The Paradox of Privatization in Inland Fisheries Management: Lessons from a Traditional System

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Abstract: Privatization, often proposed as a means to regulate natural resource use, sometimes paradoxically leads to overexploitation and social exclusion. Within the unique context of Ogan Komering Ilir (OKI) Regency, Indonesia, the privatization of swamp floodplains and rivers via the “Lelang Lebak, Lebung, Sungai” (L3S) system is a testament to this dilemma. L3S grants auction winners exclusive rights to fish, thereby privatizing common-pool resources. This study delves into the intricacies of the L3S mechanism, highlighting its significance in guiding inland fisheries’ management. Through stakeholder analysis, we pinpoint the crucial actors, as well as their interests, influence, and interrelationships. Our investigation revealed 20 distinct stakeholders, each playing different roles within the L3S framework. Based on their influence and vested interests, these stakeholders are categorized as key players, subjects, context setters, and crowds. This classification aids in discerning potential conflicts, cooperation, and synergies. Effective L3S execution hinges on collaboration, especially with pivotal entities such as fishery services, village and district heads, and village-owned enterprises. Insights gathered during the study indicate that while privatization has streamlined resource distribution, it intensifies overfishing and deepens socioeconomic divisions. This study calls for a harmonious blend of historical insights and modern governance, with a central focus on stakeholder collaboration and community involvement.

Keywords: ecosystem management; inland fisheries; lelang lebak lebung; stakeholders’ analysis; system social ecology

1. Introduction

Sustainable natural resource management is a critical issue in the discourse on sustainable development, particularly in inland fisheries. As a common pool resource (CPR), privatization is the dominant model for managing inland fisheries in open waters (inland waters) [1]. Privatization addresses the ‘tragedy of the commons’, where collective utilization can lead to resource degradation, and has become a subject of scrutiny and debate in recent years [2,3]. The debate emerges from the paradox between the theoretical merits of privatization, which suggests resource conservation and efficient allocation, and its practical implementation, often revealing a contrasting narrative. In practice, privatization has often promoted resource overexploitation and restricted local community access,
driven by factors such as limited regulation, oversight, and a focus on short-term economic gains [4–7].

These paradoxical outcomes are strikingly evident in the Ogan Komering Ilir (OKI) regency in South Sumatra, Indonesia, where a rooted traditional mechanism known as the “The Auction of Swamp Floodplains and Rivers” (“Lelang Lebak, Lebung, dan Sungai”/L3S) has been implemented to manage inland fishery resources. The L3S system serves as a localized representation of privatization with the Territorial Use Rights for Fisheries (TURFs) model [8]. Originating in the 17th century, the L3S was conceived as a community-centric approach that allocated fishing territories through auctions. The primary goal is to align sustainable resource exploitation with community welfare. Under the L3S system, exclusive fishing rights within designated territories are granted to the auction winners. This system, with its emphasis on territorial demarcations and economic rent, mirrors practices commonly found in Southeast and Central Asian countries [9,10].

However, the modern iteration of the L3S in OKI, influenced by socioeconomic shifts and governance changes, has brought forth challenges. Commercial prioritization and intensified fishing activities have raised concerns about the overfishing and marginalization of local communities [11–13]. These overfishing status conditions are linked to the practice of auctioning waters as a form of privatization in the OKI Regency [14,15]. Various factors, including the high costs associated with bid rigging in auctions and lack of robust oversight, have exacerbated these concerns and cast shadows on the socio-ecological landscape of the region. This includes the use of destructive and nonselective fishing gear [16].

Recognizing the complexities of these dynamics requires a deep dive into the roles and perspectives of the various stakeholders involved. Stakeholders, from local fishermen to commercial entities and policymakers, bring unique priorities, knowledge, and influences. By examining their motivations, constraints, and interactions, this study sought to unveil the multifaceted implications of the L3S mechanism. Such an understanding is crucial not only for identifying the challenges, but also for crafting solutions that align with the needs and aspirations of all stakeholders.

This study seeks to unravel the intricacies of the L3S mechanism in the OKI Regency, shedding light on the unintended socio-ecological repercussions of a well-intended system. Through a comprehensive stakeholder analysis, this study aims to offer insights that can inform more holistic, equitable, and sustainable resource management strategies.

