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Ecological Governance in the Mekong: U.S. Engagement and ASEAN's Role amid Strategic Rivalry with China

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ABSTRACT

The Mekong River, sustaining over 60 million people across mainland Southeast Asia, has emerged as a critical arena where transboundary water governance, environmental sustainability, and great power competition converge. As China consolidates its upstream influence through the Belt and Road Initiative (BRI) and the Mekong–Lancang Cooperation (MLC)—reshaping downstream hydrological conditions through an extensive Lancang dam cascade and deepening structural dependencies among smaller riparian states—the United States has recalibrated its engagement through the Mekong–U.S. Partnership (MUSP), emphasizing transparency, environmental standards, and multilateral cooperation as a strategic counterweight. ASEAN, as the region's principal multilateral institution, must navigate this intensifying rivalry while confronting the ecological deterioration of a basin whose fisheries, agricultural systems, and community livelihoods face compounding pressure from hydropower development and climate change. This paper examines how major powers have adjusted their Mekong strategies since 2016, analyzes the environmental consequences of those adjustments through the water–energy–food–environment (WEFE) nexus and socio-hydrology frameworks, and assesses the Association of Southeast Asian Nations (ASEAN)'s institutional capacity to embed sustainability into basin governance. Drawing on a qualitative and comparative research design, the study situates the Mekong alongside the Nile, Danube, Indus, and Amazon basins to identify transferable governance mechanisms. The findings reveal that while ASEAN possesses meaningful institutional frameworks, its collective action capacity

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remains constrained by internal member-state divergences and its non-interference principle. The study concludes that incremental, technically grounded governance reforms pursued through ASEAN's convening role represent the most realistic pathway toward a more sustainable and cooperative Mekong governance architecture.

Keywords: Mekong Basin; ASEAN; Water Governance; U.S.–China Strategic Rivalry; WEFE Nexus

1. Introduction

Few rivers in the world carry the weight of history, ecology, and geopolitics as simultaneously and as consequentially as the Mekong. Stretching nearly 4,900 km from the Tibetan Plateau through the Chinese province of Yunnan before flowing through Myanmar, Laos, Thailand, Cambodia, and Vietnam and discharging into the South China Sea via the Mekong Delta, the river sustains the livelihoods of more than 60 million people across mainland Southeast Asia. It is the backbone of one of the world's most productive inland fisheries, the lifeblood of irrigated agriculture across millions of hectares, and the cultural foundation of communities whose rhythms of life have followed its seasonal floods and recessions for millennia. Yet this river, so deeply embedded in the fabric of the region, is under mounting pressure from forces that are simultaneously ecological, economic, and geopolitical in character.

The past decade has witnessed a profound transformation in the Mekong's governance landscape. China, as the sole upstream riparian state with the capacity to regulate the river's headwaters, has accelerated the construction of a cascade of large dams along the Lancang River while simultaneously institutionalizing its regional leadership through the Belt and Road Initiative (BRI) and the Mekong–Lancang Cooperation (MLC) framework, launched in 2016. These initiatives have deepened infrastructure connectivity and financial integration across the sub-region, but they have also concentrated decision-making power in Beijing and created structural dependencies among smaller Mekong states. Downstream, the consequences have been tangible: altered seasonal flows, reduced sediment transport, declining fish catches, and intensified salinity intrusion in the Mekong Delta have all been linked, at least in part, to upstream dam operations.

Against this backdrop, the United States has recalibrated its engagement in the Mekong sub-region in ways

that reflect both genuine developmental concern and unmistakable strategic calculation. The Lower Mekong Initiative (LMI), established in 2009 as a relatively modest platform for environmental and educational cooperation, was substantially upgraded and rebranded as the Mekong–U.S. Partnership (MUSP) in 2020, signaling Washington's intent to treat the sub-region as a priority theater within its broader Free and Open Indo-Pacific Strategy. Unlike China's infrastructure-driven approach, U.S. engagement has emphasized transparency in governance, environmental standards, multilateral frameworks, and capacity-building—a model that offers Mekong states an alternative partnership but that also, inevitably, situates the river within the broader logic of great power competition.

It is within this context that ASEAN's role becomes both more important and more precarious. As a regional organization whose mainland members—Cambodia, Laos, Myanmar, Thailand, and Vietnam—are directly and asymmetrically affected by upstream decisions, ASEAN possesses neither the formal authority nor the enforcement capacity to regulate the Mekong's governance independently. Yet it is precisely ASEAN's position as a convening institution, one that maintains relationships with all major external actors while nominally upholding principles of centrality and consensus, that gives it a distinctive, if fragile, form of leverage. Whether ASEAN can translate that leverage into meaningful governance outcomes is the central question this paper seeks to address.

This study is guided by the following research question: how can ASEAN leverage its existing and potential institutional mechanisms to embed environmental sustainability into Mekong governance amid intensifying U.S.–China strategic competition since 2016? Three subsidiary questions structure the analysis. First, how have the United States and China adjusted their respective Mekong strategies since 2016, and what are the environmental and water-related consequences of those adjustments? Second, what institutional frameworks does ASEAN possess, and

how effectively can they be deployed to harmonize external engagement with ecological and developmental goals? Third, what lessons from governance arrangements in other transboundary river basins—specifically the Nile, Danube, Indus, and Amazon—are transferable to the Mekong context, given ASEAN’s distinctive features of non-interference and consensus-based decision-making?

