacts.

Sketch mapping is chosen in this study to graphically locate information in a specific territorial context (Freitas, 2015). Additionally, these kind of maps are valuable for stimulating community discussions on land use, resource distribution, conflicts, and planning. They are low-cost, do not depend on technology, and can be easily adopted and replicated at the community level (IFAD, 2009).

3.5.4 Observation

Observation is conceptualized as "accurate watching and noting of phenomena as they occur in nature with regards to cause-and-effect relation" (Oluwatosin, 2023, p. 2). It is a particularly suitable tool for generating data on the practices of the participants under study (Jociles, 2018). When using this method, the researcher must consider questions such as: What aspects should be observed? How should the observations be documented? And how can the accuracy of the observations be ensured? (Kothari, 2004). If the observation involves a clear definition of the units to be observed, a standardized method for recording the data, controlled observation conditions, and the selection of relevant data, it is referred to as structured observation. On the other hand, if the observation does not involve these pre-planned elements, it is termed unstructured observation. Structured observation is typically used in descriptive studies, while exploratory studies are more likely to use an unstructured observational approach (Kothari, 2004).

Another way to classify observations can be through non-participant or simple observation, which seeks to understand facts or situations that are public or do not strictly belong to private behaviours. On the other hand, there is participant observation, which can be direct, where the researcher is part of the group, organization, or reality being studied, or indirect, where the researcher is not part of the studied group but only aims to gather information (Méndez, 1998). This distinction also depends upon the observer's sharing or not sharing the life of the group he is observing. If the observer observes by making himself, more or less, a member of the group he is observing so that he can experience what the members of the group experience, the observation is called *participant observation* (Kothari, 2004). But when the observer observes as a detached emissary without any attempt on his part to experience through participation what others feel, the observation of this type is often termed as *non-participant observation* (Kothari, 2004).

In this study, this data collection technique is going to be used in its structured and participant versions to explore information regarding the second, third, and fourth objectives, allowing for the revelation of meanings, practices, and relationships that would not have emerged through direct questions or document review. Structured observation was chosen because this is a descriptive study, meaning there is already clarity on the data to be observed, with a consistent style of observation and recording of the observed data. Furthermore, this observation will be participant observation, as being somewhat involved with the observed groups will allow for firsthand experience of some of the experiences and provide a better understanding of the actors' actions within their environment, not just as isolated responses (Sanjuán, 2019). During the observation process, questions will be asked when clarification is needed or to gain a deeper understanding of what is occurring, always considering that, especially at the beginning, the questions should be general to build trust and familiarize oneself with the environment (Sanjuán, 2019). For recording the collected data, field notes and photographs will be taken to capture elements that help document the variables being studied.

Regarding the second and fourth objectives, participant observation will be used to examine the daily practices of social agents in their natural contexts (Jociles, 2018). This technique will help gather information on both symbolic aspects and knowledge and practices in situ, providing a deeper understanding of the environment in which these aspects develop. Participant observation will be conducted in each one of the four communities by attending daily activities of individuals or groups from the community related to land and river use and connected to sought-after information. These activities may include recreational activities linked to land and water, agricultural or livestock activities involving land and water use, as well as activities requiring water for domestic chores. A period of approximately 1 to 2 weeks will be dedicated to each community to participate in these everyday activities in a non-isolated way. While the focus will be on specific activities, it will also allow for understanding how they intertwine within the broader context of daily life. The information gathering will focus on activities performed on land and water, how they are carried out, how land activities connect with water use and its different forms, the technologies used, the knowledge required, and who participates in these activities. Finally, for the third objective, this technique will be used to collect information that may be difficult to gather through interviews, such as power dynamics in water governance, with a focus on the interactions between participants or groups of actors, participation spaces and formats, and influence in decision-making. To achieve this, attend at least one forum or meeting for public participation.

3.5.5. Document Analysis

Document analysis is a process in which the researcher organizes and represents the knowledge contained in documents, the quantity of which exceeds their reading capacity. It focuses on analyzing and synthesizing the data present in these documents by applying linguistic norms, with the aim of extracting relevant information, either from specific terms or discursive constructions, thus facilitating the researcher's understanding of the content (Peña Vera & Pirela Morillo, 2007). Martínez Corona, Palacios Almón, & Oliva Garza (2023) propose a structured method that allows for rigorous and useful document analysis for research: (1) Define the purpose of the analysis: Determine whether the focus will be on background, state of the art, theoretical framework, among others. (2) Define the research problem: Clearly define the problem and consider three fundamental principles: the subject of study, the object of study, and the method of study. (3) Identify key information: Determine the necessary categories of analysis to understand and address the problem. (4) Define the search context: Establish where to look for documents, such as in scientific databases. (5) Select search criteria: Prioritize primary sources, include both classic and modern authors, represent diverse perspectives, and avoid personal biases in selection. (6) Create a search protocol: Include elements such as language, time period, document type, and keywords. (7) Define review criteria: Set evaluation standards, inclusion and exclusion criteria, and data extraction methods. (8) Design a recording instrument: Include a section to record documents and another for full references. (9) Locate and analyze documents: Apply the defined criteria, extract relevant information, and record it appropriately. (10) Verify categorization: Ensure that the data classification is consistent with the analysis. (11) Write the final report: Create a connection map and draft the report with the findings.

In the present study, documents and the organizations issuing them will be included depending on the research objective. For the first objective, a documentary review will be conducted to find information on land and water use data, specifically regarding land use classification, distribution, and activities taking place on the land, as well as information on water use, including surface and groundwater allocations and quantity, and activities taking place in the river. To access this information, documents and public databases containing these details will be sought from 1. Official webpages of various state agencies in Bahia associated with land and water regulation, management, and monitoring, such as documents granting water rights available on the SEIA Portal (State Environmental Information System), the National Water and Sanitation Agency (ANA) GeoNetwork, the Municipal Agricultural Production dataset provided by the Brazilian Institute of Geography and Statistics (IBGE), available through the Automatic Recovery System (SIDRA) and the "Study on Expanding Water Supply in the Utinga River Sub-basin" (Bahia State Secretariat for Water Infrastructure and Sanitation, 2022). 2. From research documents: "Sowing Waters in the Paraguaçu: Reconciling Policies, Governance, and Science for Revitalization" (Miranda, et al., 2016); 3. Reports and unpublished materials (grey literature) from civil society organizations: "The planned river: A pluricultural experience in the meanders of the Utinga River stolen by agribusiness" (Dourado, 2025), and "Project to consolidate water security and restore native vegetation of the Utinga River: A strategy to combat water conflicts in the region" (Instituto AGREGAR, 2025).

For the second objective, the implementation of this technique will focus on information declared by various actors that shows their perspectives on relationships between actors and land and water. The documents will include statements published on their official websites and official statements published on other publicly accessible platforms including 1. State or federal reports, laws and policy documents: "Law No. 9,433/1997: National Water Resources Policy" (Brasil, 1997); "State Water Resources Plan – PERH" (State Water Resources Council– CONERH, 2005); "Law No. 11,612" (President of the Legislative Assembly of the State of Bahia, 2009); "Study on Expanding Water Supply in the Utinga River Sub-basin" (Secretariat for Water Infrastructure and Sanitation of the State of Bahia, 2022). 2. Academic research: "Public Water Management and Territorial Conflicts in the Paraguaçu River Basin" (Arrazola & Dourado, 2019); "Sucuiuba: Water Justice and Ancestrality in the Chapada Diamantina" (Dourado, 2024); "Water, Identities, and Defense of Territory: A Historical Journey Along the Utinga River" (Arrazola & Dourado, 2021). 3. Reports and unpublished materials (grey literature) from civil society organizations: "Geospatial Survey and Systematization of Secondary Data for Defining a Priority Area for Developing a Project on Environmental Regularization and Restoration of Degraded Areas in the Municipality of Utinga – Paraguaçu River Basin – Bahia" (Vilar, 2023); "Technical Considerations Regarding the Upper Reaches of the Paraguaçu River and Justifications for Concerns and Questions About Water Management in the Region" (Instituto Nascentes do Paraguaçu, 2018); "General Overview of the Utinga River" (Ana Trinidade, 2024).

For the third and fourth objectives, a document review will be conducted to analyze information related to power relations in the governance of land and water in the sub-basin, such as information related to the different actors, their roles, interests, and influence in decision-making, and regarding the consequences of conflicts on the communities living along the Utinga River. For this, the documents to be analyzed will be: 1. public reports and unpublished materials (grey literature) from civil society organizations: “Utinga River Water Subsystem” (Dourado, 2015); “Project to Consolidate Water Security and Restore Native Vegetation of the Utinga River: A Strategy to Combat Water Conflicts in the Region” (Instituto AGREGAR, 2025); “Conflicts in the Countryside in Brazil 2023” (Dom Tomás Balduíno Documentation Center – CPT, 2024); “Conflicts in the Countryside in Brazil 2022” (Dom Tomás Balduíno Documentation Center – CPT, 2023); “General Overview of the Utinga River” (Ana Trinidade, 2024); “Utinga: the river of clear waters that is born large and swallowed by the greed of agribusiness” (Dourado & Santana, 2023); “Project to consolidate water security and restore native vegetation of the Utinga River: A strategy to combat water conflicts in the region” (Instituto AGREGAR, 2025).

2. Academic research documents: “Peasant territories in the Paraguaçu River Basin, Bahia-Brazil, and the threats posed by agribusiness policy” (Dourado, 2018); “Public Water Management and Territorial Conflicts in the Paraguaçu River Basin” (Arrazola & Dourado, 2019); “Old Issues in New Guises: Continuities and Ruptures of Socio-environmental Conflicts Caused by Contemporary Forms of Agribusiness Expansion in the Chapada Diamantina, Bahia” (Arrazola, 2022); “Exploited Waters, Waters that Bring Together: Justifications, Conflicts, and the Production of the Commons in the Face of Agribusiness Expansion in the Upper and Middle Paraguaçu, Bahia” (Arrazola, 2022); “Sucuiuba: Water Justice and Ancestrality in the Chapada Diamantina” (Dourado, 2024); “Political Governance in the Paraguaçu River Basin Committee” (Dantas de Ávila et al., 2020); “The Expansion of Agribusiness in the Web of the Chapada Diamantina, Brazil: Contributions to the Analysis of Forms of Space Appropriation for Accumulation” (Arrazola, 2024); “Territorial Governance in the Paraguaçu River Basin Committee” (Ávila et al., 2022); “The captivity of the land” (Martins, 2015); “(Counter)mapping renewables: Space, justice, and politics of wind and solar power in Mexico. Environment and Planning” (Ávila et al., 2022); “Capitalist mode of production, agriculture, and agrarian reform” (Oliveira, 2007); “The agrarian question in Brazil: The debate on the left (1960–1980)” (Stédile, 2005); “Origin and development of capitalism in the countryside: A discussion beyond the numbers” (Brito & Peripolli, 2017).

3. State or federal reports, laws and policy documents: Law N°. 601, of 1850: Land Law (Brazil, 1850); Law N°. 9,433: National Water Policy (Brazil, 1997); Law N°. 10,432: State Water Resources Policy and the State Water Resources Management System (SEGRH) (Bahia, 2006); Law N°. 11,612: Provides for the State Water Resources Policy and the SEGRH (Bahia, 2009).

3.5.6. Spatial Analysis

Spatial analysis uses maps and spatial data to identify patterns and trends, as well as to triangulate qualitative and spatial data. The tool used for analysis is maps, as they provide a visual representation of spatial patterns, enabling the identification of changes over time and clusters. They can also be a component in data triangulation, as spatial data can be combined with qualitative data such as interviews and observations to enrich the analysis (Rucks-Ahidiana & Bierbaum, 2015). Two main types of cartographic representation can be distinguished: basic and thematic. The first refers to general cartography showing the basic features of a specific territory, such as relief, rivers, strategic infrastructures, and land occupation. The second shows the spatial distribution of one or more variables, allowing the visualization of the degree of concentration or dispersion, or how the variable being analyzed is distributed in a specific space (Molinero, 2023).

In this study, thematic maps will be used. This type of cartography will enrich the data analysis of this study, allowing the visualization of patterns and distribution of water and land use, in addition to comparing the current environmental context with that of a few years ago. To achieve these objectives, a thematic map of proportional symbols will be used to represent the distribution of absolute values of a variable (Molinero, 2023), and a spatial analysis of Land Use/Land Cover (LULC), which in its quantitative model version can be represented spatially in raster or vector format (Gallardo, 2018). For this study, a vector format will be used. For the first type of thematic map, proportional symbols map, data from the documentary analysis will be used, specifically available on the Metadata Platform of the National Water and Basic Sanitation Agency (ANA) State of Bahia, which will allow the creation of a graduated point map showing quantitative data regarding water extraction rights. On the other hand, for the LULC map, polygon layers and river path line layers of the Utinga River Basin will be used, data that will be obtained from the satellite imagery of Airbus and Maxar Technologies Imagery available on Google Earth Pro.

3.6. Data Analysis

Qualitative data analysis is a process that organizes and manipulates the information collected through data collection instruments. The aim is to establish relationships, interpret, extract meanings, and draw conclusions. This stage also determines whether the applied method is effective and whether the objectives will be achieved (Urbano, 2016). In this research, thematic analysis will be used for processing data from interviews, focus groups, document reviews, and participant observations. Furthermore, to provide a comprehensive analysis that addresses the spatial aspects of the conflict, spatial analyses will be conducted, and a sociogram will be added to visualize group interactions, such as the formation of networks and their types, based on the content of interviews, focus groups, and observations.

Braun & Clarke (2006) define thematic analysis as a method used to identify, analyze, and report themes within a set of qualitative data. One of its advantages is the flexibility it offers to adapt to different theoretical approaches and perspectives, making it a fundamental tool for novice researchers. The authors propose six stages for conducting thematic analysis: (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report.

In the first step, familiarization, the goal is to immerse oneself in the data to understand its content and context. During this stage, transcription of interviews will be conducted in a very careful way for accuracy of data recording, the data of transcriptions and field notes of participant observation will be read and re-read, and initial notes will be taken while reviewing the data. In the second step, generating initial codes, the aim is to identify characteristics of the data that are interesting to the researcher and assign codes to them. For this step, the software ATLAS.ti will be used to generate the codes in a flexible way that also allows manual codification. In the third step, searching for themes, the codes are grouped into potential themes. The codes are reviewed following the interest of responding to the four objectives and grouped according to similarities or connections, creating a thematic map illustrating the relationships between themes. In this step, the necessity of gathering more data where data saturation is not achieved will be assessed, and, if necessary, the appropriate technique will be applied. In the fourth step, the themes are refined to ensure their coherence and representativeness. The coded extracts are reviewed in relation to the themes, ensuring that they respond to the research objectives. In the fifth step, the themes are clearly defined and named to reflect their essence and relationship with the data. Subthemes can be identified if necessary to reflect different dimensions of the constructs. Finally, in the last stage, the data analysis is presented, where data illustrating the themes are presented and discussed in light of the literature review, identifying whether the results confirm, expand, or contradict the findings of other studies.

Quantitative analysis is going to be performed with spatial analysis using thematic maps of proportional symbols, which is used to represent the distribution of absolute values of a variable (Molinero Hernando, 2023), and a LULC map based on the temporal comparison of satellite images. For the creation of the thematic map of proportional symbols, the data obtained from the database review related to land use and associated water use will be georeferenced, and proportional symbols will be used to facilitate the distinction between low and high values, allowing for the display of differences and comparisons on the map. The map created based on satellite images will aim to visualize monocultures in the basin and their changes over time.

3.7. Validity and Reliability

To ensure that research is effective and meaningful, efforts are made to enhance its validity and reliability (Cohen, Manion, & Morrison, 2018). The mechanisms used to assess and ensure these aspects vary depending on the research methodology, whether qualitative and/or quantitative data collection and analysis strategies are preferred. Reliability and validity help determine the credibility and trustworthiness of research findings. Reliability refers to the consistency or dependability of results, meaning that the same outcome should be achieved under identical or highly similar conditions (Bryman, 2012). Validity, on the other hand, concerns how well a study measures the social reality it seeks to analyze (Newman, 2014). Different types of validity can be distinguished, such as content validity, criterion-related validity, construct validity, internal and external validity, concurrent validity, catalytic validity, and ecological validity, among others. The relevance of each type depends on the specific research objectives (Cohen, Manion, & Morrison, 2018). In this study, construct validity is ensured through an extensive literature review of the phenomenon under investigation, leading to clear definitions that capture the various dimensions of the constructs being analyzed. This ensures that the concept being studied aligns with theoretical definitions. Additionally, ecological validity is considered to ensure that the collected data reflect real-world conditions.

