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Studying the socio-spatial dynamics and organizational rules in Lake Guiers' region, Senegal

**For the mobilization of two living labs in
the frame of the “*Santés et Territoires*”
project**

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Abstract

In the context of a renewed dialogue on health and food security worldwide, Senegal aims to achieve food self-sufficiency by 2035, and the Lake Guiers' region is at the core of its strategy. Agro-industrial and irrigation infrastructures have dramatically increased in the area and brought many issues to overcome. The "*Santés et Territoires*" project has recently launched two living labs around Lake Guiers to collectively address health issues based on the One Health concept and the agroecological transition. This work sought to disentangle the socio-spatial dynamics and identify the organizational rules at play in the area in order to better mobilize the living labs. After a first analysis of the state-of-the-art on the diversity and complexity of the socio-spatial reality in North Senegal, we performed 39 semi-structured interviews in the Lake Guiers' region. We elaborated on two complementary frameworks to analyze the data: the TORSO model and the Institutional Grammar. The results reveal that there are direct and indirect interactions with the resources and among the diverse actors' categories which nurture conflicting situations to access and use the resources. Those conflicting situations unravel relational patterns showing the role of customary laws on the territory. A focus on the main relational and organizational drivers around the Lake features 1) an institutional inertia and 2) a willingness to break away from it that creates discrepancies about the resources' management. A crossed lecture of the two frameworks emphasizes the vertical, rigid, and detached position of institutions, the horizontal, practical and adaptative attitude of the communities and an in-between stand for external actors. The living labs' participants will have to aim for collaborative innovation and align on a shared vision to enhance territorial health.

Keywords: Living labs, One Health, agroecological transition, socio-spatial dynamics, organizational rules, Lake Guiers, Senegal

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Acronyms and abbreviations

IAD framework: Institutional Analysis & Development framework

IG: Institutional Grammar

IGT: Institutional Grammar Tools

TORSO: TerritOry-Resources-Societal-Organization

CIRAD: *Centre International de Recherche en Agronomie pour le Développement* - French Center for International Cooperation in Agricultural Research for Development

ISRA: *Institut Sénégalais de Recherches Agricoles* - the Senegalese Agricultural Research Institute

UGB: Gaston Berger University

SAED: *Société d'Aménagement et d'Exploitation des terres et des vallées du Delta du fleuve Sénégal et de la Falémé* - The Senegal River Delta and Land Development and Exploitation Company

OLAC: *Office des Lacs et des Cours d'eau du Sénégal* – the Senegalese Water streams Office

OMVS: *Organisation pour la Mise en Valeur du fleuve Sénégal* - Organization for the Development of the Senegal River

SOGED: *Société de Gestion et Exploitation du barrage de Diama* - Diama dam management and operation company

ARD: *Agence Régionale de Développement* - Regional Development Agency

DGPRE: *Direction Générale de la Planification des Ressources en Eau* – Water resources planning department.

SONES: *Société Nationale des Eaux du Sénégal* – National water company of Senegal

UN Women: United Nations Women

USAID: United States Agency for International Development

EndaPronat: *Environnement Développement Action pour la Protection Naturelle des Terroirs* – Environment, development and action for the natural protection of the territories

PSE: *Plan Sénégal Emergent* – The Plan for an Emerging Senegal

LDN: *Loi du Domaine National* – National Domain Law

LOAS: *Loi d'Orientation Agro-silvopastorale* - Agro-Silvopastoral Orientation Law

POAS: *Plan d'Occupation et d'Affectation des Sols*

PDIDAS: *Projet de Développement Inclusif et Durable de l'Agribusiness au Sénégal* - the Inclusive and Sustainable Development Project for Agribusiness in Senegal
CSS: *Compagnie Sucrière Sénégalaise* - Senegalese Sugarcane Company

WAF: West Africa Farm

KMS: *Keur Momar Sarr*

GIE: *Groupe d'Intérêt Economique* -

N: National or supra-national services

AB: Agrobusinesses

DTS: Decentralized technical services

DAS: Decentralized administrative services

LC: Local Communities

NGO: Non-governmental Organizations or international cooperation funds

A: Attribute

D: Deontic

I: Aim

B: Object

C: Conditions

O: Or Else

PART 1: Introduction and literature review

The recent health crisis has instilled a sense of urgency worldwide to deal with the emergence of new pathogens and climate change consequences. In this context, farming-related challenges are among the most preoccupying (FAO, 2015). The stake is even bigger for the countries of the Global South which are developing in more unstable conditions. Policies and economic reforms are necessary to deal with the unpredictable future of many sectors. In this context, discussions revolve around the necessity of supporting countries facing more severe negative outcomes through economic aid and research (Barbier & Burgess, 2020; Samans, 2021).

Senegal is one of the most dynamic developing countries in Western Africa. The growing population coupled with agriculture intensification creates socioeconomic and health issues that the Sahelian country must navigate while aiming for food security, international cooperation, and emergence.

1 Senegal's development context around natural resources...

1.1 Agrarian development and global politics around natural resources and productive land management

The Senegalese government has put an emphasis on the agrarian development and food self-sufficiency ever since the Independence (Benegiamo, 2020). Land and all associated resources have been at the core of the national politics, particularly because most of the population is living in rural areas (Ndiaye et al., 2009). A first major reform in 1964 has weakened customary land rights and granted more authority to the government for the resources management (Benegiamo, 2020).

Since the mid-1990s, land law reform has been on the political agenda to try and balance both legal and customary systems, but the government is facing many challenges to enact one (Hertzog-Adamczewski et al., 2023; Plançon, 2009). Nowadays, Senegal still tries to know what role the agriculture has in its society, knowing it employs over half of the active population but only contributes to 8% of the GDP (Plançon, 2009).

With agriculture being identified as a primary driver for poverty reduction, allocating consequent patches of land to foreign investors became a national strategy in the 1980s to create more production wealth (Bourgoin et al., 2016; Hertzog-Adamczewski et al., 2023). The investment in irrigation infrastructures by private actors and agrobusinesses, but also the modernization of smallholder farms is incentivized (PDIDAS, 2023). Therefore, family agriculture is prompted to adopt the national development pace through public credit, subsidized inputs, and bank loans. This evolution reflects a transition from a state-led socialism to a market-oriented agro-industrial strategies (Benegiamo, 2020).

Since 2014, the government is willing to achieve *the global emergence of the country* through the Plan for an Emerging Senegal (PSE) (Boidin, 2019). It overall promotes structural transformation of the economy, a reduction of Senegal's global deficit, investment, and job creation. Senegal also promotes international cooperation for development aid, donations, and foreign direct investment (FDI) (Diagne, 2017). The country aims to merge production management with broad social goals and establish a firm State control over rural places. It is also a way for the State to intervene into areas such as public health and education (Benegiamo, 2020).

1.2 A decentralization scheme to tackle local needs and better manage natural resources

After gaining its independence from the French colonial rule in 1960, Senegal has put a lot of efforts into rebuilding the nation yet following the French centralized structuration model (Benegiamo, 2020; Gellar, 1997). Decentralization has been one of Senegal's major focuses since the 1980s. The government was pushed by international donors, NGOs and civil society organizations to make structural adjustments policies, leading to the creation of new institutions and legal codes to address environmental and decentralization matters (Gellar, 1997; Sané, 2016). *Decentralization* means that the administrative, political, and fiscal responsibilities are transferred to regional and local services (Ndiaye et al., 2009).

It is usually associated with a disengagement from the central structure as it gives way to both governmental and grassroots local governance structures (Sané, 2016).

In 2004, 441 decentralized administrative entities were agreed upon and were broken down into regions, departments, municipalities, and rural communities (Piveteau, 2005). Nowadays, Senegal counts 14 regions, 45 departments (3 in each region) and 123 districts ("arrondissements"), divided into rural communities (RocheGude and Plançon, 2009; Sané, 2016). Each administrative level has a state representative (a governor for the region, a prefect for the department and a sub-prefect for the district), and technical services are also split accordingly (Sané, 2016). The local governments are subjected to a tutelage regime from the State (Appendix 1) (RocheGude and Plançon, 2009).

However, customary laws and traditional power structures are still important in Senegal, especially village headmen who represent the village (Gellar, 1997).

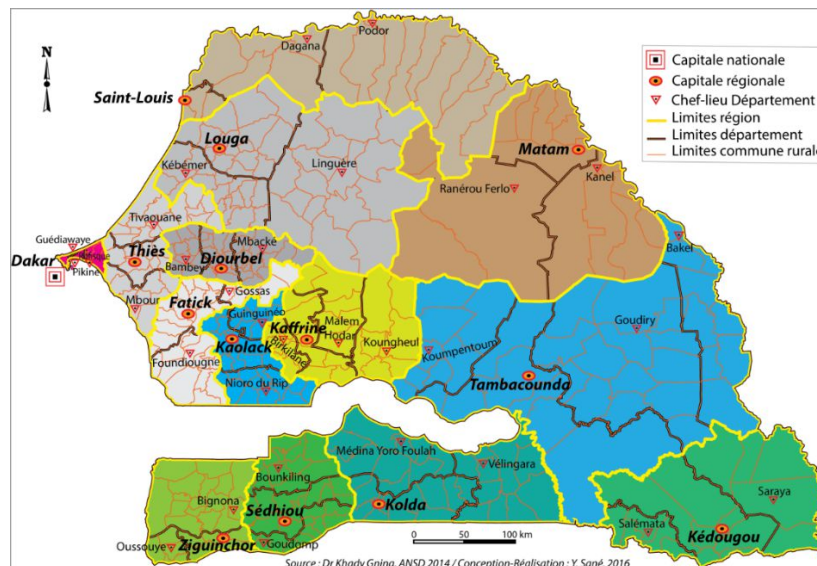


Figure 1: The administrative division in Senegal with regions (yellow lines), departments (brown lines) and rural communities (orange lines) (from Sané, 2016)

2 ...shows a high dependency on Lake Guiers

2.1 The river delta and the hydro-agricultural development in the area

The Senegal river delta is one of the most strategic areas for agro-industrial development in the semi-arid Sahelian region of Senegal (Bourgoin et al., 2022; Faye et al. 2016). A

Sate-led project called the Inclusive and Sustainable Development Project for Agribusiness in Senegal (PDIDAS) has been promoted from 2014 until 2020 to boost the industrial irrigated agricultural production (Bourgoin et al., 2022). Since the 1980s, two major dams and many canals were built near the river and its tributaries to ensure water flow regulation and permanent freshwater provisioning to the delta's fertile lands (Benegiamo, 2020). The Senegal river valley holds a potential of 240 000 irrigated hectares (Bourgoin et al., 2016). As a result, the delta has shifted from a pastoralist and seasonal flood farming traditional economy to a more intensive hydro-agricultural regime, where herders are compelled to migrate or transition to integrated agro-pastoralism (Benegiamo, 2020). From 1979 to 2015, more than 50 000 extra hectares were turned into hydro-agricultural structures (Bourgoin et al., 2016)

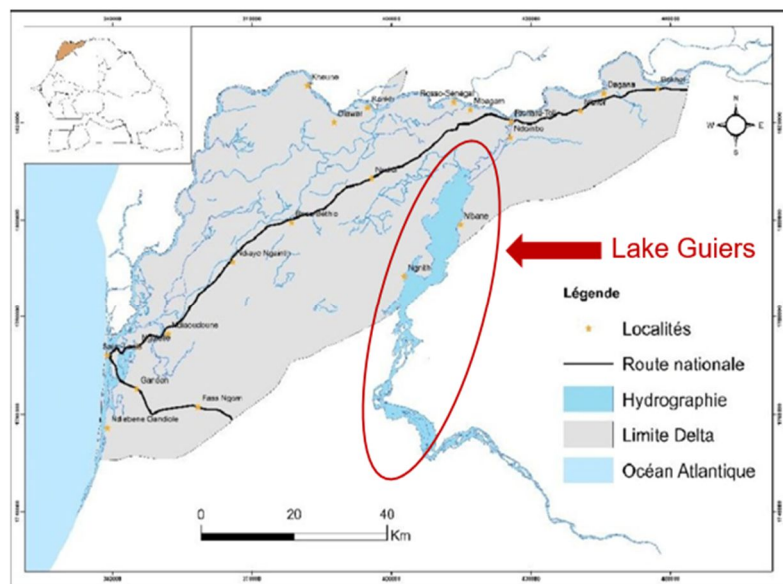


Figure 2: The Senegal River Delta and its tributaries, among which Lake Guiers (adapted from Ndiaye and Ba, 2019)

2.2 Lake Guiers, a fast-growing area facing many challenges

2.2.1 A cross-scale area with many actors and sectors involved

Lake Guiers is a consequent wetland located area on the left bank of the Senegal river delta. The 50 kilometers-long shallow waterbody is connected to the river through the Taouey canal to the north and runs downstream into the Ferlo valley (Belmin, 2018; Faye et al., 2016; Niang, 2011). The lake's area undergoes a long dry season of 8 to 9 months and a short rainy season of 2 to 3 months (Faye et al., 2016). The evaporation rate is high, and precipitations are particularly irregular and low (Belmin, 2018; Faye et al. 2016). It is currently used for domestic purposes, fishing activities, livestock watering and mostly irrigated agriculture (Tall et al., 2021).

Lake Guiers has been historically influenced by the Senegal river's water availability and flooding episodes. Like for the rest of the delta, the production systems were traditionally based on agriculture, livestock and fishing practiced concurrently among families. Before

the development of irrigated perimeters in the area, it was mostly influenced by seasonal movements of semi-nomadic populations, among which the Moors, the Fulani and Wolofs ethnicities (Seck & Valarié, 2005).

Since the 1960s and especially after the dams' construction, the improved lake fillings and the sustainability of water resources have been the starting point for many development projects and programs in North Senegal. The development of irrigation led to subsequent agricultural changes and increasingly modern hydraulic infrastructures, with the size of irrigated areas varying from large to small village-based fields (Figure 3) (Niang, 2011; Seck and Valarié, 2005). Those improvements are the results of decades of efforts driven by harsh climatic conditions to achieve agro-industrial development and food self-sufficiency (Niang, 2011). The lake is considered by the government as a vital resource (Faye et al., 2016).

Apart from being an agrarian hotspot, the Lake Guiers is one of the most strategic area in Senegal as it is the largest surface freshwater reservoir in the country, covering up to 60% of the capital city Dakar's needs (Belmin, 2018; Faye et al., 2016; Niang, 2011). The water is treated in specific stations in Ngnith and Keur Momar Sarr and transported through a 240km pipeline (Niang, 2011).

Therefore, the lengthy development process for obtaining such a configuration of Lake Guiers was motivated by both ensuring a freshwater pool for providing drinking water to the population and a dynamic agricultural production (Niang, 2011).

Nowadays, there are many actors involved in the management of the Lake Guiers' resources with diverse objectives and functions (Seck & Valarié, 2005; Tall et al., 2022) 2005):

- The territorial administration, with three sub-prefects around the lake being the representatives of the State.
- The local authorities such as the municipalities and rural communities who manage the local development.
- The technical services, the decentralized or deconcentrated actors (agriculture, fishing, environment, livestock services) in charge of the technical support of the populations and production groups. SAED is one of them, together with the Water Resources Management and Planning Department (DGPRES) services. One other important actor is the Senegalese Water streams Office (OLAC) initially founded to oversee the lake's water planning and management but later extended to all water streams and bodies in Senegal (OLAC, 2023). Among them, there is as well the Organization for the Development of the Senegal River (OMVS) national cell, which represents the interest of Senegal in the management of the Senegal river.
- The industrial actors such as the agrobusinesses or the private entity Sen'Eau (commissioned by the State for Senegal's drinking water provision)
- The local populations who practice small-scale farming.

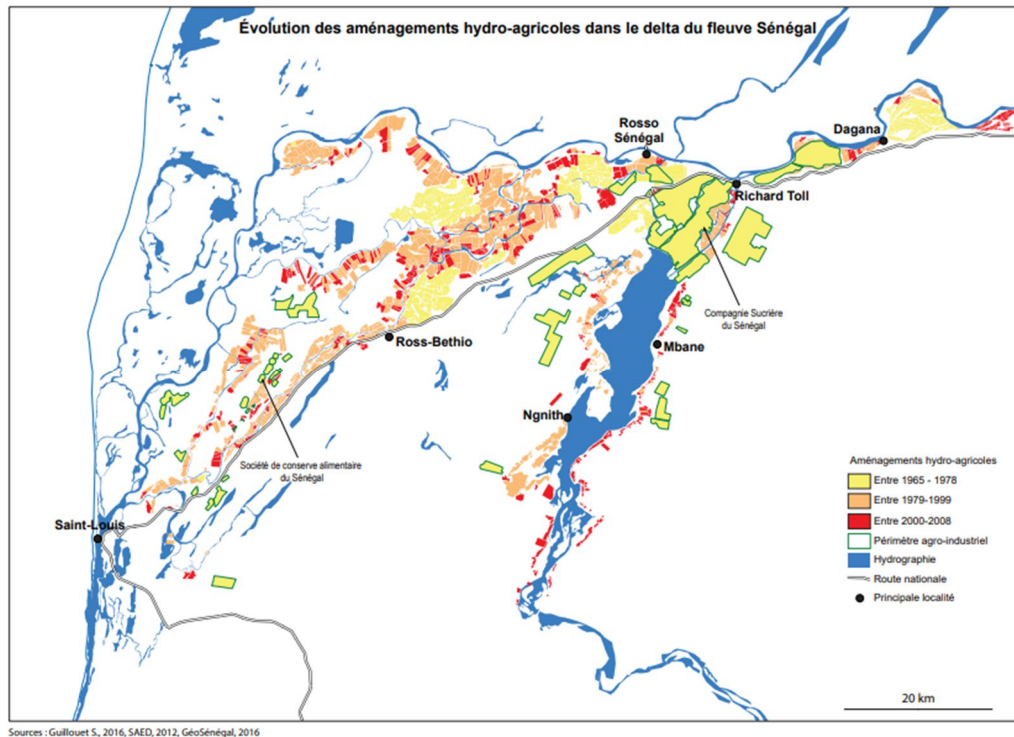


Figure 3: The hydro-agricultural infrastructures development in the Delta from 1965 until 2008 (from Bourgoin et al., 2022); in yellow: development rate between 1965 and 1978; in orange: between 1979 and 1999; in red: between 2000 and 2008. Green boxes: agro-industrial perimeters; in blue: hydrography; black lines: roads; black dots: major towns

2.2.2 A territory facing many environmental and health challenges

The large hydro-agricultural dam program resulted in significant hydrological, chemical, and ecological disruptions, but the ongoing development rate in the area participates in creating many more environmental and health issues (Niang, 2011).

Lake Guiers is a drainage effluents receptacle for agrobusinesses' activities (Diop et al., 2022; Niang, 2011). Recent studies have shown increasing nitrogen and phosphorus levels threatening the lake with eutrophication phenomena. Cyanobacteria proliferation has also been reported, impacting biodiversity and water production costs (Tall et al., 2021). The spread of aquatic plants (particularly typha) and the many changes in water management are detrimental conditions to the traditional and current agricultural practices (Seck & Valarié, 2005). The intensive use of chemical fertilizers and pesticides coupled with poor agricultural practices and input management cause water, soil and air pollution and expose the population to many health risks. Moreover, the daily use of the lake for domestic purposes of the lake's surroundings inhabitants (laundry, cleaning...) are impacting the water quality (Diop et al., 2022). The prevalence of water-related diseases such as diarrhea, dysentery or bilharziasis has risen dramatically, and respiratory and skin issues also increased consistently among the population (Diop et al., 2022). Fishermen are particularly affected, with the bilharziasis and waterborne diseases rate rising among them (Seck and Valarié, 2005).

Moreover, the rapid spatial and uses changes around the lake have nurtured competitions for accessing and using the resources. Overall, agriculture is favored over livestock when land is attributed, leading to conflicts between agriculture and animal husbandry (Seck and

Valarié, 2005). The coordination and the resolution of ongoing mismatches and health issues around the Lake Guiers' resources are crucial as the water volumes demand increases and problematic practices are spreading (Diop et al.; 2023; Niang, 2011).

3 ...on which the Health and Territories project focuses

3.1 Context and scope of the project

In the light of the Senegal's endeavor to reach food security, the country has started to discuss a "One Health" strategy, especially to deal with zoonotic issues (Ebola, Covid...) (FAO, 2015). Imagined by Rudolf Virchow in the 19th century (Bénie Bi Vroh & Seck, 2016). "One Health" is a global concept promoting dealing with the diverse health issues in an integrated way. All health-related problems (human, animal, environmental...) are thus considered from a systemic viewpoint (GHSA, 2023; Speak Up Africa, 2022). Senegal faces difficulties in developing efficient health strategies and infrastructures (Kabkia et al., 2018). Hence, intranational cooperation is a crucial parameter to implement research-action and create adequate and inclusive intersectoral health strategies nationwide (Olive et al, 2022).

In 2021, the French Center for International Cooperation in Agricultural Research for Development (CIRAD) has initiated a project funded by the French Development Agency (AFD) and the European Union (DeSIRA program) to address the question of health in four different countries of the Global South (Senegal, Cambodia, Benin, and Laos) (CIRAD 2022; CIRAD, 2023a).

The 5-year "*Santés et Territoires*" project ("Health and Territories" project) fosters an integrated and participatory approach to health at the territory scale, through the promotion

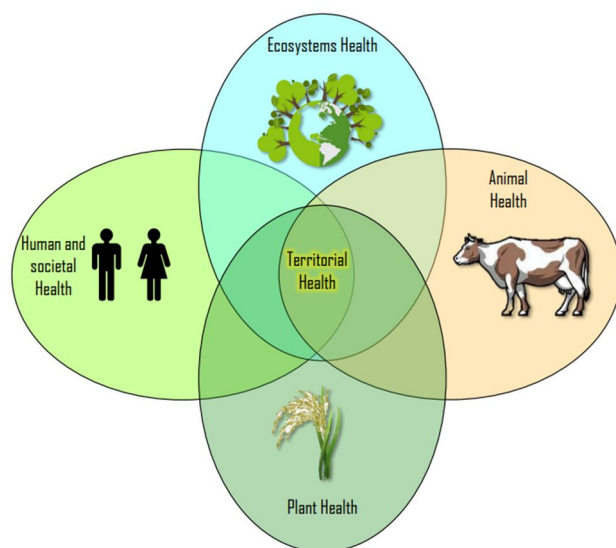


Figure 4: The territorial health according to the "*Santés et Territoires*" project

of the agroecological transition (CIRAD, 2023b). The project's driving notion of "territorial health" follows the "One Health" concept and considers the environmental, plant animal and human/social health. However, it invites a reflection that goes beyond as it also integrates the health quality of agricultural products (CIRAD, 2022).

The project encourages the co-identification of health issues by multiple stakeholders. On the other hand, it is aiming to foster capacity building and the co-creation of health indicators to find tailored solutions to the territory's specificities (CIRAD, 2023) (*Santés et Territoires*, 2023).

« *Santés et Territoires* » is revolving around four main objectives (CIRAD, 2023a; *Santés et Territoires*, 2023):

- Measuring the impact of farming practices on healths,
- Developing supporting tools and methods for assisting farmers during the agroecological transition,

- Nurturing and implementing a platform for knowledge sharing,
- Nurturing a pool of practices at the project level but also in dedicated *living labs*.

In Senegal, CIRAD collaborates with local partners like The Senegalese Agricultural Research Institute (ISRA), the University Gaston Berger (UGB) and SAED.

Given the global socioeconomic situation around Lake Guiers, the “*Santés et Territoires*” project has designated the region as one the fourth intervention area.

3.2 Supporting a transversal and participatory reflection around health by implementing two living labs

Born in the 2000s, a **living lab** is a participatory method to revitalize and develop territories that invites all types of citizens and researchers from diverse disciplines to engage with holistic problem-solving innovations. On the one hand, it can be mobilized to encourage social improvements, for example by questioning the resilience of people’s organizational structures and the social transformations to operate. A living lab can also be a place for technical and technological innovation where new practices or tools are invented (Klein & Bernard, 2017; Scaillerez, 2021).

After several preparatory steps and an extensive phase of health issues co-identification in the lake zone, the researchers have implemented two living labs following an identical format in different locations around the lake:

- In Mbane, in the north-eastern part of the lake (nearby Richard Toll),
- In Keur Momar Sarr (KMS) more downstream, in the south-western part of the lake (closer to Louga).

The identified health issues are common to both locations. However, some of them can prevail depending on the area (*Santés et Territoires*, 2023).

Based on the previous definition, the main goal of the “*Santés et Territoires*” living labs implementation is to create a **social platform** so that people across sectors can meet, open the dialogue, and define what health is to them (CIRAD 2022; *Santés et Territoires*, 2023). The living lab should also be a **technical platform** dedicated to the experimentation of new practices and the sharing of the impacts on the different health issues among the participants (CIRAD, 2023a).

In March 2023, the living labs were officially inaugurated in both places (CIRAD, 2023a)

4 The thesis’ associated research question

The many legal evolutions around land and the state’s elusive positioning towards territorial disengagement, traditional customary laws or agro-industrial development are raising questions. Lake Guiers bears a great agrarian potential, and it has become a nest for competition as the government started incentivizing cross-scale hydro-agricultural development in the region. The current context generates socio-environmental issues that the “*Santés et Territoires*” project aims to tackle.

However, the project currently lacks knowledge on the social and spatial power structures and running organizational rules to inform the correct implementation of the living labs around the lake.

We need to make sure that we understand the networking situation around the lake by considering the relationships to the resources and among diverse categories of people so

that the living labs can play fully their role in socially and technically addressing health issues.

Therefore, this master's thesis proposes to answer the following research question:

How can an analysis of the socio-spatial dynamics and organization rules in the lake's region be used to consider the mobilization of a living lab, and in what form?