To address these questions, the paper adopts a qualitative and comparative research design that integrates ecological, socio-economic, and geopolitical analysis. The water–energy–food–environment (WEFE) nexus provides a framework for examining the trade-offs and synergies embedded in Mekong resource management decisions, while socio-hydrology illuminates the dynamic interactions between human communities and the hydrological systems on which they depend. By situating the Mekong within a comparative global context and drawing on lessons from other major transboundary river systems, this study aims to contribute to both the scholarly literature on integrated water resource management and the policy debate on ASEAN’s institutional capacity in an era of intensifying great power rivalry.

2. Literature Review

Scholarship on the Mekong sub-region has grown considerably over the past three decades, yet it remains fragmented across disciplinary boundaries in ways that limit its analytical coherence. Environmental scientists, political economists, and international relations scholars have each made important contributions, but the intersections between ecological degradation, institutional design, and geopolitical rivalry have rarely been examined with the integration that the Mekong’s complexity demands. This review maps the key threads of existing scholarship, identifies their respective contributions, and locates the gaps that this paper seeks to address.

The foundational literature on Mekong water governance established early on that the management of shared river resources is inherently political. Orieschnig and Venot^[1] traced the history of the Mekong Committee—the predecessor to the Mekong River Commission—and demonstrated that cooperative governance frameworks, however well-intentioned, are profoundly shaped by the

power asymmetries and conflicting interests of riparian states. Mondal et al.^[2] extended this insight by showing that the Mekong Delta communities face a stark choice between adaptation and control as upstream interventions progressively alter the hydrological conditions on which their livelihoods depend. Grumbine and Xu^[3] brought the ecological dimension into sharper focus, arguing that the scale and pace of hydropower development across the basin pose an existential threat to biodiversity and food security that existing governance arrangements are ill-equipped to manage. More recently, Xie^[4] has drawn attention to the longer-term vulnerabilities created by glacial retreat in the Himalayas, warning that the gradual loss of the Asian water tower will compound the disruptions already caused by dam construction and intensify competition among riparian states over a diminishing resource.

The institutional dimension of Mekong governance has attracted sustained scholarly attention, though assessments of the region’s institutional landscape are largely critical. The Mekong River Commission (MRC), established in 1995 as the primary multilateral forum for cooperative water management, has been widely analyzed as a body whose formal mandate exceeds its practical authority. Telle^[5] demonstrates that the MRC’s reliance on voluntary compliance, its limited technical capacity, and its exclusion of China as a full member have rendered it structurally incapable of constraining the upstream dam-building that most directly threatens downstream states. The Asian Development Bank’s Greater Mekong Subregion (GMS) program has provided a platform for economic integration and infrastructure coordination, but its emphasis on connectivity and growth has consistently taken precedence over ecological sustainability^[6]. The emergence of the Mekong–Lancang Cooperation (MLC) in 2016 added a further layer of institutional complexity. Busbarat^[7] argues persuasively that the MLC was designed not merely to complement existing frameworks but to displace them—offering a China-centered alternative that provides more generous financing with fewer environmental conditionalities, and that structurally disadvantages collective downstream responses by operating on a bilateral hub-and-spoke model.

China’s broader strategic engagement in the Mekong sub-region has been analyzed extensively through the lens of BRI scholarship. Bharti and Kumari^[8] and Rolland^[9]

both characterize BRI infrastructure investments as serving simultaneously developmental and geopolitical purposes, creating physical and financial dependencies that extend Beijing's influence well beyond what conventional diplomacy could achieve. Azizi^[10] provides empirical grounding for this argument, documenting that nearly half of ASEAN's BRI-supported projects in 2018 were concentrated in Mekong countries, a pattern that reflects the sub-region's centrality to China's continental connectivity ambitions. Haefner and Po^[11] add an important energy dimension, showing that China's hydropower diplomacy in the Mekong serves domestic electricity needs in Yunnan while simultaneously creating downstream energy dependencies through Chinese financing of Lao dam projects. Mallick^[12] situates these dynamics within the China–Indochina Peninsula Economic Corridor, demonstrating how infrastructural integration reinforces China's strategic position across the sub-region as a whole.

The United States' engagement in the Mekong has generated a parallel but smaller body of scholarship. Bowser and Parameswaran^[13] provides one of the earliest systematic assessments of the LMI, highlighting its emphasis on knowledge-based partnerships, environmental governance, and capacity-building as a deliberate counterpoint to China's infrastructure-heavy model. Keshap^[14] and the East-West Center^[15] document the evolution of U.S. engagement into the MUSP framework, noting the expansion of its agenda to encompass energy security, transnational crime prevention, and pandemic resilience. Ha^[16] offers the most critical appraisal, arguing that despite the rhetorical ambition of the MUSP, U.S. engagement in the Mekong remains reactive, underfunded relative to Chinese investment, and insufficiently sustained across administrations to constitute a coherent long-term strategy.

Within ASEAN, the scholarly conversation has centered on the tension between institutional aspiration and political constraint. Minh^[17] demonstrates that the rapid development of renewable energy capacity in Vietnam's Mekong Delta offers a potential pathway to reducing the sub-region's dependence on hydropower, thereby easing some of the ecological pressures generated by dam construction. This possibility, however, must be weighed against persistent structural constraints. Tinh^[18] and Kitikhoun^[19] both emphasize that ASEAN's capacity to act

collectively on Mekong issues is undermined by the divergent alignments of its member states, with Cambodia and Laos closely tied to Chinese financing and Vietnam and Thailand more receptive to U.S. and Japanese partnerships. Teo et al.^[20] and Phan^[21] situate this internal fragmentation within the broader dynamics of Indo-Pacific geopolitics, arguing that ASEAN's relevance as a regional institution depends on its ability to maintain a credible posture of centrality even as external powers compete to draw its members into competing frameworks.

