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Conflicts and Arrangements between Water Users in the Upper Comoé Sub-Basins: An Interpretation through Hydro-Social Theory

SOULAMA Tiécoura and SODORE Abdoul Azise*

03 BP 7021 Ouagadougou 03, Burkina Faso

*Corresponding author

Abstract

In the Upper Comoé sub-basin in Burkina Faso, water is not only a natural resource but also the product of social, institutional, and political constructions that condition its access. The article uses the concept of hydro-social territory to show how the logics of the state, of Comoé Sugar Company, of rice farmers, and of informal operators overlap and come into tension, revealing conflicts of use and compromises aimed at maintaining a fragile balance. The study combines the use of a survey form with 384 households, institutional interviews, and field observations. The data have been statistically analyzed. The results highlight management marked by the industrial hegemony of SOSUCO, supported by the state, which dominates hydraulic infrastructures and generates a feeling of injustice from 85% of households. The average annual deficit of 8.3 million m³ increases competition between industrial, market gardening, domestic, and environmental uses. More tensions between upstream and downstream villages and land conflicts opposing customary law and state logic reinforce inequalities. The exclusion of certain actors, notably women and fishermen, fuels strategies of resistance and circumvention. Integrated Water Resources Management, through the Local Water Committee of the Cascades, plays an essential mediation role by promoting pragmatic compromises and institutional DIYs that mix official rules and local arrangements, allowing communities to cope with the chronic insufficiency of the resource.

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Introduction

In the Upper Comoé sub-basin, the issue of water is not simply a matter of volume or flow rate. Who has access to it, under what conditions, and at whose expense? This is what structures the relationships between users and ultimately shapes the territory. Water is both a vital resource and an object of struggle. It mediates the social, economic, and political relationships that determine its uses, far beyond its purely biophysical reality (Rouillé-Kiélo *et al.*, 2022). To grasp this dual material and social nature, geography has developed the concept of the hydro-social territory, understood as a space in constant

flux due to negotiations and conflicts between actors with divergent interests (Linton and Budds, 2013; Boelens *et al.*, 2016). This plurality of logics, which Rouillé-Kiélo *et al.*, (2022) refer to as territorial pluralism, is not simply peaceful coexistence. It produces friction, compromises, and ongoing reconfigurations. This plurality thus becomes a source of both complementarity and ongoing socio-political conflict and recomposition, as is the case in the Upper Comoé basin. There, one observes a space at the crossroads of domestic, agricultural, and industrial uses, where actors with potentially convergent or contradictory interests coexist.

Based on this overview, this article aims to analyze the conflicts and arrangements between water users in the Upper Comoé sub-basin. After presenting the theoretical framework and the methodology adopted, the forms of conflict at play are examined, before analyzing the arrangements and compromises structuring local resource management.

Theoretical Framework

Water has long been considered a simple natural given: a volume, a flow rate, a chemical composition. This biophysical perception fails to capture essential aspects of this resource: who controls the water, who is excluded from it, and on what grounds (Rouillé- Kielo *et al.*, 2022). To bridge this gap, Linton and Budds (2013) proposed the concept of the hydro-social cycle, which links physical and social flows. These authors argue that water, beyond its presence in waterways, also structures power relations and institutions; it also gives meaning and value to cultural practices.

This analytical framework delves deeper into the notion of hydro-social territory as defined by Boelens *et al.*, (2016), who define it as a socio-political space where the visions, uses, and logics of multiple actors overlap and clash. This territory has no fixed boundaries; it is constantly reshaped by power dynamics.

Research conducted in very diverse contexts has confirmed the fruitfulness of this prism in Turkish irrigated areas (Le Visage and Kuper, 2019), precarious neighborhoods in Haiti or the Paris basin (Resch, 2022).

In each of these cases, the same mechanism is at work: unequally endowed actors compete for a scarce resource, and the most powerful end up imposing their logic on the others.

