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Polycentric river sand governance: lessons from Makueni County, Kenya

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Concepts and Perspectives

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Abstract

Non-Technical Summary. River sand is essential for construction, but poorly governed mining can damage rivers, reduce water availability, and create conflict within communities. This study explores how Makueni County, Kenya, has responded to these challenges over time. Different actors, including local communities, county governments, and national agencies, have each developed their own approaches to regulating river sand mining, but they have often worked separately rather than together. We show how a more collaborative approach, known as 'polycentric governance', can improve coordination, strengthen community participation, and help balance economic development with healthy rivers, reliable water resources, and sustainable livelihoods.

Technical Summary. Demand for sand on a global scale has far outpaced governance, particularly in the Global South, where it is essential for infrastructure, urbanization, and livelihoods. In Makueni County, Kenya, for instance, sand governance has evolved from open access to community-driven informal regulation and, more recently, formal county-level control, all evolving against the backdrop of a tapestry of national codes that could provide some control. However, institutional disconnects across the local, county, and national levels continue to undermine sustainable river sand governance. Drawing on a historical-institutional analysis, this paper argues that Makueni's governance system displays signs of latent polycentricity. If properly institutionalized, this could support more resilient and equitable river sand management that reconciles the competing objectives of the economic use of sand and the effective conservation of its ecological functions within these vulnerable river systems. Applying three of Ostrom's principles (Principles 2, 7, and 8), we propose three key interventions:
1. Institutional diagnosis using the established building blocks approach to determine the roles, rules, interests, stakes, and interactions of community, county, and state sand governance actors;
2. Formal recognition of community organization and rules;
3. Strengthening mandates by internal vertical coordination and role clarity across actors.

Social Media Summary. From fragmented efforts to coordinated action: a polycentric path for Makueni County's river sand governance.

1. Introduction

The rapid global escalation in sand extraction, reaching approximately 50 billion tonnes annually (UNEP, 2022), has made sand both an indispensable resource and a sustainability risk. In the Global South, this demand – driven principally by urbanization, infrastructure development, and local livelihood ventures (Bachmann et al., 2024; Daghar, 2022) has overwhelmed many governance mechanisms worldwide (Noorbhai et al., 2025; Yasmin et al., 2024). Kenya's Makueni County offers a compelling microcosm of the evolution of this global sand governance dilemma: from chaos and criminality to regulatory experimentation. Yet, formal and informal systems are in tension, and missed opportunities for better river sand governance underscore the urgency for more integrative approaches. One promising emerging model seen in Makueni County is that of polycentric governance, which involves multiple decision centers operating across overlapping jurisdictions. Polycentric governance, or polycentricity, refers to the management of resources by multiple actors and decision-making centers instead of a single centralized authority or monocentricity (Jordan & Huitema, 2023; T.H. Morrison et al., 2019; Tiffany H. Morrison et al., 2023; V. Ostrom et al., 1961). This paper seeks to explore whether it is plausible that Makueni County's river sand governance has key features of polycentrism, which may only require harnessing to realize its full institutional potential.

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2. The evolution of sand governance in Makueni County

River sand governance in Makueni has evolved through three distinct but overlapping phases.

The *first phase*, from Kenya's independence in 1963 through the early 1990s, was characterized by a *de facto* open-access regime, characterized by a lack of proactive regulatory systems. Influential politicians facilitated early sand mining activities through rent-seeking, exemplified by the Muooni River-Kwa Mulu case in Emali. Ranch administrators endorsed sand mining on community ranch rivers, while local youth took control over specific river sections for sand mining. Some groups were formally registered by government authorities and issued *ad hoc* permits lacking clear governance and regulatory standards, while others operated informally, asserting control through coercive and often violent means. Though informally sanctioned, the activity lacked recognition and regulation. The outcome was ephemeral rivers supplying Nairobi's booming construction sector with little governance oversight (Bendixen et al., 2023; Padmalal & Maya, 2014), resulting in unprecedented environmental degradation (Aduda & Bolf, 2024; Duker et al., 2025; Muthomi et al., 2015).