Notwithstanding the richness of this body of scholarship, three significant gaps remain. First, the existing literature largely treats environmental sustainability and geopolitical competition as analytically separate domains, rather than examining how strategic rivalry directly shapes ecological outcomes and how ecological deterioration, in turn, feeds back into political contestation. Second, while ASEAN's constraints are well-documented, its institutional potential as a proactive governance actor—one capable of embedding sustainability norms into external engagement frameworks—remains undertheorized. Third, comparative lessons from other transboundary river basins have rarely been applied to the Mekong in a structured and systematic way that accounts for ASEAN's distinctive institutional features, including its non-interference principle and its consensus-based decision-making procedures. This paper addresses all three gaps through an integrated analytical approach drawing on the WEF nexus and socio-hydrology as organizing frameworks.

3. Methodology

This study adopts a qualitative and comparative research design grounded in the recognition that the Mekong Basin cannot be adequately understood through any single disciplinary lens. The ecological, socio-economic, and geopolitical dimensions of Mekong governance are not merely parallel phenomena but are deeply entangled, and the analytical approach adopted here is designed to capture that entanglement rather than reduce it to any one of its constituent parts. The methodology combines four elements: systematic literature analysis, structured comparative case studies, theoretical framework application, and policy evaluation.

The first element involves a systematic review of academic literature, policy documents, and institutional reports bearing on the Mekong River, ASEAN governance, and international river basin management more broadly. Source selection was guided by three criteria. Priority was given to peer-reviewed scholarship published from 2015 onward, in order to capture the dynamics that have unfolded since the MLC became operational and the U.S. Indo-Pacific strategy began to take shape—though foundational works from earlier periods are included where they establish analytical frameworks that remain indispensable. Official policy statements, institutional reports, and strategic assessments from ASEAN, the MRC, the Asian Development Bank (ADB), and relevant governments were treated as primary sources for understanding the stated objectives and formal commitments of key actors. Analysis from established regional think tanks, including the East-West Center, ISEAS–Yusof Ishak Institute, and the Center for Strategic and International Studies, was incorporated as secondary interpretive material. The literature was coded thematically across ecological, socio-economic, and geopolitical dimensions, with particular attention to points of intersection where dynamics in one domain appeared to condition outcomes in another.

The second element applies a structured comparative case study approach. Four transboundary river systems were selected as analytical comparators for the Mekong: the Nile, the Danube, the Indus, and the Amazon. The selection criteria were deliberate rather than arbitrary. Each basin was chosen because it presents at least one governance condition that is directly relevant to the Mekong's situation: the Nile illustrates the consequences of proceeding with major upstream infrastructure in the absence of binding downstream consultation mechanisms; the Danube demonstrates what legally binding institutional cooperation, full riparian membership, and transparent dispute resolution can achieve over time; the Indus shows that durable water-sharing agreements are achievable even between states locked in broader geopolitical rivalry; and the Amazon highlights the governance implications of large-scale environmental change and the importance of community and indigenous participation in basin management. Comparison across these cases is structured along seven dimensions—institutional framework, legal bindingness, dispute

resolution mechanisms, inclusion of riparian states, role of external actors, environmental outcomes, and relevance to the Mekong context—to facilitate systematic and transparent analysis.

The third element employs two theoretical frameworks that together provide the analytical scaffolding for the paper's substantive argument. The water–energy–food–environment (WEFE) nexus^[22] is applied to identify and analyze the trade-offs and synergies embedded in Mekong resource management decisions. Rather than treating hydropower, agriculture, fisheries, and environmental protection as separate policy domains, the nexus framework insists on examining how decisions made in one domain propagate consequences across the others—a perspective that is essential for understanding why the Mekong's governance challenges resist sector-by-sector solutions. Socio-hydrology^[23] is applied alongside the WEFE nexus to illuminate the feedback dynamics between human communities and hydrological systems. As upstream dam operations and climate change alter the Mekong's flow regime, downstream communities adapt their agricultural practices, fishing strategies, and livelihood patterns in ways that, in turn, generate new demands on governance institutions and reshape the political economy of water management. Together, these two frameworks enable an analysis that moves between the biophysical and the social without privileging either.

The fourth element focuses on policy and institutional analysis. ASEAN's governance mechanisms are examined in detail, including the ASEAN-Mekong Basin Development Cooperation (AMBDC), Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS), and the ASEAN Outlook on the Indo-Pacific (AOIP), alongside external initiatives such as China's MLC and the U.S. MUSP. This analysis is attentive not only to what these frameworks formally provide but also to the gap between formal mandate and practical capacity—a gap that is, in many respects, the central governance problem in the Mekong sub-region. The policy analysis draws on both the academic literature reviewed in the first element and the primary institutional documents identified as key sources, evaluating the sustainability implications of current governance trajectories and identifying areas where institutional reform is most urgently needed.

It should be acknowledged at the outset that this study operates within several methodological constraints that bear on the interpretation of its findings. The analysis draws primarily on English-language sources and official policy documents, which may underrepresent the perspectives of local fishing communities, smallholder farmers, indigenous groups, and non-English scholarship. All comparative case studies are drawn from secondary sources rather than primary fieldwork, which limits the granularity of institutional analysis that can be conducted for each comparator basin. These limitations are discussed more fully in the concluding section.