For our study, the concept of territorial pluralism developed by Rouillé-Kielo *et al.*, (2022) is central. It reminds us that the coexistence of several hydro-social territories within the same space is not the exception but rather the norm. And this coexistence is not peaceful: it produces domination, resistance, and compromises.

This is what we intend to analyze in the Upper Comoé sub-basin, demonstrating how dams and irrigation canals become instruments of power, and how meetings of the local water committee are transformed into arenas of institutional improvisation.

Methodological Approach

Study area

The Upper Comoé sub-basin, with an area of 1,928 km² (representing 11.3% of the Comoé basin), is located in southwestern Burkina Faso, upstream of the international basin (Map 1). It extends across several communes in the provinces of Comoé, Kénédougou, Houet, and Léraba (SODORE AA *et al.*, 2023, p. 33).

The climate is of the South Sudanese type, characterized by a dry season (October-April) and a rainy season (May-September), with an average annual rainfall of 1,000 mm, higher than the national average. Temperatures range between 28.7°C and 32.2°C, and evapotranspiration is highest in March-April-May. The landscape is dominated by sandstone massifs and peneplains, with promontories such as Mount Ténakourou (747 m). The hydrographic network is dense, structured by the Comoé River and its tributaries, with several dams (Comoé, Lobi, Toussiana) and lakes (Tengréla, Lemouroudougou, Karfiguéla) (SOULAMA T., 2021, p. 26). The soils, although susceptible to erosion, have properties favorable to agropastoral activities. The vegetation is mesophilic savannah, with remnants of open woodland and gallery forests. The agricultural and hydrological potential of the area has, in part, facilitated the successive settlement of sociocultural groups. Historically, the population has been marked by the Gouin, Turka, Karaboro, Dioula, Samo, and Tousian peoples (SOULAMA S., 1994, p. 20). Economic activities are based mainly on extensive agriculture (cotton, peanuts, sesame, millet, maize, sorghum, tubers) and extensive livestock farming (small ruminants, cattle, pigs, poultry), favored by transhumance routes and agro-climatic conditions.

Methodological approach

The study employs a mixed approach articulating three complementary perspectives: the systemic approach, the relational-dialectical approach, and the multiscale approach.

The systemic approach considers the sub-basin as a complex system where natural, technical and social elements interact.

The relational-dialectical approach, in the sense of Linton and Budds (2013), is interested in social relations, tensions and contradictions between actors.

The multiscale approach analyzes dynamics at different spatial and temporal scales.

These three approaches are operationalized by means of a quantitative questionnaire and semi-structured interviews.

Data collection

Questionnaire survey

The sample size was calculated according to Cochran's formula (1977) with regard to the population size with a 95% confidence level ($z=1.96$), an estimated proportion of $p=0.5$ and a margin of error of 5%, which gives $n = (1.96 \times 0.5 \times 0.5) / 0.05^2 = 384$ households.

The unit of observation is the agricultural household defined as all the people living under the same roof and using the same water resources. The selection of study sites took into account two criteria: geographical position in relation to the river (upstream and downstream) and proximity to irrigated areas (formal or informal). At each site, households were selected by systematic random sampling.

The spatial distribution of the sample took into account the demographic and functional structure of the sub-basin: 254 households in the upper downstream area (the most populated areas and those exposed to competing uses), 105 in the developed rice-growing plain of Karfiguéla, 19 upstream (the headwaters water withdrawal zone), and 6 in the lower downstream area (the outlet zone, sparsely populated). The underrepresentation of the lower downstream area is due to its low population density and not to any sampling errors. Consequently, the results from this sub-area are presented for illustrative purposes only and are not used for inferential statistical comparisons with the other areas.

Because of this spatial asymmetry in demographic sampling, not all inter-area comparisons presented in this article are based on statistical inference tests.