Reliability, in turn, refers to whether an instrument yields consistent results when measuring the same phenomenon multiple times (Bernard, 2006). In quantitative research, reliability is linked to the generalizability of results, meaning they should be replicable under similar conditions. In this study, for the quantitative dimension related to land and water use, data on granted water rights will be used. These records include the start and expiration dates of the rights and are publicly available. The information contained in these documents remains unchanged unless revoked by the authorities. Since the data is clearly identified, different researchers should be able to access and collect the same information at different points in time. In qualitative research, reliability is more closely related to the credibility of the data rather than strict replicability. Strategies such as triangulation and detailed field notes help ensure reliability in qualitative studies (Cohen, Manion, & Morrison, 2018). This study will incorporate methodological triangulation, detailed field notes from participant observations, interviews, and focus groups, as well as audio recordings (if permitted by participants) of interviews, focus groups, and sketch mappings.

Additionally, specific measures will be applied to the chosen research techniques. This study employs both qualitative strategies (semi-structured interviews, participant observation, and document analysis) and quantitative strategies (thematic mapping). Regarding interviews, Cohen, Manion, & Morrison (2018) highlight that interview validity depends on whether the questions effectively capture the intended information. To achieve this, pilot testing of the questions is conducted before full data collection. Given that the researcher is not part of the study context, and that Brazilian Portuguese is not her native language, key local contacts will be asked to assist in translating interview and focus group questions to ensure they are clear and comprehensible for participants. Regarding reliability, one way to strengthen it is by maintaining a consistent interview structure across participants and recording the interviews (with participant consent) to ensure accurate transcription (Cohen, Manion, & Morrison, 2018). This approach will be implemented in this study.

A key strategy for ensuring validity and reliability in this study is methodological triangulation, which involves integrating findings from various data collection methods (Denzin, 2017). This study will triangulate results from interviews, observations, document reviews, and participatory mapping. Participant observation will be used to gather information that may be difficult to obtain through interviews, such as participant interactions, engagement with land and water, participation spaces and formats, and influence in decision-making. Semi-structured interviews and focus groups will be conducted to further explore elements that emerged during participant observations and sketch mappings, particularly those that were only superficially addressed or require deeper analysis. These methods will help access the perceptions of actors involved in conflicts, both individually and collectively, as well as insights from those with knowledge of conflicts. Documentary review will allow access to information provided by different actors and previous research findings, serving to verify and expand upon data collected through other methods. Lastly, participatory mapping will be used to visually represent information within a specific territorial context, offering a collective perspective on these areas of inquiry and their relationship with land and water. This method complements other forms of data collection by illustrating how participants perceive their environment and their connections to natural resources.

This study will also employ member checking as a strategy to validate results, ensuring that the data authentically represent the perspectives of interviewees (Birt et al., 2016). To achieve this, after transcribing semi-structured interviews, transcripts will be sent to literate participants for them to verify the accuracy of the recorded information and provide feedback. For participants who are not literate, verification will be conducted in person or via phone calls, allowing them to confirm the accuracy of specific excerpts that may not be clear to the researcher. The research will also use member checking as a strategy to validate results. This strategy means to ensure authentic data representativity of the perspective of the interviewees (Birt et al., 2016).

3.8. Ethical issues

Brinkmann & Kvale (2005) question the assumption that qualitative research is inherently ethical or even more ethically superior to quantitative methods such as questionnaires and behavioral experiments, which are often seen as “uncaring”. The authors explore the power imbalance inherent in interviews, emphasizing that a research interview is not a neutral dialogue between equals. Instead, the interviewer’s research agenda and knowledge goals dictate the flow of the conversation and determine the direction of the exchange. According to Pilleux (1998), in a semi-structured interview, the interviewer typically controls the conversation, guiding the interviewee's responses and ending the exchange once the desired information has been obtained. This demonstrates that power in interviews lies with the interviewer, manifested in the control over the start, middle, and conclusion of the dialogue, thus ensuring pragmatic control of the interview process.

Other ethical considerations include the fact that research interviews are not just a mutual search for truth, but serve the purpose of the researcher, with the interviewer often holding monopoly over the interpretation of the interviewee's statements. The interviewer, as the "big interpreter", has the exclusive right to interpret and report what the interviewee truly meant. However, interviewees can exercise resistance or "counterpower", such as avoiding questions, giving evasive responses, or even refusing to participate (Brinkmann & Kvale, 2005). It is important to note that not all interviewees will have the same level of control.

To address the concerns mentioned above, the research has received ethical clearance from the University of Johannesburg with the number 2024-10-01/BesomiOrmazábal_Sinthumule, ensuring that the study adheres to ethical standards and protects the rights, privacy, and well-being of the participants and that gives the authorization to proceed with the research. To maintain confidentiality and anonymity, identifiable data will be coded, and the corresponding links will be kept separate. Informed consent is crucial, as it is an ethical and legal requirement for research involving human participants. According to Nijhawan et al. (2013), the informed consent process aims to provide potential participants with sufficient information in an easily understandable language, so they can make a voluntary decision regarding whether or not to participate in the research study. In addition to applying informed consent, the researcher will inquire before beginning an interview whether the interviewees consider the topic important to their activities or lives, ensuring that the research serves more than just the researcher’s interests. Each participant will be assigned a pseudonym, which will be randomly selected from a phone directory of one of the municipalities where the research is conducted. Personally identifiable information will not be collected.

Ethical issues related to privacy invasion (Koskei & Simiyu, 2015) must be considered, especially when dealing with the territory and culture of each community. It can sometimes be difficult to define what activities cross the line into privacy, such as religious ceremonies or activities reserved for specific community members. To prevent privacy invasion, participation in such activities will always be preceded by inquiries from the researcher to local community members, ensuring that the researcher’s involvement is appropriate and that access to certain physical spaces is not inappropriate. Finally, feedback on the results will be provided to all interviewees who are interested in learning the study's outcomes, as well as to other individuals or actors in the territory who express interest in the findings. Additionally, the results will be shared with the relevant academic entities at the University of Johannesburg and the University of Padova.

3.9. Limitations of the study

In this study, limitations were understood as sources of systematic bias in the design or instruments that the researcher did not or could not control and that could inappropriately affect the results (Price & Murnan, 2004). Avello Martínez et al., 2019). Regarding geospatial analysis, one limitation was the low availability of satellite imagery suitable for temporal comparison of land-use change due to the territory's low-resolution coverage. Moreover, image quality was reduced primarily by low spatial resolution and, in some cases, cloud cover, which prevented clear identification of different land uses at given points in time. To address this, broad temporal intervals were used as comparative units rather than individual years. This approach allowed delineation of the spatial extent of banana expansion between 2010 and 2025; however, it precluded identifying specific years of relatively greater or lesser expansion within that 15-year period.

With respect to the graduated symbol mapping, a further limitation lie in the available information: official data contained only water users with state-issued permits and therefore did not account for a significant number of unpermitted users, who could not be included in the mapping. Furthermore, the official data recorded the authorized amount of water extracted and the authorized area of use, but it did not specify the actual volumes extracted or the actual areas where water was used, for which no data was available. Additionally, the water-use permit records accessible through ANA's Megadados portal included flow rate, geographic location, permit purpose, year of issuance, and expiration year, but did not indicate the crop or production system for which water was used. Although this latter information was accessible via INEMA's SEIA (State Environmental Information System), obtaining it would have required opening each permit individually and reviewing multiple documents, which was not feasible within the project's data-collection timeframe.

Regarding limitations of techniques such as interviews and observation, Koskei and Simiyu (2015) describe that observation could be time-consuming and not always productive, since the researcher needed to be present whenever the phenomenon occurred. They also note the risk of introducing bias in the observation process and the impossibility of controlling events, which required waiting for them to happen; moreover, past behavior or participants' motivations and intentions could not be directly observed. In this dissertation, there were also access constraints to certain actors because the researcher was unfamiliar with the territory under investigation and relied on a key contact in the Utinga River Basin. Key contacts can present limitations by having a restricted view of relevant territorial actors or by connecting only with a subset of them. This limitation was addressed through snowball sampling, whereby key informants suggested additional people or actor groups who may have been initially overlooked, thus facilitating broader access.

Specifically for participant observation, Sanjuán (2019) distinguishes limitations derived from the researcher, the subjects, the technique, and the research circumstances. The author highlight "immutable characteristics like age, gender, and social position, which will influence access to the field and social acceptance." These limitations were especially considered here because the researcher was an outsider to the territory and country where the study took place. The author emphasized the centrality of the observer's ability to establish human relationships of quality, honesty, and mutual respect. To address this, during community visits, the researcher delivered introductory presentations to the community and to prospective interviewees, beginning with household visits and community walks. The objective was to make explicit the research aims and the researcher's interests, to learn about residents' ideas, concerns, and expectations, and to build mutual trust gradually. This approach fostered openness among individuals and families, who invited the researcher to various activities and walks, and enabled the conduct of interviews and focus groups. However, some individuals who initially expressed willingness to participate later became unresponsive or declined to engage, indicating a degree of discomfort or reluctance; their decisions were respected.

In relation to participant observation in meetings of the Paraguaçu River Basin Committee, there were difficulties in attending because of the basin's extensive geographic span and the challenge of obtaining prior information about meeting times. In response, other public events were attended instead: an emergency meeting regarding the water crisis in the Utinga River Basin; a visit by the Governor to the city of Wagner; and the Water Management Seminar organized by the Pre-Union Association of Environmental and Water Resources Employees of the State of Bahia (ASCRA).

Sanjuán (2019) also note time limitations and their relationship to financial constraints. As indicated above, participant observation required extended periods in the field and substantial time commitments. The time spent in the field was limited to a few months, consistent with the thesis timeline within the master's program and with other constraints that limited the researcher's ability to stay longer in the territory. Financial limitations were also considered, as they restricted access to different actors and affected the researcher's ability to remain in the territory or revisit key locations multiple times. Additionally, transportation posed a constraint, since there were areas where public transit did not reach or was not reliable.

Finally, a potential threat to internal validity may arise when respondents do not provide truthful answers, instead offering responses perceived as socially acceptable or desirable. Such bias may produce answers that do not accurately reflect participants' real opinions or those of the broader population (Price & Murnan, 2004). This may constitute an especially important limitation when eliciting meanings, valuations, and principles governing relationships with water and land.

Chapter 4. Results

4.1. Identification of the main land and water use activities taking place along the Utinga River Basin.

4.1.1. Land uses

The following land uses were identified and categorized in the basin. A diversity of uses within the category of agricultural, livestock, and forestry activities; urban use; conservation use; occasional residential use; and recreational riverbank use. In Brazil, the Forest Code (Law No. 12.651/2012) establishes two key conservation obligations for rural properties: the Legal Reserve (RL), a mandatory area maintained with native vegetation and subject to sustainable use, and the Permanent Preservation Area (APP), which protects ecologically significant zones such as riverbanks, springs, and steep slopes. In Bahia, projects with local environmental impact must also undergo state-level environmental licensing and authorization (Bahia, 2012).

The objective of agricultural, livestock, and forestry activities can be for commercial activities or self-consumption. Different types of productive spaces were also identified. Within the category of medium to large-scale agricultural properties, the productive space is used for commercial crop production and typically involves irrigated monoculture plantations, which, in some cases, may be developed alongside grazing animals. The most representative crops in the area are banana, cassava, passion fruit, and papaya (Brazilian Institute of Geography and Statistics, 2022). Meanwhile, in community settlements, the *quintal* [1] *is* typically used for subsistence farming (Figure 4.1). In many cases, it has an agroforestry or agrosilvopastoral system characteristic and is marked by a high level of agrobiodiversity within a limited space, and often combines fruit trees, vegetables, medicinal herbs, and occasionally small animals, reflecting a multifunctional use of space (Annex 1). The *roça*[2], used for both commerial and subsistence, may contain monocultures or more biodiverse cropping systems, and it can be based on rainfed or irrigated agriculture (Figure 4.2).

[1] Small productive area adjacent to the household.
[2] Larger plot, yet still small in size, located further from the house.

Figure 4.1. *Agroecological Quintal* **Figure 4.2.** *Roça*

Subsequently, Table 4.1. presents a systematization of the uses within the category of agricultural, livestock, and forestry types according to the structure of the productive system, and their production objective.

Table 4.1.

Agricultural, livestock, and forestry activities.

Type of productive space	Agricultural, livestock, and forestry activities	Production objective
Medium to large-scale: Agricultural property	Agropastoral systems	Commercial
	Perennial monoculture	
	Biomass/wood	
	Horticulture	
Small scale: Quintal, Roça, Roça coletiva	Perennial monoculture	Commercial and/or Subsistence
	Biomass/wood	
	Rainfed monoculture	
	Rainfed Agroforestry	
	Agroforestry	
	Agropastoral	
	Livestock farming	
	Horticultural polyculture	
	Perennial polyculture	
	Rainfed polyculture	
	Silvoagropastoral system	
	Silviculture for environmental restoration	

4.1.2. Water uses

The Secretariat of Water Infrastructure and Sanitation (SIHS, 2020) identifies the following social groups as dependent on water resources within the basin: cities, traditional communities (quilombola communities, Indigenous peoples, and agrarian reform settlements), small, medium, and large-scale farmers. The following productive water uses were identified in the basin: water for livestock, irrigation, watering, and fishing. Other uses included public supply for municipal headquarters and surrounding rural areas, recreational bathing, and human consumption. Human consumption is distinguished here between direct consumption—drinking, cooking, and personal hygiene—and domestic consumption, which includes washing clothes, dishes, and cleaning. For the aforementioned uses, different sources of water were identified, namely: surface water from the river. Table 4.2. presents the uses associated with each water source, according to the social group in which they were identified.

Table 4.2.

Water sources by type of use and social group.

Use objective	Source	Social group
Public supply	River	Cities
	Groundwater	Cities
Human consumption - Direct consumption	Rainwater	Communities: São Sebastião, Volta do Américo
	Groundwater	Communities: São Sebastião, Volta do Américo, Iuna, Payayá Territory
Human consumption - Domestic consumption	River	Community: São Sebastião
	Rainwater	Communities: São Sebastião, Volta do Américo
	Groundwater	Communities: Volta do Américo; Payayá Territory
Recreational - bathing	River	Communities: Payayá Territory; Volta do Américo; São Sebastião
Productive (Commercial or Subsistence) – water for livestock	Pond	Communities: Volta do Américo; São Sebastião
	River	Community: Volta do Américo
	Groundwater	Community: Iuna
Productive (Commercial or Subsistence) – irrigation, watering	Rainwater	Medium to large-scale producers; Communities: Volta do Americo; São Sebastião; Iuna; Payayá Territory
	River	Medium to large-scale producers
	Groundwater	Medium to large-scale producers
Productive (Commercial or Subsistence) – fishing	Pond	Communities: Iuna; São Sebastião
	River	Communities: Iuna; São Sebastião

Note. Author, based on SIHS (2020); ANA GeoNetwork (n/d); interviews and field notes.

4.1.3. Territorial and productive reconfigurations

In recent decades, land use in the area has changed markedly in connection with conflicts, especially with the spread of monocultures. Banana farming started to expand in the early 2000s and became much more prominent after 2010 (Figure 4.3). One interviewee noted that the structure of agricultural activities and the types of crops in the Utinga River basin have shifted considerably during this period.

> "The Utinga River basin has always been an agricultural and livestock-producing basin. (...) It was a sugarcane region. And it has always been a major producer of horticultural crops. (...) From the 2000s onward, bananas emerged as a profitable crop, and then people started replacing the areas of horticultural crops and sugarcane with bananas. So, bananas became, as we say, the flagship crop of the region. It started due to economic reasons; it's a crop with better profit, however, it requires a lot of water" (Interview anonymous, 23 April 2025).

In terms of tons produced, banana monoculture far exceeds other crop types and is mainly concentrated in the municipalities of Wagner and Utinga, both located in the upper part of the Utinga River. Currently, along the course of the Utinga River, there are over 3,500 hectares of irrigated land, with approximately 2.4 million banana plants each requiring about 40 liters of water per day (Instituto AGREGAR, 2024). This productive shift is tied to increasing water extraction. Between 2013 and 2017, there was a surge in large-volume rights, coinciding with the years when the river began showing signs of collapse. From 2017 to 2023, many producers combined surface-water rights with new groundwater permits and vegetation clearance, expanding cultivated areas, further pressuring the basin's aquifers, and intensifying environmental impacts, while rural, quilombola, and settlement communities simultaneously lost productive diversity and cultivated land (Dourado, 2025). However, there is an estimated 80% to 90% of all irrigators in the basin extract water without a license (SIHS, 2020). Figure 4.4 illustrates the distribution of water rights for irrigation and livestock, distinguishing between surface- and groundwater sources and the corresponding extraction flows.