4. Results and Discussion

4.1. The Mekong River: Ecological Foundations and Strategic Significance

To understand why the Mekong has become one of the most contested river systems in the world, it is necessary to begin with the scale of what is at stake. The river stretches nearly 4,900 km from the Tibetan Plateau through China, Myanmar, Laos, Thailand, Cambodia, and Vietnam, draining a basin of approximately 795,000 km² before discharging into the South China Sea via the Mekong Delta. It sustains the livelihoods of more than 60 million people in the Lower Mekong Basin alone, supporting one of the most productive inland fisheries on earth, irrigating millions of hectares of agricultural land, and providing the primary source of protein for communities across Cambodia, Laos, and parts of Vietnam and Thailand^[1,3]. The river is not merely an ecological asset; it is the material foundation of food security, economic life, and cultural identity across mainland Southeast Asia.

The ecological significance of the Mekong is difficult to overstate. The basin hosts over 1,200 species of fish, making it second only to the Amazon in freshwater biodiversity, and its seasonal flood pulse—the annual rhythm of rising and falling waters—performs ecological functions that no engineering intervention has been able to replicate^[2]. The flood pulse replenishes soil nutrients across floodplains, triggers fish migration and spawning cycles, and sustains the Tonle Sap lake system in Cambodia, which expands dramatically each wet season to become one of the most productive freshwater fisheries in the

world. This ecological architecture, built over millennia, is precisely what is now under threat. Sediment trapping behind upstream dams has reduced the nutrient load reaching downstream agricultural land. Altered flow regimes have disrupted fish migration patterns. Salinity intrusion in the Mekong Delta, accelerated by reduced freshwater flows and compounded by sea-level rise, is progressively undermining rice cultivation in one of the world's most important agricultural regions^[4].

Applying the WEF nexus framework to the Mekong reveals why these ecological disruptions cannot be treated as environmental problems in isolation. Hydro-power development provides energy—Laos alone has commissioned or is constructing dozens of dams with the ambition of becoming the battery of Southeast Asia^[7]—but it does so at the cost of fisheries that contribute an estimated USD 17 billion annually to the regional economy and provide the primary dietary protein for tens of millions of people^[15]. This is not a marginal trade-off; it is a structural tension between two development imperatives that the sub-region's existing governance frameworks have proven unable to reconcile. The energy gains from dam construction accrue primarily to the states and investors that build and own the dams, while the food security costs are borne disproportionately by downstream communities who have little political voice in the decisions that shape the river's flow. Water availability for irrigation diminishes as dry-season flows become more irregular, creating further pressure on agricultural systems already stressed by climate variability. Environmental losses—biodiversity, wetland function, sediment dynamics—are largely irreversible on any policy-relevant timescale. Allan's^[22] foundational insight that managing nexus trade-offs requires integrated institutional approaches rather than sector-by-sector planning is not simply a theoretical proposition in the Mekong context; it is an urgent practical imperative.

The socio-hydrological dimension of the Mekong's significance is equally important and equally underappreciated in conventional governance discussions. The concept of socio-hydrology, as developed by Sivapalan and colleagues^[23], draws attention to the ways in which human societies and hydrological systems co-evolve over time, each shaping and being shaped by the other in feedback loops that can either generate resilience or accelerate vul-

nerability. In the Mekong context, this means recognizing that the communities living along the river are not passive victims of hydrological change but active agents who adapt their practices in response to altered conditions—and whose adaptations, in turn, generate new demands on governance systems. As upstream dams have shortened and flattened the annual flood pulse, farmers in the Mekong Delta have shifted from flood-recession agriculture to year-round irrigated cultivation, increasing their dependence on controlled water delivery systems that did not previously exist^[24]. Fishing communities in Cambodia and Vietnam have reported significant declines in catch volumes and have adapted by shifting toward aquaculture, a transition that brings its own environmental pressures^[25]. Rural-to-urban migration has accelerated as river-dependent livelihoods become less viable, reshaping labor markets and social structures across the sub-region. Each of these adaptations creates new governance challenges that ASEAN's existing frameworks have not been designed to address.

Geopolitically, the Mekong has evolved from a shared natural resource into a strategic arena where the influence of external powers is exercised through infrastructure investment, institutional design, and the selective provision of environmental data. China's BRI and MLC have reshaped the physical and institutional landscape of the sub-region in ways that reflect Beijing's broader ambition to consolidate its position as the region's indispensable partner^[8,11]. The United States, through the LMI and MUSP, has sought to offer an alternative model of engagement built on transparency, environmental standards, and multilateral cooperation, though questions about the depth and durability of Washington's commitment remain^[14,16]. For ASEAN, the Mekong is not merely a river to be governed but a strategic space where its relevance as a regional organization is being tested. The ability to act as a credible convener—to ensure that external engagement serves regional rather than narrowly national or great-power interests—is the central governance challenge that the Mekong now poses for ASEAN. Comparative experience from other transboundary river systems, including the Danube and the Indus, suggests that this challenge is not insurmountable, but it requires institutional ambition and political will that ASEAN has not consistently demonstrated^[26,27].

4.2. Compounding Pressures: Ecological, Socio-Economic, and Geopolitical Challenges

The challenges confronting the Mekong Basin are not discrete problems amenable to discrete solutions. They are compounding, interconnected pressures that reinforce one another across ecological, socio-economic, and geopolitical dimensions, and any governance framework that addresses only one dimension while ignoring the others is likely to generate as many problems as it resolves. Understanding the nature and depth of these challenges is therefore a prerequisite for evaluating what ASEAN can realistically achieve.