Semi-structured interviews

Twenty-three semi-structured interviews were conducted to assess social representations, actor logics, and power dynamics according to Pires' (1997) principle of intentional diversification. Table 1 provides an indication of the categories of actors interviewed.

The interviews were conducted according to a thematic guide organized around four axes: i) perceptions of the resource and access rights, ii) conflicts of use experienced or observed, iii) methods of resolution and arrangement, iv) the role of formal and informal institutions.

The interviews were recorded with the informed consent of the participants and transcribed in full.

Direct observation

Direct and participant observation sessions were conducted at three sites representative of conflict dynamics: i) the area surrounding the Comoé dam during a water release in the dry season (March 2025), ii) a meeting of the Local Water Committee's technical committee dedicated to the seasonal distribution of flows (November 2024), and iii) the banks of the Comoé River in the Karfiguéla sector, during inspections of the easement zone by water police officers (January 2025).

An observation grid was used to record data at all three sites.

Data processing and analysis

The quantitative data from the questionnaire were entered and analyzed in Sphinx Plus2-v5 software, then transferred to Excel for the production of graphs and summary tables.

The analysis focuses on frequency distributions, cross-tabulations, and comparisons between areas.

The qualitative data were subjected to a thematic content analysis conducted in three stages: i) open coding of interview transcripts and field notes to identify emerging themes, ii) thematic grouping around the analytical categories of the hydro-social framework, iii) interpretation of convergences and divergences between actors and between geographical areas.

Data triangulation was done by systematically comparing, for each result, the information from the questionnaire, interviews and field observations.

Ethical issues

In the framework of the writing of this paper, artificial intelligence tools have been used to correct mistake.

Results and Discussion

Hydro-social dynamics: territories, power and conflicts

Mapping of stakeholders and typology of hydro-social territories

In the sub-basin of the Upper Comoé, water is the subject of competition between several actors (figure 1). The surveys highlighted a configuration of actors coexisting on four types of hydro-social territories and with logics that are sometimes difficult to reconcile: State, Comoé Sugar Company (SOSUCO) and rice farmers, informal operators, farmers' organizations and domestic users, NGOs and donors.

The State and its decentralized services define the legal framework and organize planning in theory. SOSUCO and the rice farmers in the Karfiguéla area dominate the economic landscape while asserting their productive weight.

Along the river, informal operators, peasant organizations and domestic users form a community and informal territory whose practices reveal glaring issues of social justice.

NGOs and donors intervene on an ad hoc basis, reshaping the dynamics without always stabilizing them.

This territorial pluralism, in the sense of Rouillé- Kielo *et al.*, (2022), is not simply a map of actors (Figure 1) but a reality of ongoing tensions and negotiations. Indeed, each territory seeks to impose its logic of access and control, without necessarily succeeding. Under these conditions, they are all forced to find compromises within the framework of the meetings of the Local Water Committee and in the informal seasonal arrangements concluded along the riverbanks.

Historical Roots of Inequality and Land Domination

To understand the current situation in the Upper Comoé sub-basin, it is necessary to go back to the 1970s, when the Burkinabè state developed the sugar plain. This development brought about a major change. Customary law, which recognized the right of lineages, and especially women, to access lowland rice cultivation, was disregarded in favor of a state-driven approach centered on SOSUCO (the state-run sugar company). Women were dispossessed of their rice-growing lands,

resulting in persistent territorial insecurity (Nébié, 1993; Zoungrana, 2006).

This land divide, between customary law and agro-industrial logic, constitutes a legacy and a foundation upon which all current land-use conflicts are built. It is the same tension that Hellendorff (2013) observes in Mali between large companies and small farmers. The striking fact in this sub-basin is the intensity of the tension: 78% of interviews conducted with non-industrial users report feelings of injustice, exclusion, and abandonment.