The second major case is eucalyptus monoculture near the community of Volta do Américo, which began around 2010 (based on Google Earth Images). These monocultures have been established in strategic areas, particularly near water springs. Additionally, eucalyptus monoculture has also begun to expand into the community itself, into roça areas of some families of the community.decades, significant changes in land use have taken place that are linked to conflicts, specifically the expansion of monocultures in the studied territory. The expansion of banana monoculture is reported to have begun in the early 2000s and gained greater prominence from 2010 onward (Figure 4.3). An interviewee described how agricultural land use has transformed in the Utinga River basin:

> "The Utinga River basin has always been an agricultural and livestock-producing basin. (...) It was a sugarcane region. And it has always been a major producer of horticultural crops. (...) From the 2000s onward, bananas emerged as a profitable crop, and then people started replacing the areas of horticultural crops and sugarcane with bananas. So, bananas became, as we say, the flagship crop of the region. It started due to economic reasons; it's a crop with better profit, however, it requires a lot of water" (Interview anonymous, 23 April 2025).

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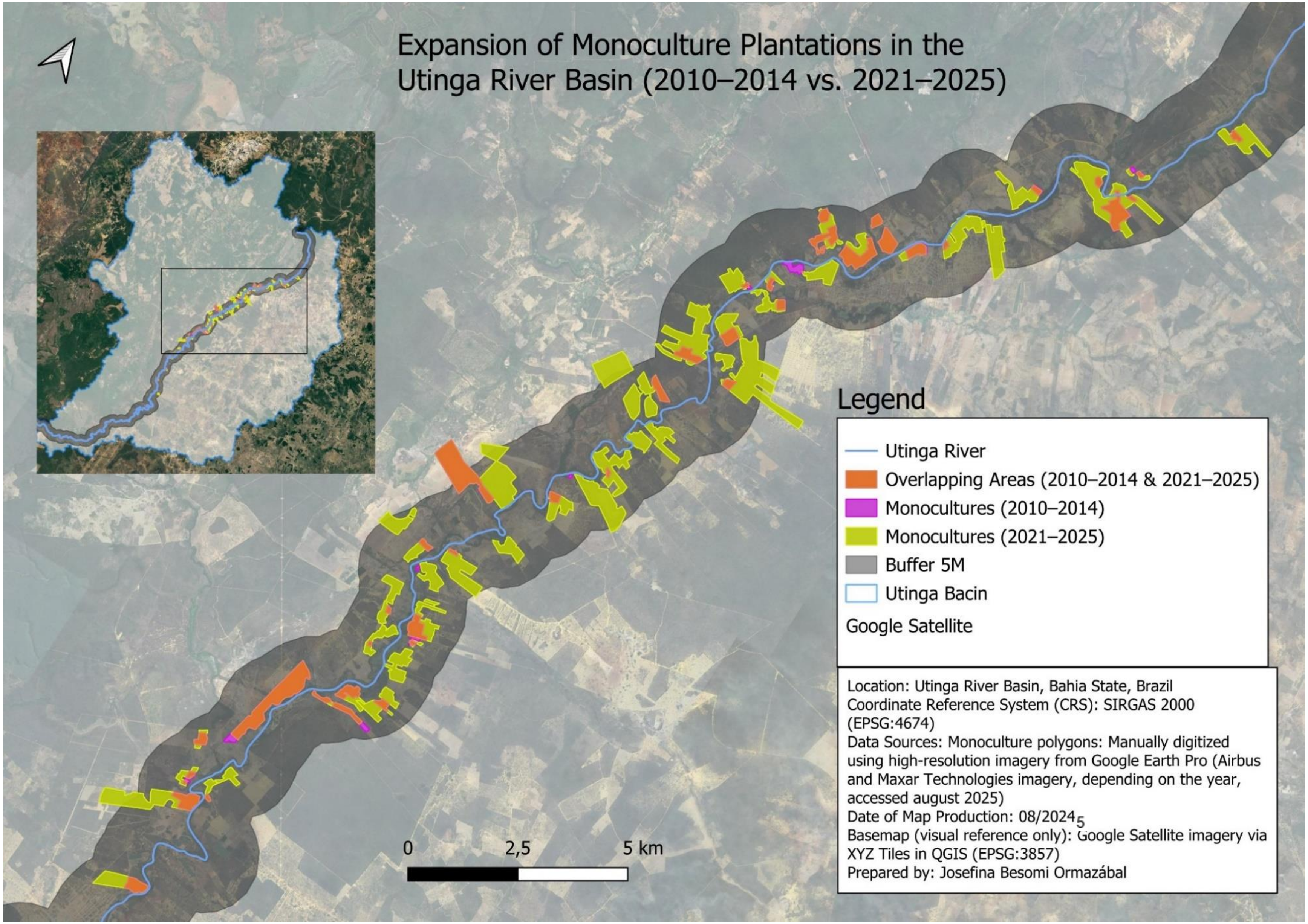

Figure 4.3. *Spatio-temporal comparison of perennial monoculture plantation area between the periods 2010-2014 and 2021-2025.*

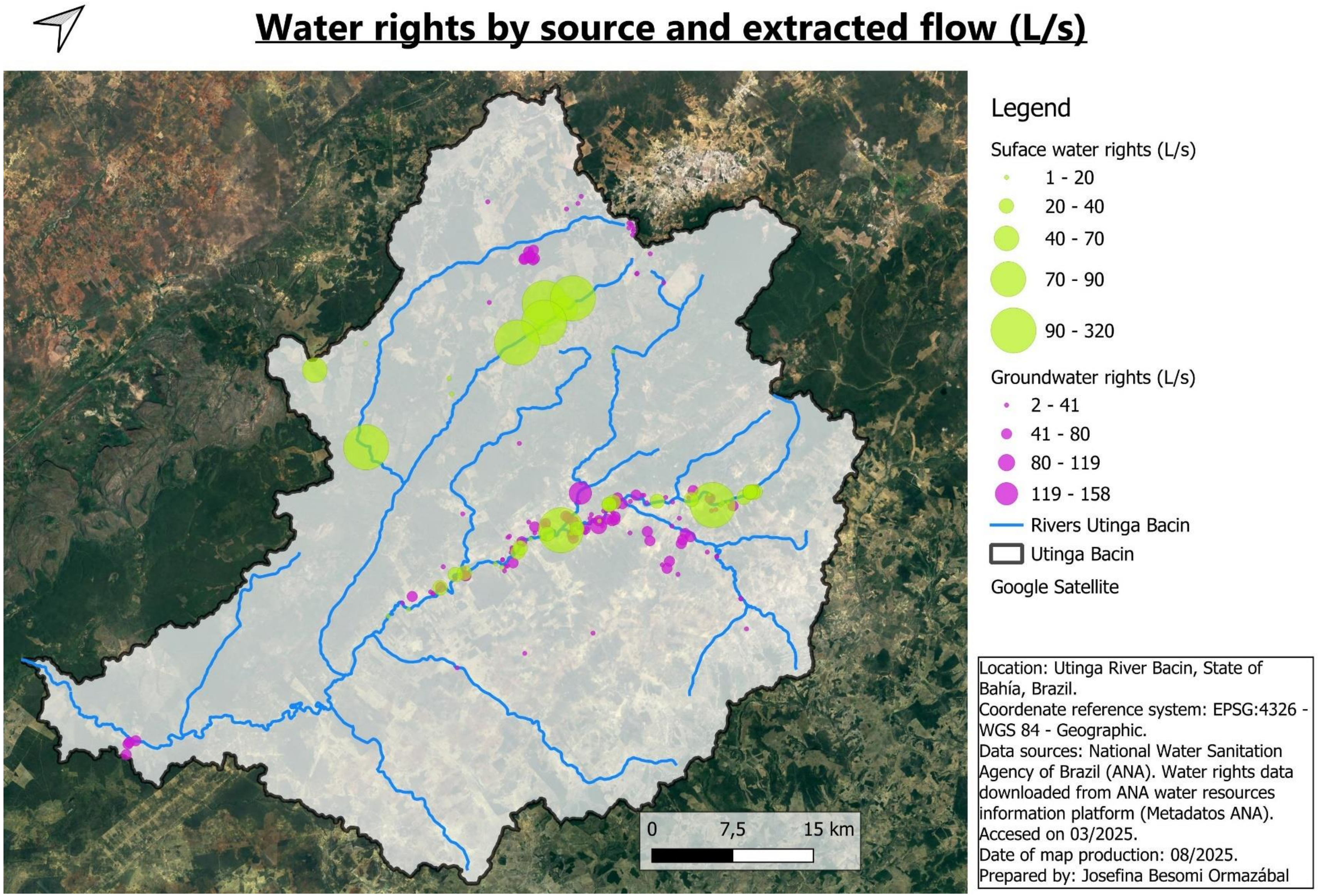

Figure 4.4. *Water rights for irrigation and animals by source and extracted flow (L/s).*

4.2. Relationships of different actors in the Utinga River Basin with land and water

4.2.1. Knowledge, practices, and technologies

It was possible to identify three main categories of knowledge, practices, and technologies in use or in dispute in the Utinga River Basin, linked to different types of land and water use mentioned in, namely: modern or conventional; traditional; and agroecological. These three fields of knowledge are not distributed homogeneously among the different groups interviewed. While in Bahia State Institute for the Environment and Water Resource (INEMA), the Integrated Water Supply and Sanitation System (SIHS), and in agribusiness[3], scientific and conventional technological approaches prevail, with some transitions continuing along the line of conventional knowledge. In peasant agriculture systems[4], a more complex coexistence was observed among traditional knowledge, agroecological experiences, and modern or conventional practices and technologies. The peasant population in the studied region has a long history of migrations and diverse roots: some are quilombola, others Indigenous, and other peasants with varied backgrounds. While many common elements can be found in their traditional knowledge and practices, this diversity is reflected in the different trajectories and transitions of the various groups regarding the relationships they establish with water and land.

In first place, regarding conventional or modern knowledge and practices, the State employs technical-scientific approaches aimed at water supply management. Agencies such as INEMA and SIHS use monitoring systems, technical teams (geologists, hydrologists, agronomists, etc.), and infrastructure strategies, including large and small dams. These constitute State-led conventional methods focused on control and supply. Agribusiness actors also rely on conventional technologies tied to monoculture and irrigated production. Practices include individual wells and pumps, drip and micro-sprinkler systems, and the use of agrochemicals and improved seedlings. In response to water scarcity, agribusiness producers have increasingly shifted from surface water extraction to private groundwater boreholes. Among communities, some conventional practices, such as the use of improved seeds or small-scale pumps, overlap with agroecological and traditional practices. In

[3] Regarding the actors of this sector, the document refers to them by different names depending on the context and on who mentions them. One designation is “larger producers,” used to contrast them with small-scale producers. They may also appear as “irrigators,” which is the category under which they fall within the Paraguaçu River Basin Committee.

[4] Regarding the actors of this sector, they appear throughout the text as “small-scale producers” or “communities”.

second place, agroecological practices observed in several communities include recovery of local seeds, crop association, reforestation of riverbanks, rainwater harvesting reservoirs, and community wells for domestic water use. Other social technologies include the reuse of domestic water and low-cost beds to optimize water retention.

In third place, traditional knowledge includes rainfed farming, flood irrigation, artisanal dams, and irrigation canals, along with the use of local seeds, seed selection, fallow cycles, and fertilization with animal manure. These practices are linked to cultural and spiritual relationships with land and water, preserved in stories and rituals, and supported by agrobiodiverse *quintais*[5], largely maintained by women. The agro-food cycle shows a continuity in which peasant families are involved in every stage: selecting planting material, caring for soil and water, harvesting, artisanal processing, and preparing food at home. This connection goes beyond production, expressing a way of life rooted in the land and in the passing on of food knowledge and culture. As one woman described while harvesting cassava: "Pulling out aipim, then peeling it, then peeling the pan, then the pan, then the belly" (Interview anonymous, 20 February 2025). In the communities, women are primarily responsible for food preparation, and women are more often seen at home while men work outside or in the fields. A clear example is the São João festival in July, a central event in Northeastern rural communities celebrating the harvest, land, and community bonds. Corn plays a key role, used in traditional dishes such as *polenta de milho com quiabo e frango*[6], *mingau*[7] and *pamonhah*[8] (Figure 4.5). Corn here embodies both food and peasant knowledge passed through cooking, songs, and collective celebrations, forming an agri-cultural cycle deeply rooted in the territory.

The coexistence of traditional, agroecological, and conventional practices found in the communities is characterized by different transition processes. Some of them were forced transitions, either due to conflicts, impositions by environmental authorities, or environmental changes; chosen transitions, adopted because they reduce the physical effort, energy, or time required for a task or because they offer ecological or social benefits; and, finally, a category of omission, characterized by the lack of transmission of knowledge, for which insufficient information is available to fully understand the reasons behind it, though elements from both of the

[5] Small productive area adjacent to the household.
[6] Cornmeal with okra and chicken
[7] Corn porridge
[8] Corn pudding

aforementioned categories can be assumed to be involved. It was identified that some of these transitions generate tensions with traditional practices, putting their preservation at risk.

Figure 4.5. *Traditional dishes.* On the left, prepare beiju with butter and cheese (Author). On the right, traditional milho-based dishes prepared for the São João festival (Interviewee).

The Payayá Territory is located within the community of Cabeceira do Rio. It shares several elements with the rest of the community but at the same time constitutes a subsystem with knowledge and practices of its own. Among the elements that are common are the agrobiodiverse quintais[9] for self-consumption, the use of motor pumps for irrigation, and a collective artesian borehole that serves the entire community. What distinguishes the Payayá Territory is the way land is used, since while in most of Cabeceira irrigated monocultures and chemical inputs prevail, within the territory land use is organized through an agrosilvopastoral system with mixed crops and biopreparations, combined with the cultivation of creole seeds and the implementation of reforestation processes. A resident of the Payayá Territory comments on the activities carried out according to the phases of the moon and adds that this includes the collection of materials for construction: "There comes a time when you have to remove the wood and even the clay itself to be able to make it. That's when there's no moon (...) It lasts much, much, much longer" (Interview anonymous, 17 April 2025). A key transition occurred in the broader community when INEMA dismantled traditional irrigation canals causing a forced shift to motor pumps. This also led to the

[9] Small productive area adjacent to the household.

adoption of a collective photovoltaic-powered motor within the Payayá Territory, showing space for choice within a forced change. Another chosen shift was the move to drip irrigation to save water: “If the system I’m using is causing harm, even if it’s traditional, and a new system arrives that is more water-efficient... I’m going to adopt it” (Interview anonymous, 18 April 2025). Traditional practices such as *mutirão*[10], lunar planting cycles, and everyday use of the river for washing and bathing persist alongside these changes (Figure 4.6).

Figure 4.6. *Traditional practices in the river.* On the left, dishwashing and laundry activities in the river; on the right, People bathing in the river (Interviewee).

In São Sebastião, between the Utinga River and its tributary, the Bonito, local agriculture is shaped by a mix of traditional and conventional knowledge, with agroecological elements appearing only to a smaller extent. Over time, environmental changes and conflicts have pushed the community into a difficult transition. Declining rainfall and the drying of the river, which interviewees link to upstream banana monocultures, have reduced production and shifted the balance between rainfed and irrigated systems. Irrigation practices reflect another key transition. Historically, the community used small manually built dams and flood irrigation canals constructed before the community settlement was developed. These systems were later dismantled by INEMA, leading to the predominance of motor pumps for irrigation. While remembered as a conflictive and imposed change, some residents also saw it as a partially chosen transition given the reduced river flow.

[10] Collective labor.

A third transition involves a shift from traditional pest management using natural repellents to the adoption of agrochemicals. This change has affected seed conservation practices, although some elders continue selecting and storing local seeds, including corn kernels chosen from the middle of the cob. Traditional practices still alive in the community are the *mutirão*[11], carried out weekly as a reciprocal work exchange that strengthens social ties and preserves peasant culture; medicinal herbs collection; production of construction materials from local clay, a knowledge still present in the community: "Clay is mud, it's the earth. It can even be used to make... You can also make a brick that raises the wall. If possible, the clay can even make roof tiles. (...) This little brick that is on the wall here it is covered. It was made right here" (Interview anonymous, 14 April 2025). Agroecological elements include the reuse of household water for irrigating home gardens (*quintais*), primarily for non-edible plants (Figure 4.7).

Figure 4.7. *Reuse of household water in the home garden*.

Volta do Américo, formerly a coffee monoculture estate, now combines a variety of crops with an ongoing agroecological transition, while rainfed farming remains the main practice. A key forced transition has been the drying of three of the seven local springs, which has been disrupting traditional practices such as washing clothes and dishes in the river and recreational bathing.

[11] Collective labor

Interviewees offered different explanations: reduced rainfall, past deforestation for coffee cultivation, and/or the recent expansion of eucalyptus plantations. At the same time, the introduction of piped water eased daily work but also changed the community's direct relationship with the river.