The *second phase* began in the late 1990s to early 2000s, with the introduction of national laws. The Environmental Management and Coordination Act (Government of Kenya, 1999) was enacted to provide for environmental protection and sustainable management of natural resources as well as instituting a requirement for Environmental Impact Assessment (EIA) for certain projects, including sand mining. In 2002, the Water Act, 2002 (Government of Kenya, 2002) was passed, providing a comprehensive framework for the management, conservation, and regulation of water resources and water services. While these laws were aimed at environmental conservation and the management and regulation of natural resource utilization, they overlooked sand specifically (Caroline Katisya-Njoroge, 2021; UNEP, 2019). In 2007, the National Sand Harvesting Guidelines (National Environment Management Authority, 2007) were passed to guide sand mining. This, however, failed as the guidelines were not implemented and sand mining business continued in a laissez-faire fashion owing to limited political will and institutional inertia. This regulatory vacuum allowed unregulated sand mining to continue, leading to a cascade of socio-economic and environmental problems such as riverbed incision, reduced groundwater storage, and violent conflicts – popularly dubbed 'sand wars' in the early 2010s (Aduda & Bolf, 2024; Constable, 2017; Daghar, 2022).

In response, locals in some parts of Makueni and Machakos counties self-organized to regulate river sand mining, while in other areas the prevailing status quo persisted. While often framed as community-based, local regulation of sand mining did not necessarily reflect a unified or formal institutional arrangement. Rather, 'community' comprised a heterogeneous set of actors with uneven authority and competing interests, including elders, youth groups, landowners, and local sand traders. Informal rules governing access and mining were emergent, negotiated, and enforced. These structured key aspects of the activity include revenue-sharing arrangements, equitable allocation of sand-loading opportunities, limits on mining intensity, and, in some cases, confining sand harvesting to local use only. In some areas, sand mining was banned altogether, and local communities, often supported by nongovernmental organizations (NGOs), teamed up to build sand dams. Groups such as the Kiwingu in Kasikeu emerged as a locally self-organized vigilante group formed to protect river systems from sand mining. Operating outside formal governance structures, this group employed coercive and at times violent tactics, including the burning of sand transport vehicles and targeted attacks on sand traders (Duker et al., 2025, 2025).

The *third* phase began with the devolution of the government in 2013. Makueni enacted the Makueni County Sand Conservation and Utilization Act, 2015 (hereinafter 'Sand Act'), through a consultative process involving a county-wide task force in 2014 and formal public participation during legislative drafting. One key lever for co-governance is that the Sand Act provides for the establishment of sand management committees at the ward and sub-county level administrative units within Kenya's devolved governance structure. These committees comprise representatives from diverse community segments, including women, youth, and persons with disabilities, and are mandated to identify sand-harvesting sites, monitor mining activities, recommend the closure and rehabilitation of degraded sites, as well as oversee implementation of rehabilitation activities (Republic of Kenya, 2015).

While this legislative shift marked a critical transition toward subnational regulation and more inclusive governance, as encapsulated in Kenya's 2010 Constitution (Government of Kenya, 2010), it has been accompanied by a growing disconnect between state-led governance and local informal institutions. The Sand Act formally included provisions for community participation in sand governance through sand management committees; however, in practice, sand management committees function largely as a tick-box exercise, with weak feedback loops between communities and authorities and an absence of meaningful co-governance. Committee meetings occur on an ad hoc basis, with no standing forum for continuous coordination, consultations, or learning. As a result, feedback between the communities, and by extension other actors, and the county authorities is limited. The formalization of Makueni's sand governance, not surprisingly, overlooked the informal institutions developed and upheld by the local communities over the years that were underpinned by a deeply embedded community agency. This oversight has led to widespread disgruntlement and active resistance to formal regulations, expressed, for example, through communities defying county efforts to designate sand-mining sites within river sections where they have invested in conservation. Often, sand dam owners resist due to unclear and uneven benefit-sharing mechanisms as well as poor state-led regulation and monitoring of mining activities. In other instances, communities continue to uphold and enforce their own locally developed rules, operating alongside, and at times in subtle defiance of formal legal frameworks. Through these parallel governance arrangements, the locals introduce an additional layer of conditions that must be met before sand mining can occur in rivers within their jurisdiction. Under such arrangements, licensed sand transporters are subject to vetting by local leadership to verify the intended destination of the extracted sand, with preference given to use within the locality. While doing this, community leaders ensure that all operators have fulfilled the requisite county government levies and permits. They also monitor harvesting levels to regulate extraction intensity and promote compliance with both local norms and formal requirements. Potentially, because of this marginalization, the government has also been criticized for being opportunistic and 'free riding' on local communities' conservation efforts and investment to pursue its fiscal objective of raising revenue through licensing sand mining.