Control: water as an instrument of power

Control of the dams is the crux of the matter. Since the agreement of January 30, 1992, SOSUCO has been entrusted with the primary management of the Comoé and Toussiana dams (Bazin *et al.*, 2011). Although the State challenged this agreement in 2020, few changes have been observed on the ground. This situation is confirmed by 85.4% of households, who believe that SOSUCO's influence on the governance of the structures remains decisive. Furthermore, water service employees cite "institutional inertia" that is slowing any real redistribution of control.

This dominance manifests itself in two ways. During the rainy season, water releases cause downstream flooding that destroys both formal and informal crops. This was observed in March 2025, near the dam. During the dry season, however, water is scarce. For 87.4% of the households surveyed, excessive consumption by SOSUCO (the national water utility) is the cause of the water shortage. This assertion by households reflects structurally asymmetrical power dynamics. Water functions here as a social marker, and consequently, the hydro-social approach allows us to understand it as the expression of a reality rooted in practices (Boelens *et al.*, 2016; Rouillé- Kielo *et al.*, 2022).

Geographical conflicts, upstream-downstream tensions

The location in the upstream and downstream sections reveals a form of geography of inequality. Indeed, during the dry season, when water becomes scarce, villages located in the upper downstream areas, such as Karfiguéla, Lemouroudougou, and Tengrela, build earthen berms in the riverbed to retain water. As a result, they constitute an autonomous hydro-social territory, to the detriment of villages in the lower downstream areas,

particularly Diarrabakoko and Siniena, whose access to water is reduced.

The local water committee then tries to find solutions, but without complete success, because beyond the visible aspects of water scarcity lie land and identity disputes. This situation is illustrated by the conflict that erupted in 2020 between the villages of Sitiéna and Djongolo. This clearly demonstrates that water can crystallize territorial rivalries that run much deeper than the simple issue of irrigation (Lasserre and Auclair, 2013).

This dynamic, however, is not unique to the Haute Comoé region. It is also found in the Kou River basin in Burkina Faso (Sontié, 2006; Traoré, 2012) and in Kenya (Rouillé-Kielo *et al.*, 2022); the upstream location, combined with agricultural intensification, almost inevitably leads to deficits downstream.

The Moussodougou dam, a space of collision between industrial visions

The Moussodougou dam is a symbolic site of confrontation between several hydro-social territories. Three visions clash there. First, there is SOSUCO, for whom the reservoir is a strategic reserve for sugarcane, a resource to be secured, not shared. Second, for the Wramba group, the reservoir's concession holder, it is a tool for economic diversification through fishing. Finally, for the local communities, the dam's water belongs to no one; it is sacred, linked to village land, and must therefore be accessible to all.

Faced with this reality, SOSUCO has instituted permanent surveillance of the riverbanks to protect its facilities and prevent the "occult practices" attributed to fishermen. For the Wramba group, this surveillance is perceived as an intrusion into ritual spaces and an infringement on ancestral rights.

At the local level, the concession of the water body to the Wramba cooperative is also generating strong criticism. Although the conditions for joining seem simple, no new integration is truly accepted. The local communities interpret this closure as a privatization of a common good, while they demand community management based on village rules.

These observed dynamics are similar to those observed around the Bagré dam, where hydroelectric exploitation comes into tension with local fishing practices (Traoré, 2012).

Protecting riverbanks: between ecological imperatives and peasant survival strategies

In the Upper Comoé sub-basin, the banks of the main rivers and bodies of water are heavily used by local populations for market gardening. This appropriation reflects the construction of a rural hydro-social territory, shaped by the scarcity of agricultural land, a consequence of the establishment of the agro-industrial complex, and by the appeal of the fertile silty soils along the riverbanks. Water and its surrounding areas thus become a vital space for farmers, who develop survival and subsistence practices there. In parallel, the State, through its water police services (Guiriko and Tannounyan), is implementing an institutional hydro-social territory focused on the regulation and preservation of the resource. Unannounced checks on waterways (Comoé, Yanon) and reservoirs (Comoé, Toussiana, Lobi dams) reflect a desire to enforce regulations, in particular the 100-meter easement strip imposed by the law on water resource management.