Another chosen transition in Volta do Américo has been the adoption of agroecological practices as part of a broader project to strengthen peasant life. Practices include intercropping, agroforestry, soil fertilization using by-products from the manioc flour house (Figure 4.8), with animal manure and organic composting, soil coverings, and planting in furrows for water retention. Social technologies such as rainwater harvesting reservoirs, water reuse systems, blackwater sanitation through evapotranspiration basins, a community borehole for domestic use, and economic garden beds were also identified. This agroecological shift directly contrasts with the eucalyptus monocultures, considered a forced transition due to conflict because of their high-water demand and the replacement of food production areas with eucalyptus: "So, the women who are the base of food production in the community have been spending their time and energy to produce eucalyptus" (Interview anonymous, 22 March 2025). Despite some households planting eucalyptus in their roças[12], they maintain agrobiodiverse *quintais*[13], ensuring food for family self-consumption. The traditional practices that still remain present include *mutirão*[14], the use of local seeds such as corn and beans, rainfed agriculture, agrobiodiverse *quintais*, and soil fertilization with animal manure. Washing clothes and dishes in the river, bathing, producing farinha de mandioca, roasting coffee, and crafting materials also remain part of daily life.

[12] Agricultural productive area.
[13] Small productive area adjacent to the household.
[14] Collective labor

Figure 4.8. *Manioc flour house.*

The quilombola community of Iúna is situated at the confluence of the Utinga and Santo Antônio rivers, in a landscape marked by several lagoons. These water bodies have a historical role in shaping community life and identity. Fishing, together with everyday activities such as washing clothes, bathing, and fetching water, has long been part of daily routines, revealing a deep and enduring relationship with these water bodies. One of the strongest elements of traditional knowledge is the management of planting times according to lunar phases and seed conservation. These practices are now at risk due to a lack of generational transmission, constituting a transition of omission. Changes in the rivers and lagoons have led to forced spatial transition. With the drying of the Utinga River, daily activities and fishing moved to the Santo Antonio River, which is farther away, making practices such as carrying water and washing clothes more difficult, especially for women. Several interviewees initially attributed these changes in the river to drought and environmental variation, but later they associated them with upstream dams, canals, and banana monocultures in the upper basin. This shift also meant the loss of some traditional fish and planting spaces, undermining the community's capacity for self-provisioning and altering historical relations with the river and lagoons.

After these transitions, a chosen shift toward agroecological knowledge and social technologies was observed. The installation of a community artesian borehole for human consumption and the adoption of rainwater collection reservoirs greatly reduced the burden previously carried by women, and the arrival of piped water enabled the reuse of household water to irrigate *quintais*. Some practices now remembered as part of a past spiritual relationship with nature include offerings to the river before fishing and to the land when producing manioc flour, as well as bringing a smoking stick to the "owner of the forest" when hunting. Another traditional knowledge nearly extinct is the reproduction of local seeds: "Before, there were seeds passed from father to son, creole seeds. (...) Then people planted, but the rain didn't come, it died, losing the seed" (Interview anonymous, 30 April 2025). This loss is now being countered through a chosen agroecological transition focused on recovering traditional seeds. Finally, traditional construction is undergoing a chosen transition, incorporating adobe and adapted methods to strengthen structures while maintaining the use of local materials (Figure 4.9).

Figure 4.9. On the left, a house made of adobe; on the right, soil extracted from the home garden to make adobe.

4.2.2. Meanings, valuations, principles of relationship with nature, and life principles

Brazilian legislation formally recognizes the economic, social, and environmental value of water, as well as its status as a universal right (Law No. 9.433/1997). However, as one interviewee from a state institution noted, "The State sees water as an economic good. Very strong economic good. Not environmental good, so the relationship between land and water, it is not studied" (Interview anonymous, 23 April 2025). This framing underscores the idea that fees on water use are meant to foster rational allocation. With regard to land, the Federal Constitution recognizes private ownership as both a fundamental right and an economic asset, while at the same time requiring rural property to fulfil a social function that includes productivity, rational use, environmental protection, and dignified labour conditions. (Constitution of the Federative Republic of Brazil, 1988, art. 186). Nonetheless, as Melo (2019) notes, the concentration of large landholdings hinders the realization of these legal principles. On the other hand, based on interviews with irrigators from the Association of Farmers of the Utinga River Basin (AABU), it is possible to identify that water and land have an economic value that drives the municipal economy. Beyond their economic value, water and land are also seen as essential for life itself. One irrigator adds that plantation expansion should be limited by water availability and argues in favor of charging all users for water to ensure collective management.

There is a diversity of valuations, principles of relationship with land and water, and life principles across the four communities (Annex 2). Common to all is the understanding of land and water as the foundation of life, means of subsistence, health, and heritage to be preserved for future generations. These meanings combine practical, historical, and spiritual dimensions, with nature often seen as a living being and provider—especially in the Payayá Territory, where maternal and protective bonds are emphasized and defending the territory is inseparable from defending life itself. In São Sebastião, land and water are conceived as inseparable elements of life, central to survival and accessed through collective arrangements that oppose overuse and private appropriation. In Volta do Américo, land and water are understood as rights inseparable from collective responsibility, where agroecology and the transmission of knowledge across generations sustain the care of soil, plants, and people. In Iúna, they are tied to coexistence and cultural memory, with particular emphasis on preserving native seeds and respecting natural cycles. Across contexts, guiding life principles include autonomy, care, respect for natural limits, collective management, generational transmission of knowledge, defence of territory, and rejection of extractive logics.

4.3. Social impacts of the conflict on traditional water-related practices of communities inhabiting the Utinga River and their reactions to those impacts.

The territorial and productive reconfigurations driven by the expansion of both perennial and silvicultural monocultures have generated significant ecological impacts, which have, in turn, produced direct social impacts by altering both the uses and valuations of land and water. Impacts on uses include reduced access to water for human consumption, livestock hydration, and irrigation.

They also involve declining agricultural production in areas dependent on irrigation, as well as negative effects on irrigation technologies. In addition, fishing has declined or even disappeared, and interruptions in public water supply have occurred. One striking example is Wagner, where in early 2018 the river's flow stopped, leaving 830 families of small farmers, quilombolas, and fishers in debt and, in some cases, facing hunger (Dourado, 2018). These changes have also affected the valuations of water and land as means of subsistence, as heritage for future generations, as spaces of collective memory and spirituality, and as foundations for food sovereignty and security. According to Instituto AGREGAR (2025), monoculture expansion and private appropriation of water caused a decrease in the capacity of rural communities in the basin to produce essential foods, with diversified production decreasing annually.

Indirect social impacts include cultural and spiritual disruptions caused by the loss of rivers and lagoons as spaces of connection; increased labor burdens, often disproportionately falling on women; psychological effects such as fear and fatalism; and the loss of recreational uses like river bathing. Adaptation strategies vary by community and include changes in land use, switching to alternative water sources, adopting agroecological practices and technologies, and maintaining traditional or locally informed practices. In some cases, however, no adaptation was possible due to lack of resources or because the uses of land and water, especially those linked to collective experiences and knowledge systems, were irreplaceable once ecological loss occurred.

The community of São Sebastião, in the middle stretch of the Utinga River, faces strong effects from seasonal droughts. Agriculture and livestock remain at the heart of the local economy, while fishing, once an everyday activity, has almost disappeared. As the river has dried, irrigation and animal watering have become increasingly difficult, and concerns now extend to water for human consumption. Families have been pushed toward rainfed farming, yet this transition is hindered by the heavy weight of economic constraints. With little capacity to buy food and no capacity pay for water trucks, people face very limited options for adapting. Interviewees also spoke of the emotional weight of production losses, describing suffering that extends not only to people but also to plants and animals. The disappearance of fish species has weakened traditional practices and knowledge, while state actions—such as dismantling traditional irrigation structures without consultation—were widely perceived as unjust. The disappearance of fish species has weakened traditional practices and knowledge that were once central to community life. The loss of fish species has disrupted traditional practices and knowledge in the settlement, while state interventions carried out without prior consultation were seen as deeply unjust. Together, these experiences connect ecological impacts with cultural loss, illustrating how the drying river and top-down measures have undermined livelihoods and weakened the community's historical relationship with land and water.

In Iúna, fishing, which was an important activity in the history of the community, was strongly affected. Además, while the main factor affecting agriculture is the lack of rain and shifting rainfall patterns, the disappearance and diversion of the river eliminated the limited water access that supported small-scale farming near its banks. The ecological impact also affected access to water for human consumption and had indirect psychological effects, and the increased workload, especially for women. As an adaptation, residents first switched from the Utinga to the Santo Antônio River to meet domestic needs. These impacts reflect disruptions in both the valuation of water as a means of subsistence and as a place of belonging. Cultural relationships with lagoons were also affected as made clear by this comment:

> "I went out to the field and saw another lagoon that disappeared, a beautiful lagoon, it had history, culturally, a beautiful lagoon, that lagoon disappeared. (...) People say they saw a mermaid, they saw a fish with a clock on its head; there were all sorts of stories. There was an enchanted lagoon over in the municipality of Andaraí, and this other one was the breath of that enchanted lagoon" (Interview anonymous, 30 April 2025).

There were no adaptations reported for this impacts, as they involve relationships with living entities tied to memory and spirituality that cannot simply be replaced by new access technologies.

In the Cabeceira do Río, the main impacts stem not from water scarcity but from upstream institutional measures responding to conflicts elsewhere in the basin. Interviewees perceived injustice in restrictions that penalized small farmers using minimal water. Direct impacts include reduced irrigation and animal watering, affecting the valuation of water as a means of subsistence and life reproduction, alongside a significant loss of biodiversity linked to the closure of traditional canals. Indirect impacts involve emotional distress and the loss of practices tied to these canals, which were later blamed for the river's drying. No adaptations were reported beyond complying with the measures.

In Volta do Américo, although rainfed farming remains the dominant practice in the roça, concerns over the potential drying of springs because of the expansion of eucalyptus plantations are recurrent. This projected problem generates fear and a sense of inevitability, with no adaptations mentioned. A second impact is the loss of agrobiodiversity due to time and labor redirected from food production to eucalyptus, affecting traditional practices and women's central role in peasant life: "So, the women (...) they stopped producing food to produce eucalyptus. (...) The child will be there watching only one kind of thing being produced, whereas what we should be doing is producing biodiversity, producing real food" (Interview anonymous, 22 May 2025). A conscious shift toward agroecological practices and water-saving technologies has begun, interpreted both as resistance to monoculture and as adaptation to biodiversity loss. These changes reinforce the valuation of water and land as heritage and as the basis for future generations' well-being. Finally, poor infrastructure and limited water access technologies create further stress, especially for women, increasing workload and prompting the use of neighbor support networks and traditional rainwater storage practices.

4.4. Role of socio-political power structures in shaping the uses of land and water in the Utinga River Basin.

In this section, the power relations between the different actors involved in the conflicts are analyzed, as well as how these relations shape, enable, and reproduce the underlying causes of the conflict, while also containing the forces that may transform these modes of interaction. Power relations as shaping forces of land and water uses define who has access and who does not. This, together with the awareness of the unequal distribution of access to water and land and the asymmetries in the different forms that power takes, gives rise to conflicts.

Regarding power relations, these can be found on the one hand, as structured relations and, on the other, as structuring relations. Structured power relations are understood here as relatively stable relations that have crystallized over time, shaped by historical-material processes between social groups and between these groups and nature. These relations articulate both the forms of production and reproduction of life and the meanings, valuations, and principles that guide social practices. In relation to the causes of the conflicts, structured power relations were identified as those that configure and allow these conflicts to emerge. In contrast, structuring power relations are understood as dynamic relations constituted by actions and practices, produced from and conditioned by the structured, which may reproduce or transform them. These are linked to actors' agency and the potential for change in power relations, distribution, and the overcoming of these conflicts.

Power relations manifest in different arenas, within the category of structured power relations, two arenas were identified: the material arena and the symbolic arena. For structuring power relations, four arenas emerged: the productive and life reproduction space; within the public space arena, the organizational arena, and institutional arenas of participation. In these arenas, mechanisms of reaffirmation, strengthening, weakening, or potential transformation of structured power relations appear, reflecting strategies of different actors to maintain or dispute control over the means of production and reproduction of life. Various types of power were also identified depending on the arena: in the material arena, economic and political power; in the symbolic arena, political, normative, and epistemic power. Between both arenas, political-economic power, the monopoly of force, and collective action capacity were observed. A diversity of power relations emerged at the intersections between the categories of structured/structuring power relations, the different arenas and sub-arenas, and the types of power exercised (Figure 4.10. and Annex 3). The following section presents how these relations take shape within conflicts.

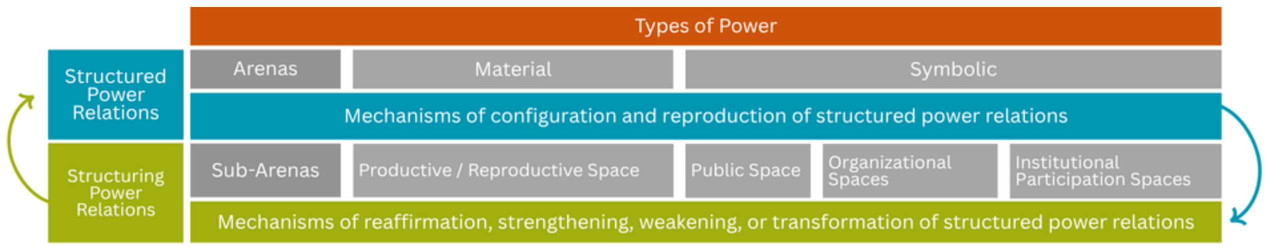

Figure 4.10. *Power relation matrix.*

4.4.1. Structured Power Relations

Regarding structured power relations, the following mechanisms of configuration and reproduction were identified in the material sphere: (I) concentration of the means of production and reproduction of life, including water, land, technologies for accessing and controlling water flows, agricultural production technologies, and information technologies; and (II) productive relations of dependency, encompassing employment relationships, dependence on public policies, and dependency through the purchase of seed and agrochemical packages. In the symbolic sphere, the mechanisms identified include normative frameworks, both legal and value-based, public power institutions, and hegemonic language.

The historical process of land accumulation in Brazil forms the foundation of the structured power relations that shape the countryside today. Since colonization, rooted in European capitalism, Brazil's territorial organization was based on large land grants by the Portuguese crown and the expropriation/appropriation of Indigenous territories, creating an export-oriented agrarian system sustained by enslaved labor (Brito & Peripolli, 2017). This first phase consolidated the *latifúndio*[15] as the dominant model and created the primitive accumulation that later sustained the development of industry and agrarian capitalism (Faria et al., 1993). Over the centuries, land concentration has continued to be a central mechanism in Brazil for preserving economic and political power. The 1850 Land Law institutionalized private property and restricted free access to land, reinforcing its concentration in the hands of those with capital. After World War II, the industrialization process further extended the reach of capitalism into rural areas (Brito & Peripolli, 2017). The Green Revolution of the 1960s and 1970s brought capital-intensive technologies and subsidized credit that strengthened large estates and placed agricultural production under corporate control. Between the 1960s and 1980s, this process made thousands of peasants leave the countryside (Stedile, 2005). In this way, the *latifúndiho* structure was legitimized through both normative and symbolic frameworks. At the same time, *coronelismo*[16] emerged as a central mechanism of territorial control, especially in Bahia, reflecting the historical concentration of land, resources, and political decision-making. As one interviewee explained:

> "Power is more determined here in this region by capital itself, by the people who really hold the strength, the possession of the land, who have… that's it, right? And the second is political power, right? Those people who go gathering votes and become *coroneis*[17], become mandarins, right? And these people end up influencing others, right? So, what he says is like an order. So that's it, it's a designation of power, right?" (Interview anonymous, 15 April 2025).

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[15] large landed estate marked by concentrated ownership and unequal rural labor relations.
[16] Local power system in Brazil where landowners controlled politics through clientelism and dependence.
[17] Local landowning elites in Brazil who exercised political and social control, especially through patronage networks.

During the 20th century, the struggle for land became a central axis of social movements, from the Peasant Leagues to the MST, pressuring the 1988 Constitution to include the social function of property. However, although settlements were created, agrarian reform did not structurally alter land concentration or guarantee the territorial rights of traditional peoples, maintaining the market logic (Oliveira, 2007).

In the Alto Paraguaçu Basin, narratives reveal long-standing traditional uses of land and water that were radically altered by the 1993 Master Plan: "the irrigation channels and the small dams started being replaced by pumps and hoses. With the discourse of efficiency, the State took control of the waters, destroying the social irrigation technologies of the people and taking away the communities' water autonomy" (Dourado & Silva, 2023). An INEMA official comments on the State's actions: "So they thought they were holding the water, they were holding what they needed. (...) And then later they saw that these dams were important. And then the reconstruction of these dams was authorized" (Interview anonymous, 23 April 2025).