As these dynamics unfold between County-led legislation and local actors, national laws on environment and water, together with the 2007 National Sand Harvesting Guidelines, have remained

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largely in the periphery, with the County effectively exercising regulatory authority in ways that often bypass or weakly enforce statutory EIA requirements, undermining the intended regulatory purpose. Further complicating the fragmented sand governance landscape, the national government promulgated the Environmental Management and Coordination (Sand Harvesting) Regulations (2024), which operationalized the 2007 Guidelines. This decision was made in an attempt to recentralize key aspects of sand governance, disregarding the sand governance realities in the different Counties. These regulations introduced national oversight of sand harvesting, including licensing of sand transportation and supervisory authority over county-level activities, effectively subordinating county institutions to state-level regulatory frameworks and sidelining local effort (Waite, 2025).

3. Shifting authority and the hollowing out of formal co-governance

Taken together, the three phases of sand governance in Makueni illustrate not only regulatory and sand governance change over time, but a progressive reconfiguration of authority, decision-making, and practices across institutional levels. The third phase may, however, have missed critical opportunities to entrench co-governance. This epoch exposes fundamental gaps in how authority, responsibility, and knowledge are distributed across governance levels. While the devolved legislation provided a framework for regulating sand mining and coordinating actors, its implementation has displaced locally embedded governance centers such as sand dam owner groups and community groups who previously developed rules to manage sand mining in their sand dams and river sections in their proximity. The locals are now seldom involved in monitoring, enforcement, or decision-making for revenue sharing and associated rehabilitation efforts. In many cases, the community is only engaged to be informed when a site is earmarked for designation as a sand mining site. Generally, sand mining activities are largely conducted in an opaque manner, resulting in limited public access to information regarding extraction processes, rehabilitation, decision-making structures, and revenue flows. This gap constrains any meaningful community participation in co-governance arrangements and leaves the local stakeholders uncertain about institutional entry points through which they can engage and contribute to the sustainable governance of river sand resources.

It is indisputable that locally embedded governance practices underscore the critical role of community agency in shaping resource management outcomes. Far from constituting mere informal resistance, such arrangements reflect context-specific regulatory innovations that enhance oversight, strengthen compliance, and align extraction practices with locally perceived social and ecological thresholds. Recognizing and formally integrating these community-based mechanisms into statutory frameworks would advance shared governance by bridging the divide between state regulation and lived practice. Embedding local vetting processes, monitoring systems, and socially enforced norms within formal policy architectures could therefore enhance legitimacy, improve accountability, and foster more adaptive and context-responsive management of river sand resources in Makueni.

Recognition of rights to organize is a principal pillar of co-management and the rules in use become meaningless if a higher authority, like the county government, does not recognize them as legitimate (Ostrom, 1990). As communities become bystanders, social monitoring has weakened, and institutional gaps have emerged, contributing to increased illegal sand mining and accelerated degradation of Makueni's ephemeral river systems. Similarly, although sand management committees were established by the county government as a formal mechanism for comanagement, they have functioned as administrative extensions of the state rather than as platforms for shared governance. Other state regulators and non-state actors, including NGOs engaged in riverine conservation and sand dam construction, operate in isolation despite statutory provisions assigning the Makueni County Sand Conservation and Utilization Authority a coordinating role (Republic of Kenya, 2015). In practice, weak coordination has resulted in fragmented interventions, limited information sharing, and poor alignment between conservation and sand mining objectives, thereby undermining effective river sand governance.

4. Why polycentric governance offers a better solution

Institutional failures such as centralized decision-making, weak integration of informal institutions, fragmented vertical and horizontal coordination, and the persistent mistrust between communities and authorities observed in the evolution of sand governance in Makueni underscore the weakness of monocentric and weakly devolved governance arrangements across complex river systems and the socioeconomic interests of actors involved. Sand governance in Makueni involves multiple actors with divergent interests. These include county authorities seeking to balance fiscal objectives and water resources development, national regulators asserting statutory oversight, private extractors pursuing profit, NGOs supporting riverine conservation and sand dam construction, as well as riparian landowners and community groups whose livelihoods and water security depend on sand retention (Aduda & Bolf, 2024; Duker et al., 2025; Mulwa et al., 2025).