Two hydro-social territories are in conflict: the peasant territory of survival and the institutional territory of preservation.

The ecological benefits of the easement strip are real (Maisonneuve and Rioux, 1998), but this matters little to producers simply seeking to feed their families. Resch (2022) also observes this in the Paris Basin: environmental policies struggle to take root locally when they contradict basic needs. On the ground, in January 2025, observations highlighted farmers re-cultivating the riverbanks after each inspection, and water police officers sometimes tolerate this in exchange for informal arrangements.

Water as a space for negotiation: institutional improvisation and hybridization of management logics

Supply and demand balance: a structural deficit at the heart of tensions

Since the development of irrigated areas, the management and sharing of water resources in the -Upper Comoé sub-basin have become a major challenge. Analysis of supply and demand reveals a persistent mismatch. Indeed, average annual needs reach 45.4 million m³, while the volume available in the three dams is only 37.1 million m³, representing an average deficit of 8.4 million m³. This deficit, which varies

considerably from year to year, reflects the competition between several stakeholders, each developing their own hydro- -social territory. SOSUCO largely dominates demand with over 31.5 million m³, situating its operations within an agro- -industrial territory where water is a strategic resource for the continuity of sugar production. The market gardeners along the river (8.1 million m³) and those in the Karfiguéla plain (1.98 million m³) cultivate a rural territory based on subsistence and diversification, where water is vital for food and economic security. The National Water and Sanitation Office mobilizes 0.98 million m³ for drinking water supply, embodying an institutional territory centered on public service. Finally, environmental demand (2.75 million m³) highlights the existence of an ecological territory, often marginalized, but essential for maintaining ecosystems. In this context, water becomes an arena for negotiation and confrontation, revealing the need for Integrated Water Resources Management (IWRM). To reconcile uses, reduce imbalances and establish compromises between actors.

The CLE-HC, a framework for consultation and arbitration of priorities

Since its establishment by decree No. 2008 -007/RCAS/CR/SG, the Haute Comoé Local Water Committee (CLE -HC) has been the central body for mediation between users. Its 14-member technical committee, established on June 24, 2008 (Figure 2), meets annually at the beginning of the dry season to develop an allocation plan: estimating the volumes of water available in the dams, negotiating the areas to be cultivated, allocating flow rates, and verifying the implementation of decisions on the ground (Palé *et al.*, 2019; Sodoré *et al.*, 2023).

However, ONEA, whose mission is to ensure the supply of drinking water to the cities of Banfora and Bérégaougou, benefits from absolute priority. Its needs, considered incompressible, are therefore systematically deducted from the total volume before any distribution among other users (Soulama, 2021).

Although this water resource allocation process perfectly illustrates the logic of Integrated Water Resources Management (IWRM) as a space for mediation (Zerbo, 2017), the systematic priority given to ONEA reveals a clear hierarchy of uses. This hierarchical practice establishes the primacy of domestic use over agricultural or industrial uses and shows that IWRM is not limited to a simple technical allocation. It organizes an arbitration

between actors with divergent interests, based on criteria of legitimacy and social priorities.