In relation to water governance, the National Water Policy (Federal Law No. 9.433/1997) and Bahia's State Policy (State Laws No. 10.432/2006 and 11.612/2009) share common foundations: water as a public good, a limited natural resource with economic value, the priority of human and animal consumption, and the principle of decentralized management with participation from government, users, and communities. The state policy specifies the social value of water as social promotion and development (State Law No. 11.612/2009, Art. 2). Both laws establish charging for use as a management instrument to ensure rational use.

This framework creates a specific economic and environmental rationality in which the user-pays and polluter-pays principles become central mechanisms. As defined by INEMA, this charge aims to improve abstraction and consumption practices, as well as the quality of effluent discharged into water bodies (INEMA, n/d). However, by mediating the relationship with water through payment, the economic valuation tends to absorb the environmental valuation, subordinating it rather than prioritizing it. Moreover, these mechanisms tie environmental burden and access to the ability or willingness to pay, introducing a new way of perpetuating and even intensifying ecological-distributive inequalities. Finally, while both national and state policies emphasize availability and quality and frame water as a public good, they omit its collective and territorial dimensions, essential to historical and cultural relationships, thus leaving these dimensions unprotected.

Regarding productive relations of dependency, the concentration of the means of production and reproduction of life has generated a class-divided social order shaped by distributive inequalities. This class division combines elements of economic power relations and spatial location that intersect. Beyond the class dimension, however, difficulties in accessing land are marked by diverse historical trajectories: links to the land, patterns of dependence on landowners, and migration histories are deeply shaped by whether groups are of Indigenous, quilombola, or peasant origin. The disadvantages in productive capacity described above create dependency relationships that threaten autonomy and the reproduction of traditional ways of life. One form of dependence lies in structured productive relations that force many to work for larger producers, as one interviewee explained: “The power they have is to take our people to go work for them. That is one of the dangerous powers. Because our people will go work for them; they won’t do something against them” (Interview anonymous, 10 April 2025). Also the subordination of producers to agricultural input companies created under the Green Revolution model in the country. In the symbolic arena, the Green Revolution represented the exercise of epistemic power: “they created schools in the countryside to train people to work within this logic of technological packages (...). With a discourse of teaching people to read, right? With all that denial of peasant culture” (Interview anonymous, 23 April 2025). Lastly, there is a need for public policies to secure technologies for accessing water, such as piped water systems, artesian wells, and rainwater reservoirs, as well as providing other technologies for developing infrastructure to support production and food commercialization projects.

4.4.2. Structuring Power Relations:

Regarding structuring power relations, mechanisms of reaffirmation, strengthening, weakening, or potential transformation of power relations identified in different arenas will be presented: I. production and reproduction of life arena; II. organizational arena; III. public arena; and IV. institutional arenas of participation.

In first place, in the arena of production and reproduction of life, access to land, water, and production technologies in the basin is deeply mediated by economic power and, in some cases, by location-based power. Those with greater economic resources can secure private property rights, drill individual wells, install more advanced irrigation systems, and access technical assistance and agricultural inputs. All the communities visited have histories of struggle for land rights or tenure regularization, and the lack of regularization still prevents some of them from accessing state projects or obtaining water permits, illustrating how economic and legal power intersect to determine access to essential means of production and reproduction of life. This economic power also determines who has access to production technologies. For instance, larger producers can invest in systems that secure irrigation and provide resilience in times of scarcity. However, communities are situated where the river flow is already reduced, making such investments non-viable Interviewees also describe how large irrigators can control water flows: “they have a pump that, when they turn it on, the water that is flowing downstream, they can bring it back and suck that water from the river” (Interview anonymous, 17 April 2025). Others mention water diversions to serve large farms and the impact of eucalyptus monocultures near the headwaters of Volta do Américo on spring flow, underscoring how economic capacity combined with territorial location shapes access and control.

Despite these asymmetries, communities actively develop strategies to secure access and greater control over their means of production and reproduction of life. Moreover, many interviewees state that their struggle goes beyond the reproduction of their lives; they seek the reproduction of their peasant ways of life, as one interviewee recounts:

> “That little old lady over there, (...) she’s already a woman of 77, and she faces the struggle. It’s not that she couldn’t be living in the city, no. If she were there, she wouldn’t be doing what she does today. (...) I go months without watching television. I go to the field, I plant cassava, and I’ve already planted it. I plant the things I need so that whenever I want, I have it, and I give it to whoever is there, whoever arrives too.” (Interview anonymous, 20 February 2025)

Communities have achieved a certain level of autonomy through collective water systems granted by municipalities. Others mobilize agroecological and conservation knowledge as collective strategies to defend water and land as rights and as the foundation of community life. In relation to seeds, this becomes even more significant when considering that the Green Revolution has had, and continues to have, a profound impact on productive relations in the Brazilian countryside by creating dependency on external inputs and replacing local varieties. Against this backdrop, some farmers maintain autonomy through traditional seeds, preserving knowledge and autonomy despite structural pressures. These dynamics show that while economic and location-based power heavily shape access to land, water, and technologies, communities continue to build counter-strategies to secure greater control over their production and the reproduction of their ways of life.

Related to the State action in the field, INEMA is required to carry out interventions to regulate water use. In connection with the exercise of epistemic power in the symbolic arena, some people complained that INEMA acts in a top-down manner and does not validate local knowledge, as one interviewee expressed: “He comes to your property and they don’t want to listen first, they just want to make a decision, right? He studied their theory over there, but the theory here in the region is the residents” (Focus Group, 15 April 2025). Another aspect, located between the material and symbolic arenas, is the monopoly of force held by the State. On this point, one interviewee recounted: “When they come here to our areas, INEMA and the police come. The farmer is working with a hoe, with a machete there, with a sickle and such. They arrive armed to the teeth. What for? We are farmers, we are not stealing. We are producing. This is not fair. (...) It’s something that I can’t understand” (Interview anonymous, 11 April 2025). Regarding restrictive State interventions implemented until a few years ago and described as violent by various actors, cases include the sealing of pumps, the closure of canals, and the breaking of small dams. In relation to pump sealing, criticism focused on the imposition of a vertical and coercive measure that prevented irrigation, while in the closure of canals and destruction of small dams the critique also included cultural violence, referring to the elimination of social technologies.

In second place, the organizational arena emerged as a key site of epistemic power disputes. What happens in this arena is fundamental for the power struggles that take place in public space and institutional participation arenas. In the case of the irrigators, one of the main strategies identified was the creation of the Association of Farmers of the Utinga River Basin (AABU). A diversity of actors emphasized that the creation of this association has allowed them to work more directly with INEMA, opening channels of dialogue with the agency. At the same time, many point to how these spaces reveal a strong interconnection and even potential conflicts of interest between representatives of public power and irrigators. One interviewee described this dynamic: “Our mayor is friends with the producers, with the irrigators. Sometimes he’s called to a community, called to a meeting. If it's the poor class, he doesn't go. When it's the rich class, he goes" (Interview anonymous, 13 April 2025).

In the communities, strategies include the creation of local producer associations and, in some cases, joining broader networks. Many interviewees from the communities stated that although they believe they have little or no power individually, organizing collectively is crucial and could create an opportunity to influence decisions, especially if all the affected communities unite. Many see education as key to raising awareness, but interviewees also noted the difficulty of building collective power in the current political context, given the structural barriers they face. As one person explained that while organizing and raising awareness are essential, this process carries serious risks: "it is not easy, right? Because we are in a highly violent country. Especially regarding the agrarian issue. So, every leadership that emerges and seeks to fight this… ends up being persecuted" (Interview anonymous, 19 March 2025).

In the public arena, communities have used strategies such as filing complaints with the Public Prosecutor's Office and, in 2017, blocking a highway with the participation of social movements and affected communities. Some interviewees noted that although these actions led to talks with the government, they did not result in change, which discourages further mobilization. A central moment in this arena was the governor's visit to the territory during a water crisis. Despite days of community discussions identifying upstream pumping as the main cause, almost no one mentioned it directly. When one farmer raised the issue, the governor responded twice with irony: "I am not God, I don't do miracles". His arrival with armed police reflected the power of the State's monopoly of force. At the same time, his speech combined different types of power: political in his position as governor, epistemic when framing "development" through the alliance with companies, and symbolic to legitimize himself by evoking his indigenous roots and his own childhood in poverty. Another aspect to consider is when different groups advocate alternative models of water governance grounded a diversity of ways to relate with water. At the 8th Water Governance Seminar, one presenter stated that the western scientific rationality is normally used to legitimize State's decisions, which exerts both epistemic and normative power. These accounts show how the public space becomes a field where political, epistemic, normative-value, and coercive powers intersect, shaping both the possibilities and limits of community action.

Finally, in the arena of institutional participation, Basin Committees in Brazil are collective bodies designed to promote participatory water management by bringing together representatives from different levels of government, water users, and civil society (State Law No. 10,432/2006). They are also arenas where political, economic, and epistemic power intersect, producing asymmetries that shape decision-making. Analyses point out that these committees are characterized by internal hierarchies.(Martins, 2015; Ávila et al., 2022). "When we talk about participatory management, organized civil society has always been and will always be the most weakened part. Because the government has political power, the users have economic power. And civil society has what? The goodwill to be fighting and working" (ASCRA member, Seminar, 25 March 2025).

A central tool in these dynamics is the use of technocratic and scientific language as epistemic power, often aligned with political authority. Martins (2015) uses the concept of "scientization of water governance" to describe how such language claims neutrality while legitimizing specific political and economic interests. This discursive power ties to economic and political power, as large landowners with access to legal and technical expertise consolidate influence. Martins (2015) further emphasizes he role of class in epistemic power excersise, arguing that the dominance of technical language reproduces social inequality both materially and discursively. Interviewees also noted that the defense of agribusiness prevails in committee discussions, often justified by its weight in the basin's economy. Other actors counter this by pointing to how the conflict reduces production capacity, undermining autonomy and forcing many young people to migrate: "They make their good earnings, and we who have a young son, 20 years old, have to go out to work for someone else's company because here there is no water to plant a tomato, to make that little bit of money for household consumption" (Interview anonymous, 11 April 2025). Finally, several interviewees questioned whether the committee itself has real decision-making power. They argued that critical decisions are made elsewhere, where economic power pressures political power and conflicts of interest emerge.

Across interviews, there was broad agreement on who holds more and less power: irrigators and the government were identified as the most powerful actors, while small farmers were seen as having the least. Many attributed the irrigators' strength to their economic power and, in some cases, their strategic location in the basin, while others pointed to the political and normative-legal authority of the government. Several interviewees emphasized that the fusion of political and economic power—whether through pressure, conflicts of interest, or the State's structural defense of economic elites—serves to reinforce these hierarchies. In the case of small farmers, most associated their lack of power with economic vulnerability, while others also pointed to limited implementation political and organizational strategies. However, many concluded that even with stronger organization, economic power remains the most decisive factor.

Despite these asymmetries, there are moments of contestation. An example of this was an emergency meeting during the peak of the water crisis in Wagner, INEMA presented a plan for a new dam on the Bonito River. Some participants strongly criticized the use of technical language, arguing that it excluded the main group affected by the drought. Because the meeting was attended by many community members directly impacted, it seemed to creat an scenario where participants felt more able to speak and challenge the official discourse. That ocation revealed civil society's efforts to reclaim alternative forms of knowledge and valuation. Yet, as Ávila et al. (2022) observe, the fragmentation of civil society hinders the formation of a strong counter-hegemonic bloc.

Chapter 5. Discussion

In the Utinga Basin, different land and water uses were identified, with a predominance of agricultural uses for both commercial purposes and self-consumption. The expansion of bananas and the advance of eucalyptus upstream reconfigure uses and place pressure on access to water, with a high prevalence of water abstractions without licenses. In relation to these predominant uses, three broad types of knowledge used by actors involved in the conflicts were identified: conventional or modern, traditional, and agroecological. They appear in different ways depending on the actor. As a result of the conflicts, direct impacts were found on water use, such as human consumption, irrigation, and fishing, and indirect impacts, such as work overload and symbolic and cultural losses. Regarding power relations, different struggles arise over the use and control of land and water, as well as over the meanings, valuations, and knowledge. The concentration of the means of production and of life, including land and water, technologies, seeds, and information, structures access and helps explain the unequal capacity to respond. The continuity and recovery of practices, including practices of agroecological transition, emerge as the most consistent form of contestation across communities. At the same time, in the institutional arenas, technical and scientific language and participatory hierarchies marginalize valuations that are not hegemonic

In the first place, conflicts in the present study were directly linked to territorial and productive transformations in the Utinga Basin, marked by the expansion of monocultures. In the upper and middle–upper river, banana plantations progressively replaced a previously diverse mix of agricultural and livestock activities, while in the headwaters of Volta do Américo, eucalyptus plantations advanced close to the spring area. Both crops are water-intensive. In the case of the banana, expansion was tied to a surge in surface-water licenses and, as the river faced prolonged crises, boreholes were added for groundwater extraction, which sustained production despite declining flows but further intensified pressure on the basin's water resources. This upstream productive shift reconfigured basin flows and prompted restrictive measures by the environmental authority. Those restrictions affected all irrigators, regardless of how much water each one withdrew, and no measure was taken to address the disproportionate consumption of certain users or the specific crops driving excessive extraction. In fact, in the case of those extracting water legally, their greater use is legitimized by the licenses that authorize it. These results echo findings from other regions. For instance, studies of land-use change have shown that new agricultural frontiers often intensify competition for water and trigger disputes (Magsi & Torre, 2013; Bruns et al., 2016). In a similar way, research on Peru's Ica Valley documents how agro-export growth redefined hydro social territories through pumping infrastructures and institutions favoring export crops (Damonte-Valencia, 2015). While Utinga shows comparable upstream–downstream reconfigurations, unlike Ica the banana production here is not solely export-oriented but also feeds regional markets. Likewise, in Ecuador, conflicts have intensified as agribusiness expansion confronts smallholders under growing scarcity (Mena-Vásconez, 2020), though in Utinga, restrictions imposed by the state are a distinctive driver of tension. A comparable dynamic is observed in Brazil's semi-arid region, where irrigation policies and agribusiness projects created "green islands" that monopolized water during droughts (Reis & Zanic, 2015); yet in the Utinga Basin, this concentration results from licensing practices and extraction capacities and not from state irrigation schemes. Finally, the case of the present research illustrates how upstream pumping, diversions, and regulatory measures cascade downstream, reshaping practices and imposing costs on groups that did not set the rules. This pattern is consistent with analyses of upstream–downstream interdependence in river basins (Molle et al., 2007; Boelens, 2009).

In relation to the knowledge systems that the different actors involved in the conflicts use to relate to land and water, the study shows that State agencies such as INEMA and SIHS, together with agribusiness actors, rely exclusively on technical–scientific knowledge. This appears in monitoring systems, technical teams of hydrologists and agronomists, and infrastructure projects such as dams and pipelines. Agribusiness similarly depends on conventional technologies, including private boreholes, pumps, drip and micro-sprinkler irrigation, agrochemicals, and improved seedlings. These findings are consistent with analyses that highlight the predominance of expert and conventional knowledge in state and corporate management of land and water (Molle, 2007; Little, 2006).

In communities, by contrast, results indicate that different knowledge systems coexist, not free from tensions, and that they can also be understood as forms of knowledge in constant interaction and movement. Identified knowledge transitions can be forced, such as when irrigation canals were dismantled by INEMA; chosen, such as adopting riparian reforestation, collective boreholes, or ecological quintais; or more ambiguous, such as the erosion of intergenerational seed knowledge. Within this coexistence, traditional practices include criolla seeds, mutirão, artisanal dams and canals, and lunar calendars. Conventional practices include improved seeds, small pumps, and agrochemicals. In the case of agroecological knowledge, it involved rainwater harvesting, composting, biofertilizers, and reforestation. Regarding these agroecological practices, these results align with some studies that underline their role in adaptation and sustainability processes, but also in the efforts of creating bridges with scientific findings that can reinforce traditional practices while reshaping them (Berkes, 2018; Reyes-García, 2023; López & Guzmán, 2012; Ploeg, 2010). This suggests that agroecological knowledge not only provides alternatives to conventional models but also contributes to the hybridization of knowledge within communities.