PART 2: Material and Methods

We have developed a general framework to answer the research question. It is composed of three main steps:

- An exploratory and preparatory phase, based on exploratory interviews with researchers and literature research on the area, the topic, the legislation and regulations, the resources, the main actors, and institutions,
- An inquiry phase based on the sampling and interviewing process,
- A data analysis phase, during which all the retrieved data from the previous phases has been processed and amplified to prepare the results part.

The exploratory and preparatory phase, as well as most of the data analysis phase have been conducted in Montpellier, France, whereas the inquiry phase has been fully performed in Senegal, during a three-month fieldwork mission (from February 27th until May 26th, 2023).

Elected methodology - general framework

Research question guiding the work

How can an analysis of the socio-spatial dynamics and organizational rules in Lake Guiers' region be used to consider to mobilize a living lab, and in what form?

Phase 1: Preparatory phase

In Montpellier (FR)

- Identifying the main challenges, the socio-geographical context, the key actors' categories, the ongoing projects and policies in the area
- Getting familiar with the project, the context, the qualitative methods, the living lab concept

Material: preparatory interviews with researchers, literature research using internal and external sources

Phase 2: Inquiry phase

In Senegal

1. Sampling and categorization

- Sampling method determination to tackle the diversity of actors in the area
- Key actors' identification and categorization

Material: short-term missions with the research team in Saint Louis, in-person meetings during the launching of the living labs with the local communities

2. Interview process

- Interview guide construction for each actor category
- Interview realization and transcription

Material: 38 semi-guided interviews, pro dictaphone, Word and Excel

- First go-through of the collected data
- In-person restitution to local communities

Material: Excel, Word, TORSO model (Maraud et Delay, 2021), 3-hour workshop

Phase 3: Data analysis phase

In Montpellier (FR)

- First thematic go-through across interviews
- Institutional grammar analysis/scanning of the transcripts

Material: Excel, Institutional analysis and development framework, Institutional grammar tools (IGT) (Crawford and Ostrom, 1995 ; Siddiki et al., 2011, Watkins et al. 2005)

- Social/societal positioning of the interviewed actors
- Social network representations based on the IG analysis
- Visual buildings

Material: TORSO model (Maraud et Delay, 2021), Excel, Gephy software, Canva

Figure 5: The thesis' elected methodology

1 The exploratory and preparatory phase

During the two-month period, the objective was to prepare for the inquiry phase starting in Senegal. First, we researched on Senegal's natural resources management framework and the specific policies to the Senegal river delta. Then, we dug into the diversity of actors and got familiar with the main sectors, activities, and populations operating and living around the lake. Meanwhile, we read more about the project, its main purposes, the past and ongoing activities. Finally, we got better acquainted with the qualitative methods and examples of past qualitative activities led in similar contexts.

We retrieved the information through a literature review using different available resources:

- Recommended literature from researchers,
- Open-access, external resources to CIRAD, such as Google Scholar, institutions' websites to obtain legal documents, sectorial letters...
- Internal sources to CIRAD, such as the on-site library to access physical documentation.
- Internal sources to the project to retrieve "grey literature" (Olivier de Sardan, 2008) like former reports, presentations, activities.

The data was organized in Word and Excel documents and using visual representations to:

- Prepare the actors', resources, and uses of those resources' categorization,
- Reflect on the interview guide construction.

Simultaneously to the literature review process, we have performed exploratory interviews with 11 researchers through in-person meetings in Montpellier or by exchanging emails. A set of questions had been prepared, tailored to the researcher's field of expertise.

2 The inquiry phase

2.1 Actors' categorization and sampling methodology

Actors' categories, also called typologies (Le Meur, 2002) demonstrate supposed common interests and attitude towards a given situation (Le Meur, 2002; Olivier de Sardan, 1995). To determine those typologies, we partly relied on the data collected in the literature and among researchers during the previous phase. However, more active research on the ground enabled us to complete the categories through the launch of the living labs and other excursions. In addition, the actors' categorization helped us to determine categories of interactions and resources around Lake Guiers.

The established categories were built to match as much as possible the diversity of actors operating around the lake. We referred to the principle of *complex triangulation* when creating the typologies (Le Meur, 2002; Olivier de Sardan, 1995); this work sought diverse viewpoints to better question the information and opinions gathered, while ensuring crossed sources of information. In addition, we paid attention to the current structuration of the informational and decisional process in Senegal as to have all hierarchical structures represented (from national to ultra-local interviewees).

We thus ended up with six categories of actors (Table 1 and Appendix 3):

Table 1: The actors' categories used for the analysis.

| Name of the category | Abbreviation used | Description | Number of interviewees per category |
|--------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The «National or supra-national services» | N | National/central bodies or supra-national institutions in Senegal | Total: 6 - 4 ministries - 1 national body (SONES) - 1 supra-national entity (OMVS) |
| The «Decentralized technical services» | DTS | Diverse sectorial services operating at the regional, departmental, or municipal level, and all attached to a central service. | Total: 12 - 5 at the circumscription level (1 in Mbane and 4 in KMS) - 7 at the regional and/or departmental level (accounting for both living lab locations). |
| The «Decentralized administrative services» | DAS | Sub-prefects of the lake's area | Total: 2 (sub-prefects) |
| The «NGOs or international cooperation funds» (NGO) category | NGO | NGOs or cooperation funds operating in the Lake Guiers' region | Total: 5 - 4 NGOs - 1 cooperation fund |
| The «Agrobusinesses» | AB | Well-known foreign agrobusinesses who have established in Senegal | Total: 3 (from around the lake) |
| The «Local communities» | LC | People living around the lake, from diverse ethnicities | Total: 11 - 3 interviewees from KMS - 8 interviewees from Mbane |
| TOTAL | | | 39 interviewees |

Once in Senegal, we agreed on a sampling method to match the set of actors' categories based on:

- 1) A pre-existing list of actors determined during the preparatory phase in France,
- 2) A definitive list established upon extra information gathered during the launch of the living labs, excursions, and discussions in Senegal.
- 3) The principle of *iteration* (Le Meur, 2002 ; Olivier de Sardan, 1995). To make sure we were retrieving reliable information about the social network, we left the inquiry process open to the exploration of the interviewee's relationships. In doing so, when X was telling us he was in relation with Y, we could incorporate Y to the set of interviewees if they appeared an important link in X's network, or if Y was cited multiple times in different interviews.

All interviewees from the «local population» (LC) category and part of the «decentralized technical actors» category (DTS) (the one operating at the municipal level) were chosen during the launch of the living labs for practical reasons. It has been the easiest way for us to meet the people who both live more closely and use the resources of the lake. We selected at least one person in each «health group» and who was particularly active (raising a hand to speak, showing, and explaining to other participants...). By choosing active participants, we wanted to make sure they would show interest in being further questioned during an interview.

Our research process was ultimately focusing on *saturation* (Le Meur, 2002; Olivier de Sardan, 1995), meaning that during the 3-month fieldwork mission, we intended to reach the exhaustivity of information regarding our research question to better conclude on the characteristics and tendencies of the categories we had determined. The triangulation and iteration processes were followed as an attempt to reach saturation.

2.2 The interview process

2.2.1 The guide structuration

We decided to establish a semi-structured interview guide with a common foundation for all categories of actors. To do so, we split the guide in three parts:

- A first part to introduce the interviewee, their relation to the lake and their influence on the area and its population (projects, production groups...)
- A second one to explore their relationships with/within institutions (ministries, technical services, NGOs...), (i.e with actors who are not considered as "local populations" leaving around the lake),
- A third one to explore their relationships to local populations or people directly using the resources of the lake.

The goals to be reached through the guide's construction were the following (Pachoud et al., 2020):

1. Explore the type of relationships among actors and especially the power relations at play, such as solidarity, trust, conflicting and dependency patterns,
2. Explore dependency patterns to certain interactions in relation to the resources,
3. Question the frequency of the interactions among actors to understand the importance of an actor in the network,
4. Highlight common links or relational patterns among actors,
5. Spot non-existing or unexplored relationships as well as marginal actors who could be of interest.

For each category, the guide was adapted with specific questions related to the category or the specificity of an actor within the category (Appendix 4, Appendix 5, Appendix 6, Appendix 7).

2.2.2 *The interviews' realization and transcription*

We performed a total of 39 interviews among all actors' categories.

The Senegalese Water streams Office (OLAC) has been put in the category «decentralized technical services» even though they do act at the national level because of their unique status. OLAC was initially the Office for the management of the Lake Guiers (OLAG) but was later missioned to manage all water bodies in Senegal. However, because of its location (its headquarters are in Saint Louis) and the focus of this work, we considered it more appropriate to place it in this category.

Regarding the «local population» category, the interview phase was organized throughout one week only due to time and organizational constraints. The difference in the number of interviewees in each location is due to the cumulation of four other interviews from the «decentralized technical services» category during the same week. We were left with less time than initially planned to meet more people in Keur Momar Sarr.

Moreover, only the interviewees from the LC and DTS category were interviewed according to each living lab zone since they had participated in the launch of the living labs. All other actors were interviewed following a systemic approach of the lake, since we ultimately did not focus our results on each living lab area. Participating in the launch of the living labs and other excursions helped us find interviewees associated with the project.

All interviews lasted between 45 minutes to 1 hour and 20 minutes. A French-speaking translator was hired for the interviews in Wolof or Peule.

We used a Dictaphone to record the interviews after getting the oral consent of the interviewees. They were all recorded but two, as the interviewees opposed the procedure. During the interview, notes and impressions were taken on paper to start visualizing the network of each interviewee. Later in the process, all interviews were transcribed on a Word document, and then analyzed using two different analysis frameworks. For the two interviews that were not recorded, the interview was transcribed as precisely as possible immediately after.

When some information went missing after the interview, we either called the interviewees or emailed them to ask additional questions.

2.2.3 *Restitution to the interviewees*

2.2.3.1 *Setting*

Around the end of the interview process (May 11-12th 2023), we decided to organize a restitution to the interviewees from the LC and the DTS categories. Two events were organized: one in Mbane, and one in KMS, with the interviewees of each location gathered accordingly (Appendix 8).

These interviewees have been chosen for three main reasons:

- They all had been interviewed at this point, and the data from their interview had been partly analyzed already,
- They all had been present at the launch of the living labs and were to take part to the following living labs events, therefore it was particularly interesting to interrogate them again.

- Interviewees from other categories had not all been interviewed at this point of the process.

Each restitution lasted 2:30 to 3 hours and were organized in French. A professional translator was hired to make sure all the information was translated and accessible.

2.2.3.2 Objectives

There were several objectives to these restitutions. On the one hand, it was a way to confront our understanding of the collected data during the interviews and obtain validation or correction about it. On the other hand, it was a way to deepen our understanding of some relationships (such as the role of a production group president or the village headman) or relational patterns (dependency to some subsidies...) (Appendix 9).

The restitution time was also meant to train our facilitation skills among a diverse public in a whole new setting. We worked on various parameters such as group animation, speech distribution and inclusiveness.

Moreover, organizing such an event was a way to align with the overall objectives of the project by promoting a participatory approach (Gliessman et al., 2015). We believe the implication of the interviewees in the whole research process is important to be as close as possible to their reality. Ideally, the restitutions would have been replicated with all interviewees involved at the end of the fieldwork time, but scheduling constraints made it impossible.

The information gathered during the restitution has been integrated into the analysis and discussion.

3 The data analysis phase

3.1 Analysis framework n°1: the Institutional Grammar

3.1.1 Definition and scope of the framework

After the interview phase was over, we wanted to extract and unravel the many socio-spatial relationships that had been mentioned and explained through the interviews and the restitutions.

Given the consequent number of interviews, we needed a framework that could explicitly highlight relationships among interviewees and within their network, but also the interactions between actors and the lake's resources. As we were confronted to a qualitative dataset collected in an informal setting, we needed to use models that could let emerge both formal and informal relationships and thus visible, invisible, or even «hidden» organizational rules and power dynamics (Gaventa, 2006).

The *Institutional Grammar* (IG) methodology has been one of the elected method to do so (Crawford & Ostrom, 1995). Initially used for analyzing law texts and policy content, several authors later intended to apply institutional grammar to qualitative research (Basurto et al., 2010; Siddiki et al., 2011; Watkins & Westphal, 2016). The IG is part of Crawford and Ostrom's work on understanding institutions: the Institutional Analysis and Development Framework (IAD framework) (Crawford and Ostrom, 1995). According to the authors, «institutions» are specific *social arenas* – called «action situations» where people perform actions and organize their *interactions* – from which emerges regulations of the human interactions (Crawford and Ostrom, 1995; Siddiki et al., 2011).

Therefore, the IG can be used as a tool (The Institutional Grammar Tool, also referred to as IGT) to identify what compose and shape the institutions through understanding those regulations, or «prescriptions» (Siddiki et al., 2011). Apart from the material environment, it distinguishes three different types of prescriptions: *norms*, *rules* and *strategies*, all regulated by human beings for the human interactions' operationality and regularity (Basurto et al., 2010; Crawford & Ostrom, 1995; Siddiki et al., 2011). Practically speaking, the IGT focuses on revealing linguistic expressions of the institutions. Using this method, it is about building «institutional statements» out of a dataset; these are described as “the shared linguistic constraint or opportunity that prescribes, permits, or advises actions or outcomes for actors (both individual and corporate). Institutional statements are spoken, written, or tacitly understood in a form intelligible to actors in an empirical setting” (Crawford and Ostrom, 1995).

3.1.2 The creation of institutional statements to analyze the interviews

3.1.2.1 The creation process

We wanted to build *institutional statements* out of verbatims or paragraphs extracted from the interviews that would unravel relationships among actors in priority. In doing so, we were also looking for what social relationships would tell us on the way human beings interact with the resources of the lake. In addition, as our dataset referred to many informal prescriptions, it appeared essential to be able to highlight «emotional», or culture-based interactions (Watkins & Westphal, 2016). Following Siddiki et al. (2011) and Watkins and Westphal (2016) studies, we have built the institutional statements according to six components which break the statement into pieces: the Attribute (A) – Deontic (D) – Aim (I) – Conditions (C) – OBject (B) and Or else (O) (ADIBCO) format (Table 2, Table 3).

We have limited the number of institutional statements to 15 per actor. In addition, we made sure there were reflecting as much as possible the general relational patterns around Lake Guiers.

Table 2: The IGT analysis framework used to build the institutional statements. Adapted from Siddiki et al. (2011) and Watkins and Westphal (2016)

| Component of the institutional grammar | Description of the component | Example of institutional statement |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Attribute (A) | The «Who?» The «animated agent» (Siddiki et al., 2011) who performs the Aim (A) in the statement | The agroindustry (A) must build infrastructures for the local communities as part of their CSR policy, for free |
| Deontic (D) | Operators referring to what is permitted (“may”), obliged (“must”), forbidden (“must not”) or wished (“should”/“should not”) within the statement. It can be implicit or explicit (the verb “required” for example indicates there is a “must”). | The agroindustry must (D) build infrastructures for the local communities as part of their CSR policy, for free. The agroindustry should (D) build infrastructures for the local communities as part of their CSR policy, for free. |

| | | |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Aim (I)</p> | <p>The «What?»</p> <p>It refers to the action that is performed, or the goal that is achieved through the statement. It includes all verbs that are non-deontic in the statements and the unanimated object in the sentence, when the Object is animated (i.e a human being or corporation).</p> | <p>The agroindustry must build infrastructures (I) for the local communities as part of their CSR policy, for free</p> |
| <p>Object (B)</p> | <p>The «To/for whom?»</p> <p>It is either the unanimated or animated receiver of the Aim (I) from the Attribute (A). In our research process, human beings were prioritized as Objects (B).</p> | <p>The agroindustry must build health infrastructures (non-human B) as part of their CSR policy, for free</p> <p>The agroindustry must build infrastructures for the local communities (human B) as part of their CSR policy, for free</p> |
| <p>Conditions (C)</p> | <p>The «How?», «When?», «Where?»</p> <p>It refers to what influences the Aim (I). Usually spatial or temporal parameters. When no precision is given.</p> | <p>The agroindustry must build infrastructures for the local communities as part of their CSR policy, for free (C)</p> |
| <p>Or Else (O)</p> | <p>It corresponds to the sanction applied if the prescription is not respected. It can be either an <i>automatic sanction</i> (the action is not performed or not as efficiently), a <i>tangible sanction</i> (fine, rewards...) or an <i>emotional one</i> (involving values or emotions such as social engagement, respect of the traditions, pride, shame, fear of social exclusion...) (Watkins et Westphal, 2016)</p> | <p>The agroindustry must build infrastructures for the local communities as part of their CSR policy, for free, or they will be marginalized among the local population (emotional O)</p> |

Table 3: The table used to analyze the interviews and build the institutional statements

| Category of actor (N, DTS...) | Actor | Verbatim or paragraph | Attribute (A) | Deontic (D) | Object (B) | Conditions (C) | Or Else (O) | Type of statement |
|-------------------------------|-------|-----------------------------|------------------------|-----------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------|-------------------|
| | | Line 3 «.....» or paragraph | Carrier of the Aim (I) | May/ must/ must not/ should/ should not | Receiver of the Aim (I), preferably another animated agent (i.e human beings) | How, Where, When the Aim (I) is performed | The emotional or tangible sanction applied when the Aim (I) is not performed | Strategy/ norm |

While creating the institutional statements, we could see whether they could be categorized as “*norms*”, “*rules*” or “*strategies*” by elaborating on Siddiki et al. (2011) and Watkins and Westphal (2016)’s work (Appendix 10):

- An institutional statement turning to be a strategy does not involve any Deontic (D) and only implies *automatic sanctions*, meaning that if the Attribute (A) does not perform the Aim (I), the consequence is that there is no action performed at all or the efficiency of the action is lessened. For example, in the following statement: «The agroindustry (A) pays a usage fee to irrigate their crops (I) to SOGED (B) monthly (C)» (*or they cannot grow anything*) (O)», if the agroindustry does not pay the fee, the outcome of it is that they cannot water their crops. The automatic sanction does not have to be explicitly written.
- A statement could be classified as a norm either when (1) there was a visible Deontic (D) in the verbatim («must», «is required», «have to», «cannot do [...] without»...) or (2) when there was an emotional sanction associated with it. As a matter of fact, a norm can display both an automatic and emotional sanction. Using the same example: «The agroindustry (A) must (D) pay a usage fee to irrigate their crops (I) to SOGED (B) monthly (C) or they take advantage of the resources (O)», we can see the sanction can be (1) automatic, since they need the water from the lake to water their plants and (2) emotional, since they need to respect the resources and abide by what people see as an equitable way to use the water. The emotional sanction is usually implicit in the interview, but it can be written down to understand why the statement has been classified as a norm.
- A rule involves a Deontic (D) as well as a sanction that is either automatic, emotional, or tangible, or all three at the times.

We ended up not classifying any statement as “*rules*” for several reasons. On the one hand, it was not possible to check the existence of a tangible sanction after an interviewee would refer to it. It would have implied that we had checked a consistent number of policy texts and because of time constraints, we could not afford to do so. On the other hand, it seemed more interesting to focus on strategies and norms since automatic and emotional sanctions were more resourceful to understand the informal relationships among actors.

3.1.2.2 *Specific case: the desired statements*

As we were questioning interviewees about their relationships, many of them were not only referring to relationships «in use» (Watkins and Westphal, 2016), but also to wished relationships or desired situations. To compile those «desired statements» (Watkins and Westphal, 2016), we decided to add two more Deontics (D) which would best reflect the wished situation: «should» and «should not». The desired statements have then been isolated from other institutional statements and were used in the analysis.

3.1.3 *The analysis of the institutional statements: identification of similar relational patterns and creation of visual networks*

Once the institutional statements were created for the entire set of interviewees, we harmonized the dataset of institutional statements on Excel to 1) identify similar relational patterns and 2) build visual networks. The objective was to highlight the role of specific actors or patterns that could be of interest to discuss in the Results' part.

The visuals were constructed with R and Gephy, an open-source software for network representations.

3.2 Analysis framework n°2: the TerritOry-Resources Societal Organization model

Apart from the institutional grammar, we have mobilized another model to question the relationships, the organizational rules and tendencies among interviewees. The TerritOry-Resources Societal Organization (TORSO) framework has been developed by Maraud et Delay (2022) to identify the social dynamics of human groups and their positioning towards the management of natural resources. Therefore, one main purpose of the TORSO model is to understand how the interactions between human beings and the natural resources are influenced by the domination processes within society. Another major point of the TORSO framework is to examine the role and capitalistic power of the state within the domination processes. Overall, the TORSO model can help us question the power structures and hierarchies at stake and their influence on the access, the use and the safeguard of the natural resources.

The TORSO framework can be used in different spatial and temporal settings and especially:

- To interrogate the context of domination of certain groups or social behaviors towards the resources over time,
- To set up a baseline for understanding the current relational patterns in relation to the management of natural resources (Maraud & Delay, 2022).

Our research process focused on the second option; we have created a baseline of the societal organization using the set of interviews.

The TORSO model recognizes two main forms of societal organization – or «ways of collective living» which are set as the axis of the graph (Figure 6) (Maraud et Delay, 2022):

- The Y axis represents the intensity to which the stakeholder or the group tends to organize following a «*social form*» of collective living. The social form relies on classes, hierarchies based on vertical power ladders, and inequality among human beings. This type of collective living follows a capitalistic logic and is the most common nowadays.

- The X axis represents the intensity to which the stakeholder or the group tends to organize following an «*anarchic-gregarious*» form of collective living. The «*anarchic-gregarious*» form promotes equal and horizontal power relations among the group, no hierarchy, no unique leaders. It is a marginalized type of societal organization but still worth to be looking at when inquiring on the relation to the resources of an area.

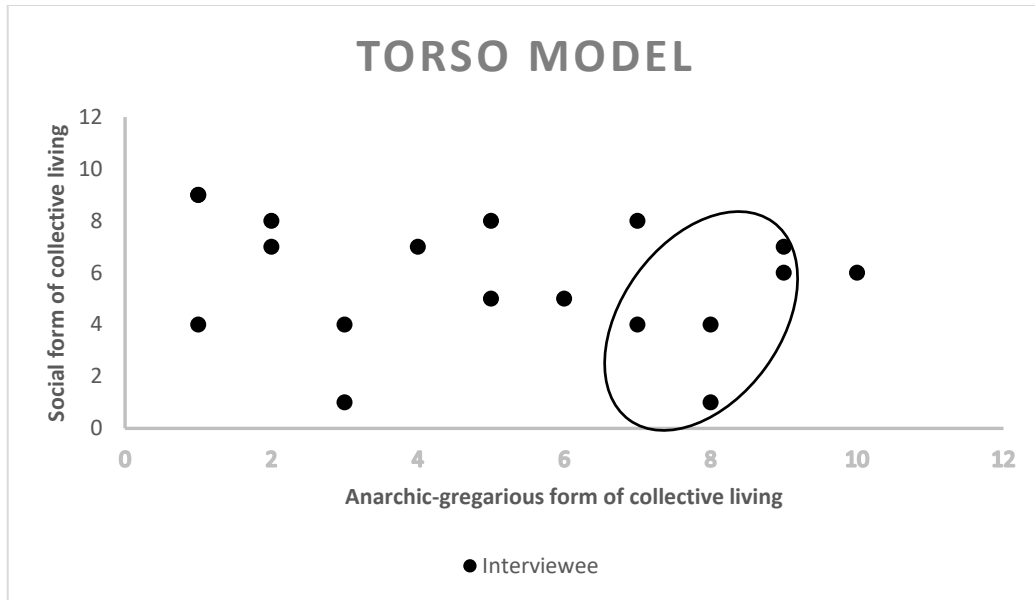


Figure 6: TORSO model used to build the baseline; each point corresponds to an interviewee and the circle corresponds to group of interviewees showing similarities in their attitudes. Adapted from Maraud and Delay (2022).

To identify the position of each interviewee on the graph, we gave a mark to each of them using the 12 criteria associated to the TORSO model (Appendix 11, Table 4). The global mark of an actor depends on the mark attributed to each criterion, ranking from -1 to 1. The more negative the criterion’s mark, the more it reflects an attitude associated with the social form of organization. Conversely, the more positive the criterion’s mark, the closer it is to an anarchic-gregarious’ attitude. The total for each criterion gives a global mark ranging from -12 to 12 and locate the actor on the graph.

Table 4: Table used for the TORSO notation.

| Interviewee | Criterion 1 | Criterion 2 | Criterion 3 | Criterion 4 | ... | Global mark |
|---------------|-------------|-------------|-------------|-------------|-----|-------------|
| Interviewee X | -0.5 | 1 | -0.25 | 0.25 | ... | 5.5 |

The methods detailed in this part have led us to obtain the following Results.

PART 3: Results

1 Section 1: A diverse range of actors, resources, and interactions in relation to Lake Guiers

This section aims at 1) setting the context of the interactions among the categories of actors and with the resources, 2) identify the main relational patterns within and among actors' categories, and 3) further interrogate the positioning of the actors among them and towards the resources as well as questioning the power structures at stake.

Sub-section 1.1 is mostly descriptive, whereas 1.2 and 1.3 are more analytical.

1.1 Resources and interactions categorization through the lens of the actors' categories

One of the first goals while interviewing on the networking situation around the lake was to get to know how people were organizing according to the resources. Knowing so would give us a better insight into the organizational rules and current issues in relation to the resources.

We challenged our understanding of the resources and interactions by asking for validation during the restitution. We ended up with categories of resources and interactions visible in Table 5.