2. Materials and Methods

2.1. Study Site

The study site was located in the OKI Regency (Figure 1), which is one of Indonesia’s largest floodplain areas. Approximately 1.2 million ha (70%) of the regency’s land is lowland and is prone to flooding during the rainy season. To capitalize on the potential of inland fisheries, the local government privatized the floodplain, granting exclusive fishing rights to individuals or organizations in specific water bodies. The regency government holds an open auction annually to determine who can use the transferred fishing rights. There were 328 auction objects with an Indonesian Rupiah (IDR) of almost seven billion (USD 480.208, exchange rate IDR 14.577/US$, in 2020).

2.2. Research Framework and Methodology

This study primarily focuses on the dynamics of Common Pool Resources (CPR) management that was privatized through an auction mechanism. The auction concept and other significant threats to inland waters have contributed to four main issues identified as challenges in managing CPR in the OKI Regency. To understand these issues comprehensively, our approach integrates stakeholder analysis with the consideration of seasonal fluctuations that affect the social–ecological landscape [17–20]. Seasons influence fish availability, hydrology, and community behavior. Data collection was conducted throughout the year to account for these seasonal dynamics, specifically the rainy season, transitional
season, and dry season. This ensured that the study’s findings considered the dynamics of the seasonal shifts.

![Figure 1. Map of L3S coverage used in this study in the OKI Regency.](image)

2.2.1. Framework for Stakeholder Analysis

The auction system used to manage inland waters adopts a privatization model for natural resource management. The state provides management authority and binding obligations to the auction winner to use the benefits of the resources, control damage, and maintain sustainability. Hardin’s theory of the tragedy of the condition of the commons, in practice, becomes the tragedy of enclosure. The tragedy of enclosure explains a situation in which the spirit of guarding common pool resources (CPRs) becomes a humanitarian disaster by limiting people’s access to natural resources [21–23].

Based on economic principles, privatization usually deals with resource allocation efficiency, and private management is more efficient than community management. However, efficiency, as an economic goal, often prevents the achievement of other goals, especially the social aspects related to the use of resources, such as community welfare, ensuring the sustainability of natural resources, and improving the economy of local communities in general. Thus, the effectiveness of privatization should be conceptualized more broadly than more efficient resource use, especially to achieve the goals that result from the interaction between applicable and desired social and ecological systems by more parties.

This study focuses on the dynamics of CPR management that is privatized through an auction mechanism. The auction mechanism and other significant threats to inland waters contributed to the four main issues identified as problems in managing CPR in the OKI Regency [24]. These include ineffective management, stakeholder conflicts, marginalization of the community in accessing natural resources, and a decrease in fish resources. To address these concerns holistically, a sustainability evaluation was guided by several key criteria, including fish stock abundance and diversity, equitable benefit distribution, economic driving, and the enhancement of livelihood and living standards for fishing communities and villages [25–28].

The issues are expected to be understood: what in L3S has ensured that condition? The existing conditions and ways to achieve this goal were then approached using stake-
holder analysis. The study examines stakeholders’ perspectives on privatization, originally theorized as a mechanism to prevent the ‘tragedy of the commons by promoting efficient resource utilization’; however, in practice, this has often led to contrary outcomes. The study further examines what happens during the implementation, and where gaps occur. The action arena between stakeholders is the existing CPR practice and a response to the additional features. Figure 2 illustrates the research framework.

Figure 2. Research framework.

2.2.2. Stakeholder Analysis Methods

A stakeholder analysis was conducted to understand the governance of the auction’s current practice and intervention implementation plan [29]. The stakeholder analysis was performed in three stages [30].

1. Identifying stakeholders. This information was gathered by asking respondents open-ended questions: “which actors have an influence on the auction practice and intervention implementation plans?” and “which actors get affected by the auction practice and intervention implementation plans?” [31]. In this study, stakeholders were initially identified through a combination of desk research and interviews with key informants, such as local government officials and the leaders of fishing communities. These informants were chosen based on their prominent roles and knowledge of the local fisheries management system. Subsequently, a snowball sampling technique was employed, where these key informants suggested additional stakeholders, enabling us to expand our stakeholder network and ensure diverse and inclusive representation in our study.