The most immediate and most documented challenge is ecological. The Mekong is one of the most heavily dammed river systems in Asia, and the pace of dam construction shows little sign of slowing. China has built eleven large dams on the Lancang River in Yunnan province, with a combined installed capacity of approximately 15,000 MW, and has plans for additional facilities further upstream. In the lower basin, Laos has commissioned or is constructing a series of mainstream dams—including the Xayaburi dam, completed in 2019, and the Don Sahong dam, completed in 2020—that have drawn sustained criticism from downstream states and environmental organizations for their impacts on fish migration and sediment transport^[3]. The cumulative effect of this dam cascade is a hydrological system that has been fundamentally altered from its natural state. Sediment that once flowed freely from the Tibetan Plateau to the Mekong Delta, nourishing floodplains and sustaining fisheries along the way, is now largely trapped behind upstream reservoirs. Studies have estimated that sediment loads reaching the delta have declined by as much as 50% compared to pre-dam conditions, with direct consequences for agricultural productivity and coastal land stability^[4]. The seasonal flood pulse, on which the entire ecological and agricultural architecture of the lower basin depends, has been flattened and made irregular by dam operations that prioritize electricity generation over downstream ecological needs.

Climate change intensifies each of these pressures in ways that are already observable and are projected to worsen significantly. Xie^[4] documents the accelerating retreat of Himalayan glaciers, which currently contribute a signif-

icant portion of the Mekong's dry-season flow, and warns that their progressive disappearance will create a period of initially increased but ultimately reduced river discharge that will compound the disruptions already caused by dam construction. Rising temperatures are intensifying drought frequency and severity across the sub-region, with the 2019–2020 Mekong drought—the worst recorded in living memory—causing catastrophic reductions in water levels that devastated fisheries and rice cultivation simultaneously^[25]. Sea-level rise is accelerating salinity intrusion in the Mekong Delta, where land subsidence driven by groundwater extraction and reduced sediment deposition has already lowered much of the delta below sea level, making it one of the most climate-vulnerable agricultural landscapes on earth^[2].

Viewed through the WEF nexus, these ecological challenges manifest as compounding trade-offs that defy easy resolution. The energy imperative—meeting the rapidly growing electricity demand of Mekong states and exporting surplus power to Thailand and China—drives dam construction that simultaneously undermines the food imperative by reducing fish stocks and agricultural productivity. The water imperative—ensuring sufficient freshwater flows for irrigation and drinking water—is compromised both by upstream dam operations that alter seasonal flow patterns and by climate change that reduces overall water availability. The environment imperative—preserving the biodiversity, wetland functions, and ecological processes that underpin long-term basin productivity—is subordinated to all three of the other imperatives in current decision-making frameworks, with consequences that are increasingly irreversible. Grumbine and Xu^[3] warned over a decade ago that the scale of hydropower development in the Mekong was approaching a threshold beyond which ecological recovery would become impossible; the evidence accumulated since then suggests that threshold may already have been crossed in some parts of the basin.

The socio-economic challenges of the Mekong sub-region are inseparable from its ecological trajectory. The basin is home to more than 334 million people, with approximately 40% under the age of 25^[6], a demographic profile that reflects both the dynamism and the vulnerability of the region's development situation. The fisheries of the Mekong contribute an estimated USD 17 billion annu-

ally to the regional economy^[15], but this figure understates the true social significance of fish as a source of dietary protein for communities that have few affordable alternatives. As fish stocks decline under pressure from dam construction, overfishing, and habitat degradation, the food security implications extend well beyond the immediate economic loss, affecting nutrition, health, and social stability across some of the sub-region's poorest communities. Rapid urbanization and industrialization are increasing demand for energy and infrastructure, creating political pressures on governments to prioritize dam construction regardless of downstream consequences. The result is a development trajectory in which short-term energy and economic gains are systematically privileged over long-term ecological and food security outcomes—a trade-off that the sub-region's governance frameworks have proven consistently unable to rebalance.

The geopolitical dimension of the Mekong's challenges is in many respects the most consequential, because it is the dimension that most directly shapes the institutional environment within which ecological and socio-economic problems must be addressed. China's position as the sole upstream state with the physical capacity to regulate the river's headwaters gives Beijing a structural advantage in Mekong governance that no amount of downstream institutional creativity can entirely offset. The MLC, as Busbarat^[7] demonstrates, was designed to institutionalize this advantage by creating a China-centered framework that provides financing and development support while circumventing the multilateral accountability mechanisms that the MRC, however imperfectly, was designed to provide. The bilateral hub-and-spoke structure of the MLC prevents downstream states from coordinating their responses to Chinese dam operations and creates incentives for individual states to seek favorable bilateral arrangements rather than collective governance solutions. Cambodia and Laos, whose development financing is heavily dependent on Chinese investment, have shown limited willingness to challenge Beijing's upstream management even when its consequences for their own populations are severe^[8].

The United States' engagement, while providing downstream states with an alternative partnership and a degree of geopolitical leverage, introduces its own complications. Washington's emphasis on transparency, envi-

ronmental standards, and multilateral cooperation reflects genuine values and provides a meaningful counterweight to China's infrastructure-driven model^[13,14]. However, Ha^[16] is right to note that U.S. engagement in the Mekong has been uneven across administrations, underfunded relative to the scale of Chinese investment, and insufficiently embedded in long-term institutional commitments to constitute a reliable governance partner. The result, as Kittikhoun^[19] warns, is a sub-region increasingly pulled between two competing external frameworks—a dynamic that creates opportunities for individual Mekong states to play one power against the other, but that also risks fragmenting the collective governance capacity that the basin urgently needs.