Table 5: Resources and interactions' categories with LC = local communities, AB = agribusinesses, DAS = decentralized administrative agents, DTS = decentralized technical agents, NGO = NGOs and cooperation funds and N = central directions and supra-national institutions

| Resources of Lake Guiers' area | Interactions between the resources and the actors regarding food production | Type of interaction with the resources | Actors' categories involved |
|-----------------------------------------|-----------------------------------------------------------------------------|----------------------------------------|-----------------------------|
| Water from the lake | Production (agriculture, cattle breeding, fishin, forestry products) | Direct | LC, AB |
| Halieutic resources (fish, aquaculture) | Product transformation (fish, crops) | | |
| Land | Regulation, repression | Indirect | N, DAS, DTS |
| Animal resources | Sensibilization/Formation | | DTS, NGO |
| Forestry resources | Advising/Mediation | | LC, AB, DAS, DTS, NGO |
| Hydraulic infrastructures | Preservation/Maintenance | | LC, DTS, AB, NGO |
| Social peace | | | |

1.1.1 The Lake Guiers' resources: a potential for food production

Throughout the interviews and the restitutions, we could confirm that most of the interactions with the lake's resources are related to agricultural production:

- “It is an area which contributes to food security, and especially horticultural produce” (« *C'est une zone qui participe à la sécurité alimentaire, à la production de produits maraichers* ») (Interviewee from the NGO category)
- “It is hard to get any activity done without the lake, especially for gardening and cultivation purposes [...]. The lake is our big focus » (« *Il est très difficile de laisser le lac parce que toutes les activités se retrouvent par rapport à ça: le jardinage, pour les champs [...]. A chaque fois, on se concentre sur le lac* ») (Interviewee from the LC category)

The water, the land, the animals, the halieutic resources, the hydraulic infrastructures, the forestry resources are mainly seen for their potential to grow agricultural goods, get animal products (meat essentially), fish or practice aquaculture by the different actors' categories. The «social peace» is not a natural but a human-made resource like hydraulic infrastructures. However, it is also linked to food production as it has been identified as one of the most precious resources to preserve when conflicts arise between crop farmers and cattle breeders.

Meanwhile, we understood that there are direct and indirect interactions with the resources.

1.1.2 Direct interactions with the resources: production and transformation of agricultural goods

On the one hand, we referred to *direct interactions* as the interactions between the actors and the resources that impact the quantity, quality or functioning of the resources.

We identified the LC and AB categories as the ones directly interacting with the resources for agricultural production and transformation purposes. The AB category focuses on crop production and transformation (either sugar cane or vegetables like potatoes), whereas the LC category grows crops like rice and vegetables, raises cattle (mostly sheep, goats and cows) for the meat and fishes in the lake. Women oversee the crop and fish transformation process and sell the products on the market or to neighbors.

- “The communities are the food producers, be it crop farmers, cattle breeders or fishermen” (« *Les communautés, c'est les producteurs, que ce soit éleveur, agriculteur ou pêcheurs* ») (Interviewee from the NGO category)

1.1.3 Indirect interactions with the resources: the actions affecting the direct interactions

On the other hand, we identified the *indirect interactions* as those impacting the *direct interactions*' efficacy and effectiveness.

We could see that the N, DTS, DAS, NGO categories do not have any direct interaction with the resources for agricultural purposes, but rather influence those that the LC and AB categories can have with the resources to produce food.

Regulation/Repression

This type of interaction refers to the punitive or controlling behaviors certain actors can display to manage the production and transformation processes. Through the interviews, we could see that the actors' categories having those type of interactions are the N, DAS, DTS categories:

” We receive action plans to satisfy the state’s demand, because the State manages the needs of the population” (*« On reçoit des plans d’action à faire pour satisfaire telle demande car c’est l’Etat et que l’Etat gère les besoins des populations »*) (Interviewee from the N category).

Sensibilization/Formation

Certain actors provide the producers with professional formations on crop or animal diseases, soil and water pollution, chemicals uses or bush fires. The NGO and DTS categories were identified as presenting such interactions:

“We train a pool of local people so that they can teach others” (*“On forme un pool de formateurs local et c’est eux qui sont censés dispenser des cours”*) (Interviewee from the DTS category, vet services)

Advising/Mediation

We understood that the LC, AB, DAS, DTS, NGO categories are advising producers and cattle breeders to both get better yields but also to better protect the resources of the lake. They are also handling conflicts among farmers, mainly based on empirical knowledge or traditional customs.

Preservation/Maintenance

The N, DTS, AB, LC, NGO categories are taking care of the technical maintenance of hydraulic infrastructures and canals (manage the water flow, dig the canals, create new ones) so that producers can use them as effectively as possible, and they manage the preservation of the resources (firebreaks, water samplings...).

The N category’s only interaction seems to be about regulating other interactions based on directives and policy content. The other types of indirect interactions somehow entail a geographical and social proximity to the food producers: the actors need to interact with the farmers and the resources.

In addition, the implication of the LC category in advisory, mediation as well as preservation dealings show their multipolar profile in the resource management.

It is interesting to note how most of the categories performing indirect interactions (N, DTS, DAS in particular) have on the paper a bigger say on how to manage the resources while usually operating further from the lake – and its resources - (either in Saint Louis or Dakar for most of them). Conversely, those having direct interactions are supposed to apply and follow the directives while having their agricultural activities close to the lake:

- “Decisions are usually taken following the hierarchy, meaning that they are first treated at the national level, then the regional, departmental and finally local level” (*“C’est souvent des décisions qui sont traitées par niveau hiérarchique donc d’abord au niveau national, puis régional, puis départemental, puis local”*) (Interviewee from the N category)
- “We apply the directives. When the minister share directives, we have to follow them.” (*« Les directives s’exécutent. Quand le ministre donne des directives en matière d’activités, il faut les exécuter. »*) (Interviewee from the DTS category)

- “No matter the activities, be it related to agriculture or fishing, they are carefully monitored” (“*Quelques soient les activités, agricoles ou pêche, elles sont très surveillées*”) (Interviewee from the DTS category)

Overall, it seems the general trend is that the LC and AB categories take care of producing food while the N, DTS, DAS and NGO categories influence their production activities. For example, the forestry agent supervises the way the communities deal with the trees and the fruit, the agricultural agent advice on how to best use chemicals on the crops, the fishery services regulate which nets to use and how, the NGOs or international cooperation funds provide them with knowledge or tools to strengthen their practices. Meanwhile, the N category oversees the management of all regional, departmental, and municipal services.

1.1.4 Other interactions at stake around the lake

Those observations are made while focusing on agricultural production as the main activity around the lake. However, it seems the water resource is dealt with differently among actors' categories. Since water and all activities related to it (including fishing) are not supposed to be a «transferred competence» to any decentralized services, the interactions between the resource and the actors are different, especially when it comes to the water availability & drinkability management.

The actors from the N, NGO or DTS categories in charge of managing the water flow (like OMVS, DGPRES or SAED) or withdrawing water from the lake (like SONES) can in this case have direct interactions with the water resources (increase or decrease the water flow or quantity) which in turn influence the interactions of the LC and A categories with the water. The actors from the N, NGO, DTS category do not directly interact with the resources for agricultural purposes (they do not withdraw water for their crops and therefore do not affect the quantity or quality of water in this sense), but they still have *direct interactions* influencing other *direct interactions* among actors' categories (they impact the irrigation calendar of the crop farmers):

- One interviewee from the LC category mentioned the interference of the state's structures in the water availability for crop production: “There's no frequency [regarding how they manage the water flow], that is the main issue. Every time farmers need more flow, they close [the bridge]. Everytime we need them to open it, they close it. It is frequent. We do not get any notice about it » (« *Il n'y a pas de fréquence, c'est ça le problème. A chaque fois que les cultivateurs en ont besoin, ils ferment. A chaque fois qu'on n'en a pas besoin, ils ouvrent. C'est un cas qui est très fréquent. On ne nous informe pas par rapport à ça.* ») (Interviewee from the LC category)

It is also worth pinpointing that several interviewees see the lake as one of the main providers of drinking water to the big cities in addition to providing productive water to the nearby farmers. In addition, interviewees mentioned the LC category is using the lake for recreative but also domestic purposes:

- « They [the communities] wash their horses [in the lake], women do the laundry, children go swimming there » (« *Ils lavent leurs chevaux [...], les femmes vont faire leur linge au niveau du lac, les enfants se baignent* ») (Interviewee from AB category)

Exploring the types of resources and the interactions at stake between the actors and the resources confirms that Lake Guiers is a multipurpose element with many actors involved in the process of managing the resources. There seems to be a vertical organization where the actors on top of the hierarchical ladder (the N category) decide on how to manage, the mid layer (the DTS, DAS, NGO category) diffuse and enforce the directives and the bottom layer (the LC and AB category) apply and deal with the practical consequences of those directives.

1.2 Mapping of the interactions

After getting a clearer idea of the type of resources and the interactions at stake among the actors and those resources, we started to analyze the networks of interactions among and within the actors' categories previously identified.

1.2.1 Innovative visuals using the institutional statements: the actors' categories networks

After analyzing interviews through the lens of the institutional grammar tools, we have thought of an innovative way to mobilize the institutional statements through creating social networks visuals for each category of actors. We used the Attribute (A) and the Object (B) of the statements to create nodes, and the Aim (I) to visualize the interaction. Each network highlights the main relationships and questions the centrality of some actors in the network. The centrality of a node – an actor - can be defined as the number of edges connecting this node to another node. The bigger the node in the network, the more links it has within the network.

We decided to group the networks' analysis for some categories according to the identified complementarities or similarities in the interactions.

1.2.1.1 The LC category

The LC category's network (Figure 7) is the most intertwined of all. The three more central nodes represent the major facets of the local communities.

On the one hand, the "smallholder farmers" (referring to all smallholder farmers who are mostly male) and "female farmers" nodes show links to actors referring to the agricultural production: the "chemicals retailers", the "*Bana Bana*" (informal intermediary crop retailer), the "canals" for irrigation, the "cattle" they water thanks to the lake. The "female farmers" 's position in the left corner of the LC category's network reflects their unique position and organization among the communities. They tend to rely on a larger network than the male farmers and work in bigger production groups. Their "production group president" is chosen to represent them and negotiate loans to the bank on behalf of all the group. Female farmers also have a particular link to the "youth association": they support one another in their activities (cleaning or recreational matters).

On the other hand, the "local communities" node is interacting with actors in relation to the socio-cultural life: For instance, the "village headman" is involved as one of the main mediator and representative of the communities. The "wise committee" and "wise men" refer to the conflict management: the local communities seem to rely on experienced and/or respected villagers to handle social issues.

Furthermore, the three central nodes display loops: they foster interactions among them for many activities.

The agrobusiness “Swami Agri”, “OLAC” and “SAED” are all external to the “bubble” the three main nodes create, reinforcing the impression of self-reliance for production, socio-economic and cultural activities.

The analysis of the LC category’s network reveals that they organize around agricultural production and local socio-cultural figures who represent them and manage conflicts. Their daily operability is ensured by self-reliance and cooperation among them. External interventions do not appear as essential in their organization.

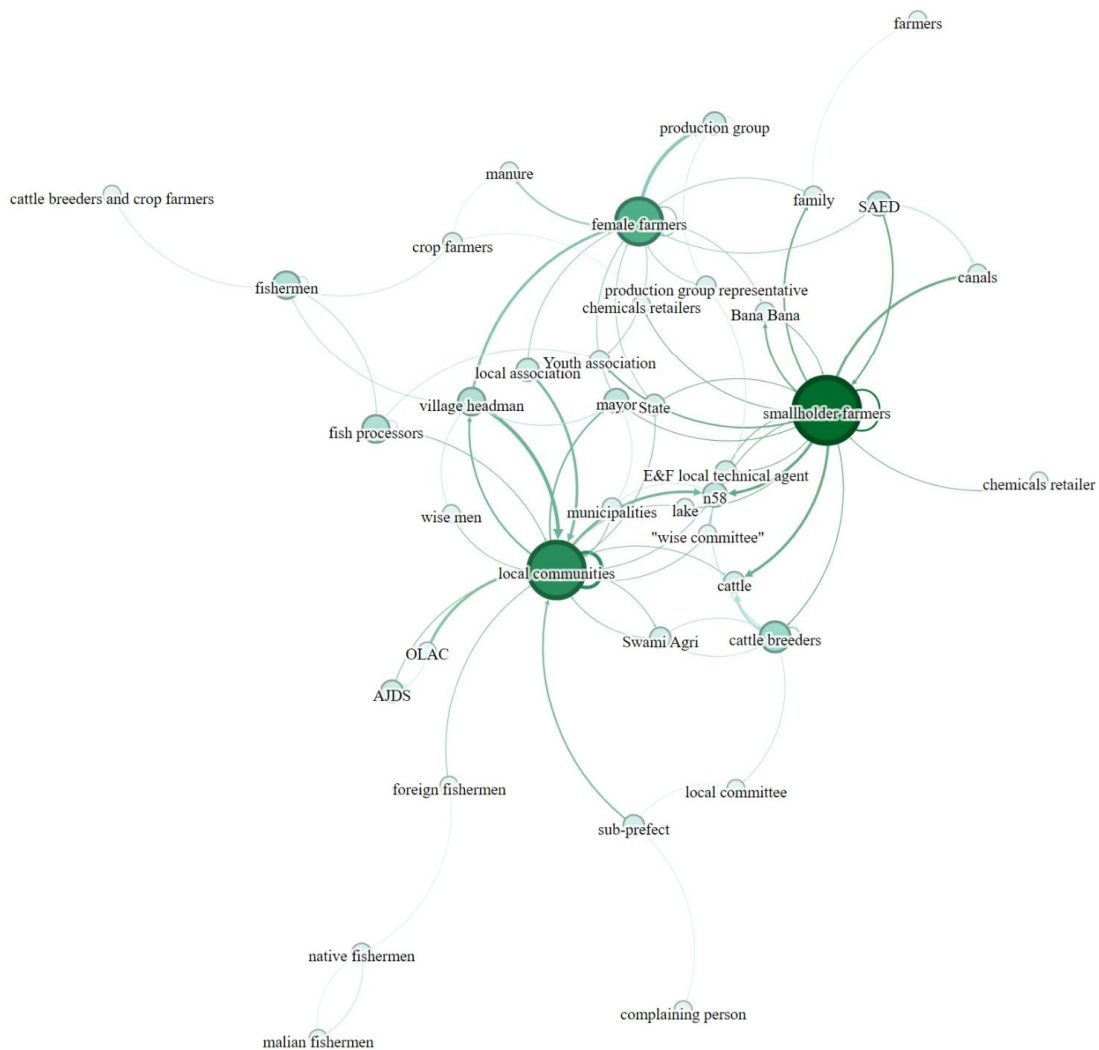


Figure 7: The LC category's social network, created after the IG analysis.

1.2.1.2 The institutional actors

The N category and DTS categories

We have decided to jointly analyze the networks of both the N (Appendix 12) and DTS (Appendix 13) categories as they reveal similar patterns at different hierarchical ladders. In both figures, the «local communities» node has an important centrality.

The actors from the N category (“State”) emphasize their role to practically support the communities through their decentralized services (“technical services”). The DTS agents (“fishery center”, “local technical agent” ...) are supposed to be the LC’s spokespersons and help them better use the resources across productive sectors (fishing, agriculture, livestock...). “SAED” centrality in the DTS category’s network shows how connected the structure tells us to be around Lake Guiers (Appendix 13). The link between either the local (“municipalities”, “local fishery agent”) or departmental/regional services (“OLAC”, “ARD”) and the LC category pinpoints the many levels from which the government can supposedly connect with the population.

The «local technical agent» (which includes the vet, the agricultural, the forestry and the fishery agents) is connected to nodes referring to hierarchy or their superiors because many N and DTS actors mentioned how the decentralized services are supposed to report their actions regularly to the closest higher interlocutor in the hierarchy (usually the departmental or regional service) (Appendix 13). Meanwhile, the central services relay the information from the government and supposedly train the decentralized technical services.

Overall, both networks based on the institutional statements’ analysis (Appendix 12, Appendix 13) show there is a constellation of actors at diverse hierarchical levels whose work is supposedly focused on the LC’s activities development. The networks highlight the contradiction between the willingness to reach out to the LC category through the multiple services (SAED, OLAC, public agents...) and the hierarchical structuration of such services that affect the way they access the LC category.

The DAS category

In Appendix 14, the «sub-prefect» is having the biggest degree. This node seems to be connected to almost all other nodes, and its relation to other is usually based on control.

The connection between the “sub-prefect” and other actors like the “village headman”, the “municipalities” or the “technical agent” is not surprising since the sub-prefect, as “representative of the State”, is closely supervising the activities’ legality in the circumscription. The sub-prefect also administratively represents the “local communities”, which explain the connection between the two nodes. However, the network’s comparison reveals this link is not perceived as important by the LC category who tend to refer to the village headman as their main representative (Figure 7). Interestingly, the sub-prefect does legitimize the village headman’s role by presenting him as the «local administrative representative».

The DAS' network analysis unravels discrepancies in the perception of the role of *representative* between the government (here the sub-prefect) and the local communities. If the sub-prefect does embody the legal power, the village headman represents both the legal and the traditional powers. The village headman seems to be an interface between the legal and traditional power structures.

1.2.1.3 *The "external" actors: the NGO and AB categories*

The "external" denomination refers to the actors' international structure which is rooted either in foreign cooperation and/or investments (all actors of these categories have a foreign head office).

Both networks (Appendix 15 and Appendix 16) display similar relational patterns towards the local communities and the institutional structures, explaining why we have chosen to discuss them together.

On the one hand, the networks help us understand that the AB and NGO categories are subjected to a control of their activities. For instance, agribusinesses need to report their current situation and conflicts with smallholder farmers to the "sub-prefect". The NGO category are asked to share their data with the government and align with the ongoing politics when developing projects.

On the other hand, they can also cooperate to run their activities: the agribusinesses mentioned their reliance on SAED's experience and knowledge of the area and the farmers' needs. Moreover, "OLAC" asks CSS to dig the Taouey canal and maintain other canals. The NGO category tends to collaborate with the municipalities as a priority because they rely on them to implement actions.

Both categories are connected to the «local communities» since they all want to get them involved in their activities. In Appendix 16, the "local communities" are connected to all three of the agribusinesses from the category: the "WAF" (West African Farms), the "CSS" (Senegalese Sugar Cane Company) and "Swami Agri" (a Senegalese Indian agrobusiness). This can be explained since agribusinesses provide them with work and infrastructure for their agricultural activities. Interestingly, there is no specific link to the "smallholder farmers" but to the communities because of the agribusinesses' implication in the LC's socio-cultural life: they also realize cultural, educational, or health-related investments. They also promote good relationships with the "village headman" since he has been identified as the representative of the local communities by the AB category.

The network analysis of the NGO and AB categories highlights the need to connect to both the state's structures and the population on the ground to run through their activities. The AB category will implement specific actions to reach out to the LC category, interfering not only in the productive sphere but also the socio-cultural environment of the population they cohabit with.

The networks' analysis of all categories of actors reveals three main groups of actors: the local communities (the LC category), the "institutional" actors (N, DTS, DAS categories) and the "external" actors (AB and NGO categories). It invites us to do global lecture of the institutional statements' visual representations:

The state's endeavor to connect with the local communities seems difficult due to hierarchically based interactions patterns and the autonomous organization of the LC category. Moreover, the representation of power and who holds it seems to differ, widening the gap between them. External actors seem to evolve in between as they depend on both institutions and local populations for their activities.

In the light of such results, we wanted to better visualize the actors' positioning according to one another and towards the resources, using a complementary tool to the IG. In doing so, we intended to deepen our understanding of the power structures at play among and between the institutional actors, the local population, and the external actors. Our goal was also to unfold the domination processes associated with the resources' management.

1.2.2 The TerritOrial Resources Social Organization model

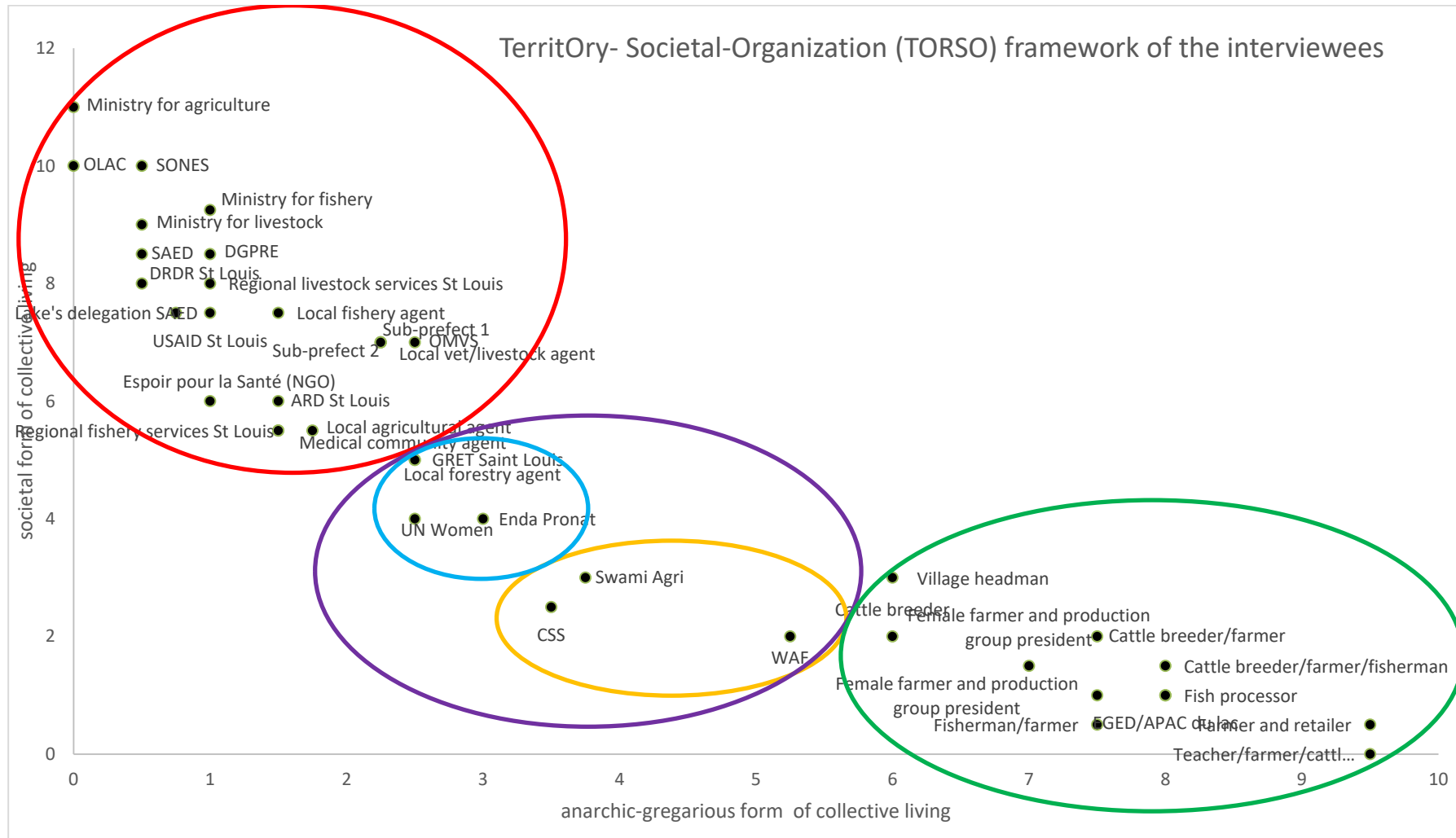


Figure 8: TORSO model with all interviewees. Adapted from Maraud and Delay (2022)

Based on the analysis of the interviews through the 12 criteria of the TORSO, we ended up with a global graph showing the attitude of each actor towards the two different forms of collective living (either the social or anarchic-gregarious form) (Figure 8).

- On the one hand, we observe on the top left of the graph a clear tendency of attitudes associated with the social form of collective living among the actors from the N, DTS and DAS category (**red circle**). The actors closer the bigger tendency to follow a social form of organization seem to be from the N category (ministries or central directions like SONES, DGPRE), closely followed by the DTS like SAED, DRDR, the departmental vet services or ARD. Just below, the DAS category with the two sub-prefects is visible. Their societal positioning shows similarities: they rely on a vertical organization based on hierarchy, a power concentration in the centralized structures (national/central directions) which leaves the decentralized structures (regional, departmental, and local services) with little to no space for decision-making and adaptation to the local environment. The management of Lake Guiers' resources is made from afar since the main decisions are taken at the national level; these actors do not directly depend on the resources and foster a capitalistic use based on profitability and efficiency to align with the national politics. The position of the DTS in this part of the graph has us question their action capacity, and especially the one of the local technical agents. Although they do interact with the local population, the overall lack of "*accessibility*" (meaning the very closed functioning structure of such jobs), availability and their model of authority cause both a disconnection from the local communities' day-to-day reality and a form of status quo regarding the management of the water, the food production, the social, educational or health infrastructures.

The unexpected combination or grading of some criteria pinpointed other interesting elements: the "*authority*" and "*consensus significance*" criteria should match and get similar grades. According to Maraud and Delay (2022), if one is negative, the other should be as well. However, for the DTS and DAS categories, we could observe that a mark below 0 at the "*authority*" criterion would usually associate with a rather positive grade at the "*consensus significance*" criterion. Even though the authority level is supposed to be high (the actors are governmental representatives), the state's agents would rather seek consensus and amicable solutions than use their status to impose one. In addition, the "*structure morphology*" criterion has been harder to assess for the DTS and DAS categories. Moreover, their decentralized profile should provide them with a rather *multipolar profile* since they are supposed to be "local decision-making arenas" either at the regional, departmental or circumscription level. Yet, their bureaucratic structure appeared quite heavy with all procedures having to be validated by the central direction. Therefore, their "*management practices*" were categorized as *representative* rather than *associative*.

The supra-national entity for the Senegal river basin's water management (OMVS) position's is lower than the ministries' one. It is its capacity to locally offer environmental management opportunities to the population along the lake that explains its location. Several interviewees mentioned that the OMVS creates local associations among the youth and provide them with material to maintain the lake's shores and dig the canals.