2. Stakeholders were categorized according to their interests and influence using an influence–interest matrix [31]. Stakeholders were classified into four quadrants: key players, subjects, context settlers, and crowns. In determining the levels of interest and influence of stakeholders, the study used the following considerations (Table 1):

3. Development of stakeholder linkage matrix [32]. This describes the role and relationship of stakeholders, which is useful for evaluating the trade-offs of interest. The relationship between stakeholders is categorized into four states: conflict, cooperation, complement, and unlinked/unknown.
Table 1. Guided questions to assess the interests and influence of stakeholders.

<table>
<thead>
<tr>
<th>Assessment of Influence</th>
<th>Assessment of Interest</th>
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<tbody>
<tr>
<td>- Do the stakeholders influence directly the regulatory-making processes of the auction mechanism?</td>
<td>Do auction practices directly impact the stakeholders interest?</td>
</tr>
<tr>
<td>- Do the stakeholders have a significant role in the auction practices?</td>
<td>Do the stakeholders have preferences regarding auction practice?</td>
</tr>
<tr>
<td>- Are the stakeholders able and competent in providing direct recommendations to the regulators regarding auction mechanisms?</td>
<td>Do the stakeholders’ responsibility and interests intersect the auction practices?</td>
</tr>
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The level of influence and interest are determined by the number of yes answers: High [3 yes answers]; medium to high [2 yes answers]; medium to low [1 yes answer]; low [no yes answers].

2.3. Data Collection and Analysis

2.3.1. Design for FGD Stakeholders with Asymmetry Power

FGDs were conducted with different groups of participants to prevent conflict or debate in the discussion because of their different interests or the domination of powerful individuals and patrons [33]. The following three-level FGDs were performed.

1. At the village level, Bangsal Village, OKI Regency. The FGDs were conducted three times with the participants, including the head of the village, community monitoring group, director of village-owned enterprises, community leaders, fishermen, and auction winners. The first FGD examined the current condition of the village’s fisheries, including fish stocks and diversity, fishing gear and harvest time, the number of people engaged in fishing, the arrangement among various users in managing inland fisheries’ resources, the impact of privatization and the dynamics of the auction mechanism, constraints and conflicts among stakeholders, and the conflict resolution mechanism. The second FGD discussed options for intervention programs, as well as community perspectives and readiness. The third FGD aims to validate the information obtained from government officials at the OKI Regency Level.

2. At the government level, OKI Regency. The FGD participants were from the OKI Regency Fishery Service Office, which includes the head, secretary, capture and aquaculture unit head, fishery extension officers and university researchers. The FGD analyzed the data collected from the FGDs at the village level, including fishing conditions, conflict situations, and implementation plans for intervention. This FGD also aimed to validate information from the community of Bangsal Village.

3. The final FGD involved broader stakeholders. The FGD was attended by the following groups: (1) OKI Regency officials (Regency Fishery Service Office and Regional Planning and Development Agency); (2) academics from South Sumatera Province (Sriwijaya University, University of Muhammadiyah Palembang, OKI Islamic University, and Research Center for Marine Resources Conservation and Inland Fisheries at National Research and Innovation Agency); (3) Non-Governmental Organizations (NGOs) (Muhammadiyah South Sumatra Environmental Council, South Sumatra Watershed Forum, South Sumatra Peat Monitoring Node); and (4) stakeholders at the village level (head of the villages, director of village-owned enterprises, fishermen community leaders). The objective of the FGD is to discuss three main issues: the state of fisheries in the OKI Regency, auction practices, and options for intervention strategies. Regarding auction practice, the FGD elaborated on the auction mechanism and how it affects the resource and community, the role of each stakeholder, and areas for improvement.
2.3.2. Semi-Structured Interview

In-depth semi-structured interviews were conducted with diverse stakeholders involved in the L3S system. A total of 40 individuals, including local fishermen, auction winners, government representatives, and community figure, were interviewed (Table S1). These dialogues were designed to extract perspectives on the socio-ecological sustainability of the L3S system and to identify potential conflicts or collaborative approaches among stakeholders.

2.3.3. Direct Observation

Direct observation sessions were conducted to witness on-ground operations and interactions within the L3S framework. This involved observing auctions, fishing activities, and the interactions between various stakeholders. The observations aimed to provide a real-world context for the information gathered during interviews and to identify any discrepancies between stated practices and actual behaviors.

2.3.4. Data Analysis

Data from the interviews and observations were transcribed and analyzed using a thematic analysis. This method facilitates the identification of recurring themes, patterns, and insights related to the L3S system’s socio-ecological implications. The results of this analysis were then compared and contrasted to identify areas of consensus and divergence among the stakeholders.