For ASEAN, these compounding challenges define both the difficulty and the necessity of a more assertive governance role. The ecological deterioration of the Mekong is not a problem that any single state or external power can solve unilaterally; it requires the kind of collective institutional action that only a credible regional organization can convene and sustain. The question is whether ASEAN possesses the political will and institutional capacity to play that role effectively—a question to which the evidence, examined in the sections that follow, provides a cautiously qualified answer.

4.3. Washington's Strategic Recalibration: From the Lower Mekong Initiative to the Mekong–U.S. Partnership

The United States' engagement in the Mekong Basin has never been purely humanitarian in its motivation, and understanding its evolution since 2016 requires situating it within the broader arc of Washington's strategic competition with Beijing rather than treating it as a self-contained development initiative. When the Lower Mekong Initiative was launched in 2009 under Secretary of State Hillary Clinton, it represented a relatively modest effort to deepen U.S. diplomatic presence in mainland Southeast Asia through cooperation on health, education, environment, and governance. Its ambitions were real, but its resources were limited, and for much of its first decade, the LMI operated at the margins of U.S. foreign policy, sustained more by the personal commitment of individual diplomats than by a coherent strategic vision^[13]. What transformed

U.S. engagement in the Mekong was not a sudden awakening to the river's ecological importance but a sharpening recognition, accelerating from around 2016 onward, that China's expanding infrastructure and institutional presence in the sub-region were reshaping the strategic landscape of mainland Southeast Asia in ways that Washington could no longer afford to ignore.

The Trump administration's Free and Open Indo-Pacific Strategy, formalized in 2017, provided the conceptual framework within which the Mekong was recast as a theater of strategic competition rather than merely a development challenge. Secretary of State Mike Pompeo's intervention at the Lower Mekong Initiative Ministerial Meeting in August 2019 was particularly significant in this regard. Pompeo^[28] directly accused China of manipulating Mekong flows through its upstream dams to the detriment of downstream communities, framing U.S. engagement as a defense of the sovereignty and economic autonomy of lower Mekong states against what he characterized as coercive upstream behavior. Whatever the merits of this framing as an empirical description of Chinese dam operations—and the evidence does suggest that upstream dam management has contributed to downstream flow irregularities—its primary function was political: to position the United States as the champion of downstream states' interests and to delegitimize China's claims to benign regional leadership. The Mekong was being consciously reframed as a microcosm of the broader Indo-Pacific competition, with water governance as the terrain on which competing visions of regional order would be contested.

The establishment of the Mekong–U.S. Partnership in September 2020 formalized this strategic reorientation. Building on the LMI's programmatic infrastructure while substantially expanding its ambition and scope, the MUSP elevated U.S.–Mekong engagement to a comprehensive framework encompassing economic recovery, energy security, transnational crime prevention, environmental governance, and public health^[15]. The financial commitments announced under the MUSP were substantial relative to previous U.S. engagement in the sub-region: USD 156.4 million in new funding was announced in 2020 alone, including USD 52 million for post-COVID-19 economic recovery, USD 55 million for transnational crime prevention, USD 33 million for energy market development, and USD

6.6 million for infrastructure improvement ^[29]. The Biden administration subsequently reaffirmed and deepened these commitments, with Keshap ^[14] reporting that total U.S. development assistance to Mekong-related initiatives over the preceding decade had exceeded USD 4.3 billion—a figure that, while significantly smaller than China’s BRI commitments in the sub-region, nonetheless represented a meaningful long-term investment in the region’s governance and development capacity.

What distinguishes U.S. engagement from China’s is not primarily its scale but its model. Where China has prioritized the financing and construction of large physical infrastructure—dams, roads, railways, and ports—the United States has consistently emphasized knowledge-based partnerships, institutional capacity-building, and the promotion of governance standards. Bower and Parameswaran ^[13] documents how LMI projects drew on expertise from institutions including Intel, Harvard University, and the U.S. Geological Survey to develop innovative approaches to water management and environmental monitoring, reflecting a deliberate effort to offer Mekong states the kind of technical and scientific partnership that Chinese financing cannot easily replicate. The Friends of the Lower Mekong, established in 2011 and subsequently incorporated into the MUSP framework, extended this approach by building a coalition of like-minded partners—including Japan, South Korea, Australia, and the European Union, alongside multilateral institutions such as the ADB and the World Bank—to coordinate development support and amplify the governance standards that Washington sought to promote ^[30]. U.S.–Japan cooperation under this framework invested USD 29.5 million in regional power grid interconnection projects, while U.S.–South Korea collaboration supported satellite-based hydrological monitoring programs designed to enhance transparency in the management of cross-border water flows ^[30].

The environmental dimension of U.S. strategy deserves particular attention, both for what it has achieved and for the questions it raises about motivation and sustainability. U.S.-supported programs in the Mekong have genuinely contributed to enhanced environmental monitoring, improved data-sharing among lower Mekong states, and the development of scientific capacity in countries where such capacity was previously limited. The Eyes on

Earth study commissioned under the MUSP framework, which used satellite data to demonstrate that Chinese dams had withheld water during the 2019 drought, was a notable example of how U.S.-supported technical capacity could generate politically significant findings about upstream dam management. At the same time, it is important to recognize that the U.S. commitment to environmental standards in the Mekong coexists with a broader pattern of U.S. energy and climate policy that has not always been consistent with the environmental values Washington promotes abroad. Ha ^[16] is therefore right to caution that U.S. environmental engagement in the Mekong, however genuine in its immediate programmatic commitments, is ultimately embedded within a strategic logic that prioritizes competition with China over ecological outcomes—and that this embedded logic creates risks of inconsistency and discontinuity that undermine the long-term governance value of U.S. engagement.