- On the other hand, we were able to identify a range of actors whose organizational attitude oscillates more towards the anarchic-gregarious form of collective living (**green circle**). Those actors are all part of the LP category for several reasons. First, their “*dependency on resources*” is tangible as they adapt day to day to the water availability to produce food. They also rely on the other resources mentioned in Section 1 part 1.1 of the results for production and recreative purposes and are greatly affected by the changes that can occur after a decision is taken by the government. Secondly, they present a *multipolar* and *associative* profile: they work in webs of close relations following mostly a horizontal structure. To produce food is the main objective and therefore supporting one another is more important. It is not to say there is no power dynamics and inequalities among them, especially when looking at the role of female farmers, but solidarity is an essential adaptation skill they depend on. Therefore, consensus has a *high significance* in almost every decision the community takes to ensure the effectiveness of their actions. Moreover, it seems the more associative the profile (located on the far-right extremity of the green circle), the more they tend to conduct actions locally and rather independently from the government actions (cleaning the lake, distributing medicine). Their lack of connection to the state’s structures creates self-management opportunities in a certain number of situations. It seems they perform best as anarchic-gregarious groups when the state’s presence is not tangible.

However, those actors have been positioned knowing that they are evolving in a global social system which is highly oriented towards the social form of collective living. What holds the local population from fully aligning with the anarchic-gregarious form is usually their high level of “*dependency on the market*” (for running activities, for getting irrigation infrastructures, expanding the cultivation area...). This dependency is either linked to the N category’s funding (projects like PDIDAS or subsidies) or external actors like NGOs or international cooperation funds – the NGO category- (material, trainings). Therefore, it can prevent them from performing local initiatives.

The position of the “village headman” is confirmed to be at the *interface* of two realities, as mentioned in part 1.2.1 of the results. He is an administrative representative somehow connected to the state’s structures – and the social form - but still mainly rooted in the local “bubble” as the main caretaker of the village.

- The actors in-between those two tendencies (**purple circle**) are both actors from the AB category and the NGO category and their marks show that their attitude is neither completely falling into the social nor the anarchic-gregarious form.

The NGO category has a more *accessible* structure since they do want to involve the local communities in their project. In some cases, the local population can join the structure in the long run. They are rather reachable and tend to go and meet with the local population to better know their needs and seek *consensus* in their activities. However, they are closer to the red circle since they cannot run their projects without the authorization of the State. Moreover, they are usually international actors whose functioning adapts to the socio-geographical area but still must align with the mother group.

The actors from the AB category are closer to the green circle because they seem to closely depend on their relation to the LC category. They seek a *high level of*

consensus to operate in the area and tend to *associate the local communities to their structure for work and cultural acceptance*. Nevertheless, their operating techniques are industrial, and the board is usually international. They also are regularly in touch with the DAS category since the government closely supervises their interactions with the resources.

The AB category have a quite important *dependency on the resources* (they withdraw water, create canals for their crops) and advocate for environmentally friendly practices (pesticides and salinity management), but it is questionable whether they do it because of their own convictions or because the state pressures them in having a tidy agenda about environmental norms.

The TORSO seems to concur with the IG networks' analysis: the actors from the purple circle seem to depend on their strings with both categories.

Overall, it seems that the more dependent the actors are to institutions (or the more they get involved) the closer they get to the social form of collective living. The resources of Lake Guiers are then managed according to a distant and general viewpoint which fosters *indirect interactions*. Conversely, the less strings they have with governmental structures, be it voluntarily or not, the more they can adopt an anarchic-gregarious attitude. Therefore, they can seize self-management opportunities regarding the resources and *directly interact* with them.

However, all categories are embedded in a global social form of collective living where the state sits on top of the hierarchical ladder. It creates an apparent hierarchy in the decision-making process for the resources' management, demonstrating a domination of the institutional structures over the local communities and "external" actors. Nevertheless, the domination-based decision-making process is disconnected from the reality on the ground. The resources are handled mostly according to their availability and the existing material, socio-economic and cultural means.

In the light of Section 1 of the results, we intend to dive into:

- Section 2: The conflicting situations within and across actors' categories resulting from the interactions identified above,
- Section 3: The main driving forces and organizational patterns, or lack thereof, among the different categories and their significance.

2 Section 2: Conflicts around the access, the use and the sharing of the resources of Lake Guiers

In this section, we decided to focus on three main conflicting situations to 1) better explore the consequences of the discrepancies in the management of the lake's resources, 2) unravel the conflicts and the associated patterns resulting from such discrepancies and 3) deepen our understanding of conflict management techniques in a context of confronting worldviews.

All three conflicting situations are illustrated by the associated institutional statements. To be as concise as possible in the results, Part 2.2 (Appendix 18) and 2.3 (Appendix 19) of Section 2 of the results have been placed in the Appendices section.

All tables displayed in Section 2 are institutional statements which follow the format: Attribute (A) – Deontic (D) – Alm (I) - Object (B) – Conditions (C) and sometimes a Or Else (O) (ADIBCO format). The D and O boxes can be found empty or missing when no component was associated with the statement.

2.1 An entry through the conflicting interactions between crop farmers and cattle breeders

2.1.1 Space management from afar and productive activities impinging on one another

The lake is a key area for both crop farmers and cattle breeders: they both need the water for their fields and the cattle. The land is another resource which is essential to both activities since the crop farmers use it to grow food and the cattle breeders to graze the livestock in pastures. Since both activities use the same resources, the State has intended to delimitate areas for each and therefore avoid issues around conflicting uses. Those plans (POAS) are fostered by the technical services (either agricultural or vet services) as they are getting implemented along the lake:

Table 6: Institutional statement created out an interview with an actor from the DTS category

| | | | |
|---------------|--------|---------------------------------------------------------|------------------------|
| SAED and CADL | define | areas for agriculture and areas for pastoral activities | through official signs |
|---------------|--------|---------------------------------------------------------|------------------------|

However, many cattle breeders complain about the growing amount of land converted to agricultural fields around the lake. According to them, there are two main issues arising from this situation. First, the pastoral lands are becoming rarer, and they end up being less accessible patches to the cattle. The remaining pastoral lands are usually located further from the lake, and this leads to more efforts to reach them. Secondly, access to water is more difficult due to the pastures' distance to the lake and the number of fields along the waterbody, which tend to occupy the shores as irrigation becomes easier.

The situation is particularly tense during the dry season – throughout the rainy season, the rain can create temporary ponds that the cattle prefer -. Considering the situation, the cattle breeders prefer taking the shortest corridors to the lake that the farmers and/or the POAS have created.

Most cattle breeders complain that the crop farmers do not let big enough corridors for the cattle. As a matter of fact, the shortest corridors to the lake are the ones located next to the female farmers' fields, since they have smaller fields than male farmers. However, their fields being smaller, they also create smaller corridors:

Table 7: Institutional statement created out of an interview with an actor from the LC category.

| | | | |
|-----------------|------|----------------------------------------------------------|-----------------------------------------------------|
| Cattle breeders | take | the smallest pathways to the lake since there is no POAS | choosing the ones nearby the female farmers' fields |
|-----------------|------|----------------------------------------------------------|-----------------------------------------------------|

Others affirm that they are no POAS at all, or that the signs defining the areas cannot be read because most of the local population is not able to read. Several interviewees mentioned that no effort was intended to meet with the population and explain to them the new delimitations.

Hence, although the technical agents encourage the respect of the POAS, it seems they are confusions in the way they are implemented or handled:

Table 8: Institutional statement created out of an interview with an actor from the DTS category.

| | | | | | |
|------|------|-----------------------------|-------------------------|--------------|-------------------------------------------------------------|
| SAED | must | encourage the POAS' respect | by the local population | at all times | Or conflicts arise between crop farmers and cattle breeders |
|------|------|-----------------------------|-------------------------|--------------|-------------------------------------------------------------|

2.1.2 Unjust adaptations and reactions to an uneven access

When facing this situation, cattle breeders try and find other solutions to water the livestock during the dry season. On the one hand, they can use ponds, canals, or reservoirs the agrobusinesses have created for the local communities. However, it is not always accessible. They can also withdraw water from the lake and bring it to their animals. On the other hand, two more radical options can be chosen:

- They do more transhumance to look for other pastures, heading to the south,
- They do not respect the corridors and let their animals stray in the fields, removing the fences around the fields if there are any to create bigger corridors.

The second option is at the core of the conflict between the crop farmers and the cattle breeders:

- “Sometimes, cattle breeders let their cattle enter the fields. It’s a problem. We hear about it every year » (« *Parfois, les éleveurs font rentrer les bœufs dans les champs des autres. C’est un problème. Chaque année on en entend parler. Si tu ne peux pas être tout le temps présent, ton périmètre est en danger* ») (Interviewee from the DTS category).

The technical services encourage crop farmers to put fences around their fields:

- “They have the same space. [Cattle breeders] will find greenery in the fields. You can imagine what happens if the fields are not fenced.” (« *Ils ont le même espace. Ils vont trouver la verdure dans le champ. Tu imagines un peu ce qu’il se passe, avec des champs qui ne sont pas sécurisés avec des barrières, avec des clôtures*”) (Interviewee from the DTS category).

But according to the crop farmers, it is not preventing the cattle breeders from letting their cattle stray. Therefore, it seems that the confusing and unsystematic situation about the

POAS, coupled with the growing land occupation by crop farmers along the lake are pushing the cattle breeders to adopt uncivil behaviors.

However, the cattle breeders do not only let the livestock stray because of the absence of POAS or the unfitted corridors. The lack of feed is another reason that was brought up. With the pastures disappearing, some farmers would rather let their animals eat what is grown in the crop farmers' fields rather than lose their animals:

Table 9: Institutional statement created out of an interview with an actor from the DAS category.

| | | | | |
|-----------------|--------|-----------------|-----------------------------------------------------------|--------------------------|
| Cattle breeders | prefer | straying cattle | when there is not enough fodder available in the pastures | or the animals might die |
|-----------------|--------|-----------------|-----------------------------------------------------------|--------------------------|

Since many farmers end up with wrecked fields and consequent to total yield loss, several interviewees mentioned how serious those conflicts can be, some even leading to death:

- “You know, around the lake, agriculture has developed since the water is not salted anymore. So when the cattle breeders cannot find pastures, they let their cattle stray in the fields and sometimes people fight to death” (*« Vous savez, autour du lac, il y a l’agriculture qui s’est développée depuis que l’eau n’est pas salée. Donc les éleveurs quand ils ont du mal à approvisionner en pâturage, ils lâchent les animaux au niveau des champs et parfois les gens se battent même à mort »*) (Interviewee from the DTS category).

2.1.3 The importance of cultural parameters and traditional practices in handling conflicts

In the light of how those conflicts arise, we unraveled several ways to handle them.

First, there is the legal procedure. The technical services, usually the agricultural agent (CADL) and/or the vet are called by either one or both conflicting people to come and report the damage to the sub-prefect. There is an entire procedure to be followed when the complaining person wants to take the legal pathway:

Table 10: Institutional statements created out of an interview with an actor from DTS category.

| | | | |
|-----------------|-------------------------|------------------------|-----------------------------------------------------------------------------------|
| The CADL agent | reports the damages to | the sub-prefect | after recording them together with the complaining person and the village headman |
| The sub-prefect | transfers the report to | the complaining person | after he validates the report from the CADL |

| | | | |
|------------------------|------------------------|------------|---------------------------------------------------------|
| The complaining person | reports the damages to | the police | prior the police ask the responsible to pay the damages |
|------------------------|------------------------|------------|---------------------------------------------------------|

Before the police is summoned, all technical agents and the sub-prefect intends to manage the situation on their own; they want to seek consensus among the people in conflict, since the police's intervention might lead to escalating tensions. Additionally, the sub-prefect encourages the local population to get the conflicts managed amicably (preferably among them or else with the presence of technical agents) by creating local committees in the circumscription. It seems that the local arrangements are more efficient solutions than the POAS or the legal denunciation.

Table 11: Institutional statements created out of an interview with an actor from DTS category.

| | | | |
|-----------------|-------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------|
| The sub-prefect | summons a committee with the vet and the agricultural agent | for conflicts management among cattle breeders and crop farmers | prior to calling the police, at the local, departmental and regional scale |
|-----------------|-------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------|

However, the local technical agents would rather avoid contacting the sub-prefect in the first place as to keep it at an even more informal level of conflict resolution. The more they try and have it discussed amicably, the more they have a chance to find satisfying and peaceful solutions for everyone. There is somehow the will to avoid the official implication of the state.

When a cattle breeder initiates legal proceedings, they usually stop the procedure before the end because of the discouraging effect:

Table 12: Institutional statement created out of an interview with an actor from the DAS category.

| | | | | |
|--------------------|-----|----------|---------------------|--------------------------------------|
| The cattle breeder | may | call off | the legal procedure | when he learns there is one going on |
|--------------------|-----|----------|---------------------|--------------------------------------|

The other - and preferred – option is then the amicable agreement between the conflicting parties.

The crop farmer is usually the one who goes and confronts the cattle breeders with evidence. Family members from each side and the village headman are usually involved as well. After discussion, compensation is agreed upon and no officials are informed.

What we understand then is that most of the times, the conflicts are handled as followed, the next step being implemented only when the previous one did not work:

- 1) The two conflicting people confront each other, usually in the presence of their family and the village headman,
- 2) The local technical agents are called and get involved as to mediate and find a solution,

- 3) The sub-prefect interferes only when the technical agents cannot find an amicable solution. He summons the conflicting people and discuss with them.
- 4) The sub-prefect starts a legal procedure. It is first used as a dissuasive tool and is pursued only when the discouraging technique fails.
- 5) The legal procedure goes through, and the police is called.

Table 13: Institutional statement created out of an interview with an actor from the DAS category.

| | | | | |
|----------------------------------|-----|-------|-----------|-------------------------------------------|
| Cattle breeders and crop farmers | may | solve | conflicts | amicably instead of choosing legal pursue |
|----------------------------------|-----|-------|-----------|-------------------------------------------|

It is important to pinpoint that cattle breeders are traditionally Peules people whereas crop farmers are Wolofs. Ethnic variables are essential parameters explaining why respecting amicable arrangements is necessary. Social peace among the ethnicities is at the core of the Senegalese culture, and the intrusion of the state into such cultural conflicts is not encouraged.

Exploring conflicts around Lake Guiers highlights the amicable management of tensions on the ground and the partial inaction of the government in handling the conflicts. This inaction seems both purposeful and unintended. On the one hand, the state's structures usually interfere on the local communities' demand to enforce amicable arrangements rather than offering other solutions. On the other hand, it appears that the identified alternatives proposed by the state to avoid conflicts around the resources are either dysfunctional or unknown of the local communities (POAS, local fishery council...). Some actors like the agrobusinesses will try and find functional options.

Overall, Section 2 reveals that social peace, and especially between any actor and the local communities, seems to be one of the most essential resources to preserve, no matter how it is achieved. Somehow, the institutional structures and the external actors tend to both support and disapprove local arrangements around resources management but prefer to concur with the LC category's way of doing to avoid generating conflicts between them and the population. However, the state's distant position towards the resources could also explain why they tend to not interfere in such situations.

In Section 3 of the results, we came to further interrogate the driving forces and organizations explaining that conflicts are handled amicably rather than with legal sanctions and long-term structural solutions. Additionally, we delved more into the government's organizational patterns as to question its remote positioning to the resources management. Finally, we explored the consequences for external actors' activities.

3 Section 3: An institutional void encouraging local power structures and external interventions to handle the resources

Relying on both the IG and the TORSO model, section 3 displays 1) the desired and necessary operationality of the family-based structure and of informal arrangements, 2) the state's inefficiency to address the decentralization needs and offer other viable organization options to the populations and 3) the action capacity of other actors to fill the existing gap between the populations and the government.

3.1 The management of the resources and conflicts through local amicable agreements: willpower or carelessness?

3.1.1 Solidarity and family at the core of local interactions

The local communities are promoting a *nuclear-based functional unit*, where the family and neighbors are at the center of all interactions. Since most communities live in rather small villages, they all benefit from knowing one another in their everyday interactions, which reinforces the interdependence defining their lifestyle. In other words, they seek close interactions which create even more dependence on one another. The loop that could be spotted in Figure 7 (Section 1 of the results) is an illustration of this self-reinforcing behavior. This type of organization can be observed when looking at farming practices. All smallholder farmers give priority to family members when it comes to managing the fields or handling the cattle. They support one another and share the land and the production among the family.

Neighboring farmers also tend to share the same canals and material and maintain them together without external interventions most of the time.

Farmers would rather get organized in production group among family members, except for female farmers who are said to organize better among themselves than the males.

Within a village around Lake Guiers – or a group of villages –, *solidarity* is an essential element to perform everyday activities.

Knowledge exchanges based on empirical or past training are constant, and especially for production purposes:

- Among cattle breeders, cattle health issues or lack of fodder are usually managed among them.
- Crop farmers support one another by giving advice on how to use chemicals, avoid diseases or get more yield,
- The female farmers who all work in production groups together tend to seek advice among experienced male farmers, like a “*Goru Mbotay*”. However, they have a renowned sense of equity and rely on a knit organization around the funding they get from the bank. When making profit, they share it among them and reinvest the money,
- Fishermen help one another by sharing boats and material; the fish processors prefer buying to neighboring fishermen.

Apart from production purposes, the entire village organizes many activities. The female farmers support financially the youth association (ASC or AJDS) which likes to organize sportive events, local associations take care of cleaning the garbage in the village, they

gather around religious festivities. Overall, the local communities are used to prioritizing self-organization in order to run the essential tasks in the village.

3.1.2 A local resources management strategy respecting the social proximity

Therefore, the local population seems to emphasize on *self-management* for production purposes:

- They organize in groups with local boards to deal with production, cleaning, fodder, manure management.
- They sometimes create their own canals and take care of the canals maintenance when there is no intervention of the State's structures.
- They also prioritize the local workforce when needing assistance (during the transhumance-related activities, for the harvesting period...).
- When selling their production, a "*Bana Bana*" – an informal local retailer - from the area is usually the privileged intermediary before selling on the nearby market.
- They can exchange goods (milk against crops...) and manage conflicts among them.

Following the same logic, *illegal practices and exchanges* take place in informal settings. Cheaper veterinarian products and possibly other chemicals imported from Mauritania are sold among the communities, and because the communities work in small networks, the diffusion of such products gets easier. Usually, those retailers are called "*auxiliaries*" among the local communities.

As for crop farmers, they can import unregistered crop varieties from Mauritania.

Moreover, when the situation cannot be dealt with only based on other farmers' advice, the farmers tend to seek advice from the official chemical retailers who might not be the most impartial councilors since they are not technical services and are willing to sell any product they have.

Usually, the communities first go to the more *experienced individuals* (farmer, fisherman, cattle breeder) and especially those who got trainings in the past or who have the more empirical knowledge. When no solution is found, they will seek whatever solution is the cheapest and fastest, even when it implies illegal and/or inadequate options. This scenario takes place especially when there is no technical agent in the area to offer other options.

Likewise, the preference for networking within the community together with the tendency to refer to experienced members are particularly visible when it comes to conflict management. As observed in Section 2 of the results, there is a strong incentive to find amicable arrangements. This appears particularly important knowing the dependency patterns within the local communities on which they rely to ensure an optimal everyday functioning. If conflicts become too serious, there is a risk of compromising the entire network. The balance that is found through the amicable arrangements does not definitively resolve the issues, but they help keeping the people working together:

- « Conflicts happen quite often, but here people negotiate a lot between them. I have never seen anyone paying for something, but we discuss a lot and we say, "next time, you do not do this". But I have never seen any fight » (« *Il y a souvent des conflits, mais ici les gens négocient beaucoup entre eux. Je n'ai jamais vu quelqu'un qui a payé quelque chose, mais on discute et on dit « la prochaine fois, ne fais pas ça ». Mais je n'ai jamais vu une bagarre* ») (Interviewee from the LC category).

Family members such as the paternal aunts are powerful figures for ending conflicts while restraining it to the private sphere.

When it does not work, the local communities strongly rely on the village headman to interfere when conflicts happen. He is referred to as *the main authority* in the village, and his only presence can be enough to have people find peaceful solutions. Even the mayor or the sub-prefect do not act in the village without his consent.

Furthermore, the population turn to the “wise men” - a council of chosen experienced people in the village - for bigger disputes which threatens the entire village’s tranquility.

The deadly fights were never mentioned among the LC category, having us reflect on whether they happen often or if the governmental services have exaggerated the situation. It seems there is a will to *conserve the image of solidarity and peace among the villages*.

Overall, the LC category seeks support and prioritizes family, neighbors, and experienced people in any activity. They foster a nuclear-based structure because it is efficient for running their productive activities and getting rapid, socially desirable outcomes. More than cooperation, it seems that dependency to one another is what creates favorable conditions to self-reliance and autonomous behaviors. The dependency is nurtured by family bonds, the respect of other ethnicities and solidarity within the village. However, it seems their solidarity network is also necessary due to the “non-intervention policy” of the state in many daily scenarios. A structuration in favor of local synergy is both wanted and required in the current social reality of Lake Guiers’ area.

3.2 A dysfunctional state-led normative and structural framework

The organizational context of the LC category is nurtured by a governmental structure that mostly does not meet the people’s needs.

3.2.1 An inefficient decentralization process

3.2.1.1 A form of inertia caused by the lack of administrative and technical support...

The cultural structure of the local communities encourages togetherness and solidarity, especially when it comes to conflict management. Even though the management of activities – and especially those in relation to the resources – remains mostly at the local level, we understand that it is not always due to communitarian preferences or opposition to external interference. It seems that *the lack of technical and administrative support among the local population* is creating many unwanted situations and forces people to find makeshift but effective solutions.

There are discrepancies between the actors’ speeches on that topic.

On the one hand, the authority representatives like the sub-prefect or the state’s institutions like SAED and OLAC present themselves as efficient, supportive, and omnipresent structures, whose role is even indispensable sometimes. In the DTS network visible in Appendix 13, the rather consequent size of their nodes is a consequence of such a vision:

- "We understand the needs of the population" (*“Nous maitrisons les besoins des populations”*) (Interviewee from the DTS category).

On the other hand, the actions they are supposed to perform appear mostly not operational:

- “The system is in place, but the operationality is the problem” (*“Le dispositif est en place, mais c’est l’opérationnalité qui pose problème”*) (Interviewee from the AB category).

When interrogating the LC and AB category, we understood that there is a form of *inertia* coming from the institutions. We intended to comprehend how the decentralization process embodies this inertia:

❖ The first reason appears to be *the inefficiency of some implemented structures*. For example, the sub-prefect’s local councils for conflict management or the local fishery councils. Both initiated by the government, they are not active in pursuing their roles.

❖ The second reason seems to be *the unclarity or inefficiency of some roles*, like the mayor’s or OLAC’s. The mayor has been presented several times as an unreactive representative who can sometimes prioritize its personal interests. OLAC’s role is quite elusive: many people could not agree on what they actually do and how they do it:

“OLAC is looking for its role, it is not quite clear yet” (*“OLAC est en train de chercher son rôle, parce que ce n’est pas encore clair”*) (Interviewee from the NGO category)

❖ A third reason for the inertia would be *the lack of local technical agents*. As a result, it generates several consequences:

- 1) The local technical services’ actions are partially performed or not at all. For example, SAED do maintain the canals but not several times a year, and not all canals. They do advice some farmers, but mostly rice farmers and in the Senegal’s river valley, not around the lake.
- 2) Those actions and their consequences (legal, environmental) are unknown: the information does not reach the target (the local communities) and the population perform as they think is best. For example, the population must respect certain practices but has not been informed of them. The POAS is supposed to be implemented and respected, but some people do not hear of them. Crop farmers will use the wrong chemical without knowing its harmful potential or its inefficacy.
- 3) Those actions and their consequences (legal, environmental) are known but not considered and/or respected. People know about the technical services’ actions and sanctions, but they only have to fear social sanctions and rarely legal ones since technical agents are either rare or not present. And because most conflicts are handled without drastic social consequences (only explanations and sometimes financial compensations), they tend to reproduce illegal actions. For example, they prune trees knowing it is forbidden, let their cattle stray or use small nets.

In addition, when the technical agents are present, the decentralized structures cannot always perform any of their supposed roles because of a lack of material or funding from the government. For example, the fishery center used to patrol with OLAC’s boat since they did not have any from the fishery services. Now the only boat is broken, they cannot properly control the practices around the lake. The forestry or medical agent do not have any car and need to borrow the mayor’s one when it is free. The overall lack of funding does not allow any proper training or financial aid to the farmers or fishermen.

- “[...] I am the only vet in the area; we work in very difficult conditions” (« [...]Je suis seul dans la zone ; on travaille dans des conditions très difficiles ») (Interviewee from the DTS category).

The situation creates a *sense of abandonment* within the local communities who are then forced to find other solutions. Their social structure incentivizes such attitude, but it does not give them additional keys to enhance their practices, reduce the pollution or coordinate the resources management.

Furthermore, the same impression could be identified in the speech of the DTS category. Interestingly, the category who expressed the more sentences that we have identified as “desired statements” is the one of the decentralized technical services. The main point that was raised is the need for material support in their activities:

- “We do not why, but there is no proper means at the central direction level to truly support the decentralized services” (“On ne sait pas pourquoi, mais il n’y a pas la matière au niveau de cette direction pour pouvoir vraiment appuyer les services déconcentrés”) (Interviewee from the DTS category).

The LC category was the following, expressing the need for support and especially funding for developing the infrastructures (canals, medical centers...).