Between modernity and custom: institutional tinkering with the resource

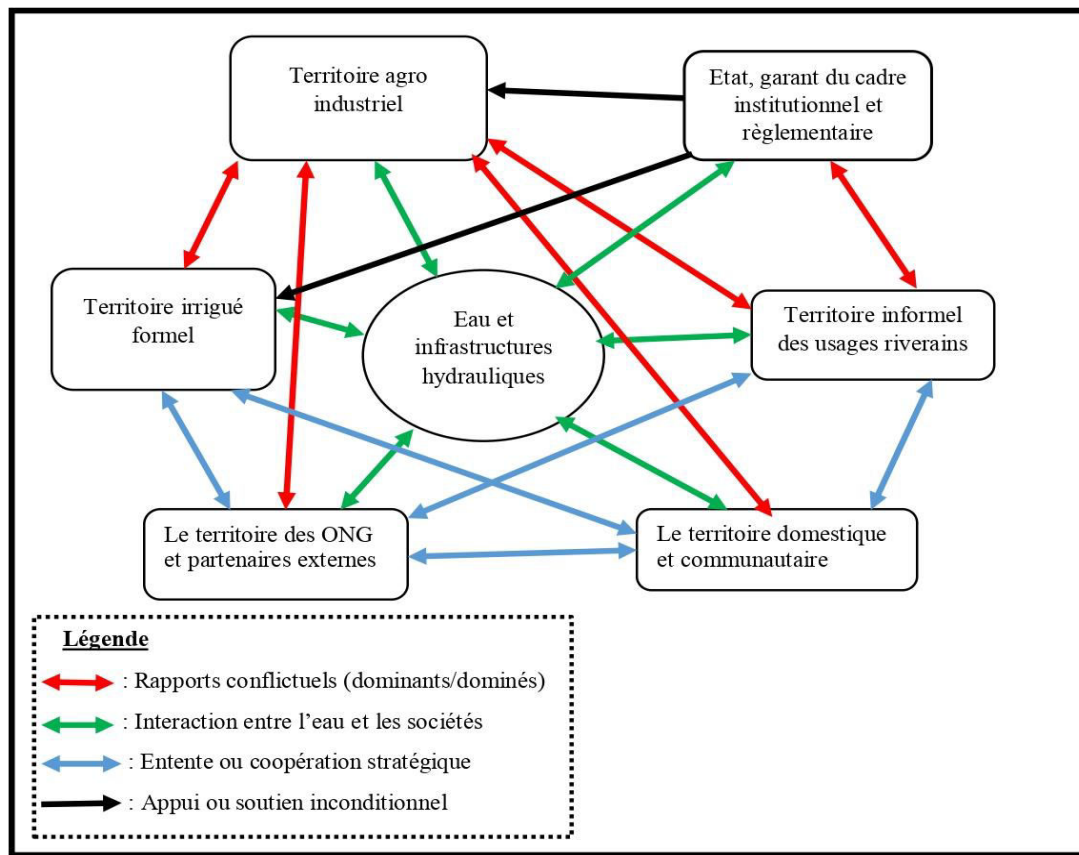
In the -Upper Comoé sub-basin, official mechanisms are insufficient to regulate water use. While the CLE-HC (Local Water Commission of the Upper Comoé) does organize a rotating schedule between farmers in the Karfiguéla plain and informal market gardeners, this framework coexists with a persistent customary view of water. Indeed, for almost all the households surveyed, water is inalienable, tied to land ownership, and must remain accessible to all (Zoungrana, 2006).

This coexistence reveals a divide between two visions. On the one hand, a modern, institutional approach, inspired by international recommendations (Hellendorf, 2013), considers water as an economic good to be allocated according to principles of efficiency. On the other hand, a customary approach advocates for universal and equitable access to the resource, championed by local structures. The tension between economic rationality and customary law explains users' resistance to imposed rules and the difficulties in implementing the rotating water allocation schedule. It illustrates the complexity of these hydro- social territories -, where productive, institutional, and cultural logics clash. In this context, Integrated Water Resources Management (IWRM) emerges as an essential mediation tool, capable of creating compromises between contradictory visions of water.