For ASEAN, the evolution of U.S. strategy in the Mekong creates a complex set of opportunities and risks that resist simple characterization. The opportunities are real: U.S. engagement provides lower Mekong states with an alternative source of financing, technical expertise, and political support that reduces their dependence on Chinese investment and gives them greater room to maneuver in their relationships with Beijing. The multilateral framework of the MUSP, with its emphasis on coordination among like-minded partners, also aligns naturally with ASEAN’s own preference for inclusive, consensus-based regional architectures and offers potential synergies with existing ASEAN mechanisms such as the AMBDC and the AOIP. The risks are equally real, however. A sub-region in which U.S. and Chinese engagement is openly competitive creates pressures on ASEAN member states to align more explicitly with one external power or the other, threatening the internal cohesion that is the prerequisite for any effective collective governance response. The Mekong risks becoming, as Kittikhoun ^[19] has warned, a second South China Sea—a space where great power rivalry overwhelms the institutional frameworks designed to manage shared resources cooperatively. Navigating between these opportunities and risks is the central strategic challenge that U.S. engagement poses for ASEAN, and it is a challenge to which the organization has not yet developed a fully co-

herent response.

4.4. Beijing's Three-Dimensional Strategy: Dams, Infrastructure, and Institutional Consolidation

If the United States' engagement in the Mekong is best understood as a strategic response to a challenge that China has defined, then understanding China's strategy is essential to understanding the governance environment within which ASEAN must operate. China's approach to the Mekong is neither monolithic nor static, but it is characterized by a consistency of underlying purpose that distinguishes it from the more episodic and administratively fragmented engagement of other external powers. Beijing's strategy operates across three interlocking dimensions—upstream hydrological control through dam construction, economic and infrastructural integration through the BRI, and institutional consolidation through the MLC—and it is the interaction among these three dimensions, rather than any one of them in isolation, that gives China's Mekong strategy its distinctive character and its far-reaching consequences.

The upstream dimension is the most physically consequential. China has constructed eleven large dams on the Lancang River in Yunnan province, with a combined installed capacity of approximately 15,000 MW, and has plans for additional facilities that would extend the cascade further into the upper reaches of the river system. These dams provide substantial electricity generation for Yunnan province and contribute to China's broader renewable energy transition, but their downstream consequences have been severe and, in important respects, irreversible. The trapping of sediment behind upstream reservoirs has fundamentally altered the nutrient dynamics of the lower basin, reducing the fertility of floodplain soils and undermining the productivity of fisheries that millions of people depend on for food and income^[3,4]. The regulation of river flows for electricity generation has flattened the seasonal flood pulse that drives the ecological and agricultural rhythms of the lower basin, creating conditions of artificial stability in some seasons and artificial scarcity in others that bear little relationship to the natural hydrological cycle on which downstream communities have organized their livelihoods for generations. The 2019–2020 Mekong

drought brought these dynamics into sharp political relief. Analysis conducted by the U.S.-funded Eyes on Earth research group, using satellite data to measure water storage levels in Chinese reservoirs, concluded that upstream dams had withheld significant volumes of water during a period of severe downstream drought, contributing to water levels in the lower Mekong that were the lowest recorded in living memory. China disputed these findings, pointing to low rainfall in the upper basin as the primary cause of reduced downstream flows, but the controversy highlighted the fundamental asymmetry of the governance relationship: China controls the headwaters and decides unilaterally how they are managed, while downstream states bear the consequences of those decisions without any formal right of consultation or redress.

The economic and infrastructural dimension of China's strategy is articulated primarily through the BRI, which has channeled substantial investment into Mekong countries' transportation networks, energy systems, and industrial zones since its launch in 2013 and its significant deepening after 2016. Bharti and Kumari^[8] and Rolland^[9] both characterize BRI investments as serving simultaneously developmental and geopolitical purposes—addressing genuine infrastructure deficits while creating financial dependencies, strategic assets, and political relationships that extend Beijing's influence well beyond what conventional diplomacy could achieve. The scale of this investment in the Mekong sub-region is considerable: Azizi^[10] documents that nearly half of ASEAN's BRI-supported projects in 2018 were concentrated in Mekong countries, with Cambodia, Laos, and Myanmar receiving particularly intensive investment in port facilities, road and rail connectivity, and energy infrastructure. The Laos–China Railway, completed in December 2021, is perhaps the most visible symbol of this investment strategy—a USD 6 billion project that connects Kunming to Vientiane and is designed to integrate Laos into China's southern connectivity corridor while generating substantial debt obligations that give Beijing significant leverage over Vientiane's policy choices. Haefner and Po^[11] demonstrate that China's hydropower financing in the sub-region follows a similar logic, with Chinese state-owned enterprises financing and constructing dams in Laos and Cambodia under arrangements that give Chinese companies operational control and generate

electricity export revenues that flow primarily back to China rather than contributing to local development in ways that would reduce dependence on continued Chinese investment.

The institutional dimension of China's strategy is embodied in the MLC, formally launched in 2016 as Beijing's preferred multilateral framework for sub-regional governance. Busbarat^[7] provides the most penetrating analysis of the MLC's design logic, arguing that it was conceived not as a complement to existing frameworks such as the MRC but as a strategic alternative that would gradually displace them by offering more generous financing with fewer environmental conditionalities and by organizing sub-regional cooperation around a hub-and-spoke structure with China at the center. The MLC's bilateral architecture is particularly significant in this regard. By managing its relationships with each Mekong state individually rather than facilitating genuine multilateral dialogue, the MLC prevents downstream states from developing coordinated positions on shared concerns such as flow management, sediment transport, and environmental impact assessment. Each state is effectively incentivized to seek the best bilateral arrangement it can negotiate with Beijing rather than to invest in the collective governance capacity that effective basin management would require. This fragmentation of downstream political agency is not an accidental byproduct of the MLC's design; it is, as Busbarat^[7] argues, one of its most important strategic functions.