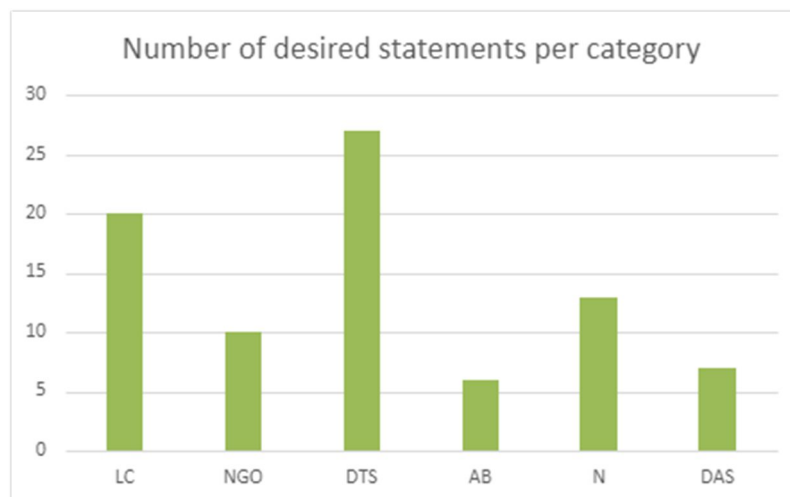


Figure 9: Number of desired statements for each category of actor. The desired statements display a Deontic (D) “should” or “should not”. LC = local communities, AB = agribusinesses, DAS = decentralized administrative agents, DTS = decentralized technical agents, NGO = NGOs and cooperation funds and N = central directions and supra-national institutions

3.2.1.2 Local relays as essential elements for the technical services

Since most technical services operate in large areas with reduced material and human means, they tend to rely on the local communities’ “network of relays” to better implement their actions.

One of the main local partners is the “communitarian relay”. Composed of only volunteers within a village, they oversee the information relay to the population. Even the regional services seen the “communitarian relay” as one of the main allies for the local agents:

- «[...] In addition there are the communitarian relays ; the vet works a lot with a network of relays. We call them auxiliaries or communitarian relays. Those people are not negligible in the system. They help the vet a lot. [...] If he did not get help

from the relays, it would probably not work. They work a 100% with the relays ». (*[...] Et en plus il y a les réseaux communautaires; le chef de poste travail avec un réseau de relais. On les appelle les auxiliaires ou bien les relais communautaires. Ces gens ne sont pas négligeables dans le système. Ils aident bcp le chef de poste véto [...]. S'il n'est pas aidé par les relais communautaires, ça risque de ne pas marcher. En tout cas eux, ils travaillent à 100% avec les relais communautaires.*) (Interviewee from the DTS category)

Those volunteers – or “auxiliaries” - are “engaged” for their community and can also be individuals that the local technical agent selects and gets to train. They are especially important for monitoring activities. For instance, the “Badienou Gokh” (experienced woman respected for their traditional knowledge about women) is a major relay for the medical agents. The forestry agent depends on them for bush fires or illegal pruning activities. The vet will train them in detecting diseases and taking care of small injuries:

The local “auxiliaries” can also become trainers for other people: after getting trained, they endorse the role of trainer and get to share the knowledge they have learned with others. It somehow reinforces the informal knowledge diffusion among the local communities, while giving the impression to the governmental services they have helped the communities.

Moreover, the village headman is once again known to be a good relay for any of the technical services.

The decentralization process is dysfunctional due to 1) the inefficiency of some implemented structures, 2) the blurry roles and actions of some DTS actors and 3) a lack of technical agents that a) generates a lack of support, credibility and information and b) encourages harmful practices for Lake Guiers' environment and population. The situation creates confusion and a sense of abandonment within both the DTS and LC categories, who have expressed many “desired” statements illustrating a need for more human and material support.

By using local relays as operating strategies, the technical services compensate the current circumstances. They also foster better communication patterns and make sure their actions are better accepted and understood.

3.2.2 A tendency to over structuration and control within institutional services

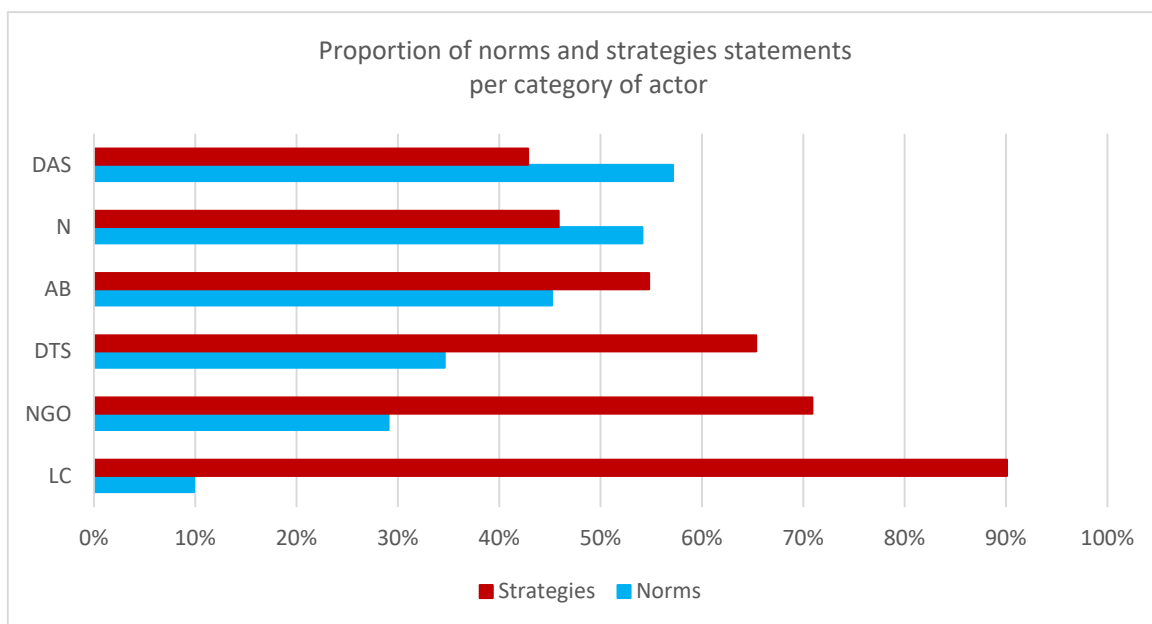


Figure 10: Proportion of norms (in red) and strategies (in blue) per category of actors extracted out of the IG analysis. LC = local communities, AB = agribusinesses, DAS = decentralized administrative agents, DTS = decentralized technical agents, NGO = NGOs and cooperation funds and N = central directions and supra-national institutions

A *fourth reason* explaining the inertia in institutions is the *tendency to over structuration in the governmental services*. Although the decentralization is supposed to delegate action capacity to the region (regional services), the department (the departmental services) and the circumscription (the municipal-level services), it seems the importance of hierarchy sometimes hampers the applicability of the services' measures.

Looking at Figure 10 and the proportion of statements classified as "norms" (the statements referring to the obligation, using a Deontic (D) being a "may", "must", "must not", "should", "should not") per category, we can observe that the decentralized administrative services are the ones associated with the most "norms" statements. Interestingly, the national services are close but a bit behind, and the DTS category is only in 4th place.

The DAS category referring more to "norms" than their hierarchical superior reveals a form of rigidity within the decentralized structures who officially represent the State: *the norms they refer to are usually what their hierarchy has commanded them to do*. The DTS category displays more "strategies" as the lack of resources force them to find options to perform any action. As opposed to the administrative agents, the technical agents tend to evoke less obligations but rather their unsteady operating logics. One the one hand, it illustrates how the decentralization does not manifest itself in a greater form of independence from the central direction. On the other hand, it exposes how some state's services need to pull away from the government's directives to be efficient.

Conversely, the proportion of statements "strategies" is the biggest in the LC category, closely followed by the NGO and the AB categories. Those actors seek concrete actions and interactions to the resources to run their activities. If "norms" refer to the obligation, they can also involve an emotional consequence such as the respect of cultural norms and the

fear of exclusion. Theoretically, the LC category could display more “norms” than “strategies” due to their strong cultural bind. But as producing food is at the core of their preoccupations, “strategies” prevail as to access and use the resources.

The AB category confirms its position as an “in-between”, with a proportion of norms and strategies being almost equal. Here, the emotional sanction applies to most of the “norms” they refer to since *they depend on social integration among the local communities to be able to expand their activities*. Similarly, to the LC category, their direct interaction to the resources implies more “strategies” to access and use them.

Many times, the decentralized services mentioned the importance of respecting their direct hierarchical superior as one the main virtue of the administration:

- « [My superior] can contact me, anytime, day and night. I have an obligation to report any aspect he needs to know. It is an obligation. If he needs anything or a report, I must give it to him » (« *Tous les jours, à tout moment, il [mon supérieur] peut me contacter, la nuit comme le jour. J’ai l’obligation de lui rendre compte sur tous les aspects qu’il a besoin de connaître. C’est obligatoire. S’il a besoin d’une information ou bien d’un rapport, je suis soumis de lui remettre ça* ») (Interviewee from the DAS category)

Respecting the administrative « skeleton » (“ossature”) being a sine qua non condition in the governmental services, the information flow must respect the structural chain.

There are many steps to implement any action, and these create blockages in the way the information and the procedures are applied.

For example, a regional agent cannot contact an agent at the circumscription level unless there is a serious matter to be handled:

- “We do not have the right to treat directly with the municipalities” (“*Nous on n’a pas l’habilitation d’aller traiter directement avec les collectivités territoriales*”) (Interviewee from the DTS category)

They need to check with the departmental service first. Likewise, a central direction cannot answer directly to any demand from the local communities. If some people happen to come to the capital city to meet with them, they will register their reclamations but will transfer the question to the departmental service. When the departmental service is done reading and validating, they will send the demand to the regional service, which will take care of validating it and sending it to the central service.

Moreover, all decentralized technical agents must report regularly to both their superior in the technical line but also to the one in the administrative line.

The reliance of written reports and printed letters is at the core of the administration system in Senegal. Rather than sending emails or doing phone calls, they need to send official demands through the post:

- “Administration means writing” (“[...] *l’administration c’est l’écrit*”) (Interviewee from the DTS category)

The governmental structures are built according to a clear structure where the decentralized services *must* strictly follow the directives from the central direction. It seems they cannot fully seize their role, meaning they cannot adapt the measures locally. The rigid structuration of the information and the people involved in the chain block them from being reactive and adaptative to everyday interactions among people and the resources.

People in need of governmental support – and especially financial one – must follow strict procedures which usually take many months – or even years - before getting satisfied and involve many services (administrative, technical...). This applies even for people working *in* the state’s structures. Regarding the local communities, they are incentivized to create production groups or, even better, cooperatives, to be able to qualify to any subsidy; they need to have their activity legally declared to the authorities. In the end, it does eventually lead to getting helped but it mostly generates unsustainable dependency patterns to heavy procedures.

When facing such structural bottlenecks, actors across sectors need to navigate two options:

- 1) Abide by the *inertia* and do not act to change things,
- 2) Break away from official procedures to find more viable, informal solutions (seek auxiliaries, relays, illegal or wobbly trades...)

3.3 Opportunistic behaviours from other actors around the lake

The partial or total dysfunction of the governmental structures, impacting mostly the decentralized actors, creates a void that some other actors can fill in.

3.3.1 Opportunities to operate locally for external actors

The two main categories that can display such attitudes are the NGO and AB category. In both cases, those actors act for the development of the area and seek to satisfy the population needs to better implement their projects.

The NGO category is usually one of the only sources of income for the LC category. They operate in diverse areas around the lake and act on many socio-economic issues (mediation among actors, female farmers’ activities development and valorization...) but also health-related problems (create sanitation structures, build new waterpoints, test of remedies for the bilharziasis...) Many people mentioned how having NGO partners was essential to get more funding and thus develop new canals, material, processing infrastructures like mills. The LC category can also benefit from training sessions and learning on new agricultural practices.

On the other hand, the role of agrobusinesses clearly resemble the NGO category’s role except they are private structures which primary role is intensive agricultural production. Therefore, their role in ensuring the development of the LC category is more intriguing.

As we demonstrated in Section 1 part 1.2.1.3 and 2 part 2.3 (Appendix 19), it seems the help they provide is essential so that they can operate in the area:

- 1) Without helping the population, their primary role would be compromised essentially because they are accused of resources grabbing and especially land grabbing. They need to install a trade-off situation so that the local communities and their representatives tolerate their presence in the area. Thus, they create “social envelopes” and CSR policies in relation to the population’s well-being and good development conditions that go beyond agricultural preoccupations.
- 2) Because the state’s structures cannot entirely cope with the social, environmental, and health-related demand from around the lake (cleaning the canals, building safe roads, renovating buildings, creating hospitals, bringing drinking water to all populations...), the agrobusinesses’ presence is seen from all side (the State, the communities and the agrobusinesses themselves) as a potential provider of such services. As a result, the agrobusinesses’ presence is not only presented as a positive factor for economic growth (job creation, industrial and massive food production) but for the development of many sectors.

The agrobusinesses themselves signify that they are better aware of what the LC category depend on than some administrative agents:

- “Sometimes I know more than the mayor; I’m in contact with the communities all the time. You learn fast because they come to work for you every day; they come from the 60 villages that make up the community. They tend to tell you things that the mayor doesn’t know.” (« Moi parfois je sais plus que le maire; je suis tout le temps en contact avec les communautés [...]. Ils ont tendance à te dire des choses que le maire ne sait pas ») (Interviewee from the AB category)

Moreover, the trade-offs are sometimes visible through the donation of a consequent amount of money to the municipalities. It supposedly allows the municipalities to invest, but sometimes it also helps them pay their wages in advance when the government cannot provide more money. All this is done in rather informal conditions.

This way, the agrobusinesses somehow “buy” social peace and the government passively agree to such situations.

3.3.2 An interference under the State’s supervision: willpower or negligence?

The government imposes regulations on both the NGO and AB actors.

Many actors from the NGO category mentioned how they must align with the State’s directives when implementing a project. Without an official collaboration, they would not be allowed to operate. The control of the administration appears to hinder their capacity to operate according to their own directives and beliefs. Nevertheless, it seems it is also a way for the government to address its own development objectives. By making sure the NGO play by the rules, they can share the benefit of their actions:

- « If the [State] program do not have the data, we must share it with them so that they know. In general, they do not know the real data. They know there is the disease, but they do not know the prevalence. They conduct studies that are not extended to all areas. So we collaborate. » (« Si le programme [de l’Etat] n’a pas ces données, nous sommes obligées de partager les données pour qu’ils sachent. En général, ils ne connaissent pas les données réelles. Ils savent qu’il y a la maladie, mais le niveau de

prévalence, ils ne le connaissent pas. Ils font des études qui ne sont pas étendues à toutes les zones. Donc on collabore") (Interviewee from the NGO category).

However, it seems it is also a good option for the NGO category since the decentralized services might know better which target to choose and how to implement their projects.

As for the AB category, it seems they are pressured by many controls from the administration. At least once a year, a committee composed of many sectorial services (agricultural, hygiene, territorial development, sub-prefect, governor...) come to check whether they meet the environmental norms they are supposed to follow. Their statistics are followed by SAED, and they need several authorizations before enlarging their fields or building specific canals:

- “When agrobusinesses settle somewhere, they must inform us. We must give them authorization. And then, we check. The SAED is the one authorizing the water withdrawal. No one can withdraw water without SAED’s endorsement, or we sue them.” (*“Lorsque les agro-industries doivent s’installer, ils nous informent. On doit leur donner l’autorisation. Et ensuite on vérifie. Le prélèvement de l’eau, c’est la SAED qui l’autorise. Personne ne peut prélever de l’eau sans l’aval de la SAED, sinon on va porter plainte »*) (Interviewee from the DTS category)

Likewise, they are paying the official water usage fee to the SOGED (OMVS service in charge of Diama’s dam and its associated water flow) for irrigation purposes, where most farmers around the lake do not pay any.

Some agrobusinesses complained about the unfairness of such a situation, particularly because they cannot pretend to any subsidy from the government (fertilizers, seeds, material...). From their door, the situation seems unbalanced knowing the constraints they have. Among those constraints, some of them made us understand they were not willing to keep endorsing roles they know are the government’s duties:

- “We’re even asked to fill in neighborhoods, so you can imagine!” (« On nous sollicite même pour remblayer des quartiers; je vous laisse imaginer ! ») (Interviewee from the AB category)

Hence, opportunistic behaviors stem from the State’s structures partial or total (un)official inaction. Those behaviors are both unofficially prompted by the government (by not acting to change the situation) and closely regulated as to make sure the State controls what the NGO and A actors are doing on their behalf.

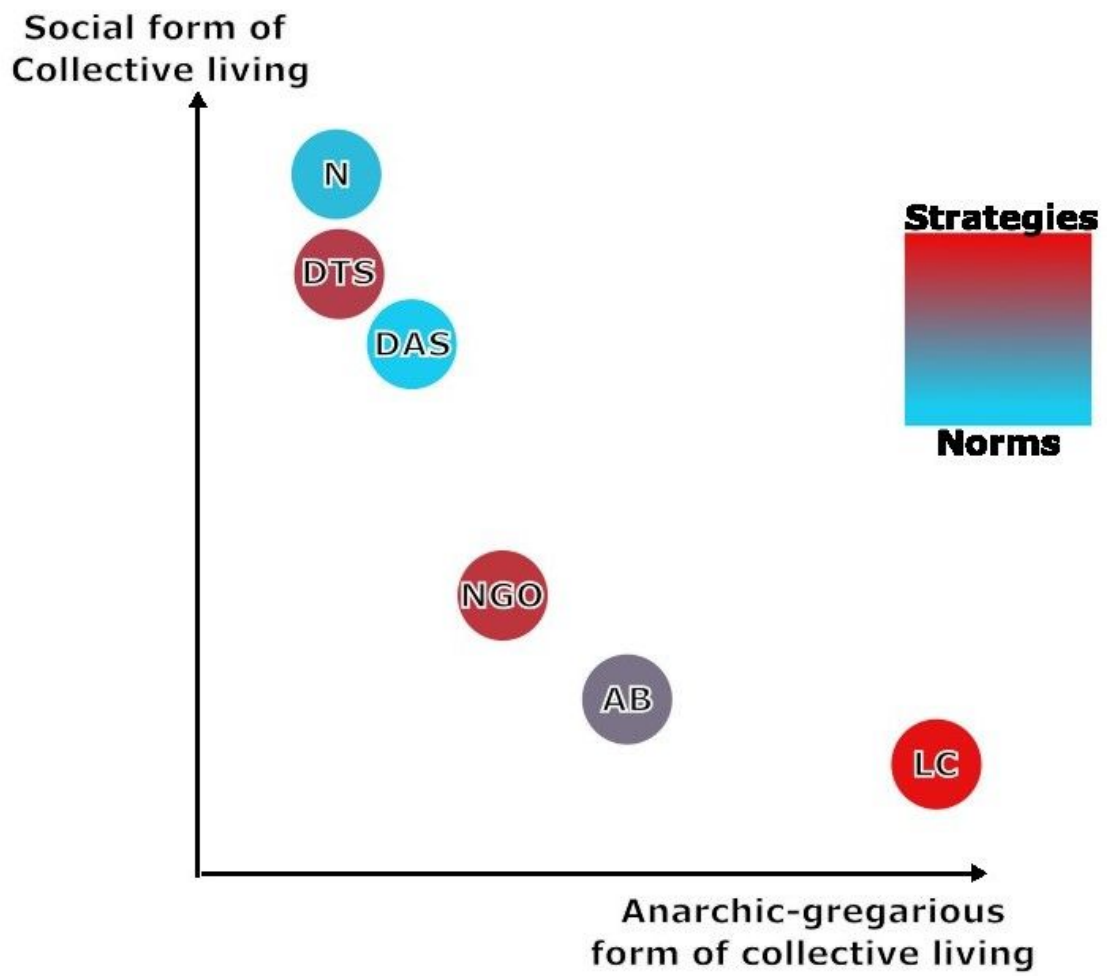


Figure 11: The combination of the TORSO model and IG analysis

Figure 11 has been created through combining the IG analysis and the TORSO model. It is an original way to put into perspectives the interactions and the prescriptions (norms and strategies) identified with the IG by questioning the power ladders and the actors' attitudes towards the resources in the Lake Guiers' social arena.

The graph reveals that:

- Institutional actors (N, DTS, DAS categories) align with a social form, therefore interacting from a distance with both the resources and the population. The decentralized technical and administrative actors are torn between sticking to the dominating governmental structure ("norms") and finding makeshift solutions ("strategies") enabling them to break away from inertia and perform what there are commanded to. The state both officially and unofficially support the actions of the NGO and AB categories by implementing structural changes that their current everlasting centralized and dysfunctional position does not allow them to do.
- The NGO category seek to reach out to the LC category, therefore focusing on "strategies" that make their attitude oscillate between abiding by the Senegalese government's "norms" and adapting their actions to the local communities.
- The AB category is the most adaptative of all actors (grey colored). The agrobusinesses adopt attitudes that both align with the capitalistic and land commodification orientation of Senegal, but they also depend more on the resources and seek the approval of the local communities, therefore adopting "strategies" to get more accessible, create more consensus and foster local decision-making. The "norms" they respect are mostly customary traditions (showing solidarity, respecting the local representatives, nurturing social peace...) instead of the law, therefore bypassing the legal procedure to connect with the population (funding of projects, elusive trades with municipalities...).
- The LC category is the more strategically oriented towards accessing and using the resources; their rather horizontal, solidarity-based interactions are focused on one main purpose: producing food in a self-managed way to both compensate the state's absence or overstructured presence and reinforce their autonomy. Therefore, it makes them the more aligned with the anarchic-gregarious form of collective living.

In the light of such results, we understand that the consideration of the resources and how to manage them is not aligning.

Therefore, the consideration of health at the scale of Lake Guiers will depend on the capacity of the living labs' participants to agree at every level on a *common action plan* to improve the health situation on the territory.

Part 4: Discussion and Propositions

1 Discussion

This master's thesis worked on establishing a situation report about the socio-spatial dynamics and organizational rules at play in the Lake Guiers' region, to better inform the mobilization of two living labs for the "*Santés et Territoires*" project.

1.1 Horizontal direct interactions opposing vertical indirect interactions

Based on semi-directed interviews, we could identify the multiplicity of actors, resources and interactions around Lake Guiers which mainly revolve around agricultural production. The LC category was identified as one of the most connected actors' categories as they are both directly using the resources and indirectly involved in their management. Overall, it appears that the relationship with and positioning towards the lake's resources becomes less and less direct as you move up the hierarchical ladder of the governmental structures. Following the created TORSO model (Figure 8), the more the actor's attitude align with the social form, the less direct its relation to the lake's resources are. Conversely, the more the actor's attitude follows the anarchic-gregarious form, the more direct their interactions with the lake's resources are. Those having the more decision-power, and therefore indirect interactions with the resources, are the ones on top of the "social form" axis (N, DAS, DTS categories). They decide according to a capitalistic, pragmatic viewpoint concurring with their current positioning towards land privatization, commodification and intensification of the agrarian production around the lake (Bourgoin et al., 2016; Plançon, 2009). They embody a form of disconnection to the resources and the needs of those who depend on it.

1.2 Social peace and customary habits at the core of conflicts resolution

We then focused on specific situations displaying interactions within and among actors' categories in relation to the resources of the lake. It came to our attention that there is a superposition of needs which mainly results in conflicting interactions among people. A form of hidden power (Gaventa, 2006) emerge from those case studies, where people confront their values and beliefs to access the resources. Among these categories, the operability of productive actions depends mainly on "strategies", but "norms" get involved when it comes to respecting the traditional social structures and the "social peace" resource. The need for "social peace" and amicable arrangements entails confrontations that follow the conflict management rules of the LC category. Those conflicting situations seem to remain a status quo as no long-term solution is considered, but it is unclear whether it is always voluntary or a default option. Seck and Valarié (2005) mention the private interests being preferred over global public solutions in Senegal, which could explain why people tend to handle issues among them, especially when financial compensations are involved. It is oftentimes the case between agrobusinesses and the local communities or their representatives (mayor, village headman...). In addition, the prevalence of customary rights despite the governmental measures and the complicity of the state through its inaction could be both favorable conditions to such arrangements (Traoré, 1997).

1.3 An institutional inertia encouraging grassroots mutual support and external intervention

Then, we highlighted what globally frames the interactions and relationships around the lake. A nuclear, family-based structure is at the core of the LC category's organization, which still highly relies on traditional power structures and solidarity to operate around the lake. We could see that the dependance to a close network of people is both a will and a necessity in a system where governmental development interventions are quite rare or uncertain. Then, we dug into the dysfunctional decentralization process in the Lake Guiers' area and the state-led over-structured model that does not align with its initial disengagement strategy. It seems the governmental disengagement is closer to a form of governmental absence, or inertia, which leads to a lack of material, administrative and technical support to both its own services (the DAS and DTS categories) and the LC category. It also creates "conflicts of competences" among the diverse actors categories (Seck & Valarié, 2005). This conflict arises as some actors like the "auxiliaries" or "local relays" tend to better support technical actions than the official services. It is also visible when looking at the vertical hierarchical structuration of the information and procedural chains, pictured by the number of "norms" statements and the tendency of the N, DTS and DAS categories to align with the social form (Figure 8). A strong reliance on hierarchy and bureaucracy hinders the DTS, DAS but also LC category's action capacity for developing their activities.

The NGO and AB categories – the two categories that interfere with external financial resources - can perform actions on the ground despite and in response to the vacant space left by the N, DAS and DTS categories. Paradoxically, the state seems to establish a firm official control on the AB and NGO action capacity while encouraging the implementation of actions the government is officially in charge of. It is questionable whether this interventionist endeavor from the government is a way to regain control on situations it knows to be overall out of its grasp. Traoré (1997) discusses the notion of intermediary between the state and the populations, and the NGO and AB categories reflect an adaptative position.

1.4 Identified limits to the work

It is worth noting that this thesis has based its results on the actors' speeches analysis and interpretation to guide the results. To conduct qualitative work in a highly politicized and sometimes polarized context creates a possible bias in the collected information and the identified worldviews. Moreover, the translation from Wolof or Peule to French of part of the interviews implies a loss in the information gathered. Although the methods employed have been used to ensure a form of objectivity to this work, they were used in the light of our own understanding of the situation and of the tools. For example, there was no peer reviewing of the created statements as recommended by the researchers using the IGT (Basurto et al., 2010; Schlüter & Theesfeld, 2010; Siddiki et al., 2011; Watkins & Westphal, 2016) and more statements were built for the DAS category as we were adjusting the framework to our dataset. In addition, the visual buildings of the IGT into social networks is innovative and implies that adjustments could be made.