Other cases in the Andes show how hybrid territories of knowledge emerge under external pressures. In Mollepata, Peru, irrigation systems are embedded in ritual and normative orders, but they are also shaped by negotiations with external actors, such as development agencies, state programs, and NGOs (Boelens, 2014). These negotiations imply that local practices persist and remain central, yet they are constantly reworked through encounters with external projects. Similarly, Mena-Vásconez (2020) describes how communities in the Ecuadorian highlands resisted floriculture while adopting it in small plots. Both cases illustrate a strong predominance of traditional practices combined with a selective openness to external influences. By contrast, in the present investigation, such a predominance of traditional knowledge is not easily identifiable. Communities appear more diverse, and strategies differ across and within them. In some places, traditional practices remain stronger, while in others, external practices have been more readily integrated. This diversity could be linked to the varied histories and cultural backgrounds of the studied communities, which differ from the continuity of indigenous groups in Ecuador that have remained in the same territory for centuries (Mena-Vásconez, 2020). This difference could help explain why results here show more dynamic and heterogeneous knowledge systems.

Finally, clear tensions were found between expert and local knowledge. State authorities implemented restrictive measures and solutions without consultation, ignoring the valuations and practices of local communities. While other research notes that states sometimes integrate local knowledge into their frameworks, this integration often occurs under the rationality of techno-scientific governance, thereby annulling alternative logics (Boelens et al., 2019). In the present study, no such process was observed; instead, state interventions were described as purely vertical. This contrasts with the findings of Dupuits, Puertas, and Guadamud (2023) in Kayambi, Ecuador, where frictions between expert ecosystem-service framings and grassroots water justice were partially mitigated through institutional funds that enabled co-creation. In Bahia, by contrast, no cooperative arrangements were reported concerning water governance. This highlights a divergence of rationalities: while in Kayambi local knowledge could at least be integrated, in this case, state and corporate expertise prevailed entirely, and communities seem to hybridize knowledge on their own terms.

In relation to the valuations of land and water through which actors establish their connections with these resources, the results of this investigation show both common patterns and diversity. Across communities, land and water are recurrently valued as heritage to be passed on to future generations, as spaces of belonging tied to identity and history, and as essential means of life and subsistence. In some communities, these valuations appear consistently across different interviewees, while in others, the emphasis is more diverse. For instance, certain groups highlight spiritual and symbolic relations, such as water as mother, whereas others stress food production or self-consumption. Diversity is also found within communities, since not all individuals articulate the same priorities. By contrast, state agencies adopt a narrow focus, framing land and water primarily in economic terms through licensing and allocation instruments, a perspective that agribusiness irrigators also endorse by stressing that water use should be paid for. This configuration is consistent with Díaz (2015), who shows that value systems vary across and within groups, and with Martínez-Alier's (2009) argument that socio-environmental conflicts arise from clashes of valuation languages, where governments and corporations privilege economic registers while communities stress heritage, identity, spirituality, and the reproduction of life, which often find little recognition in dominant economic framings. The results confirm that, even when recognizing social or environmental values in discourse, the State privileges economic valuation in practice. This is most evident in the licensing system and in the user-pays and polluter-pays principles enshrined in law, which frame water access in monetary terms and render invisible other valuations such as water for the reproduction of life, heritage for future generations, leisure, and spiritual or symbolic relations.

The emphasis on payment for water observed in state agencies and agribusiness also resonates with Avcı, Adaman, and Özkaynak's (2010) in their study of gold-mining conflicts at Mount Ida, Turkey, where pro-mining actors stressed valuations like economic prosperity and employment and business opportunities, and opposing actors highlighted environmental protection, community life and livelihood, public health, and a nationalistic discourse of resistance to foreign projects.

Similarly, in the present case study, agribusiness irrigators use a language that underscores employment and the necessity of paying for water use, whereas communities highlight valuations like livelihoods, heritage, and environmental protection. Unlike in Mount Ida, however, nationalist and public health valuations are absent here, a difference linked to the distinct nature of the projects, that is, agribusiness expansion within a river basin versus a transnational mining initiative.

The valuations expressed by communities in this study can also be understood as aligned with Latin American research on the defense of land and water as common goods. Svampa and Viale (2014) argue that the "commodities consensus," understood as a development model based on large-scale resource extraction for global export, reflects an economic logic of nature. In contrast, communities and social movements articulate values rooted in cultural preservation, identity, and spirituality, which they interpret as a defense of the commons against extractivist logics (Svampa and Viale, 2014). In this study, similar forms of valuation emerge, with land and water understood as heritage, experienced as spaces of belonging, and evoked as a spiritual mother linked to material connections. Moreover, principles such as reciprocity and distribution, reported in several communities, also echo findings from other research that frames such values as principles of environmental justice. In Ecuador, for instance, Avcı et al. (2010) identify valuation forms connected to territorial rights, the sanctity of nature, cultural preservation, and justice claims, which often collide with dominant economic and political interests. At the same time, this study shows variation, as some communities emphasize these principles more consistently, whereas in others valuations appear more fragmented, which highlights the coexistence of plural valuation languages but also the presence of a unified community-wide strategy.

Regarding the social impacts of identified conflicts, the present investigation shows that conflicts generate a sequence of impacts. Ecological impacts appear first, with the drying of rivers, lagoons, and springs. From these follow impacts on uses, such as the impossibility of irrigating, fishing, or accessing water without moving to other sources. Lastly, these disruptions give rise to social and cultural impacts, including work overload, the loss of traditional practices, symbolic damage, and psychological distress. In some cases of psychological distress, particularly those linked to fears of future deterioration, such as rivers drying completely or the community facing thirst, the sequence does not operate in the same way, since these impacts emerge without requiring major changes in use. These findings partly align with results of previous studies. Gudynas (2009, 2013) also describes cascades of impacts that move from ecological extraction to broader social and cultural consequences. The findings of this study resonate with that view but contribute by showing a sequential order in which ecological degradation triggers disruptions in uses, which in turn produce social and cultural consequences. Svampa (2013) and Martínez-Alier (2009) emphasize ecological, social and cultural, economic, and political impacts of socio-environmental conflicts. The present study is consistent with their emphasis on ecological degradation and cultural losses, but diverges in the weak presence of political impacts. Moreover, while they identify economic impacts as a distinct dimension, here they are better understood as part of the impacts on land and water uses, which may or may not involve economic consequences depending on whether they affect livelihoods directly through income or through use-values such as irrigation and fishing.

Reductions in available water for particular groups produced direct impacts on human consumption, irrigation, and the disappearance of fishing, together with indirect impacts that include work overload often borne by women, psychological effects, and symbolic and cultural losses. These patterns are consistent with evidence from conflicts emerging as a result of industrial tree plantations, where recurrent outcomes were water scarcity and the loss of local ecosystem uses (Gerber, 2011), and with studies showing aggravated effects on women, such as those in northern Ghana on health impacts of water insecurity for women irrigators (Dinko & Nyantakyi-Frimpong, 2023), and in rural India where water scarcity has been shown to disproportionately increase women's physical burdens and time spent in water collection, with cascading effects on their health and household food security (Crow & McPike, 2009). Concerning adaptations to these impacts, variations can be observed across communities. In some places, water sources were replaced, in others, the means of access shifted, and in yet others, agroecological transitions were adopted. In certain cases, no adaptation was possible because the uses or valuations at stake could not be substituted. They also align with studies that document gendered burdens linked to unequal water access among women irrigators in northern Ghana (Dinko & Nyantakyi-Frimpong, 2023). Other research points that losses related to sacred waterscapes, traditional practices, and cultural links are not substitutable by implementing technical alternatives or monetary compensation solutions (Falconi & Oleas, 2023; Temper & Martínez-Alier, 2013; Rodríguez-Labajos & Martínez-Alier, 2015). In the present case, this is visible where the drying of lagoons and the interruption of river-based practices entailed cultural and spiritual damage that could not be replaced.

Regarding power relations in the basin, the study identified both structured and structuring dynamics. On the side of structured relations, they appear as historically crystallized mechanisms of control, such as the concentration of land and water, technologies of access, production inputs, and information systems, together with the consolidation of a technical–scientific hegemonic language in legal and institutional frameworks. These elements define who can access and control water flows and on what terms. The concentration of the means of production and reproduction of life is the structured factor that most strongly explains inequality of access. This resonates with Bekele et al. (2022), who show how land and water investments concentrate control in Ethiopia, and with Woodhouse (2012), who argues that commodification constrains redistributive reforms in South Africa, although in the present study what stands out is the crystallization of concentrated access rather than blocked reforms.

In relation to structuring power, the results show that actors deploy strategies across different sub-arenas. The arena of production and reproduction of life, the organizational arena, the arena of formal participation, and public arenas. Molle (2007) identifies four strategies that are consistent with some of the strategies identified in this study and can be categorized within these sub-arenas. Telling stories can be classified within the symbolic arenas of formal participation and public spaces, where this study also identified strategies such as demonstrations, appeals to legality, and the public appearances of political authorities. Weaving alliances is consistent with one of the strategies observed in the organizational arena, which in this study appeared alongside other strategies such as reflection, awareness, and peasant education. At the same time, controlling technologies can be categorized within the material arena of production and reproduction of life, which in this study also includes employment control and state action through restrictions and enforcement. Finally, deliberating alternatives were not observed in this case, which may be linked to the weak organizational capacity of the communities and the absence of sustained collective proposals.

Examining more deeply the structuring power relations, specifically within the arena of institutional participation identified in the research, it was found that Brazil's Basin Committees, particularly the Paraguaçu committee, are spaces where political, economic, and epistemic power intersect, generating asymmetries in decision-making. Internal hierarchies persist. A central mechanism is the use of technocratic and scientific language as epistemic power aligned with political authority, claiming neutrality while legitimizing specific interests; this works as an epistemic filter with a class bias, since actors with legal and technical resources consolidate influence. Scale has a role in the functioning of the committee, because the committee is constituted at the larger Paraguaçu basin scale, its rules and criteria extend to the Utinga sub-basin that has particular conditions, and this can dilute place-based claims. The results suggest that the committee's decision authority is limited as key decisions are seen to occur in other arenas under economic and political pressure. These findings align with work on the scientifization of water governance and the classed reproduction of power through technical discourse (Martins, 2015), and with studies that document internal hierarchies within Brazilian basin committees (Ávila et al., 2022). The findings also resonate with research showing frictions between standardized expertise and situated local claims in participatory arenas (Dupuits et al., 2023), and with arguments that stress that scalar definition and information asymmetries depoliticize conflicts even under formal participation (Kallis et al., 2006).

Finally, these results are consistent with the findings of Boelens (2008) and Swyngedouw (2009), who stress that material, symbolic, and institutional dimensions are essential to power relations and the configuration of water conflicts. However, in the results of this study the institutional dimension appears as moving within and across the material and symbolic arenas rather than standing as an autonomous plane. In the power relations identified here as structured, institutions are inscribed in the symbolic arena, legitimizing hierarchies and economic valuations, and ultimately reinforcing the power relations of the material arena. In contrast, in the power relations identified as structuring, the State manifests across both the material and the symbolic arena through infrastructures, enforcement, and discourses of participation.

Also, the analysis of results of this study aligns with an integrated political-ecology perspective in which the material dimension that refers to access to land and water, infrastructures and technologies, productive uses and work, and the epistemic–symbolic dimension that refers to meanings, valuation languages, and principles that organize relations with nature, constantly operate together. This approach is consistent with the literature on hydro social territories, which define water territories as historically produced in the interaction between infrastructures, financial means, and legal–administrative arrangements that are in a dialectic relation with knowledge systems and cultural practices, shaping who gets water, in what quality and quantity, and for what purposes (Boelens, Shah, and Bruins, 2016; Swyngedouw, 2009; Bruns et al., 2016). In this sense, the findings align with analyses that state that water not only flows along hydraulic gradients but also along power gradients, as governance decisions and devices mediate biophysical cycles and redistribute benefits and burdens (Swyngedouw, 2009; Bruns et al., 2016).

Chapter 6. Conclusions and recommendations

6.1. Introduction

This chapter begins with a synthesis of the main results, highlighting the predominant land and water uses in the Utinga River Basin, the ways in which different actors relate to nature, the social impacts experienced in the communities, and the socio-political power relations that shape access and control over resources. This synthesis provides the basis for drawing together the broader lessons of the study. The conclusions identify critical points in the reproduction of power relations and the risks of aggravating conflicts if present trends are not addressed. The conclusions point out that the expansion of water-intensive monocultures, together with the predominance of economic valuation in public policy and the persistence of asymmetric governance mechanisms, has reinforced inequalities in access to land and water. These processes put peasant modes of life at risk, as they increase dependence on external actors, reduce the space for autonomous decisions, and erode cultural and productive practices that have long sustained local livelihoods. The analysis also shows that while legal and policy frameworks formally recognize social and environmental values alongside economic ones, in practice economic valuation predominates, reinforced by instruments and discourses that present it as neutral. This emphasis contributes to making other ways of valuing land and water less visible and to sustaining the asymmetries that underpin current conflicts.

From these reflections, the chapter moves to a set of recommendations as orientations that may inform future debates and actions. The recommendations address different but interrelated domains: governance arrangements and decision-making mechanisms, distributive criteria for water allocation, preventive measures that integrate land and water management, and policies to support peasant modes of life while reducing relations of dependence. Across these domains, the emphasis is on recognizing the diversity of values and principles that guide relations with land and water and on reducing the asymmetries that sustain conflict in the basin.

6.2. Answers to research questions and objectives

The Utinga Basin is predominantly agricultural, while also sustaining numerous communities whose everyday life depends on access to water. The study identified a variety of uses, including commercial and self-consumption farming, livestock and forestry, urban and conservation activities, occasional residential occupations, and riverbank recreation. Medium and large farms concentrate on irrigated monocultures for market production, where banana stands out by far compared to other crops such as cassava, passion fruit, and papaya. In community settlements, home gardens and roças combine rainfed and irrigated systems—sometimes monocultural, sometimes biodiverse—supporting subsistence through multifunctional agroforestry and agrosilvopastoral arrangements with high agrobiodiversity. These uses unfold within a legal setting defined by conservation obligations for rural properties through Permanent Preservation Areas and Legal Reserves. In recent decades, territorial and productive configurations have been reshaped above all by the expansion of banana plantations from the middle to the upper stretches of the Utinga River, together with the advance of eucalyptus near the headwaters in Volta do Américo. The strong growth of banana monocultures has been the main driver of increasing water demand, first intensifying surface abstractions and, as river flows declined, leading to a marked rise in groundwater pumping through boreholes. Despite recurring water crises, banana production in particular did not contract but continued to expand, further increasing pressure on water resources. Official data also indicate that a high proportion of water use takes place without licenses, highlighting the scale of informal and unregulated abstractions across the basin.

Regarding the ways that different actors have to relate with land and water, the study shows that state agencies and agribusiness actors rely mainly on technical and scientific knowledge, expressed through monitoring teams, hydraulic infrastructure, and conventional technologies such as private boreholes, pumps, drip and micro-sprinklers, agrochemicals, and improved seedlings. Their practices are oriented toward increasing efficiency and sustaining commercial production. Communities, in contrast, draw on a heterogeneous and shifting repertoire in which traditional, conventional, and agroecological knowledge coexist and transform over time. Subsistence farming is organized through home gardens, roças, and multifunctional agroforestry or agrosilvopastoral systems. In these spaces, seed selection, planting cycles guided by lunar calendars, food processing, and meal preparation are intertwined with memory, identity, and, in some communities, cultural or spiritual practices connected to the river and the land. These relations show that production is tied to material needs and cultural and social life. Transitions in community practices take different forms. Some are forced, as when public interventions dismantle irrigation canals or restrict pumping. Others are chosen, such as riparian restoration, the digging of community wells, rainwater harvesting, the strengthening of ecological home gardens, and the partial recovery of seed knowledge through exchange and collective initiatives. At the same time, there are ambiguous situations, particularly in the erosion of intergenerational seed knowledge, where practices weaken even as some efforts to maintain them continue.

Relations with land and water are also articulated through valuation languages. For many community members, water and land are valued as heritage for future generations, as spaces of belonging tied to identity and history, and as the basis of life itself. The agro-food cycle, often narrated through cassava cultivation and manioc flour processing, illustrates how production, memory, culture, and spirituality are brought together. State discourses, together with those of irrigators, formally recognize social and environmental values alongside economic ones, but in practice, management is primarily shaped by economic valuation, reinforced by policies and instruments based on user-pays principles. This emphasis makes other values less visible in decision-making.

The impacts identified in the basin are diverse and depend on the conditions of each community, although certain common elements can be observed. In several communities, families reported difficulties in securing water for human consumption, irrigation, and fishing. As river flows decreased and lagoons dried, daily tasks often had to be carried out at more distant sources, which increased the time and physical effort required and placed a heavier burden on women. In one community, the interruption of river-based practices also carried spiritual meaning, and its loss was experienced as something that could not be replaced by technical solutions or compensation. In other places, the closure of canals and the destruction of small dams erased social technologies that had organized collective work and supported community-based management of water. Adaptations to those impacts were also diverse, but again, certain common patterns can be identified. In some communities, the installation of wells and the use of rainwater reservoirs and household water reuse helped ease domestic burdens and sustain home gardens. In others, agroecological practices such as composting, biofertilizers, and reforestation became strategies to maintain production and partially rebuild autonomy. Local associations and inter-community networks also played a role in supporting these responses and reducing isolation. At the same time, participants described fear and obstacles that limited the continuity of collective action, showing that while responses persist across the basin, their scope and strength vary from place to place.