In this context, therefore, we propose polycentric governance as a potentially better-suited institutional arrangement for Makueni's complex sand–river system. Polycentric state-governance was first proposed by Ostrom in 1961 (V. Ostrom et al., 1961) and was later expanded into the commons governance discourse (E. Ostrom, 2010b; E. Ostrom et al., 1999). This discourse emphasizes the criticality of locally self-organized collective action institutions for solving commons problems (Gardner et al., 1990; E. Ostrom et al., 1999). Rather than privileging one actor, polycentric systems enable collaborative governance through nested and interconnected institutions and could be ideal for governing complex commons like sand, relying on multiple, overlapping, semiautonomous centers that collaborate, compete, and co-regulate.

Although the concept of polycentric governance has no universally agreed definition (Stephan et al., 2019), the concept is still recognized as a versatile hybrid approach for natural resource governance. Examples where it has been applied include cross-country marine fisheries management (Tuda et al., 2021), climate change discourse (Jordan & Huitema, 2023), forest management (Bixler, 2014), and water resources management (Baldwin et al., 2016; McCord et al., 2017), among others.

We are cognizant that polycentrism is not a panacea, but an option that recognizes multiple centers of authority and the need for coordination across scales (community to state), as illustrated by the river sand governance landscape in Makueni. The three core institutional elements identified by Ostrom's design principles are present across communities; non-state actors like NGOs, county governments, and national regulators, providing the foundation for a polycentric governance system in Makueni. However, these elements operate in isolation, at times in conflict, with weak

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alignment between local norms and place-based realities, county institutions, and national regulation. The core challenge is not the absence of the pillars of polycentrism, but the lack of recognition and coordination of Makueni's already existing polycentric governance landscape.

At the same time, we acknowledge key critiques of polycentricity, which is often promoted as inherently desirable for its emphasis on inclusive participation and decentralization, yet whose effectiveness remains contested. Recent scholarships emphasize that its effectiveness is highly conditional. For instance, empirical studies provide evidence that such systems frequently suffer from coordination deficits; multiple centers of authority operate without effective mechanisms for alignment, leading to fragmentation rather than complementarity (e.g., Tiffany H. Morrison et al., 2023a). Other critiques highlight how power asymmetries can persist, or even intensify, within polycentric arrangements, allowing well-resourced actors to dominate decision-making and undermine equity and accountability (e.g., Malik & Berg, 2024). Morin and Couette (2025) challenge optimistic assumptions underlying polycentric governance. They argue that the presence of multiple centers of authority does not inherently generate shared learning, innovation, or normative alignment, and may still result in unsustainable resource governance in the absence of clearly articulated values and a more explicit engagement with the political–economic conditions shaping governance outcomes. Similarly, Soto-oñate et al. (2026) argue that polycentric governance is conceptually attractive but offers limited guidance on how authority is articulated and coordinated across scales and without contextualization, polycentricity risks remaining more descriptive than operational.

In the context of Makueni's sand governance landscape, these insights suggest that the key challenge is not the absence of polycentric governance, but the conditions under which its existing features can be made to function more effectively. Multiple centers of authority are already evident across community institutions, county structures, national regulators, and non-state actors, yet weak coordination, uneven power relations, and limited alignment across scales constrain their capacity to operate in complementary ways. Addressing these challenges through clearer normative orientation, stronger mechanisms for coordination, and closer engagement with the political–economic drivers of sand mining therefore represents a critical imperative for translating Makueni's latent polycentric features into more coherent and sustainable sand governance. These critiques do not exhaust the limitations of polycentric governance but highlight several key challenges that are particularly salient in efforts to operationalize polycentrism within complex, multi-level resource governance contexts such as sand mining in Makueni.