The sampling method for this work has been mainly focusing on the researchers' and living labs' pre-existing knowledge of the area, especially for the LC category. This method implies limitations about the diversity of actors that were included in the study. For practical reasons, we sometimes narrowed the triangulation process to the relationships other actors would mention, which can create a bias in the analysis. Moreover, the creation of categories implies a generalization that might oversimplify the reality.

Finally, the thesis has been written in English for academic purposes. Although the translation of the verbatims and institutional statements has been done rigorously, a change in the language can create a bias and not fully live up to the original content.

1.5 Perspectives for the living labs

In the light of the methods used and results obtained, the project is left with several aspects to explore for better mobilizing the living labs. The identified lack of flexibility and operability in the institutions hampers a holistic approach to handling the resources management and hinders the creation of a common action plan to the resolution of health issues at the territorial scale. However, the question of health is of interest for all actors living or operating at the scale of Lake Guiers.

According to Janin and Pecqueur (2017), one of the most successful models of living lab is the “collective innovation living lab”. This network-oriented model promotes collaborative innovation in a multi stakeholders setting. Based on participatory activities, it aims at finding long-term innovative solutions to collective issues by questioning and adapting existing infrastructures or tools and finding new ideas. In the case of the project, it is about questioning the existing health infrastructures and solutions but also finding collective agroecologically informed answers to health issues.

Based on Figure 11 and the identified categories, strong representatives’ figures such as the village headmen, “*Goru Mbotay*” and “*Badienou Gokh*” should be included to encourage the population to follow the example. The living labs could also find some allies in the technical services already involved to make of the state’s structural loophole an opportunity to better act in association with the actors on the ground. Their willingness to find solutions to the governmental inertia and lack of resources through cooperating with local relays and auxiliaries is a proof that working jointly, be it formally or informally, creates positive outcomes for the territory. On the other hand, the administrative actors (mainly sub-prefects) should be included in the living labs since it would give the state’s the impression to be part of the process. Their role as representatives can show other participants that the government acts in their favor and support local initiatives for the territory.

Nevertheless, the living labs should also focus on integrating more actors and dive into the network of some new categories. It seems a focus on the local communities, the agrobusinesses and the NGOs’ action capacity is relevant since 1) they are operational in accessing and using the resources and 2) they are all interested in inclusion, solidarity, and action to varying degrees around Lake Guiers.

As the LC category is of importance in the use and management of the resources, it would be interesting to dive more into their own solutions to handle health issues.

In addition, it appears necessary to make of the living labs a federating platform, knowing 1) how intricate the relationships among people and to the resources are in the territory, 2) the failed previous attempts to create efficient councils for natural resources management. Therefore, it would be necessary to ensure the living lab’s long-term efficiency through organizing collective activities to create more inter-relation among the members and build a common vision of a healthy territory.

This work proposes several actions to leverage the living labs.

2 Propositions

The three following propositions are aiming to include more actors to the global reflection on health, explore the informal health solutions mobilized by the local communities and work on a common vision and action plan on the future of the territory and the living labs.

2.1 Proposition 1: Realize a new social network analysis and extend the living labs' participation to more actors

Content of the proposition

To live up to the diversity of actors and make sure the living labs foster the collaboration of all actors operating around Lake Guiers, it appears important to explore the networking situations and operating logics of more actors' categories than the ones presented in this work. In addition, it would be interesting to get a better overview in each living lab's area (Mbane and KMS) as some actors might be more relevant to include in one but not in the other.

This proposition would require a rather long period of time to make sure that all key actors of Lake Guiers are identified and acquainted with the project. We thus suggest hiring two master's thesis students to take care of each living lab's zone, from February to July 2024 (6-month work) with a 3-month fieldwork trip to Senegal.

The students would be recruited by the "*Santés et Territoires*" project and found among students from a French university preferably, since French is one of Senegal's official languages, like PURPAN or ISARA. In Senegal, they would be staying in the trainee's house at the partner institution ISRA CRA, Saint Louis, and would periodically move to each location.

The objective of each master's thesis would be to 1) further explore the networking situations of the actors in the following list in either Mbane or KMS area, 2) investigate the motivations and obstacles of the following actors to join the living labs:

- Operating NGOs in each living lab area,
- Operating agrobusinesses in each living lab area,
- The Malian fishermen, since they have a big impact on the halieutic resources and their integration to the area remains elusive.
- Medical agents at the regional, departmental, and local level, as they were mostly missing in this work,
- Local relays and informal auxiliaries since they are key people to the management of health-related issues and important to the DTS category.
- Female farmers' production group, as they are usually dynamic and strongly rely on solidarity across families and villages.
- Any other actor so far unidentified.

To meet their objectives, both students should:

- ✓ Prepare their fieldwork mission by 1) doing extensive literature research on the area, 2) exploratory interviews with researchers and former master's thesis students or trainees from the project, 3) preparing an interview guide for semi-guided interviews, 4) prepare a short pitch to promote the living labs and why they should be part of it.
- ✓ Identify actors according of each category to previous works on the project but also by prospecting in each living lab's zone,

- ✓ Interview a pool of approximately 30 actors among the categories above during the 3-month fieldwork mission in Senegal. Pitch the relevant actors about joining the living labs.
- ✓ Prepare a restitution to all available actors interviewed to enhance their understanding of the networking situations, motivations, and obstacles to join the living labs,
- ✓ Extend a formal invitation to all relevant interviewees for the next living lab gathering.

Both students could work jointly or at least should meet and discuss their results at least once before and after the restitutions.

Action plan and budget

Table 14 present a summary of all actions that need to be taken to realize the proposition.

Table 14: Action plan for the implementation of Proposition 1

| Actions to lead | Description | People involved | Period of time | Budget |
|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------|
| Hire two new master's thesis students | | | | |
| Find the external structure to support the thesis | Either CIRAD, ISRA, SAED for the "Santés et Territoires" project | Two or more researchers involved in the project to be the external tutors | October to November 2023 (2 months) | 0 |
| Create a master's thesis offer | Present objectives and the master's thesis format | Researchers from the "Santés et Territoires" project | October to November 2023 (1 month) | 0 |
| Hire the students | Share the offer to universities, select two motivated and French-speaking students | PURPAN, ISARA | November 2023 to January 2024 (2 months) | 0 |
| The master's thesis work process | | | | |
| Social network analysis and motivation level of new actors' categories of Lake Guiers | 6-month stipend for the thesis' work | The two trainees and their tutors | February to July 2024 (6 months) | $3487.05\text{€} \times 2 = 6974.1 \text{€}$ (net stipend/person) |
| Fieldtrip mission to Lake Guier, Senegal: Actors' identification and semi-guided interviews realization | Objective of 30 interviewees across categories | The two master's students and their project's tutors | March to May 2024 (3 months) | $1200\text{€} \times 2 = 2400\text{€}$ (net estimated actual costs) |

| | | | | |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------------|----------------|
| Organize a restitution to the available actors in each location | Confirm their understanding, collect more information | The two master's students, the available interviewees, and the project's tutors | End of April 2024/May 2024 | |
| Thesis defense | Share the results to the university and the "Santés et Territoires" project | The two master's thesis students | October 2024 | 0 |
| BUDGET for 6 months | | | | 9374.1€ |

The global budget was estimated after 1) an official simulation of the students' net estimated stipend (Appendix 20) and 2) this master's thesis fieldwork mission's actual costs in Senegal. CIRAD would only have to cover the 2400€ corresponding to the field trip. The budget for the fieldwork covers most of the expenses in Senegal. It includes the costs of essential vaccines to fly to Senegal, flight tickets, educational equipment (pens, notebooks...), transportation in Senegal (taxi or rented car), phone sim card and package, food, and accommodations for punctual trips around Lake Guiers, snacking and potential compensation for the interviewees attending the restitutions. Everyday costs (for accommodation and food in Saint Louis) shall remain in charge of the master's thesis students, that the stipend will cover.

To invite the relevant interviewees to join the living labs, we have invented a general pitch that could be adapted to the type of actors and the healths they are interacting with in their activities (Appendix 21).

Hindering forces of the proposition

The budget does not include the tutors' salaries. In addition, hiring two students instead of one can represent a cost that the project might not be able to bear. Alternatively, the project could decide to take a gap year student who would have enough time to explore each living lab's area. In this case, the budget must be divided in two, and the stipend's allocation needs to be revised.

Furthermore, the students should pay attention to their prospecting and interview scheduling since Ramadan could happen during their fieldwork. During this one-month religious time, Muslim people fast and yet work all day. The students should preferably avoid performing this phase of their work during this time, or else keep the interviews short (less than an hour) to respect people's time and energy.

Finally, the students should be careful when pitching the relevant interviewees about the living labs. Their tutors should validate their targets first, and the students need to consider the identified power structures that might prevent the newly identified actors from joining the living labs (conflicts, cultural opposition, subordination to another actor...).

2.2 Proposition 2: Creating a workshop to investigate the informal health management techniques

Content of the proposition

In the lake's area, many "auxiliaries" and "local relays" appear invested in managing the resources and therefore the healths (animals, plants...). In addition, it seems traditional, empirical customs usually outweigh scientifically proven or legal methods among the population living around the lake. During our work, we heard of certain informal practices but did not get the chance to collect them and interrogate people on them.

Therefore, we think organizing a workshop to unravel the operational and non-operational empirical, informal ways of dealing with the diverse health issues among the local communities would be of interest.

The workshop could be organized during the next living lab gathering in each location. The facilitators could be people from the research team: Aicha Sall, PhD student in sociology and Dr Pierre Martin who is currently working on a project to detect plants extracts being used as cures.

Here is what the workshop could aim at:

- Gather around 10 unofficial "health agents" like legal or illegal auxiliaries, local relays, "*Badienou Gokhs*", "*Goru Mbotays*" after being clearly identified through previous works, for example using the interviewees list from this thesis and Proposition 1.
- List all ways of dealing with the identified health issues among the local communities for each health (Human, Animal, Vegetal, Social, Halieutic/Environmental)
- Identify the level of trust or distrust into those techniques' efficiency,
- Collect information on practices that are not aligning with the agroecological principles.

Action plan and budget

The workshop would be organized during the next living lab gatherings in 2024. The budget for the gathering is unknown, but the workshop's costs are expected to be included in the global costs.

Aicha could translate in Wolof during the workshop. It could be recorded to come back to it afterwards. Let us imagine it would take place in the morning, from 10am until 1pm. A drafted workshop can be found in Appendix 22.

Hindering forces of the proposition

This workshop's realization relies on a good knowledge of key actors involved in the informal management of natural resources and healths. A prospection period might be necessary if previous works are not sufficient, and the associated costs have not been included.

The workshop's timing is an estimation. The facilitators should be aware of the usual delay of the activities in the living labs. However, they should not run it after 1pm since Muslim people do the afternoon prayer around that time.

The facilitators will need to emphasize that the entire workshop will be conducted in Wolof to make sure every participant can understand. Some people might not know how to write and could feel uncomfortable going to the paperboard in front of everyone. The facilitators must adapt their activities accordingly and make sure these are inclusive. They should invite all participants to participate or speak at least once during the workshop.

2.3 Proposition 3: Defining a common vision of the living lab's achievements for an improved health situation around Lake Guiers

Content of the proposition

To make the living labs a “collective innovation” platform (Janin & Pecqueur, 2017), the participants would benefit from creating a “shared vision” (Parker, 1990) of the living labs' achievements (i.e improve health at the territorial scale). The multilayers of needs, the role of many actors and activities in perpetuating existing health issues and the dysfunctional structures of information across sectors create a gap in perceptions of the situation around the lake. Consequently, it creates a gap in the perception of the “desired future” as many current worldviews get to confront one another (Checkland & Poulter, 2006; Parker, 1990). To create a clear vision shared by all participants of a common project is more likely to invite people to align their day-to-day decisions with the vision. We need participants of the living labs to “own the vision” of the desired health situation and solutions that they will get to implement themselves (Francis, 2019). The living lab could then become 1) a nest to the visioning process 2) a connecting platform where people network and collaborate 3) a tool to implement the vision in time.

A vision can be created throughout one or several “visionary exercises” (Francis, 2019; Parker, 1990) but it would be interesting to follow the evolution of the objectives and the vision created by the participants throughout the entire project.

Therefore, we thought of offering a PhD position to work on the following topic:

A SHARED VISION FOR A HEALTHY TERRITORY
Creating a common future for Lake Guiers' people and resources
through a collaborative and action-oriented living lab experience

A 3-year PhD thesis is a long-term project, that could start at the end of 2024 if the student can be found quickly. It would run from the end of 2024 to 2027, which means it would end one year after the “*Santés et Territoires*” project is over. This way, the PhD thesis could also take a retrospective viewpoint on the project and its capacity to mobilize a common vision to achieve its objectives.

The student would periodically travel to Senegal and stay at the International Research and Development Institute (IRD) in Dakar and at the ISRA trainee's accommodation in Saint Louis. The duration and frequency of the missions to Senegal are to be determined. While in France, the home university and/or CIRAD's structure in Montpellier could host the student.

The objectives of the PhD thesis could be to:

- ✓ Evaluate the current degree of alignment and understanding of the projects' objectives and expectations among the current participants.
- ✓ Considering the previous evaluation, organize several “visionary exercises” during the living labs gatherings to create a shared vision of the desired health situation around the lake,
- ✓ Evaluate with the participants whether the current actions or experiments led in the living labs are aligning with the common vision,
- ✓ Together with the living labs participants, determine and monitor action-oriented steps to be supported by the living labs with the participants to accomplish the vision,

- ✓ Evaluate the visioning process and its impact on the living lab's format and objectives.

Working on a common vision would also help define a clear orientation for the living lab. Discussing the format, the governance, and the rules of the living lab as a supportive tool to implement the vision could make the living lab an operational participatory platform on the long run.

Some hypotheses to start the reflection with could be:

- The worldview from the local communities dominates at a local level, but the one from the government dominates at the global level.
- The participants lack concrete objectives to enhance the territorial health.
- The current position of some actors in the living labs can hinder the group's creativity and the emergence of new actions to deal with health issues.
- The living labs need to turn into a unified group to better envision the future.

Action plan and budget

Table 15 present an overview of the actions that need to be taken to realize the proposition.

Table 15: Action plan for the implementation of Proposition 3

| Actions to lead | Description | People involved | Period of time | Budget |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------|--------|
| Hire a PhD student | | | | |
| Find the external structure to technically support the thesis | CIRAD for the "Santés et Territoires" project | One or more researcher involved in the project to be the external tutors | End of 2023 | 0 |
| Find an internal and/or external financing source | CIRAD + external partner (AFD, European Union financing programs, "Occitanie" region) | The project and another structure | End of 2023 | 0 |
| Create a thesis offer | Present objectives and the PhD thesis format | Researchers from the "Santés et Territoires" project | January 2024 (1 month) | 0 |
| Hire the student | Share the offer to universities, select one motivated and French-speaking students | PURPAN, ISARA, public universities | February 2024 to April 2024 (2 months) | 0 |
| The PhD thesis work process | | | | |

| | | | | |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------|-------------------------------------------------------------|--------------------------------|
| Creating a visioning process for the living labs' achievements | 3-year stipend for the thesis' work | The student and their tutor(s) | July 2024 to July 2027 (3 years) | 1680 x 36 months = 60 480 € |
| Literature research and evaluation phase of the project | Preparatory phase of the visioning process | The student and their tutor(s) | July 2024 to December 2024 (6 months) | |
| Visioning exercises + evaluation of the current activities' alignment to the vision + action steps identification | Development of the vision, its means, and the actions to implement to implement it | The student and their tutor(s) | January 2025-December 2026 (end of project) (2 years) | |
| Visioning process evaluation / Retrospective on the project | Conclusion phase of the visioning process | The student and their tutor(s) | January 2027 to July 2027 | |
| Thesis defense | Share the results to the university, the partners and the "Santés et Territoires" project | The student | To be determined (end of 2027 ?) | |
| BUDGET (for 3 years) | | | | 60 480 € |

The global budget was estimated through information collected on the website of the French Ministry for Higher education. It was based on the 2024 estimated monthly gross stipend of 2100€ for a PhD contract signed with a public structure (Ministère de l'Enseignement supérieur et de la Recherche, 2023). A 20% reduction has been applied to obtain the approximative monthly net stipend of 1680€. It is supposed to cover the students' operating expenses. This estimation is supposed to cover the student's operating expenses (material, travel costs...).

Hindering forces of the proposition

The thesis budget is only an overview of the general costs inherent to the work. It can only be used as an estimation. For example, it does not cover the additional activities the student could be asked to perform apart from the research process. The student could also look for additional resources from the research institute or a partner. Overall, the funding is a key element that cannot be precisely predicted before starting the hiring process, and the PhD thesis' objectives and focus would have to be agreed upon with the research team.

General conclusion

Using a relational lens, this master's thesis work focused on studying the socio-spatial dynamics and organizational rules in Lake Guiers' region to better know how to implement the "*Santés et Territoires*"s living labs. Based on 39 semi-directed interviews, we elaborated on the Institutional Grammar from Crawford and Ostrom (1995) and the TORSO model from Maraud and Delay (2022) to unlock relational patterns, regulation and domination processes as well as societal attitudes embedded in Lake Guiers' specific social arena. The original combination of both methods allowed us to better scrutinize the official, informal, and culturally oriented prescriptions and question their significance within the bigger picture of the actors' societal orientation in Lake Guiers' region.

The research process reveals that there is a superposition of needs towards the resources which creates many interactions revolving around food production. The direct and indirect identified interactions to the resources are related to the position of the actor towards the society and the resources. Additionally, the actors' position depends on the tendency to rely on norms dictated by either the law or customary traditions, and on strategies that inform a greater autonomy from the Senegalese institutions. The more the actor identifies with vertical hierarchy and a detached relation to the resources (here, the central and decentralized administrative services), the more it relies on rigid norms that reveal a form of inertia within the governmental institutions. Conversely, the more the actor concurs with horizontal social structuration, consensus, and connection to the resources (here, the local communities), the more it refers to socio-cultural norms and strategies to enable actions and break away from the institutional inertia. From those global relational tendencies emerge discrepancies in how to manage the Lake Guiers' resources, resulting in conflicts for 1) accessing and using them and 2) controlling the interactions on the territory. Institutional loopholes and the strong incentive for customary laws invite some actors like decentralized technical agents, agrobusinesses or NGOs to adapt their operating logics to more informal but operational processes.

In the light of such results, we emphasized several options to best mobilize the living labs. As a general remark, we have invited the project to focus on "collaborative innovation" within the living labs to seek participation from diverse actors in the co-construction of solutions (Janin & Pecqueur, 2017). It is worth paying attention to the local communities and the actors who engage in daily activities with them as they are driving forces for directly managing the resources and thus, the healths. Therefore, to explore the networks of more actors' categories from and in relation to the local population (agrobusinesses, local relays...) and invite them to join the living labs could be worthy. Then, we suggest organizing a workshop to better know what informal solutions to health issues the local communities might have. Finally, we support the creation of a "shared vision" (Parker, 1990) within the living labs to 1) make the project a supportive platform for reaching the vision and 2) enable concrete actions for the territorial health.

The living labs are promising platforms that can become a participatory tool to harmonize the diverse viewpoints and act jointly on enhancing the global health around Lake Guiers.

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As this thesis is defended in the context of a double degree, we have elected the reference style APA 7th edition for more consistency.

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Appendices

Appendix 1: The decentralization in Senegal (adapted from Rochegude and Plançon (2009) and Sané (2016)).

| Territorial organization | Circumscription administrative Hierarchical level | Figure of authority | Local collectivity | Figure of authority |
|--------------------------|------------------------------------------------------|---------------------|--------------------|------------------------------------|
| Region | Yes / 1 | Governor | No | None |
| Department | Yes / 2 | Prefect | Yes | Departmental Council (Chairman) |
| District | Yes / 3 | Sub-prefect | No | None |
| Municipality | Non | --- | Yes | Municipal council (mayor) |
| Village | Yes / 4 | Village headman | No | None |

Appendix 2: Scope of the “*Santés et Territoires*” project (2021-2026)

Grey arrows: intervention areas

Orange arrows: Partner countries



Appendix 3: Detailed table on the actors' categories

| | Name of the category | Number of interviewees per category | Services or profession of the interviewee | Total of interviewees |
|--------------------------------------------------------------|---------------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Interview with 1 representative/spokesperson in each service | The «National or supra-national services» | 4 ministries | Ministry for Agriculture, Ministry for Water Management (DGPRES services) Ministry for Livestock, Ministry for Continental fishery activities | 6 |
| | | 1 national body for drinking water management | SONES | |
| | | 1 supra-national entity | OMVS | |
| | The «Decentralized technical services» | 5 at the circumscription level | <u>in Mbane</u> : 1 fishery agent <u>in KMS</u> : 1 forestry agent, 1 agricultural agent, 1 vet agent, 1 medical agent. | 12 |
| | | 7 at the regional and/or departmental level | Regional fishery services St Louis Regional vet/livestock services St Louis Regional agricultural services (DRDR) St Louis ARD St Louis OLAC SAED SAED's Lake Delegation | |
| | The «Decentralized administrative services» | 2 at the circumscription level | Sub-prefects | 2 |
| The «NGOs or international cooperation | 4 NGOs | Gret EndaPronat UN Women Espoir pour la Santé | 5 | |

| | | | |
|-------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| funds» (NGO) category | 1 cooperation fund | USAID | |
| The «Agrobusinesses» | 3 agrobusinesses | CSS West Africa Farms (WAF) Swami Agri | 3 |
| The «Local communities» | 3 interviewees from KMS's area | 1 Fish processor 1 Cattle breeder 1 Cattle breeder/farmer/fisherman | 11 |
| | 8 interviewees from Mbane's area | 1 Fisherman/farmer 1 Cattle breeder/farmer 1 Farmer and retailer 1 Female farmer and production group president 1 Village headman 1 Female farmer and production group president 1 Teacher/farmer/cattle breeder 1 EGED/APAC du lac | |
| TOTAL | | | 39 interviewees |

Appendix 4: Interview guide for the LC category

All interview guides have been translated in English.

1. Focus on use and management activities on lake resources

- What are your lake-related activities?
- How do you use the lake's water?
- How do you access the lake according to your activity? Routes/irrigation/...

2. Relations with institutions

- Are any institutions involved in your activities? With which institution are you generally in contact? If so, for what?
- For each institution listed, ask:
 - How often do you contact/use...?
 - Is it they or you who call on them?
 - How do you usually communicate?
- Are there any institutions with which you currently disagree?
- Are there any projects around the lake run by institutions with which you currently disagree?

- Are there any institutions from which you would like to receive particular help? Who would you like to create links with?

3. Relations with other local players

- Who do you work with on a regular basis? Who are your key contacts?
- Who do you work with on an ad hoc basis?
- Are there any local players with whom you currently disagree?
- Are there any local contacts with whom you would like to forge closer ties?
- Who do you turn to for advice?
- Who do you turn to first when you need help (with the herd, harvesting, etc.)?
- Who do you turn to for supplies of seeds/products/livestock?
- To whom do you sell your production?

For each player listed, ask:

How do you maintain contact with...?

How often do you contact/use...?

How do you usually communicate?

Where do you usually meet? In the field, at the watering hole...

4. Conclusion/Opening

Do you have anything to add about your relationships with the actors mentioned?

Do you have any questions about what we discussed?

What did you think of the interview?

Appendix 5: Interview guide for the N category

Guide institutions - ministries

1. Focus on the management of activities and lake resources

- What is your role at national level? More specifically at lake level?
- What projects around the lake have you initiated/are you involved in?
- On what scale are you involved? Local/departmental/regional/national

2. Relations with other services

- What is your role in relation to regional, departmental and municipal services?
- What links do you have with :
 - Regional departments?
 - Departmental services?
 - Local authorities?
- Who makes the decisions? Do you submit injunctions to these different departments? In consultation or not (with other ministries, councils, etc.)?

- Would you say that the path of directives is linear? From the ministry to the local population, via the regional, departmental and municipal services?
- How often are directives reviewed?
- How are reg, dept, communal services kept informed of revisions/changes to directives?

3. Relations with local actors

- How are changes in directives transmitted to local populations? Intermediary?
- Are guidelines/measures adapted locally? How (or is it up to local people to adapt to these measures)?
- Can local communities submit requests directly to the Ministry? By what means (politician, civil servant, telephone call, e-mail, official letter, etc.)?
- What is your role with farmers/farmers/fishermen in general? Do you work directly with them or not?
- Are there any local contacts with whom you'd like to forge closer ties?

For each actor listed, ask:

How do you maintain contact with...?

How often do you contact/use...?

How do you usually communicate?

How do you go about meeting them? Travel, group meetings, contact person...

4. Relations with other national institutions

- With whom do you regularly work to carry out your activities/projects? Who are your key contacts?

For each actor listed, ask:

How do you maintain contact with...?

How often do you contact/use...?

How do you usually communicate?

Are there any institutions with which you currently disagree?

Are there any projects around the lake run by other institutions with which you currently disagree?

Are there any institutions with which you would like to create a link?

5. Conclusion/Opening

Do you have anything to add about your relationships with the actors mentioned above?

Do you have any questions about what we discussed?

What did you think of the interview?

1. Focus on management activities and the lake resources

- What is your role in lake management?
- What is your main function in lake management?
- What projects around the lake have you initiated/are you involved in?
- On what scale are you involved? Local/departmental/regional
- When do you consider your intervention necessary?
- Relations with other institutions
- With whom do you regularly work to carry out your activities/projects? Who are your key contacts?
- Who do you work with for more exceptional activities (projects, etc.)?

For each player listed, ask:

How do you maintain contact with...?

How often do you contact/use...?

How do you usually communicate?

- Are there any institutions with which you currently disagree?
- Are there any projects around the lake run by other institutions with which you currently disagree?
- Are there any institutions with which you would like to create a link?