3. Results

3.1. Identifying Stakeholders and Their Interests

This study identified 20 prominent actors with distinct roles and interests (Table S2). The relevant stakeholders were categorized into three groups: government entities, users, and the professional sector. These actors were involved in the implementation of the auction and considered to influence upcoming interventions. The government is a regulator, implementer, and facilitator of auction activities. The user categories were community groups affected by the policy. They used water bodies for various economic and social purposes. They are the most vulnerable groups because they are economically and socially weak [34]. The third category was professional and comprised non-direct stakeholders, such as researchers, academics, and Non-Governmental Organizations (NGOs). This group is a facilitator and advocate for community groups on environmental and societal issues. Although this group was not actively involved, its contribution was crucial. This group has a sufficiently audible voice to assist vulnerable groups in raising their concerns.

In the governmental sector, stakeholders such as the Provincial Fisheries Service, Head of District, and Community Empowerment and Village Service (CEVS) play pronounced roles in shaping policies and guiding community development with a keen interest in promoting sustainable fisheries management, achieving fiscal targets while maintaining social harmony, and facilitating smooth village development initiatives, respectively. The Regency Fishery Office and Head of Village further complemented these efforts, aligning their interest in fulfilling statutory obligations and nurturing the growth of the regency fishery sector, while ensuring food security at the village level.

A diverse range of user stakeholders, including auction winners, bidders, and fishermen, maintain a significant influence through capital assets and networks. These entities are fundamentally driven by the desire to secure fishing rights, win auctions, and acquire favorable fishing spots. These stakeholders, such as peasant fishermen, buffalo herders, and rice field owners, rely heavily on the landscape for their livelihoods. They aim to secure employment opportunities, unhindered access to floodplains, and protection of their crops and livestock, thereby highlighting a deep-rooted interdependence with natural resources.

In the professional sector, groups such as the fishery extension and Community Surveillance Group work diligently to ensure the conflict-free documentation and monitoring of fishery activities, showcasing a concerted effort to ensure sustainable practices. Entities
such as NGOs and the National Research and Innovation Agency (BRIN) have brought to the fore a profound commitment to addressing conservation, ecological, and property rights issues through advocacy and scientific research, underlining a professional obligation towards a sustainable fisheries landscape.

3.2. The Classification and Categorization of Stakeholder Groups

A matrix chart divides the identified stakeholders into four quadrants based on their influence and importance level: key players, subjects, crowns, and context setters (Figure 3). Key players are central to the success and effectiveness of interventions. The programme must foster active collaboration and involvement among these groups. The Regency Fishery Office oversees the implementation auctions, bearing responsibilities that span economic (increasing locally generated revenue), ecological (ensuring fisheries' sustainability), and social (enhancing community fishermen’s welfare) interests. Village-owned enterprises (VOE) are expected to be pivotal in coordinating and aiding community groups in their quest to enhance management. This includes supporting community surveillance groups and running hatchery units, which are critical in restocking activity interventions. The village head has significant responsibilities, including authorizing budget support from village funds and establishing a legal framework through village regulations for various programmes. The district head plays a crucial role in supervising district-level auction activities and has approving the policies and budgeting strategies devised by the village head.

Figure 3. Matrix of influence and interest. The color backgrounds represent the stakeholder categories. Dark brown represents policy makers, light brown represents professional parties, and orange represents users.

The subjects encompassed stakeholders with a high dependence on the program, yet they had limited influence. To ensure that their concerns are adequately addressed, it is vital for this demographic to build alliances with groups capable of yielding decisive outcomes, such as academic institutions and the house of representatives. Despite their central role as governmental frontrunners, fishery extensions face challenges arising from constrained resources. The financial stability of bidders and auction winners, who have heavily invested in fishing gear, is fundamentally linked to securing fishing spots where this gear can be effectively utilized. The Community Surveillance Group encounters difficulties...
in fulfilling its supervisory responsibilities due to limited capacity and resources. Rice field owners, although holding legal titles on their lands, find that their rights conflict with the privileged auction-winners’ right to fish on their properties.

Context-setters are characterized by their high influence, although this is coupled with low interest in the program. Keeping this group informed about the program’s dynamics is vital, leveraging their potential to break deadlocks, notably by aiding key players in overcoming encountered barriers. Their engagement is fundamental, serving as the catalyst for resolving issues and facilitating solutions. However, it should be noted that their participation is voluntary; hence, it is crucial to formulate approaches and address issues that can facilitate their involvement.