Informal compromises and the resilience of the actors

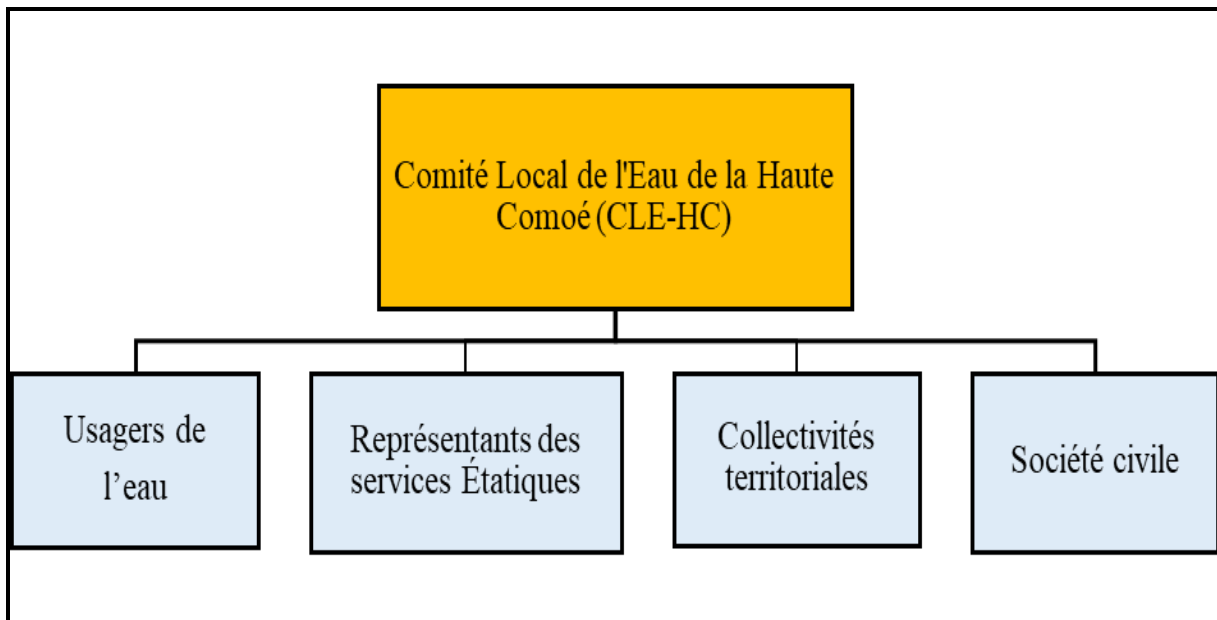
Alongside official mechanisms and customary rules, there are what could be described as seasonal arrangements. For example, during the dry season, the Union of Cooperatives of Operators of the Karfiguéla Developed Perimeter (UCEPAK) SOSUCO agrees to halve the cultivated areas to limit pressure on the resource. Similarly, during critical periods, SOSUCO sometimes agrees to delay irrigating its sugarcane fields to allow rice farmers in the plains and those along the river to meet their needs. These arrangements illustrate the actors' ability to move beyond formal rules and customary practices to devise pragmatic solutions that take realities into account. They reflect a logic of ongoing negotiation, where water becomes a space for compromise and social regulation, revealing the complexity of hydro- -social dynamics in the area.