2. Relations with local actors

- Who do you work with in the field on a regular basis? Who are your key contacts?
- Who do you work with in the field on an ad hoc basis?

For each actor listed, ask:

How do you maintain contact with...?

How often do you contact/use...?

How do you usually communicate?

How do you go about meeting them? On-site visits, group meetings, contact person...

- Who do you think are the most active local actors? Why or why not? The least active? Why or why not?
- Are there any local actors with whom you currently disagree?
- Who do you think local actors also interact with?
- Are there any contacts in the field with whom you would like to forge closer ties?

3. Conclusion/Opening

Do you have anything to add about your relationships with the actors mentioned?

Do you have any questions about what we discussed?

What did you think of the interview?

Appendix 7: Interview guide for the AB category

1. Focus on management activities and the lake resources

- What are your activities in relation to the lake ?
- How do you use the resources around the lake and what is the surface you use ?
- At what territorial scale do you put SenegIndia?
- On which communes are you present? KMS and Mbane?
- Do you have several branches (agricultural wise)?
- How is it organized? Who's leading etc

2. Relations with institutions

- Which institutions or other groups (NGO...) are you in relation with/collaborating with? For what purpose?
- Give the 3 main actors

For each actor listed, ask:

How often do you get in touch with...?

Who reaches the other one first in general?

How do you usually communicate with one another (phone call, email, official letter, visits,...)

- Where do you get funding? Is the State one of them?
- Is there any institution you aren't agreeing with? Having discrepancies with? Any of their action you don't approve? What about projects you don't approve?
- With whom would you like to get (more) in touch with?

3. Relations with local actors

- Who are you working with locally? Who are your main spokesperson?
- Give the 3 main actors.
- Do you need local workforce? How does it work?
- What happens if there are disagreements with your actions locally? Is there any local actor you are disagreeing with ?
- Do you have any relation with other agrobusinesses around?
- With whom would you like to get (more) in touch with locally?
- What construction do you do for the local population? How often do you do these?

For each actor listed, ask:

How often do you get in touch with...?

Who reaches the other one first in general?

How do you usually communicate with one another (phone call, email, official letter, visits,...)

Where do you meet one another?

4. Conclusion

Do you have anything to add regarding the relationships we have just talked about?

Do you have any questions?

What did you think of the interview?

Appendix 8: Number of participants at the restitution in each living lab location

| Location | Number of people from the LC category present at the restitution/ number of people in LC | Number of people from the DTS category present at the restitution (circumscription level)/ number of people in DTS (circumscription level) | TOTAL of participants |
|-----------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Mbane | 5/8 | 1/1 | 6 participants |
| Keur Momar Sarr | 2/3 | 3/4 | 5 participants |

Appendix 9: Outline of the restitutions

Translated to English.

Restitutions to local stakeholders - Mbane and KMS, May 11 and 12, 2023

Context

The feedback sessions took place on May 11 and 12 in Mbane and Keur Momar Sarr respectively, with the actors interviewed who were available (6 in Mbane, 5 in KMS), in the presence of my supervisors Amandine Hertzog and Etienne Delay.

The aim of the restitution was to provide feedback on the information understood via an initial analysis of the interviews carried out, in order to 1) obtain validation of this information, 2) if necessary, supplement it and 3) deepen understanding of certain social dynamics (level of dependence, importance of certain social roles, mode of management and regulation of uses or resources, etc.).

Restitution's outline

The presentations were organized according to the same model, corresponding to a presentation of between 2h30 and 3h. Four different times had been devised to structure the exchange, as follows:

Time 1 (T1): Review of certain points raised during the interviews

1) Validation of the "blocks" Actors/Uses-Actions/Resources

During this time, the aim was to explain how I had grouped the actors, uses-actions and resources according to what I had understood from the interviews, and to ask for their validation and modification as necessary.

2) The role of women in productive activities

The aim was to summarize what I had understood about women's work in each productive branch (livestock, agriculture, fishing), to question the importance of their role and their tendency to form MSEs compared with men.

3) The role of the group president

Since MSEs are commonplace in the villages and more widely in the commune, and I was able to interview several MSE presidents, I wanted to ask about 1) the choice of president, 2) the role, 3) the qualities required and 4) the links necessary for a president.

Time 2 (T2): Looking back at existing ties and dependence on social ties

1) Internal management and self-regulation

The aim was to validate the rather gregarious organization of local actors who are not part of institutions; they seem to live more in association (grouping together of producers, mutual aid, exchange of services) with a tendency to call on either the village chief or the elders in the event of disagreement/conflict only if the problem is not resolved between the two people. I wanted to validate the fact that there is a form of internal relationship management (they use the same canal, sometimes the same motor pump, agree on the irrigation day, maintain the canals together, try to settle conflicts amicably, etc.).

I also wanted to ask about the presence of local resource persons ("Swiss army knife" people) to whom people would tend to turn.

2) The financial dependence of local communities

The aim was to validate the various actors on whom local actors depend for their productive activities, and to validate the reasons why they depend on them (subsidies, training, facilities, etc.) and supplement where necessary.

I also tried to explore the following question: if all but 2 subsidies disappeared, which would you choose?

3) Relaying and adapting directives

I wanted to validate the fact that local agents (CADL, SAED, Eaux et Forêts, fisheries, livestock) are local relays who tend to apply state directives (regulatory size of canals, agricultural advice, doses to be applied, bush fires, pruning, vaccination) and transmit information to the local level.

The questions to be explored were:

- Would you say that it's the measures that adapt to you, or you who have to adapt to the measures?
- When you take a decision or initiative, do you go to them?

Time 3 (T3): Level of trust and level of dependence on resources

1) Institutional functions and level of trust

I wanted to validate the following roles:

Institutions seem to have:

- 1) Support, guidance, coordination, advice.
- 2) Regulation/repression/control.
- 3) Training and awareness-raising (pedagogical aspect).
- 4) Mediation.

The aim was to ask each participant to choose from the different "roles" the actor they trust most and the one they trust least.

Another part was planned, but was not carried out in both cases for timing reasons.

Time 4 (Final period): Opening up to opportunities and threats

To conclude, the participants were asked to consider the opportunities and threats that exist, i.e. the possibilities to be seized and the obstacles to be overcome, for the sustainability of the region.

Appendix 10: Watkins and Westphal (2016) analysis framework, on which this thesis has elaborated to build its own IG analysis framework.

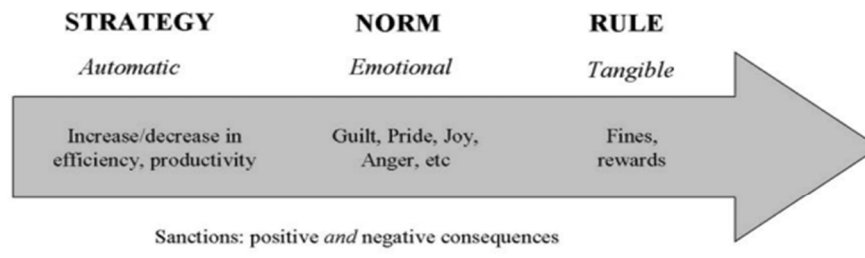


Figure 4. Strategies, Norms, Rules, and Their Associated Sanctions. Based on Schlüter and Theesfeld's (2010) Diagram.

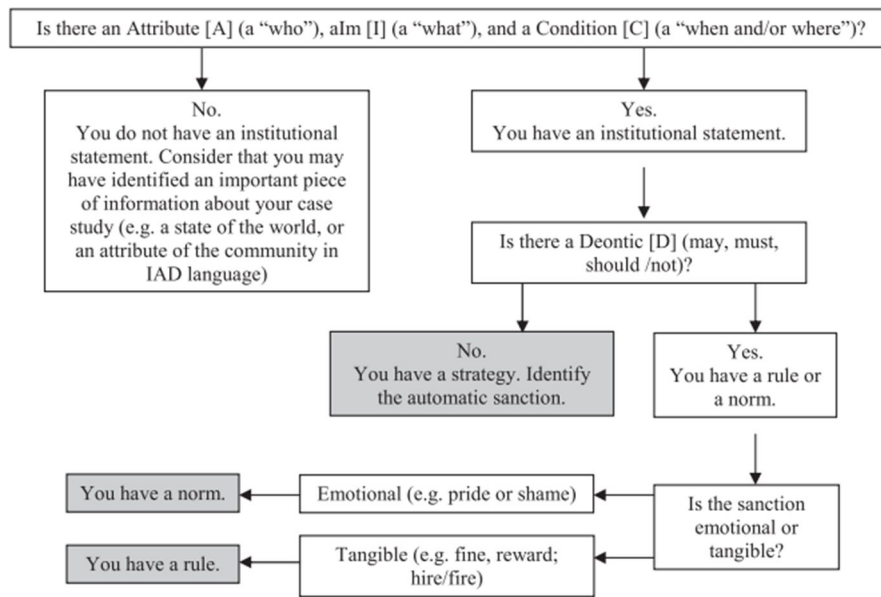
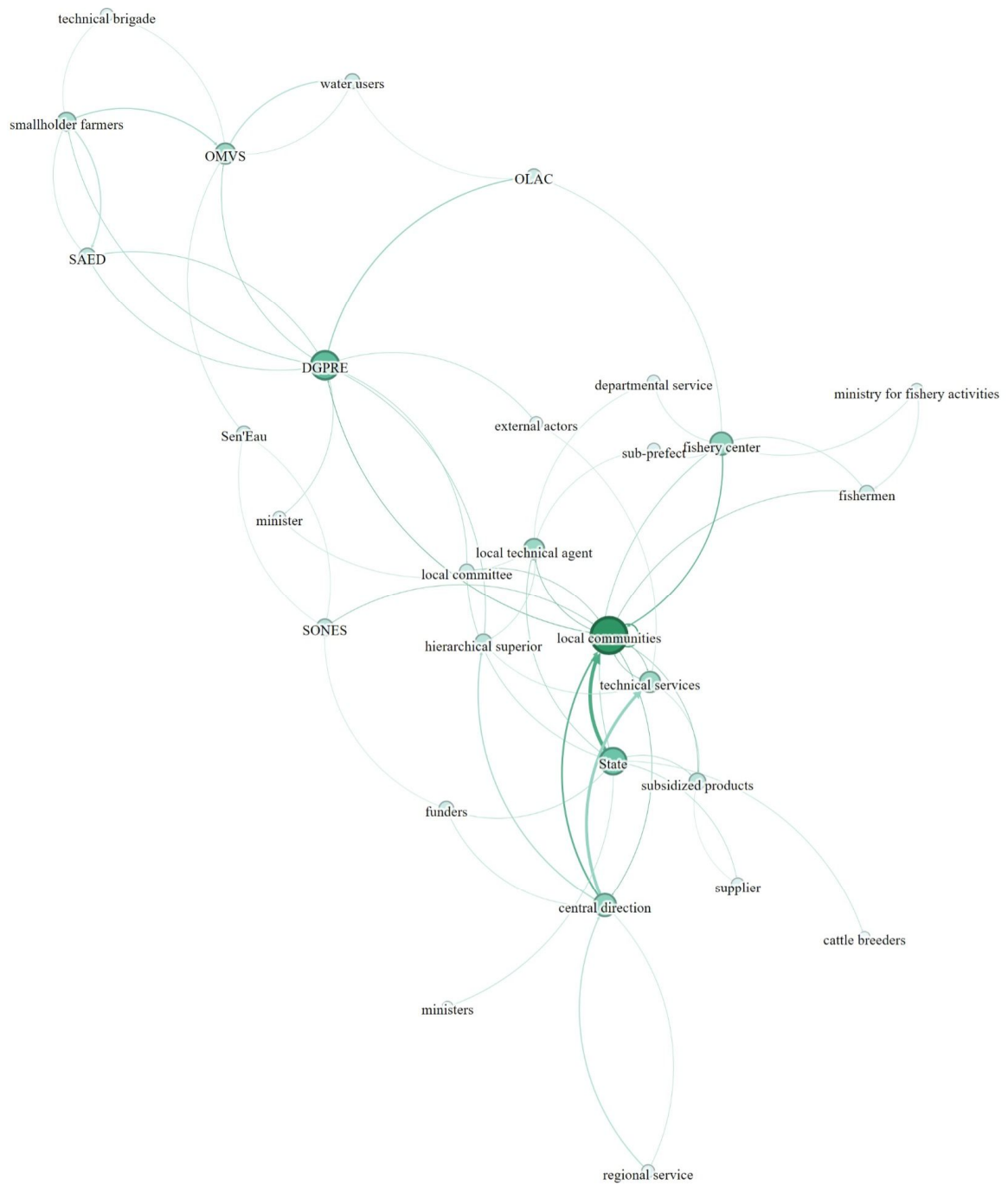


Figure 1. Decision Tree for Determining Whether You Have an Institutional Statement.

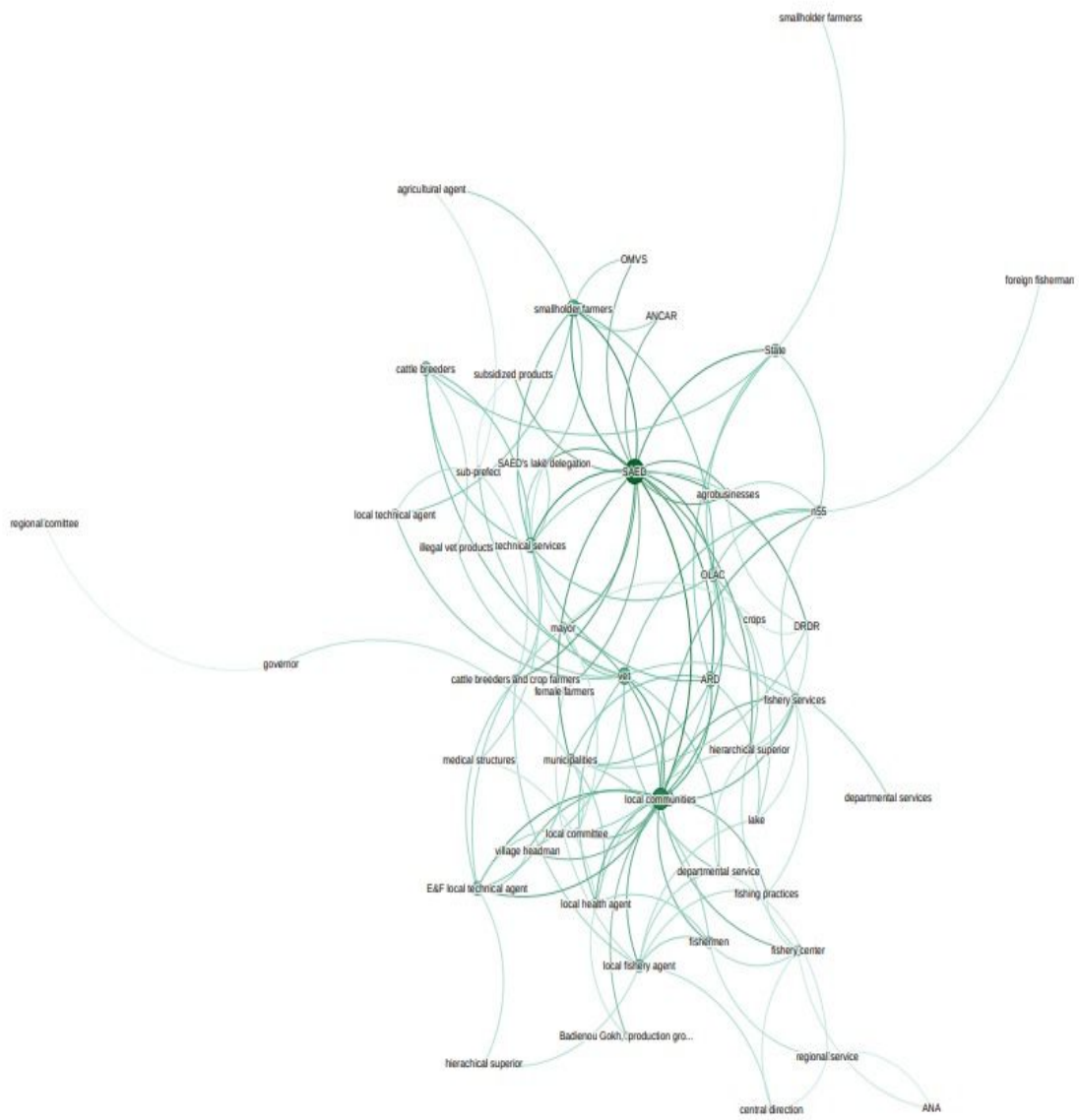
Appendix 11: TORSO criteria and notation (Maraud and Delay, 2022)

| Criterion | Anarchic-gregarious form of collective living +1 | +0.5 | 0 | -0.5 | Social form of collective living -1 |
|---------------------------|--------------------------------------------------|------|---|------|-------------------------------------|
| Management practices | Associative profile | | | | Representative profile |
| Spatial scale | Ultra-local | | | | Supra-national |
| Demographic scale | Low number of inhabitants | | | | High number of inhabitants |
| Bureaucratic significance | Low | | | | High |
| Accessibility | Including | | | | Excluding |
| Dependence on market | Low | | | | High |
| Property form | Low | | | | High |
| Authority | Non-existent | | | | High |
| Consensus significance | High | | | | Low |
| Dependance on resources | High | | | | Low |
| Impact ratio on resources | High | | | | Low |
| Structure morphology | Multipolar | | | | Centralized |
| TOTAL | 12 | 6 | 0 | -6 | -12 |

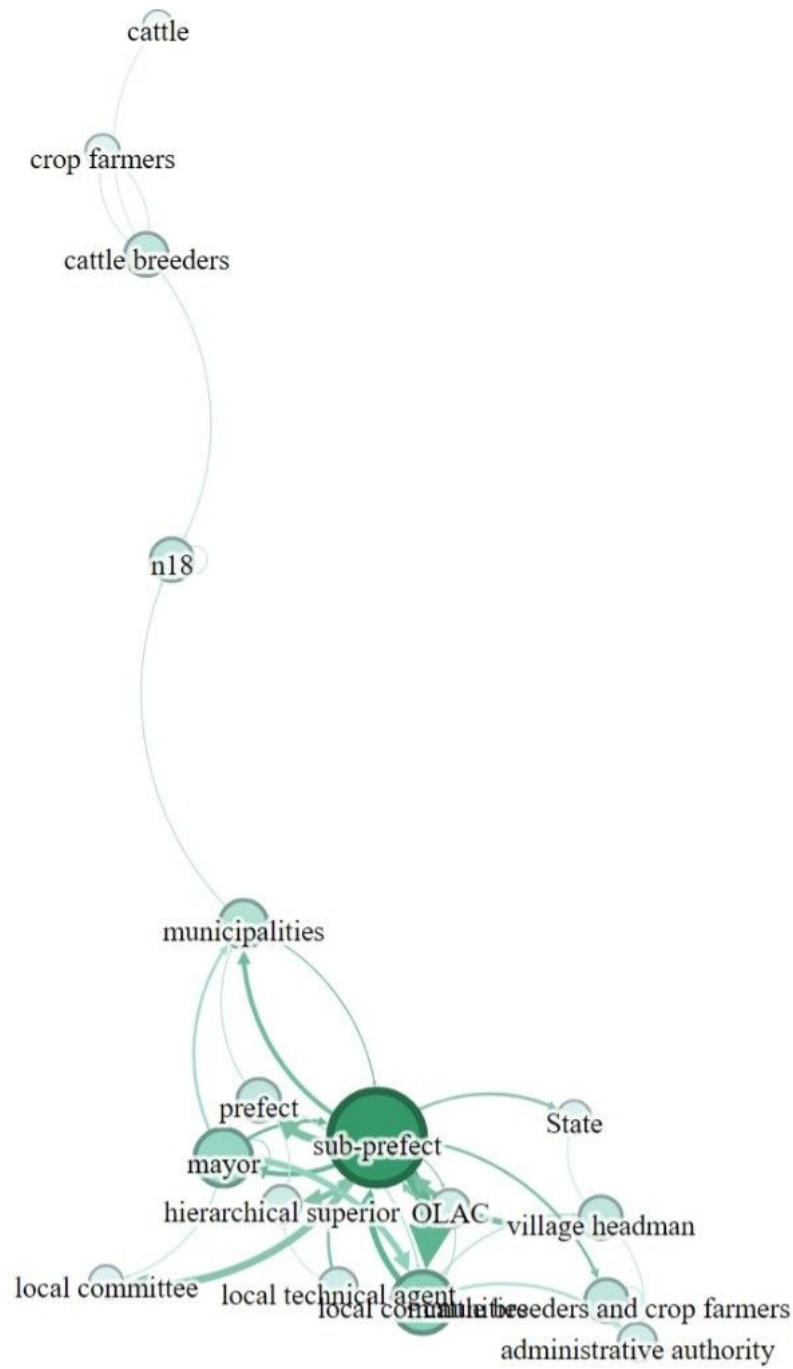
Appendix 12: Network of the N category based on the IG analysis, built with Gephy software



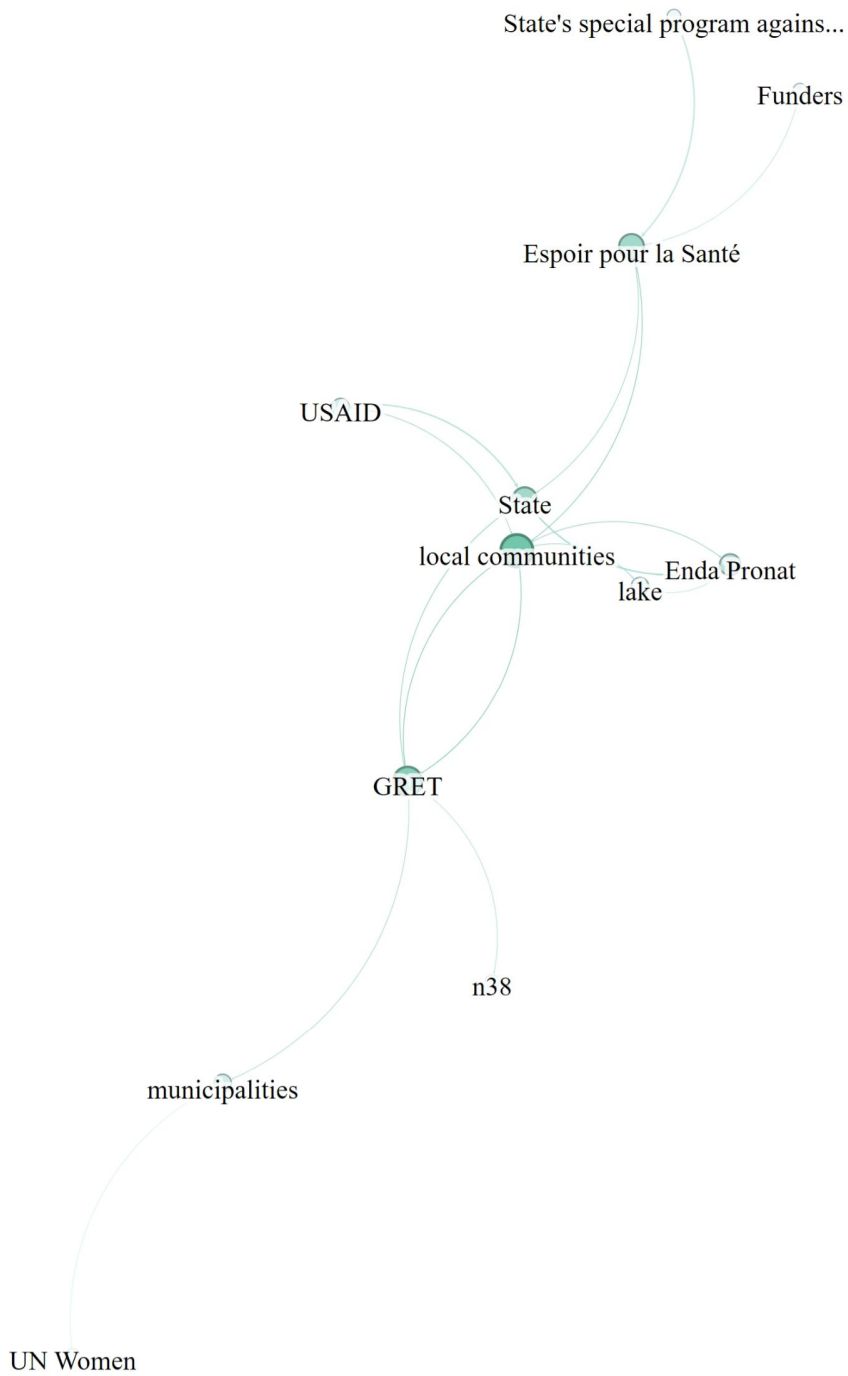
Appendix 13: Network of the DTS category based on the IG analysis, built with Gephy software