Crowds encompass stakeholders with limited resources, necessitating continuous updates regarding the dynamics of L3S. Under conducive circumstances, this group can forge strategic alliances and encourage primary stakeholders to address the concerns of vulnerable factions. Stakeholders in this group, including buffalo herders and water transportation users, are keenly interested in mechanisms that would grant them the right to utilize resources more effectively. The involvement of the Community Empowerment and Village Service is indispensable in this context, as they facilitate the necessary approvals for budgets and policies at the village level.

3.3. Relationships between Stakeholders

Based on the analysis derived from the stakeholder linkage map theory, a deep understanding of the dynamics between various stakeholders in the context of natural resource management emerges. In the analyzed matrix, relationships were differentiated into three primary categories: potential conflicts (represented by red), complementary dynamics (denoted in blue), and cooperative ties (highlighted in green) [35,36]. The absence of color signals undefined or non-existent relationships between certain stakeholders.

The analysis revealed several relationships characterized by potential conflicts. The identification of these relationships is a pivotal process, paving the way for the formulation of appropriate mitigation strategies to forestall conflict escalation and foster harmony. Interventions can encourage dialogue between conflicting entities, foster mutual understanding, and seek solutions that are beneficial to all involved parties.

Complementary matrix–performance relationships indicate existing synergies and reciprocal dependencies among various stakeholders. Understanding these dynamics is essential for leveraging such relationships to foster more inclusive and enduring solutions. Strategies to enhance these relationships could facilitate closer collaboration and foster the sharing of resources or information, thereby nurturing a fertile ground for productive alliances.

Cooperative relationships reflect the tradition of collaboration among certain stakeholders. The nurturing and expansion of these ties will be integral to the blueprint of intervention strategies, emphasizing the construction of trust and fostering platforms conducive to future collaboration.

Actor linkage map analysis provides a strong framework for navigating an intricate web of stakeholder relationships in natural-resource management. Utilizing the insights obtained from this analysis is central to the crafting of effective intervention strategies that adeptly weave various interests into a tapestry of sustainable and inclusive resource management. With these insights, intervention strategies can be devised in harmony with the established patterns of stakeholder relationships, capitalizing on opportunities for cooperation and complementarity while steering clear of potential conflicts [37]. The relationship pattern details are shown in Figure 4.
4. Discussion

4.1. Tracing Back the Roots: L3S and Its Historical Conservation Approach

Historically, the L3S system, deeply rooted circa the 17th century in the Palembang Darussalam Sultanate era, was not merely a mechanism for resource management but also represented the intricate socio-cultural fabric of the local communities. Auctions of water bodies, documented in “Oedang-Oendang Simboer Tjahaja”, reflected not only economic transactions, but also a commitment to maintaining ecological balance [38,39]. This commitment was embedded in the tribal government’s emphasis on fish sanctuaries. These sanctuaries ensured the protection of vital breeding grounds, fostering sustainable harvest while preserving species diversity. Beyond mere conservation, these practices symbolize the harmonious relationship between humans and nature, emphasizing the principle of taking only what one needs. The L3S system was initially designed to prioritize sustainable resource management, considering ecological and societal concerns while still considering economic interests. Recognizing the vital role of local stakeholders, the system allowed for artisanal fisheries the right to have a voice in decisions, ensuring that fishing practices did not harm the environment or socio-cultural fabric of the community.

Comparative studies have shown that indigenous practices such as L3S are often more sustainable than modern commercial systems. Such practices prioritize the community over individual gains and take a long-term view of resource management, considering future generations [8,40]. The conservation approach of the L3S, which is deeply intertwined
with local customs and traditions, serves as a powerful reminder of the importance of integrating indigenous knowledge into contemporary resource management frameworks.

4.2. The Modern L3S: A Departure from Tradition?

The transition from tribal governance to regional government administration caused a significant shift in the L3S operational dynamics. Modernization, while providing benefits, also came with challenges. Increased competition, driven by commercial interests, started to alienate artisanal fishermen, exacerbating socio-economic disparities, and led to the dilution of community-driven checks and balances [41,42]. The challenge with modern systems, as evidenced by the L3S, lies in balancing economic growth and ecological sustainability. Technological advancements and global market dynamics have intensified pressure on local resources. As a result, the L3S, which once stood as a model of sustainable resource management, is grappling with the challenges of overfishing, habitat degradation, and socio-economic inequities. The research indicates that traditional systems, when integrated with modern governance structures, can offer solutions to these challenges [43,44].