Figure.1 Actor logics and local compromises

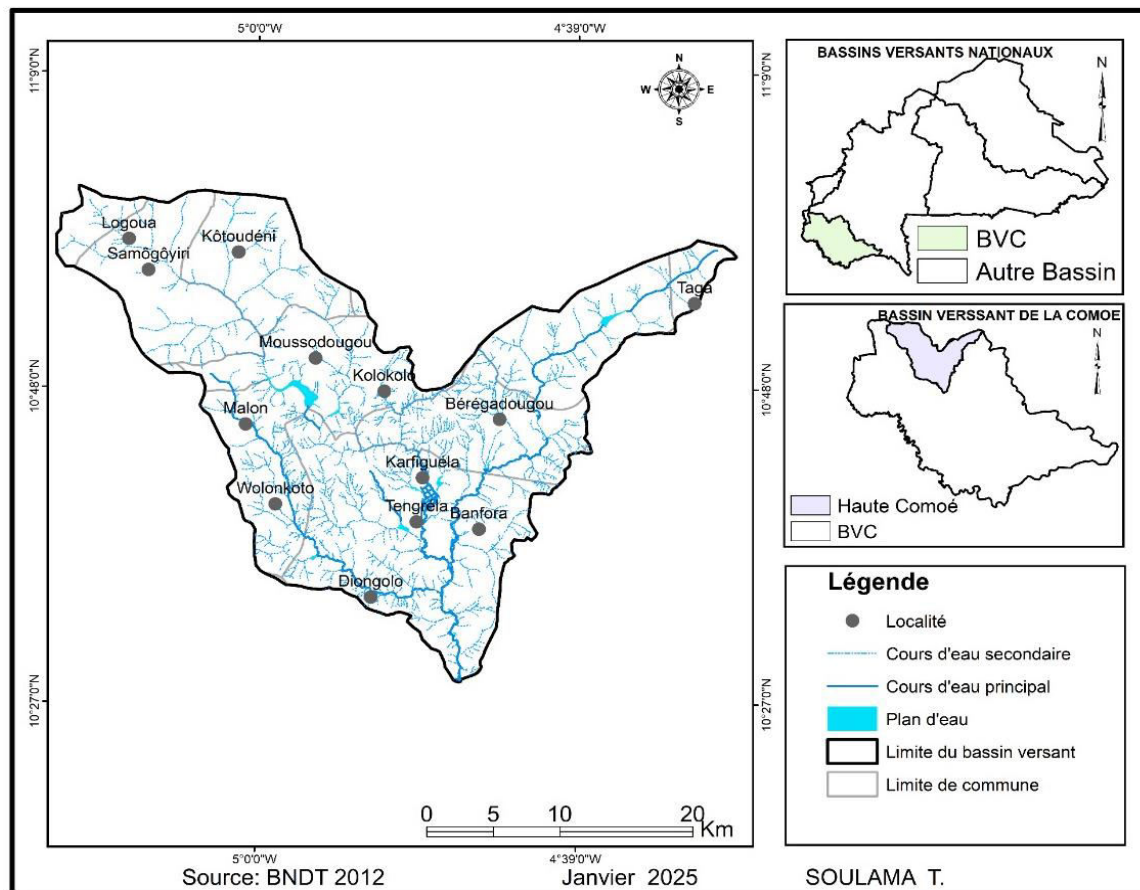


Sources: authors, field surveys, 2025

Figure.2 Composition of the Haute Comoé Local Water Committee



Sources: authors, field surveys, 2025

Map.1 Geographical location of the study area**Table.1** Distribution of semi-structured interviews by category of actor

Categories of actors	Number	Profile
Institutional actors	8	Regional Directorate, Water Services, Town Hall
Representatives of the Comoé sugar company	3	Technical Director, Hydraulics Manager
Member of the Local Water Committee	4	President, board members, technicians
Agricultural users	5	Rice farmers, market gardeners, informal farmers
Excluded actors (women, fishermen)	3	Wramba group, women farmers

Sources: authors, field surveys, 2025

This interpretation aligns with Yolette's (2025) analysis, which, concerning Haiti's slums, shows that access to water relies on a conflictual coexistence between formal and informal infrastructure.

In both contexts, this hybridity produces composite hydro-social territories, where community resilience and persistent inequalities intertwine.

In conclusion, Analysis of the Upper Comoé sub-basin reveals that water transcends its biophysical dimension to become a major socio-political issue, characterized by

asymmetrical power dynamics and multiple conflicts. While Integrated Water Resources Management offers a framework for mediation capable of generating pragmatic compromises, the long-term viability of this hydro-social territory will depend on the ability of institutions to transform these precarious arrangements into inclusive governance that reconciles economic productivity, social justice, and environmental sustainability. This requirement is all the more pressing given that climate change risks exacerbating the already observed water deficit, intensifying tensions and making more equitable and resilient regulation essential.

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