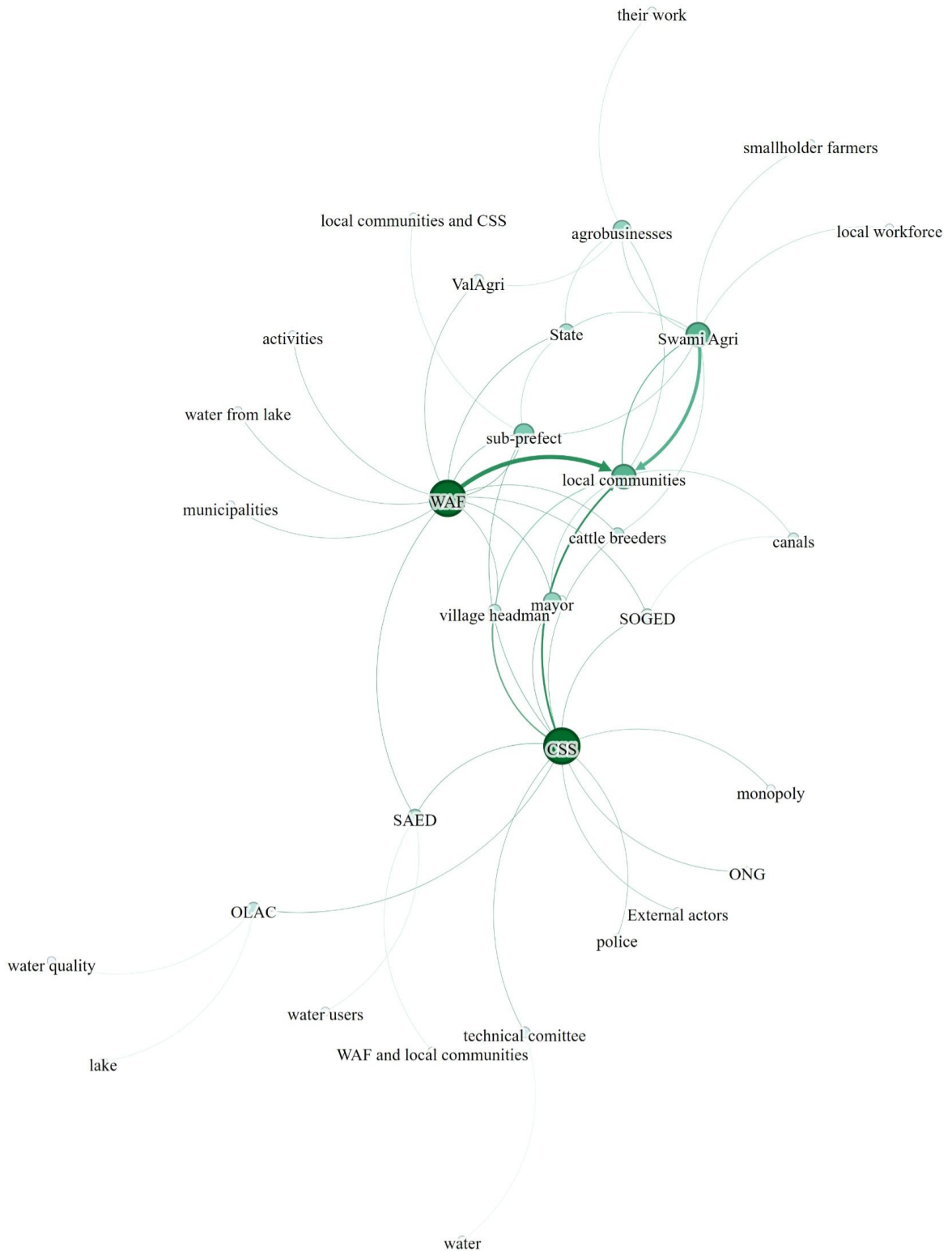
Appendix 14: Network of the DAS category based on the IG analysis, built with Gephy software



Appendix 15: Network of the NGO category based on the IG analysis, built with Gephy software



Appendix 16: Network of the AB category based on the IG analysis, built with Gephy software



Appendix 17: TORSO notation for each actor

| Actor | Anarchic-gregarious form | Social Form | Total |
|----------------------------------------------|--------------------------|-------------|-------|
| Enda Pronat | 3 | 4 | 7 |
| EGED/APAC du lac | 8 | 1 | 9 |
| SONES | 0,5 | 10 | 10,5 |
| Copelac | 6,5 | 3 | 9,5 |
| ARD St Louis | 1,5 | 6 | 7,5 |
| OLAC | 0 | 10 | 10 |
| DRDR St Louis | 0,5 | 8 | 8,5 |
| USAID St Louis | 1 | 7,5 | 8,5 |
| UN Women | 2,5 | 4 | 6,5 |
| SAED | 0,5 | 8,5 | 9 |
| Regional fishery service St Louis | 1,5 | 5,5 | 7 |
| Lake's delegation SAED | 0,75 | 7,5 | 8,25 |
| Espoir pour la Santé | 1 | 6 | 7 |
| Regional livestock service St Louis | 1 | 8 | 9 |
| GRET Saint Louis | 2,5 | 5 | 7,5 |
| Sub-prefect 1 | 2,25 | 7 | 9,25 |
| Local fishery agent | 1,5 | 7,5 | 9 |
| Local forestry agent | 2,5 | 5 | 7,5 |
| Medical community agent | 1,5 | 5,5 | 7 |
| Local agricultural agent | 1,75 | 5,5 | 7,25 |
| Local vet/livestock agent | 2,25 | 7 | 9,25 |
| Fisherman/farmer Mbane | 7,5 | 0,5 | 8 |
| Farmer and retailer | 9,5 | 0,5 | 10 |
| Cattle breeders/farmer | 7,5 | 2 | 9,5 |
| Farmer and production group president | 7,5 | 1 | 8,5 |
| Village headman | 6 | 3 | 9 |
| Female farmer and production group president | 7 | 1,5 | 8,5 |
| Teacher/farmer/cattle breeder | 9,5 | 0 | 9,5 |
| Cattle breeder/farmer/fisherman | 8 | 1,5 | 9,5 |
| Fish processor | 8 | 1 | 9 |
| Cattle breeder and | 6 | 2 | 8 |
| Sub prefect 2 | 2,25 | 7 | 9,25 |
| CSS | 3,5 | 2,5 | 6 |
| WAF | 5,25 | 2 | 7,25 |

| | | | |
|--------------------------|------|------|--------------|
| SwamiAgri | 3,75 | 3 | 6,75 |
| DGPPE | 1 | 8,5 | 9,5 |
| Ministry for fishery | 1 | 9,25 | 10,25 |
| Ministry for agriculture | 0 | 11 | 11 |
| Ministry for livestock | 0,5 | 9 | 9,5 |
| OMVS | 2,5 | 7 | 9,5 |

Appendix 18: Part 2.2 from Section 2 of the results

2.2 An entry through the conflicting situation between the local and the foreign fishermen

2.2.1 Fishing activities and the framework around to handle activities

Although continental fishing activities represent only a small part of all fishing activities in Senegal, the Guiers' lake is known for being a coveted fishing resource by both local and foreign fishermen.

The fishery services have implemented two fishery centers around the lake, which are supposed to be training the local communities on fishing and aquacultural practices, as well as experimenting new fishing techniques:

Table 16: Institutional statement created out of an interview with an actor from the DTS category

| | | | | |
|---------------------|------|-------|--------|------------------------------------------|
| The fishing centers | must | train | people | about new techniques, practices, engines |
|---------------------|------|-------|--------|------------------------------------------|

However, several actors from the fishery services admitted that the local fishery agent also have the unofficial role of enforcing the fishing rules (nets size and width). Therefore, they also endorse a regulatory role even though it is not the initial vocation of such centers. This is explained by the absence of control stations around the lake, with agents in charge of regulating and sanctioning the forbidden fishing practices:

Table 17: Institutional statement created out of an interview with an actor from the DTS category

| | | | |
|---------------------|------------|---------|------------------------|
| The fishing centers | should not | control | the fishing activities |
|---------------------|------------|---------|------------------------|

The fishery center is presented by the technical services as the closest step to the local communities; it is said to be a resourceful interlocutor for the fishermen and the overall local population who can learn about fishing in the centers. They also have a role in mediating between conflicting fishermen.

2.2.2 How fishermen can supposedly handle the resources on their own under certain conditions.

Th fishing practices can also be discussed at the local level. Fishermen can create local fishery councils and agree on management rules, spanning from the protected areas, the fishing calendar to the nets and fish size. The rules need to be respecting the fishery’s codex. For example, the size of the authorized nets can be smaller among a community of fishermen than the minimum size written is the codex.

Table 18: Institutional statement created out of an interview with an actor from the DTS category

| | | | | |
|-----------------------|-----|-------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------|
| The local communities | may | decide jointly on | common rules for fishing and protecting the halieutic resources | as long as it follows the fishery code and does not exclude any community |
|-----------------------|-----|-------------------|-----------------------------------------------------------------|---------------------------------------------------------------------------|

The codex’s rules are to be respected by all fishermen. The local councils set a list of rules that only a specific group of people within a delimited area has agreed to respect. Those councils can either be initiated by the local fishmen, or by the fishery services as an attempt to increase the homogeneity of the practices around the lake. In some cases, the prefect can support the local council’s decisions by enacting new local policies. In addition to the codex’s fishing practices, the government can decide to create official protected or restricted fishing areas.

2.2.3 How conflict arise from discrepancies between practices and roles

The fishery services insist on the respect of the codex’s practices and those from the fishery councils since they are supposed to be aligning with the codex:

Table 19: Institutional statement created out of an interview with an actor from the N category

| | | | | | |
|---------------|------|-----|-----------------------------|--------------|-----------------------------------------------|
| The fishermen | must | use | required fishing techniques | at all times | or the fishing resources are not well managed |
|---------------|------|-----|-----------------------------|--------------|-----------------------------------------------|

However, all fishermen do not respect the law or the community rules when they are any. On the one hand, there are the fishermen within one community who do not respect the communitarian rules, but they seem to be rare. On the other hand, the “foreign” fishermen, and especially the malian fishermen, are told to have disruptive practices regarding the halieutic resources. Should they be from outside a local community – for example, from other parts of Senegal – or from the neighboring country, the local communities around the lake tend to complain about disrespectful practices which do not align with either the community’s fishing rules and/or the fishing codex.

All fishermen from outside of Senegal are required to have a fishing permit, but it seems that most of them do not respect the law whether they have a permit or not:

Table 20: Institutional statement created out of an interview with an actor from the DTS category

| | | | |
|---------------------|------|--------|----------------------------|
| A foreign fisherman | must | detain | an official fishing permit |
|---------------------|------|--------|----------------------------|

- «Some fishermen have illegal fishing practices and most of them are malian nets. I do not want to stigmatize anyone, but honestly it is starting to be a plague because they truly have illegal fishing practices. Even with a permit, their practices are illegal. This is non-regulated fishing practices » (*« Il y en a qui pêchent illégalement, et la plupart ce sont des filets maliens [...] Je veux éviter de stigmatiser, mais sincèrement ça commence à devenir un fléau, car ils ont des techniques de pêche très illégales. Même s'ils ont des permis de pêche, leurs pratiques sont illégales. C'est une pêche non-réglémentée »*) (Interviewee from the DTS category)

The main issue the local communities are confronted with is the fishing of juvenile fish. Where the Senegalese fishermen tend to respect the law using bigger nets, the Malian fishermen are used to smaller but wider nets, which capture even immature specimens. The State's structures together with the local fishermen do not approve this as they believe it causes the halieutic resources to decrease and threatens the activities on the long run. In addition, the Malian fishermen are believed to intentionally damage other fishermen's nets. They also like to burn the main aquatic plant around the lake ("the typha") as to catch as many fish as possible. In doing so, they destroy any hiding spots the fish could find and put the crops and pastures at risk. Therefore, the local fishermen tend to avoid the Malian fishermen when it comes to work:

- « We do not work with the Malians, there is no work relations. They have their own nets, their own boats on the other side [of the lake]. Their material is different. They use nets with small meshes. We use meshes of 50, 60, 70 whereas they use meshes of 27, 30. Our way of fishing is different. We do not like to fish the juveniles, but they do not have any category. If they cannot eat it, they dry it and take it to Mali" (*« On ne travaille pas avec les maliens, il n'y a pas de relations de travail. Ils ont leurs filets, leurs pirogues. Ils n'ont pas leurs pirogues avec nous ; ils ont leurs pirogues de l'autre côté. Leur matériel est différent. Eux ils utilisent des filets avec de petites mailles. Nous on utilise des mailles de 50, 60, 70 et eux de 27, 30. Notre façon de pêcher est différente. Nous, on n'aime pas attraper les petits poissons, eux, ils n'ont pas de catégories. Ils pêchent tout ce qui bouge. S'ils ne peuvent pas le manger, ils le sèche et l'emmène au Mali »*) (Interviewee from the LC category)

However, it seems rather complicated to regulate the Malian's practices. More than the legal consequences, the social sanctions awaiting the Malians create an uncertain outcome for the fishery activities around the lake. Apart from an uncoordinated resource management strategy, the situation can also lead to deadly fights.

It seems that once again, the amicable solution is preferred to any other and the village headman can be involved as to find peaceful agreements:

Table 21: Institutional statement created out of an interview with an actor from the LC category

| | | | |
|----------------------|-----------------------|----------------------|------------------------------------------------------------------|
| The native fishermen | manage conflicts with | the malian fishermen | amicably, without fighting, with the help of the village headman |
|----------------------|-----------------------|----------------------|------------------------------------------------------------------|

But even when finding amicable arrangements, it appears challenging to agree on common practices around the lake when the actors involved are not aligning:

- « There are many issues, they cut your nets. But we cannot say anything unless we catch them doing it. [...] We give them recommendations, and they follow them. But the thing is, they follow them a few days and then they do it again” (*“Il y a beaucoup de problèmes, ils coupent tes filets. Mais on ne peut rien dire si tu ne le trouves pas sur le moment en train de le faire. [...] On fait des recommandations, et ils appliquent. Mais le problème c’est qu’ils appliquent quelques jours et après ils le refont.* ») (Interviewee from the LC category)

Interestingly, the local communities seem to separate the conflicts over the fishing practices to the rest of their daily activities. The “social peace” resource is manifesting here as they try to seek cohesion and solidarity as an overall objective for the well-being of the communities:

Table 22: Institutional statement created out of an interview with an actor from the LC category

| | |
|-------------------|------------------------------------------------------|
| Foreign fishermen | live and play the native football with the villagers |
|-------------------|------------------------------------------------------|

Table 23: Institutional statement created out of an interview with an actor from the LC category

| | | |
|------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------|
| Native fishermen | stay in good terms with the malian fishermen | by buying and exchanging fishery goods / mixing for everyday activities (prayers, football games) |
|------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------|

2.3 An entry through the trade-off situation between agrobusinesses and the local population

2.3.1 *The agrobusinesses' ability to implement functional communication patterns with the local communities and their representatives.*

The agrobusinesses have a unique position around the lake. As they start to flourish all around the lake, they operate in the same area as smallholder farmers. Therefore, they are developing not only in the same geographical space but also in the local communities' socio-cultural context. As a results, one of their main challenges in order to operate around the lake is to gain social acceptance and appreciation from the local communities.

To do so, they need to foster communication skills as to better reach out to the local population and show they care about their opinions and wellbeing:

Table 24: Institutional statement created out of an interview with an actor from the AB category

| | | | | | |
|------------------|------|--------------------------------------------------------|---------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| The agroindustry | must | create optimal conditions for non-formal conversations | with the local population | local | prior to conflicting situations or for any demands by opening their door to the main authority figures (village headmen, mayors, subprefects) |
|------------------|------|--------------------------------------------------------|---------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|

Since they need to show they understand and respect the power structure at play around the lake, they also tend to create good relationships with the population's representatives and prioritize them when they exchange over the population's reclamations:

Table 25: Institutional statement created out of an interview with an actor from the AB category

| | | | | |
|------------------|------|--------------------------------------|-------------------------------------------------------|-------------------------------------------|
| The agroindustry | must | develop respectful relationship with | a the village headman as the authority representative | by receiving them when they come to visit |
|------------------|------|--------------------------------------|-------------------------------------------------------|-------------------------------------------|

Moreover, they would rather search for assistance among the local representatives (either the sub-prefect, the village headman or, sometimes, the mayor) when conflicts arise with the local communities:

Table 26: Institutional statement created out of an interview with an actor from the AB category

| | | |
|-----------------------------|------------------------------------------|-------------------------------------------------------------------|
| The agroindustry must go to | mediators (sous-préfet, chef de village) | when they are in conflicting situations with the local population |
|-----------------------------|------------------------------------------|-------------------------------------------------------------------|

Meanwhile, the local population has developed its ways to reach out to the agrobusinesses. They can either go directly and meet with the agrobusinesses' representatives or choose among them one spokesperson. Sometimes, the spokesperson has been agreed upon by both the local communities and the agrobusinesses in order to collect all demands or discussion points from the local communities. It is usually an authority representative (the mayor or more likely the village headman).out of an interview with an A actor. Created out of personal notes.

Table 27: Institutional statement created out of an interview with an actor from the AB category

| | | | |
|-----------------------|------------------------|------------------|-------------------------------------------------------------------------------|
| The local communities | express their needs to | The agrobusiness | through a local representative of the agrobusiness or by going there directly |
|-----------------------|------------------------|------------------|-------------------------------------------------------------------------------|

2.3.2 The multiple compensations for preserving social peace

Apart from ensuring good communications patterns with the communities and their representatives, the agrobusinesses are used to implement several actions to secure the local communities' satisfaction. Those actions, from the IGT's point of view, are either "strategies" since they could not operate in the area without those, or "norms" since they need some of these actions to prove their legitimacy and gain people's trust. Most of the times, it seems to be a mix of both:

- "We take into account their needs, naturally, and that is what leads to a sustainable peace. Without this, there is no peace. Without stability, without helping the population, without access to water, without basic infrastructures, there cannot be prosperity » (*On prend en compte leur besoins, naturellement, et c'est ça qui provoque la paix durable. Sans cela, il n'y a pas de paix. Sans stabilité, sans aider les populations, sans accès à l'eau, sans infrastructures de base, il ne peut pas y avoir de prospérité* ») (Interviewee from the AB category)

The agrobusinesses can, for example, employ the population and therefore propose new sources of income to them.

In addition, they intend to know as best as they can the population's daily needs through meetings with the local communities, but they can also anticipate doing specific social assessments:

Table 28: Institutional statement created out of an interview with an actor from the AB category

| | | | |
|------------------|-------------|------------------------------|-------------------------------------------------------------------------------------------------------------|
| The agrobusiness | anticipates | the local populations' needs | by doing a community need assessment per age, sex categories and prioritizing the needs and the emergencies |
|------------------|-------------|------------------------------|-------------------------------------------------------------------------------------------------------------|

The compensations also manifest through several “gifts” to the local population, which can be related to farming activities since they are the main operations around the lake. Aware of the tensions between crop farmers and cattle breeders, they can provide material solutions to help avoid these. They can cultivate fodder or get rid of the straw to this end, build waterpoints for the cattle and new canals or provide farmers with seeds:

Table 29: Institutional statement created out of an interview with an actor from the AB category

| | | | |
|------------------|--------------|--------------------|----------------------------------------------|
| The agroindustry | offers straw | to cattle breeders | everytime they harvest as to avoid conflicts |
|------------------|--------------|--------------------|----------------------------------------------|

Nevertheless, the offsets can also go far beyond the agricultural activities. In most cases, agrobusinesses have a special “social envelope” as to enhance the local communities’ social or cultural life by building new infrastructures like schools, mosques, or roads. For some of them, it is even part of their CSR policy. It is worth pinpointing that most of them have a special focus on health infrastructures as well: they create and fund hospitals with medicine and buy new ambulances. They can also provide the communities with food.

Table 30: Institutional statement created out of an interview with an actor from the AB category

| | | | | |
|---------------------|-----------------------------------------------------|--------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------|
| Agrobusinesses must | offer free food products and health infrastructures | to the local communities | with the village headman and the medical structures managing them | or they might not secure their legitimacy in the area/ not be trusted |
|---------------------|-----------------------------------------------------|--------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------|

Therefore, it seems important for the agrobusinesses to be able to connect with the local communities. Rather than being seen as rivals for the access and use of the resources, they prefer to be considered as development partners who can support the population while participating in the agro-industrial take-off of Senegal. However, the situation does not always fit the communities.

2.3.3 Tensions arising from discrepancies in the resources management.

Even with the many arrangements the agribusinesses reach with the local communities, there can be tensions linked to their presence and their activities.

Some agrobusinesses can have issues with the cattle breeders not respecting their property and letting their animals stray in the fields. To provide them with fodder can ease the tensions around the sharing of the resources, but it is not always sufficient to avoid straying issues into the agrobusinesses' property. It can provoke strong reactions among them. To the question "Does straying issues happen a lot? », one of the actors from the A category answered:

- *"Anytime we are confronted to population [...] who have more consideration for their cattle than their own children!"* (« A chaque fois qu'on est confrontés à des populations [...], qui considèrent plus leur bétail que leurs propres enfants ! ») (Interviewee from the AB category)

Other agrobusinesses disapprove the way the population use the canals. The domestic activities can pollute the water and foster human or crop diseases.

The communities were also found to complain about the water pollution caused by the agrobusinesses practices. For example, they have draining techniques causing the salt and many pesticides to surface. Another problem mentioned was the monopoly on cattle manure. Most cattle breeders collect and sell it to the agrobusinesses as an extra income's source, which then makes the prices rise and decrease its availability for smallholder farmers who used to get it at a low price, or even for free. Some shared their concerns about how the pastures might lose their fertility in the long-run if the demands from the industries keep growing:

Table 31: Institutional statement created out of an interview with an actor from the LC category

| | | | |
|-----------------|-------------------|---------------------|-------------|
| Cattle breeders | sell their manure | to the agrobusiness | in priority |
|-----------------|-------------------|---------------------|-------------|

Table 32: Institutional statement created out of an interview with an actor from the LC category

| | | | | |
|--------------------|----------|----------------|------------|-------------------------------------------------------|
| The female farmers | must not | collect manure | in the pen | or breeders don't make profit out of it and get angry |
|--------------------|----------|----------------|------------|-------------------------------------------------------|

The propensity of agrobusinesses to expand their activities affects smallholder farmers' lands, which are indubitably the first in line together with the pastures. The decentralized services were told to make sure that the agrobusinesses are respecting the POAS and the existing configurations:

Table 33: Institutional statement created out of an interview with an actor from the AB category

The agrobusinesses must respect the existing pastures and dedicated paths for cattle when expanding their activities or the service can block their activity/project

Appendix 20: Proposition 1: stipend's estimation for 1 master's thesis student (based on the 2023 calculations)

Internship agreement

Agreement signature date: 01/02/2023 Is the employer a public body? Yes Number of hours per day : 7
Hourly rate of gratuity: 15.00

Monthly bonus based on the trainee's actual presence

| | Month | Year | Number of days present | Number of hours | Hourly social security ceiling | Monthly bonus |
|------------------|----------|------|------------------------|-----------------|--------------------------------|---------------|
| 1st month | February | 2023 | 20 | 140 | 27,00 € | 567,00 € |
| 2nd month | March | 2023 | 23 | 161 | 27,00 € | 652,05 € |
| 3rd month | April | 2023 | 19 | 133 | 27,00 € | 538,65 € |
| 4th month | May | 2023 | 19 | 133 | 27,00 € | 538,65 € |
| 5th month | June | 2023 | 22 | 154 | 27,00 € | 623,70 € |
| 6th month | July | 2023 | 20 | 140 | 27,00 € | 567,00 € |

Total payment due for 123 days (861 hours): €3487.05 Monthly payment smoothed over the entire duration of the internship (6 months): €581.18

Appendix 21: Proposition 1: pitch for inviting the selected actors to join the living labs

“The *Santés et Territoires* project is aiming at creating better living conditions for all people from and working around Lake Guiers through focusing on health as a common resource. It has recently launched two “Kourel”* around Lake Guiers: one in Mbane, and one in Keur Momar Sarr. The project has defined a Kourel as a shared social and technical platform

where people from many sectors and ethnicities learn and work together to find solutions for enhancing the health situation in the area. After identifying the key health issues around the lake together with the local communities and institutional actors involved in the projects, they have started identifying the orientations of the living labs. In addition, experimental techniques will be experimented soon. However, recent works within the project have revealed that more actors should be part of the experience too in the light of their role on the territory. Without _____, the project believes there would be a considerable knowledge loss which would hinder the living labs' development. To have you as part of the project would help to find more holistic solutions to the health issues and allow for more dialoguing and bonding among the participants. Your experience and knowledge on _____ would benefit all participants to find adequate agroecological practices to enhance _____. We officially invite you to the next living lab gathering in dd/mm/2024 to better learn about the project and the current activities.”

**"Kourel" is the Wolof translation for "living lab"

Appendix 22: Proposition 2: Example of workshop that could be led.

| Workshop's activity | Description | Material | Timing | Expected outcomes |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Welcome the participants (10 to 15 max) and small presentation | The facilitators gather participants in an isolated area from other participants to the living lab. They offer a drink. Each participant presents themselves in front of the group, as well as the facilitators. | A room, 15 chairs, snacks. | 10 min | Create a peaceful and energized atmosphere. Create a sense of togetherness |
| Part 1: Brainstorming with sticky notes | By pairs of 2, participants are asked to write 2 or 3 informal ways of dealing with specific health issues they relate to on sticky notes. Aicha can write for them if they do not manage to write. | Sticky notes, pens | 15 min | Invite participants to reflect by pairs be part of the reflection process. |
| Part 2: Plenary session | Aicha collects and translates orally all sticky notes. Pierre associates the sticky notes with the main health issues listed on a paper board. Participants are invited to share more options if there were missing any. | Paper board with white sheets | 45 min | List all ways of dealing with the identified health issues among the local communities for each health (Human, Animal, Vegetal, Social, |

| | | | | |
|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------|
| | | | | Halieutic/Environmental) |
| Break: 15 minutes | | | | |
| Part 3: Circle the practices they trust or distrust | Participants are invited to add a green dot on 2 sticky notes they trust to be efficient. The same is done in red for the ones they believe to be inefficient. Ask the participant to explain why. | Colored pens | 30 minutes | Individually identify the level of trust or distrust into those techniques' efficiency |
| Part 3bis: Plenary discussion | Open the discussion to all participants. Discuss which green or red colored sticky notes they agree or disagree about. | Sticky notes and paper board | 30 minutes | Collectively identify the level of trust or distrust into those techniques' efficiency |
| Part 4: Focus on the green colored sticky notes | Remove red-colored sticky notes the group jointly agreed on (and place the ones they are unsure about at the extremity of the board). Focus on the green colored sticky notes and how often they refer to them. | Sticky notes and paper board | 30 minutes | Collectively identify the level of trust into the selected techniques' collectively. Determine their applicability and frequency. |
| Closure | Thank the participants and invite to join the rest of the living labs participants | | 5 minutes | Close the discussion. |
| TOTAL | | | 3h | |

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