4.3. Paradox of Privatization: Conservation Goals vs. Commercial Exploitation

While privatization was posited as a solution to the ‘tragedy of the commons’, the L3S system’s trajectory highlights its paradoxical outcomes. The intention behind granting exclusive fishing rights was to ensure regulated and sustainable usage. However, evidence, as seen in declining fish populations and environmental degradation, suggests a shift towards over-exploitation. This trend is not isolated, but reflects broader global challenges, in which privatization often amplifies resource exploitation pressures [45,46]. Privatization in the L3S system presents a paradox: while it promises enhanced resource allocation and economic efficiency, it simultaneously challenges both equity and sustainability. Dominant commercial entities equipped with sophisticated fishing technologies have not only escalated resource extraction but have also sidelined traditional fishing communities. Consequently, contemporary L3S confronts a pressing dilemma: How can we balance burgeoning commercial interests with paramount conservation objectives and the rights of local communities?

4.4. Bridging the Gap: Learning from the Past for a Sustainable Future

The essence of rejuvenating the L3S system is to strike a balance between its historical roots and the present-day challenges. An indispensable element of this equation is stakeholders’ proactive engagement. The actor-linkage map reveals intricate dynamics, unveiling possible conflicts and collaborative opportunities, thus charting a path for bespoke interventions [47,48]. Constructive dialogues between commercial entities, fishermen, and policymakers can steer the L3S system towards a more sustainable trajectory.

The historical significance of sanctuaries and community-oriented regulations can be seamlessly woven into the present governance structure. Collaborative decision-making, enriched by the perspectives and apprehensions of all involved parties, stands paramount. The reverence for traditional knowledge systems and the emphasis on community engagement will be instrumental in ensuring that the L3S system thrives as a model of sustainable and equitable resource management [49,50].

An example of this synergy is evident in the Tapus Villages. This village showcases an approach to the L3S that is deeply anchored in community traditions and values. Notably, while the community is an active participant in the auctions, they ensure the absence of competing bidders, thus ensuring stable access prices to water bodies. Upon securing control, they champion sustainable practices that prioritize community well-being [51]. A salient initiative that they have adopted is a three-month fishing moratorium during the breeding season, safeguarding the regeneration of fish populations. This community-driven modus operandi, bolstered by pivotal stakeholders, such as the village head and fisheries department, underscores how the amalgamation of cultural norms with strategic foresight can sculpt a sustainable and community-focused resource management paradigm.
5. Conclusions

The L3S system, with its deep historical roots, embodies a fusion of sustainable fishery practices that has evolved over time. While its modern implementation has economic benefits, it also faces challenges, especially in the domains of resource over-exploitation and socio-economic imbalances. Central to these challenges is the paradox of privatization, where conservation objectives sometimes clash with commercial pursuits.

This study emphasizes the significance of stakeholder engagement and the nuanced dynamics they bring to the L3S system. By using the wisdom of historical practices and integrating them with modern management strategies, we can navigate the complexities of the L3S landscape. Embracing the core values of the L3S system, ecological harmony and community well-being, is crucial. This can be achieved through collaborative decision-making, assimilating traditional knowledge, and fostering genuine community involvement.

An exploration of the L3S mechanism revealed the potential socio-ecological risks of disparities in access to resources, leading to community marginalization and fish resource depletion. We discerned that while privatization within the L3S framework offers certain benefits, it also has inherent challenges that can lead to adverse effects. Addressing these issues requires a nuanced approach that respects stakeholder perspectives, ensuring that any interventions are both accepted and effective.

This study illuminates the intricate facets of the L3S system and its implications. By elucidating the interplay between stakeholder interests and dynamics, we offer insights that are valuable to both academia and policymakers. While our study provides a holistic view of L3S challenges, it is imperative to acknowledge its limitations in scope, particularly regarding intervention specifics. We advocate for future research to delve deeper into intervention designs, further enhancing our understanding and management of the socio-ecological intricacies intrinsic to systems, such as L3S.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su152316273/s1, Table S1. Stakeholders interviewed for the study. Table S2. Stakeholders influence and interests.

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