Makueni's experience meets three key conditions for polycentric governance:

1. Existence of multiple decision centers (E. Ostrom, 2010b): These include community groups, county institutions, national regulators, NGOs, and informal actors who exhibit a strong capacity for rulemaking, monitoring, and even enforcement in line with Ostrom's principles (E. Ostrom, 2006).
2. These actors operate within overlapping authorities: Overlapping jurisdictions arise both functionally and spatially. Authority over sand mining is exercised concurrently by community institutions, county governments, and the national government, while sand governance is also inherently transboundary and does not align neatly with administrative boundaries, particularly within shared river basins (Hackney, 2025).
3. Existence of overarching rules (McGinnis & Ostrom, 2011): A set of overarching rules governing sand mining exists at both the national (Water Act, 2002 amended, 2016, Environmental Coordination and Management Act, 1999, amended 2013 and Environmental Management and Coordination (Sand Harvesting) Regulations (2024), county level (Sand Act, 2015, amended 2022) though they often clash rather than align, causing fragmentation and weakening the overall system.

5. Toward an integrated governance mosaic: three steps to operationalize polycentric sand governance

To move from fragmented coexistence to functional polycentric governance, we argue that three steps are crucial in Makueni County's river sand governance. These steps draw on key elements of Ostrom's design principles, specifically congruence between rules and local conditions (Principle 2), minimal recognition of rights to organize (Principle 7), and nested enterprises (Principle 8). Together, these principles provide a framework for recognizing locally grounded institutions, aligning regulatory rules with place-based realities, and embedding community-level governance within coordinated multi-level arrangements.

A critical first step for Makueni is carrying out a deliberate diagnosis of its sand governance system using, for instance, the building blocks concept advanced by Tiffany H. Morrison et al. (2023), who frame polycentricity as recurring motifs of interaction among actors, venues, and issues. Applying this approach would help identify where actor–venue–issue linkages are blocked by *inter alia*, weak mandates, disparate interests, or lack of information, allowing for strengthening polycentric governance from within and positioning Makueni as a credible case for broader reform. In Makueni, actors (e.g., county officials, sand committees, sand dam owners, NGOs, extractors), venues or decision-making centers (e.g., county public meetings, county environment committee, ward and sub-county sand committees, community and NGO forums), and issues (e.g., sand permits, river conservation, water storage, revenue and benefit sharing etc.) are present but weakly connected. Community actors participate in venues in the form of *barazas* (public meetings) convened by the County government but with limited authority and information; sand mining decision-making often operates in parallel with water resources management despite the intricate relationship between sand and alluvial water in the ephemeral rivers- an underpinning motivation for communities' sand conservation is to retain alluvial water. Key issues such as mining thresholds and benefit sharing are also neither typically clear nor effectively addressed across governance spaces. Further, we also argue that while Tiffany H. Morrison et al. (2023) recognize venues as decision making spaces with (formal) authority to design, adopt and implement public policies, the local communities have created informal venues in form community barazas (public meetings) and vibrant social media mobilization and engagement that has from time to time, challenged the decisions taken in the (formal) venues. For instance, community outcry over unregulated sand activities under County watch has led to the imposition of localized bans as a reactive intervention by the County government. Deliberate diagnosis of Makueni's sand governance system, we argue, will strengthen the next two steps as it unpacks the individual units involved and their interests, stakes, spaces (or the lack of) for collective action, and clarity of policy issues around river sand governance.

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Issue	What needs to be done
1. Weak internal integration of actors, venues, and issues within Makueni's sand governance system	a. Undertake a deliberate institutional diagnostic of Makueni's sand governance using the building blocks framework (actors–venues–issues) to identify blocked linkages.
	b. Strengthen information flows and decision authority across existing venues (e.g., sand committees, environmental committees, community forums, county environment forum) to better integrate sand governance efforts.
2. Local community initiatives remain weakly recognized by authorities and law	c. Formally recognize local community organizations and legitimize community-led sand governance practices (e.g., localized sand mining moratoria, sand dam protection rules) within the Makueni County Sand Conservation and Utilization Act and subsidiary regulations.
	d. Embed locally evolved rules-in-use, ecological knowledge, and conservation practices into county decision-making processes to strengthen community agencies, self-organization, and legitimacy.
3. Fragmented and weakly coordinated sand governance roles across levels of authority.	e. Clarify and formalize nested mandates by specifying the internal vertical coordination and role clarity of the various actors across scale.
	f. Institutionalize vertical coordination mechanisms through regular joint review forums, shared reporting requirements, and structured information exchange across scale