Regarding power relations, the study distinguishes between structured and structuring power relations. Structured relations consolidate over time in the concentration of land and water, in the control of technologies, inputs and information systems, and in a hegemonic technical–scientific language embedded in legal and institutional frameworks. They also include relations of dependence that tie some actors to others for access to the means of production and reproduction of life. Together, these elements define who accesses and controls flows and under what conditions and explain unequal capacities to respond when conflicts intensify. Structuring relations, in turn, emerge in ongoing struggles across arenas of production and reproduction of life, organizational spaces, formal participation and public debate, where actors deploy strategies such as building alliances, controlling technologies, appealing to legality, and mobilizing technical–scientific language to legitimize particular interests. Different forms of power intersect in these processes, and their expressions vary across the basin. Economic and political power concentrate control over the distribution of land and water and decision-making in formal and informal spaces, while epistemic power operates through technocratic languages that claim neutrality but legitimize particular perspectives. Normative power frames what is considered valid in decision processes, and the State's monopoly of force is present in enforcement and policing. These dynamics appear in common across the basin, but with distinct emphases depending on whether they take place in institutional arenas, in state interventions in the field, or in organizational arenas. In institutional arenas such as the Paraguaçu Basin Committee, political, economic and epistemic power converge, internal hierarchies persist, and decisions are often perceived as being taken elsewhere under pressure. In the field, state interventions are described as vertical and insensitive to differences in use. In organizational arenas, local associations and inter-community networks attempt to reduce isolation and strengthen capacity for collective action, but participants described this organization as fragile and constrained, with fear and obstacles limiting its continuity.

6.3. Conclusions

This research examined conflicts over land and water use in the Utinga River basin, where agriculture is the dominant activity and where many communities depend on rivers and aquifers for daily life. The interaction of territorial and productive changes, new abstractions, and regulatory measures has reconfigured uses and flows. The expansion of banana monocultures from the middle to the upper reaches of the Utinga River, together with the advance of eucalyptus plantations near the headwaters in Volta do Américo, and the rise in water licenses and pumping illustrate how these transformations unfold. Restrictions imposed by the environmental authority were applied during moments of crisis and often generalized across the basin without distinguishing between heavy and light users, or between water use for subsistence and for commercial purposes. As a result, crises and restrictions produced impacts distributed unevenly according to actors' position along the rivers, their economic capacity, their gender, and crucially, their differentiated capacity to access water licenses. These dynamics reveal that transformations in land and water use, modes of relating with nature, policies, and power relations are inseparable processes that together determine who gets water, in what quantity, and for what purposes.

The results show that power is exercised through a combination of crystallized, structured power relations and more dynamic, structuring ones. Both dimensions reflect historical processes of material and symbolic configurations of social relations with land and water, shaped by different knowledge, values, and principles. Structured relations are consolidated hierarchies of access and control, while structuring relations show a more mobile character, creating openings for change through the dynamic interactions that take place in material and symbolic arenas. Taken together, these relations shape both the emergence and the course of conflicts, while also determining whose voices gain legitimacy in decision-making and who carries the greatest risks and vulnerabilities. In this context of shifting relations, actors engage with land and water through heterogeneous knowledge systems. State and corporate actors rely on expert teams, technocratic discourses, and conventional technologies, while communities combine traditional, conventional, and agroecological knowledge in constant movement. However, when decisions privilege narrow economic valuations, many of these meanings lose visibility in the arenas where rules are defined. This produces epistemic asymmetries that mirror and reinforce material inequalities. Participation is thus filtered not only by institutional rules but also by disparities in whose knowledge counts and who is marginalized.

The impacts of these conflicts are multiple. Families across communities reported constraints on drinking water, irrigation, and fishing, as well as changes in domestic tasks. The drying of lagoons and rivers forced longer journeys to access water, increasing time and physical effort while eroding river-based practices. Communities deploy diverse strategies of adaptation, with greater or lesser difficulty; however, because their modes of life are grounded in coexistence with land and water, in some cases they find no viable alternatives when key valuations and principles of relation are undermined. The power relations linked to the concentration of means of production, the geographic position within the basin, and the access to water rights shape the distribution of impacts, and, at the same time, the capacity of communities to adapt. What is ultimately at stake is the reproduction of peasant modes of life, and with them, the very existence of communities as collective beings. The research documents knowledge of planting times by lunar cycles and seed conservation, agroecological practices attentive to the environment, collective life histories anchored in the river and in home gardens, and subsistence production with significant agrobiodiversity. These practices sustain identity, cultural reproduction, and livelihoods. Yet they remain largely invisible in decision-making spaces and in the design of solutions. When restrictions are generalized and decisions are taken from above without considering the diversity of actors who relate to land and water, local values and principles are disregarded. The legal recognition of water as a social and environmental asset, while important, leaves aside other forms of valuation capable of integrating cultural and relational dimensions, and in practice, it gives way to economic instruments that perpetuate inequalities. Over time, these processes weaken autonomy, deepen dependence on public policies or companies, and undermine the reproduction of diverse peasant livelihoods.

Measures adopted to confront conflicts illustrate how power operates in the structuring dimension. State responses have been predominantly restrictive and reactive, often triggered by drought crises rather than preventive planning. Water licenses, although conceived as an instrument of regulation, cover only a minority of users and are based on chronological order of application, which does not address disparities in economic resources, information, or geographic position. These are, in practice, disparities in the capacity to access water rights. Moreover, implemented solutions to the crises have focused almost exclusively on water use, leaving aside land uses and the productive models that intensify pressure on the basin. The absence of measures to regulate the types or extent of crops reflects a fragmented approach that ignores the inseparable relation between land and water. In this context, solutions centered on increasing supply, such as new reservoirs or groundwater extraction, risk stimulating further expansion of water-intensive monocultures and reinforcing the territorial and productive transformations that generated conflict.

Another factor that contributes to the maintenance of conflicts is the discourse of development and employment promoted by agribusiness and supported by the state in the structuring dimension of power relations. While families across the basin do need income sources and opportunities, the ways in which these needs are met are not neutral. Different visions of development prioritize different modes of action: for some actors, employment is to be generated through companies producing for regional or external markets, while others emphasize the creation of economic opportunities from within the communities themselves. Strategies that strengthen the commercialization of community products, increase local control over value chains, or recognize the principles and knowledge embedded in peasant life point to alternative ways of sustaining diverse livelihoods. Yet without transforming the structured power relations that sustain hierarchies, and without changes in how power operates in decision-making arenas, measures will continue to generalize burdens, reproduce hierarchies, and intensify inequalities.

The way governance mechanisms are conceived is fundamental to addressing conflicts in the basin. The framing proposed by Brazil's National Water Agency, where river basin committees are forums built around a "common interest" in water use, points to the recognition of water as a resource whose multiple uses must be managed. Yet defining the common interest only in terms of use risks leaving aside other elements that are equally essential for governance. In this sense, it becomes necessary to collectively construct shared foundations of meaning and principles of relation with water and land that can move beyond the legal framing of water as a "common use good" (Federal Law No. 9.433/1997), toward an understanding of water as a collective good that transcends individual or sectoral interests of use. The joint construction of such collective foundations could enable the plurality of meanings, valuations, and modes of relation practiced by different actors in the basin to coexist and be sustained, rather than being subordinated to hegemonic economic valuations. Recognizing plurality, differentiating responsibilities, and overcoming crystallized asymmetric power relations are therefore preconditions to avoid further loss of knowledge, to reduce dependence relations, and to permit the reproduction of diverse peasant modes of life in the basin.

6.4. Recommendations

The results of this research point to the need for governance and management of the Utinga River Basin that address historical asymmetries, recognize the diversity of values and knowledge systems, and enable peasant modes of life in their productive and reproductive dimensions. The recommendations that follow are offered as reflections and possible directions to inform governance, public policy, and collective action. They are not intended as definitive prescriptions, but as contributions to an ongoing debate.

Governance: power relations

Any governance arrangement should begin by acknowledging the asymmetries and inequalities that have longshaped access to and control over land and water. This means looking not only at formal arenas such as licensing systems, committees and regulatory frameworks, but also at the informal mechanisms through which power is exercised. These include conflicts of interest, local arrangements that privilege certain actors, and the control of water-extraction technologies, such as pumps and wells, which have become key means of consolidating unequal access to water in the basin. Kallis and colleagues (2006) show that participatory processes arenas where asymmetries of power and knowledge strongly influence outcomes and therefore require deliberate strategies to counterbalance them. Munda (2008), through the Barcelona School, advances Social Multi-Criteria Evaluation as a methodology to address incommensurable values in a way that does not erase diversity and makes power dynamics visible.

Based on these insights, it is recommended to reconsider quotas of representation, voting, and other mechanisms of decision-making in basin governance, so that such reconsideration serves to reflect on the differentiated roles and interests of actors in water governance. State agencies, companies, and academic institutions do play important roles, but these cannot be equated to the roles of people who inhabit the basin and whose livelihoods depend directly on land and water. Their protagonism should be the basis for democratic management, while recognizing the complementary contributions of other actors. A further issue identified in this study is the role of technical–scientific language in governance arenas. The evidence shows how knowledge expressed outside technical–scientific codes is often disregarded. It is therefore recommended to create institutional arrangements that do not exclude these knowledges but recognize them as valid and complementary. Finally, the elaboration of the Basin Plan, currently in progress, is crucial as it will set the foundations for future management. However, its validity must be questioned if it is elaborated in a context of markedly asymmetric power relations. For the plan to serve as a legitimate tool for the basin, these asymmetries must be explicitly addressed.

Governance: plurality of valuations and knowledge

The basin is home to a diversity of incommensurable forms of valuation, including ecological, spiritual, cultural, social, economic, and environmental ones. These valuations do not disappear, but governance practices often act as if they did not exist, which makes invisible other rationalities and cultural differences. Kallis and colleagues (2006) argue for deliberative spaces and scenario-building methods that allow multiple valuation languages to be expressed, while Munda (2008) provides methodologies that incorporate incommensurability in a structured way. Together, these contributions show that effective governance requires recognition of diversity rather than reduction to a single standard. It is recommended to consider the forms of valuation identified in this study and to deepen their understanding even further. Beyond identifying them through research or participatory exercises, there is a need for a different presence of the state in the territory, one that can work with these rationalities and principles of relation in ways that are culturally pertinent. This requires professionals and technicians capable of integrating and respecting different knowledge systems. The role of social scientists is especially important here: not only in times of active conflict, but also in building collaborative governance that takes diversity seriously. Such an approach would help ensure that solutions are co-constructed and that the plurality of principles of relation with land and water is sustained.

Water distribution and licensing

The licensing system in place today is based on chronological order of application. In practice, this favors those with more financial resources and access to information. In the Utinga River Basin, distributive justice in water access requires criteria that reflect real demand within the basin, and not only administrative order. Human consumption and animal hydration should remain priorities as established by law, but this research also highlights the importance of protecting water for subsistence production, which is essential for the reproduction of peasant livelihoods. To move in this direction, it is necessary to update data on river flows and to carry out a comprehensive cadastral registry of all users in the basin, including those who do not currently hold licenses. Active licenses should then be reviewed in light of total demand and flow availability, with distributive criteria debated with basin actors themselves. This would allow allocation to be guided not only by legal priorities but also by conceptions of water justice that reflect the diversity of values and principles present in the basin.

Preventive solutions and land–water integration

It is recommended to include and place emphasis on preventive policies that integrate the indivisible relation between land and water. Instead of focusing primarily on restrictions applied during crises, policies should consider how land-use patterns shape water availability and how water management in turn affects land uses. Many actors in this study expressed concern that solutions centered on increasing water supply, such as new reservoirs or expanded groundwater extraction, could stimulate further expansion of water-intensive monocultures, potentially continuing or aggravating conflicts. These concerns should be taken into account when designing solutions. Preventive policies should also go beyond ensuring sustainable practices at the level of individual producers. They must recognize the cumulative effects of land use at the territorial scale. The expansion of banana and eucalyptus monocultures, for instance, generates pressures that cannot be understood in isolation. A territorial perspective is needed, one that can take account of these cumulative dynamics. Within this perspective, agroecology stands out as a particularly relevant path. It brings together ecological and cultural dimensions, while combining traditional practices with contemporary scientific knowledge, and in doing so creates fertile ground for genuine dialogue between different ways of knowing. Public policies and technical assistance can build on these experiences, supporting solutions that respect local rationalities and at the same time strengthen the capacity to adapt to changing conditions.

Enabling peasant modes of life and reducing dependence

Enabling peasant modes of life calls for policies that directly confront the structured power relations which keep communities in subordinate positions. This includes ensuring access to sufficient land and promoting a fairer distribution and control of the productive and reproductive means of life, with a gender perspective. It also requires increasing efforts to generate income within communities, with particular emphasis on youth, so that possibilities for permanence and autonomy are strengthened. Valuing the biodiversity present in the communities and protecting agrobiodiversity is also essential. Seeds, planting cycles and collective practices belong to cultural heritage and at the same time help communities remain resilient and adaptive. Policies need to respect and strengthen these forms of land and water management, ensuring that governance grows out of them instead of replacing them. In this way, dependence on external actors can be reduced and autonomy strengthened, enabling the reproduction of diverse peasant modes of life.

The findings of this research and the literature reviewed converge in showing that conflicts in the Utinga River Basin result from the interaction between land and water uses, power relations, and diverse modes of relation with nature. Addressing these conflicts requires political and institutional transformations that make asymmetries visible and open spaces for plurality and recognition. Strengthening governance mechanisms that put basin inhabitants at the center, promote distributive justice in water use, and develop preventive measures that connect land and water, offers a path toward protecting biodiversity, sustaining knowledge systems, and enabling the continuation of diverse peasant modes of life.

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Annex 1.

Varieties – Community of São Sebastião

Results of the data collection in 5 home gardens

Specific Category	Variety	English Name	Scientific Name
Fruit Trees	Acerola	Barbados cherry	*Malpighia emarginata*
	Aroeira	Brazilian peppertree	*Schinus terebinthifolia*
	Banana	Banana	*Musa spp.*
	Cacau	Cocoa	*Theobroma cacao*
	Café	Coffee	*Coffea arabica*
	Cajá	Golden plum	*Spondias mombin*
	Cobi	Cobi (local fruit tree)	*Not identified*
	Coco da Bahia	Coconut	*Cocos nucifera*
	Goiaba	Guava	*Psidium guajava*
	Graviola	Soursop	*Annona muricata*
	Imbu	Spondias tuberosa	*Spondias tuberosa*
	Jabuticaba	Jabuticaba	*Plinia cauliflora*
	Jamelão	Java plum	*Syzygium cumini*
	Laranja	Orange	*Citrus sinensis*
	Lima	Sweet lime	*Citrus limettioides*
	Limão	Lemon	*Citrus limon*
	Mamão	Papaya	*Carica papaya*
	Manga	Mango	*Mangifera indica*
	Maracugina	Maracugina (medicinal plant)	*Not identified*
	Palma	Cactus (for fodder)	*Opuntia spp.*
	Palmeira	Palm tree	*Not identified*
	Pinha	Sugar apple	*Annona squamosa*
	Pitaia	Dragon fruit	*Hylocereus spp.*
	Pitanga	Surinam cherry	*Eugenia uniflora*
	Romã	Pomegranate	*Punica granatum*
	Sabugueiro	Elderberry	*Sambucus spp.*
	Siriguela	Spanish plum	*Spondias purpurea*
	Tamarindo	Tamarind	*Tamarindus indica*
	Umburana	Amburana	*Amburana cearensis*
Vegetables – Fruits	Abacaxi	Pineapple	*Ananas comosus*
	Coco da Bahia	Coconut	*Cocos nucifera*
	Noni	Noni	*Morinda citrifolia*
	Ora-pro-nobis	Edible cactus	*Pereskia aculeata*
	Pimenta	Chili pepper	*Capsicum spp.*
Vegetables – Roots	Aipim	Cassava	*Manihot esculenta*
	Batata	Sweet potato	*Ipomoea batatas*
	Mandioca-do-mato	Wild cassava	*Manihot spp.*
	Andu	Pigeon pea	*Cajanus cajan*