The second step is the formal recognition and legal legitimation of locally self-organized initiatives, consistent with Ostrom's principle of minimal recognition of rights to organize (Gardner et al., 1990). This recognition lays pillars for strengthening community agency through 1) gaining legal legitimacy, (2) clearer jurisdictional authority, and (3) improved coordination with higher-level state actors. This would move communities from being informal actors existing to comply with imposed rules to equal partners in governance, with legitimate authority to make decisions, regulate access, and enforce agreed rules, all the while working within the broader constitutional rules prescribed in state laws. This way, collective action would be enhanced and improve communities' capacity to negotiate with state authorities and private extractors, reinforcing the self-organization and stewardship already evident in Makueni's river sand governance. We argue that these community initiatives emerged to fill a governance vacuum when formal law was absent or weakly enforced and continued to play a critical role in holding more powerful actors accountable.

Third, strengthen internal vertical coordination and role clarity by formally defining and nesting the functions of community groups invested in sand governance, county-level sand governance functions, and national-level functions. This would entail establishing clear mandates for access control, permitting, monitoring, conflict resolution, and institutionalizing routine information-sharing and joint review mechanisms across the three levels. This would enable the autonomous decision centers to operate in a coordinated manner, transforming existing institutionally and operationally fragmented structure into a functional polycentric governance system.

6. Risks and rewards of polycentric governance in Makueni and beyond

Despite its acknowledged weaknesses, polycentric governance remains a compelling option for Makueni because existing river sand and water governance practices already exhibit several polycentric features, even though they are not yet fully articulated or coherently integrated as a polycentric system. Communities organized around shared sand dams and river sections have demonstrated strong self-organization (a key pillar of polycentrism according to Ostrom (2010a), exclusion of outsiders, and willingness to invest in maintenance and protection, often independently of the state, illustrating functional commons governance rather than institutional absence. In such a context, further centralization risks marginalizing key governance actors, particularly communities, while enabling state appropriation of local resources for revenue generation, undermining stewardship incentives, and deepening mistrust. Polycentric governance, when grounded in Ostrom's design principles, offers a context-sensitive alternative in which the state plays a restrained but essential role of protecting community rights, providing regulatory frameworks, and preventing external encroachment, while leaving day-to-day access, monitoring, enforcement, and benefit-sharing decisions with local users (Pahl-wostl & Knieper, 2023). Makueni's river sand governance experience offers valuable insights into the limits and potential for polycentric river sand governance. What appears as system redundancy may in fact provide resilience. As earlier demonstrated, community groups in Makueni responded creatively to resource (sand and water) decline (Maringa, 2022), faster and arguably more effectively than state bodies (Lynggaard & Gallagher, 2023), arresting a menace that was rooted in state inaction and, in many cases, state facilitation. The proactivity exuded in the second phase of Makueni's sand governance history, getting organized, setting rules, and building sand dams, shows community institutions are often more adaptive to ecological and socioeconomic shocks.

As Makueni continues to refine its approach, it offers a timely and instructive case for sand governance in Africa and comparable contexts. The immediate policy priority is to institutionalize the latent polycentricity already evident in the county's sandscape by formally recognizing community-led initiatives. Also key is understanding and strengthening internal integration among actors, venues, and issues, and anchoring river sand governance within a nested framework. This requires deliberate institutional diagnosis and legal reforms rather than incremental adjustments, including clear recognition of community rights to organize, mechanisms to translate local rules-in-use into county decision-making, and vertical and horizontal coordination. This diagnosis is especially salient as the County moves to repeal the existing Sand Act, 2025, to introduce new legislation that seeks to place communities more centrally in the sand governance paradigm, a shift that holds promise but will depend critically on whether deliberate learning, reflection, and institutional adjustment are actively pursued in practice. Ongoing legislative reform presents a critical policy window to align statutory design with lived governance practices, reflecting on the lessons from a decade (2015–2025) of county-led sand regulation, ensuring that future sand regulation reflects the place-based

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realities of sand governance (UNEP, 2022) and promotes stewardship, equity, and water security rather than undermining these. This will require political will and inclusive dialogue, but most of all, it will require recognition that governance does not reside in laws alone, but in the lived practices of those who depend on the resources, here vividly demonstrated by the collaborative agency of local communities in their quest to protect sand for water.

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