Vegetables – Legumes	Fava	Broad bean	*Vicia faba*
Herbs	Alfabaca	Sweet basil	*Ocimum basilicum*
	Alfazema	Lavender	*Lavandula spp.*
	Angelica	Angelica	*Angelica archangelica*
	Arruda	Rue	*Ruta graveolens*
	Babosa	Aloe vera	*Aloe vera*
	Boldo	Boldo	*Peumus boldus*
	Caninha do brejo	Marsh cane	*Costus spicatus*
	Capim-santo	Lemongrass	*Cymbopogon citratus*
	Erva cidreira	Lemon balm	*Melissa officinalis*
	Hortelã	Mint	*Mentha spp.*
	Hortelã amargo	Bitter mint	*Not identified*
	Hortelã graudo	Large-leaf mint	*Mentha spp.*
	Hortelã miudo	Small-leaf mint	*Mentha spp.*
	Mangalô	Sword bean	*Canavalia gladiata*
	Mastruz	Wormseed	*Dysphania ambrosioides*
	Muringá	Moringa	*Moringa oleifera*
	Orégano	Oregano	*Origanum vulgare*
	Pata de vaca	Cow's foot	*Bauhinia forficata*
	Piu-piu	Local herb	*Not identified*
	Poejo	Pennyroyal	*Mentha pulegium*
	Quebra pedra	Stonebreaker	*Phyllanthus niruri*
	Salsa	Parsley	*Petroselinum crispum*
	Salvia	Sage	*Salvia officinalis*
	Viola	Violet	*Viola spp.*
Ornamental Plants	Arano	Ornamental plant	*Not identified*
Animals	Galinha	Chicken	*Gallus gallus domesticus*
	Galinha da Angola	Guinea fowl	*Numida meleagris*
	Pato	Duck	*Anas platyrhynchos domesticus*
	Porco	Pig	*Sus scrofa domesticus*
	Égua	Mare	*Equus ferus caballus*

Total plant varieties: 64

Total animal types: 5

Varieties – Community Iúna

Results of the data collection in 3 home gardens

Specific Category	Variety	English Name	Scientific Name
Fruit Trees	Abacate	Avocado	*Persea americana*
	Abacaxi	Pineapple	*Ananas comosus*
	Acerola	Barbados cherry	*Malpighia emarginata*
	Araçá	Wild guava	*Psidium cattleianum*
	Açai	Açaí palm	*Euterpe oleracea*
	Banana	Banana	*Musa spp.*
	Buriti	Buriti palm	*Mauritia flexuosa*
	Café	Coffee	*Coffea arabica*
	Goiaba	Guava	*Psidium guajava*
	Jabuticaba	Jabuticaba	*Plinia cauliflora*
	Jaca	Jackfruit	*Artocarpus heterophyllus*
	Limão	Lemon	*Citrus limon*
	Mamão	Papaya	*Carica papaya*
	Manga	Mango	*Mangifera indica*
	Maracujá	Passion fruit	*Passiflora edulis*
	Pinha	Sugar apple	*Annona squamosa*
	Pitanga	Surinam cherry	*Eugenia uniflora*
	Pé de coco dende	Oil palm	*Elaeis guineensis*
Leafy Vegetables	Cebola	Onion	*Allium cepa*
	Cebolinha	Chives	*Allium schoenoprasum*
	Coentro	Cilantro	*Coriandrum sativum*
	Palma	Cactus (for fodder)	*Opuntia spp.*
Vegetables – Fruits	Abobora	Pumpkin	*Cucurbita maxima*
	Maxixe	West Indian gherkin	*Cucumis anguria*
	Pimenta	Chili pepper	*Capsicum spp.*
	Quiabo	Okra	*Abelmoschus esculentus*
Vegetables – Roots	Aipim	Cassava	*Manihot esculenta*
	Batata	Sweet potato	*Ipomoea batatas*
	Batata-doce	Sweet potato	*Ipomoea batatas*
Vegetables – Legumes	Andu	Pigeon pea	*Cajanus cajan*
	Feijão	Common bean	*Phaseolus vulgaris*
Vegetables – Cereals	Milho	Corn	*Zea mays*
Herbs	Alevanto	Local herb	*Not identified*
	Babosa	Aloe vera	*Aloe vera*
	Boldo	Boldo	*Peumus boldus*
	Capim-santo	Lemongrass	*Cymbopogon citratus*
	Cherimbao	Local herb	*Not identified*
	Erva cidreira	Lemon balm	*Melissa officinalis*
	Fedegoso	Senna plant	*Senna occidentalis*
	Hortelã	Mint	*Mentha spp.*
	Hortelã miudo	Small-leaf mint	*Mentha spp.*
	Mangalô	Sword bean	*Canavalia gladiata*
	Manjericão	Basil	*Ocimum basilicum*
	Mastruz	Wormseed	*Dysphania ambrosioides*

	Quebra pedra	Stonebreaker	*Phyllanthus niruri*
	Sintorela	Local herb	*Not identified*
Animals	Cabra	Goat	*Capra aegagrus hircus*
Animals	Galinha	Chicken	*Gallus gallus domesticus*
Animals	Vaca	Cow	*Bos taurus*

Varieties – Community of Volta do Américo

Results of the data collection in 6 home gardens

Specific Category	Variety	English Name	Scientific Name
Fruit Trees	Abacate	Avocado	*Persea americana*
	Acerola	Barbados cherry	*Malpighia emarginata*
	Ameixa amarela	Yellow plum	*Spondias mombin*
	Banana	Banana	*Musa spp.*
	Café	Coffee	*Coffea arabica*
	Ciriguela	Spanish plum	*Spondias purpurea*
	Coco	Coconut	*Cocos nucifera*
	Coco da Bahia	Coconut	*Cocos nucifera*
	Goiaba	Guava	*Psidium guajava*
	Jabuticaba	Jabuticaba	*Plinia cauliflora*
	Jaca	Jackfruit	*Artocarpus heterophyllus*
	Laranja	Orange	*Citrus sinensis*
	Limão	Lemon	*Citrus limon*
	Manga	Mango	*Mangifera indica*
	Maracugina	Medicinal plant	*Not identified*
	Papaya	Papaya	*Carica papaya*
	Pinha	Sugar apple	*Annona squamosa*
	Pitanga	Surinam cherry	*Eugenia uniflora*
	Romã	Pomegranate	*Punica granatum*
	Tanjerina	Tangerine	*Citrus reticulata*
	Urucum	Annatto	*Bixa orellana*
Leafy Vegetables	Alface	Lettuce	*Lactuca sativa*
	Cebolinha	Chives	*Allium schoenoprasum*
	Coentro	Cilantro	*Coriandrum sativum*
	Couve	Kale	*Brassica oleracea*
Vegetables – Fruits	Abóbora	Pumpkin	*Cucurbita maxima*
	Maxixe	West Indian gherkin	*Cucumis anguria*
	Pimenta	Chili pepper	*Capsicum spp.*
	Pimentão	Bell pepper	*Capsicum annuum*
	Quiabo	Okra	*Abelmoschus esculentus*
	Urumcum	Local vegetable	*Not identified*
Vegetables – Roots	Aipim	Cassava	*Manihot esculenta*
	Alho poro	Leek	*Allium ampeloprasum*
	Araruta	Arrowroot	*Maranta arundinacea*
	Açafrão	Turmeric	*Curcuma longa*
	Batata	Sweet potato	*Ipomoea batatas*
	Beterraba	Beetroot	*Beta vulgaris*
	Cenoura	Carrot	*Daucus carota*
Vegetables – Legumes	Feijão	Common bean	*Phaseolus vulgaris*
	Feijão Andu	Pigeon pea	*Cajanus cajan*
Vegetables – Cereals	Cana	Sugarcane	*Saccharum officinarum*
	Milho	Corn	*Zea mays*
Herbs	Alecrim	Rosemary	*Salvia rosmarinus*
	Capim-santo	Lemongrass	*Cymbopogon citratus*

	Cidreira	Lemon balm	*Melissa officinalis*
	Erva-doce	Fennel	*Foeniculum vulgare*
	Giranda	Local herb	*Not identified*
	Hortelã miudo	Small-leaf mint	*Mentha spp.*
	Lavanda	Lavender	*Lavandula spp.*
	Levante	Local herb	*Not identified*
	Manjericão	Basil	*Ocimum basilicum*
	Menta	Mint	*Mentha spp.*
	Orégano	Oregano	*Origanum vulgare*
	Piu-piu	Local herb	*Not identified*
	Ruda	Rue	*Ruta graveolens*
	Salsa	Parsley	*Petroselinum crispum*
	Salvia	Sage	*Salvia officinalis*
Animals	Galinha	Chicken	*Gallus gallus domesticus*
	Galo	Rooster	*Gallus gallus domesticus*
	Pato	Duck	*Anas platyrhynchos domesticus*
	Peru	Turkey	*Meleagris gallopavo*

Total plant varieties: 57

Total animal types: 4

Varieties – Community of Cabeceira do Río

Results of the data collection in 2 home gardens

Specific Category	Variety	English Name	Scientific Name
Fruit Trees	Acerola	Barbados cherry	*Malpighia emarginata*
	Banana	Banana	*Musa spp.*
	Coco da Bahia	Coconut	*Cocos nucifera*
	Goiaba	Guava	*Psidium guajava*
	Laranja	Orange	*Citrus sinensis*
	Manga Antiga	Old mango variety	*Mangifera indica*
	Muringa	Moringa	*Moringa oleifera*
	carambola	Starfruit	*Averrhoa carambola*
	graviola	Soursop	*Annona muricata*
	mexerica	Mandarin	*Citrus reticulata*
	pinha	Sugar apple	*Annona squamosa*
Other Tree types	Anjico	Anjico tree	*Anadenanthera spp.*
	Brauna	Brauna tree	*Melanoxylon brauna*
	Imbuzero	Imbu tree	*Spondias tuberosa*
	Mutamba	Mutamba	*Guazuma ulmifolia*
	Ora-pro-nóbis	Edible cactus	*Pereskia aculeata*
Native Trees	Aroeira Pimentera	Brazilian peppertree	*Schinus terebinthifolia*
	Barriguda	Barriguda tree	*Ceiba speciosa*
	Coco licurí	Licuri palm	*Syagrus coronata*
	Jatobá	Jatoba	*Hymenaea courbaril*
	Jurema	Jurema	*Mimosa tenuiflora*
	Mogno	Mahogany	*Swietenia macrophylla*
	Mulungu	Mulungu	*Erythrina velutina*
	Pau d'arco	Trumpet tree	*Handroanthus spp.*
	Pau ferro	Brazilian ironwood	*Libidibia ferrea*
	Pitomba	Pitomba	*Talisia esculenta*
	Putumuju	Putumuju tree	*Not identified*
	São João	São João tree	*Not identified*
	Timbaúva ou orelha de macaco	Timbaúva / Monkey-ear tree	*Enterolobium contortisiliquum*
	Umbaúba	Cecropia tree	*Cecropia spp.*
Leafy Vegetables	Alface	Lettuce	*Lactuca sativa*
	Coentro	Cilantro	*Coriandrum sativum*
Vegetables – Fruits	Pimenta	Chili pepper	*Capsicum spp.*
	Pimentão	Bell pepper	*Capsicum annuum*
	Tomate cereja	Cherry tomato	*Solanum lycopersicum var. cerasiforme*
Vegetables – Roots	Aipim	Cassava	*Manihot esculenta*
	Alho poro	Leek	*Allium ampeloprasum*
	Açafrão	Turmeric	*Curcuma longa*
	Beterraba	Beetroot	*Beta vulgaris*
	Cebolinha	Chives	*Allium schoenoprasum*
	Cenoura	Carrot	*Daucus carota*

Vegetables – Legumes	Feijão de corda	Cowpea	*Vigna unguiculata*
Vegetables – Cereals	Cana	Sugarcane	*Saccharum officinarum*
	Milho	Corn	*Zea mays*
Herbs	Alecrim	Rosemary	*Salvia rosmarinus*
	Capim-Santo	Lemongrass	*Cymbopogon citratus*
	Cidreira	Lemon balm	*Melissa officinalis*
	Clitoriana	Butterfly pea	*Clitoria ternatea*
	Dente de Leão	Dandelion	*Taraxacum officinale*
	Hibisco	Hibiscus	*Hibiscus sabdariffa*
	Hortelã Graudo	Large-leaf mint	*Mentha spp.*
	Imburana	Imburana	*Amburana cearensis*
	Manjericão	Basil	*Ocimum basilicum*
	Ruda	Rue	*Ruta graveolens*
Ornamental Plants	Ipe amarelo	Yellow ipê	*Handroanthus albus*
	Ipe roxo	Purple ipê	*Handroanthus impetiginosus*
Animals	Cabra	Goat	*Capra aegagrus hircus*
	Cavalo	Horse	*Equus ferus caballus*
	Coelho	Rabbit	*Oryctolagus cuniculus*
	Galinha	Chicken	*Gallus gallus domesticus*

Total plant varieties: 56

Total animal types: 4

Annex 2.

Category	Cabeceira	São Sebastião	Volta do Américo	Iuna
Meanings of land and water	• Nature as a being: mother, provider (spiritual connection); • Life; • People and nature as inseparable.	• Life; • Foundation of everything; • Nature as being: feels.	• Life; • Land and water are rights.	• Basis for coexistence.
Valuations of nature	• Spiritual; • Place of belonging (identity, history); • Livelihoods; • Reproducer of life; • Heritage, better life for next generations.	• Livelihoods; • Home; • Heritage, better life for next generations; • Space for learning; • Basis of health; • Basis of autonomy.	• Livelihoods; • Home; • Heritage, better life for next generations; • Basis of health.	• Spiritual; • Place of belonging (identity, history); • Livelihoods; • Basis for development.
Principles of relationshi p with nature	• Conservation, rescue, defense; • Conscious use – coexistence, recognition, respect, care, distribution; • use for subsistence; • Non-appropriable; • Reciprocity; • Collective relationship: intergenerational transfer of principles and knowledge; • Critique: unconscious use; • Critique of appropriation, accumulation, and for profit.	• Use for subsistence • Critique: unconscious use • Critique of appropriation, accumulation, and for profit	• Food production • Collective relationship: Conscious use, coexistence, recognition, respect, care, distribution. • Reciprocity • Collective relationship (intergenerational transfer of principles and knowledge)	• Reciprocity; • Conservation, rescue, defense: • Collective relationship: intergenerational transfer of principles and knowledge; • Collective relationship: Conscious use, coexistence, recognition, respect, care, distribution.
Life principles	• Care for reproduction of life; • Spiritual connection to Mother Earth; • Autonomy; • Defense of life;	• Care for reproduction of life; • Autonomy.	• Healthy life; • Defense of life; • Fight for the right to land. and water • Agroecology as horizon	• Autonomy.

Meanings and valuations of nature, principles of relationship with nature, and life principles.

Annex 3.

Structured and structurant power relations

<table>
<tr><td rowspan="2">TYPES OF POWER</td><td>Location</td><td>Economic</td><td>Economic-Political</td><td>Political</td><td>Normative</td><td>Epistemic</td></tr>
<tr><td colspan="3">Monopoly of force</td><td colspan="3">Capacity for collective action</td></tr>
<tr><td rowspan="2">STRUCTURED POWER RELATIONS:

CONFIGURATION AND REPRODUCTION MECHANISMS</td><td colspan="3">MATERIAL ARENA</td><td colspan="3">SYMBOLIC ARENA</td></tr>
<tr><td colspan="3">Concentration of means of production/reproduction of life:
- Water and land
- Access and control technologies, water flows
- Information technologies
- Seeds and inputs

Productive relations of dependence:
- Employment
- Public policies
- Inputs</td><td colspan="3">Normative frameworks: legal and value-based elements that validate and protect or allow their expansion:
- Land as private property (legal and value-based)
- Water as an economic good (legal and value-based)
- Types of valuations and principles of (value-based)

Institutions of public power

Hegemonic language:
- Technical-scientific</td></tr>
<tr><td rowspan="2">STRUCTURANT POWER RELATIONS:

REAFFIRMATION, STRENGTHENING, WEAKENING OR POTENTIAL TRANSFORMATION MECHANISMS</td><td colspan="3">PRODUCTIVE/REPRODUCTION OF LIFE ARENAS</td><td>PUBLIC ARENAS</td><td>ORGANIZATIONAL ARENAS</td><td>INSTITUTIONAL PARTICIPATION ARENAS</td></tr>
<tr><td colspan="3">• Access to means of production/ reproduction: land, territory, water, technologies;
• Implementation of traditional knowledge, principles of use of water and land;
• Employment with control;
• Monitoring (with police presence);
• Restrictive water use policies.</td><td>• Demonstrations/protests;
• Public appearances of political authorities (with police presence);
• Use of hegemonic/ counter-hegemonic language.
• Legality as a legitimizing tool.</td><td>• Alliances, networks of influence;
• Reflection and awareness;
• Education with peasant education.</td><td>• Participation in meetings;
• Struggle over hegemonic/counter-hegemonic language.</td></tr>
</table>