Applying the WEF nexus to China's Mekong strategy reveals the full scope of the trade-offs that Beijing's approach generates for the sub-region. The energy gains from China's Lancang dam cascade are real and substantial—approximately 15,000 MW of installed hydropower capacity represents a significant contribution to Yunnan's electricity supply and to China's renewable energy portfolio. But these energy gains are achieved at a cost that is distributed almost entirely to downstream communities rather than borne by the Chinese state or the Chinese consumers who benefit from the electricity generated. The food costs—declining fish catches, reduced floodplain fertility, disrupted agricultural calendars—fall on some of the most economically vulnerable communities in Southeast Asia, communities that have neither the political voice nor the financial resources to seek compensation or alternative livelihoods

easily^[3,15]. The water costs—reduced dry-season flows, irregular flood pulses, increased salinity intrusion—are borne by the downstream states whose farmers and fishing communities depend on predictable hydrological conditions for their livelihoods. The environmental costs—biodiversity loss, wetland degradation, altered sediment dynamics—are largely irreversible and will compound over time as the combined effects of dam construction and climate change interact. This is, in Allan's^[22] terms, a profound nexus governance failure: decisions made in the energy domain by one upstream state are generating cascading negative consequences across the food, water, and environment domains for tens of millions of people in five downstream countries, without any institutional mechanism capable of internalizing those costs or requiring the decision-maker to account for them.

The socio-hydrological consequences of China's strategy are equally significant and similarly underappreciated in conventional governance discussions. Sivapalan and colleagues^[23] argue that the co-evolution of human societies and hydrological systems creates path dependencies that are difficult and costly to reverse—a point that has immediate relevance to the Mekong context. As Chinese dam operations have altered the seasonal flow regime of the lower Mekong, downstream communities have begun adapting their agricultural and fishing practices in ways that, while individually rational, are collectively generating new vulnerabilities. Farmers in the Mekong Delta have invested in irrigation infrastructure designed for the altered flow conditions created by upstream dams, creating dependencies on continued dam-mediated water delivery that did not exist under natural hydrological conditions. Fishing communities have shifted toward aquaculture as river fisheries decline, a transition that requires capital investment and technical knowledge that many households lack and that creates new environmental pressures through water use and waste discharge. Rural-to-urban migration has accelerated as river-dependent livelihoods become less viable, reshaping labor markets and social structures in ways that generate pressures on urban infrastructure and social services that governments are not prepared to manage. Each of these adaptations represents a social feedback on the hydrological system that, taken together, is transforming the governance landscape of the lower Mekong in

ways that extend far beyond the immediate ecological consequences of dam construction.

China's framing of its Mekong engagement as mutually beneficial cooperation—embodied in the MLC's official rhetoric of shared development and win-win outcomes—sits in considerable tension with the evidence of its actual consequences for downstream communities. Beijing has made some concessions to the demand for greater transparency, establishing the Lancang–Mekong Water Center in 2020 and agreeing to share hydrological data with MRC member states on a more regular basis than previously. Mallick^[12] situates these concessions within China's broader interest in maintaining the legitimacy of the MLC as a governance framework and managing the reputational risks associated with being seen as an unresponsive upstream hegemon. But data-sharing, however welcome, does not address the fundamental governance deficit: downstream states receive information about how China manages the Lancang dams but have no formal mechanism for influencing those management decisions or seeking redress for their downstream consequences. For ASEAN, this governance deficit is the central challenge that China's Mekong strategy poses—and it is a challenge that cannot be addressed through bilateral diplomacy alone but requires the kind of multilateral institutional framework that ASEAN is, in principle, positioned to provide.

4.5. ASEAN between Centrality and Constraint: Institutional Capacity and Political Fragmentation

ASEAN's relationship with the Mekong is at once central and paradoxical. Central, because five of its ten member states depend directly on the river for food security, energy, and economic livelihood, and because the governance challenges of the Mekong Basin are inseparable from the broader questions of regional autonomy, institutional credibility, and sustainable development that define ASEAN's contemporary agenda^[18]. Paradoxical, because ASEAN was not designed as a water governance institution, possesses no formal authority over the Mekong's management, and must navigate the river's governance challenges through a set of institutional mechanisms that were built for different purposes and that reflect a founding philosophy—non-interference and consensus-based

decision-making—that sits in considerable tension with the kind of assertive, binding governance that effective basin management requires.

Understanding what ASEAN can realistically contribute to Mekong governance requires beginning with an honest assessment of its internal political landscape. The organization's ten member states do not share a common strategic orientation toward the Mekong, and the divergences among them are deep enough to constitute a structural constraint on collective action. Cambodia and Laos have aligned themselves closely with China, and for reasons that are readily understandable: Chinese investment under the BRI and MLC has provided both countries with infrastructure financing on a scale that no other partner has been willing or able to match, and the political relationships that accompany that financing give Beijing substantial influence over Phnom Penh's and Vientiane's positions on Mekong governance questions^[7,8]. Vietnam and Thailand have shown considerably greater openness to U.S. and Japanese engagement through the MUSP and Friends of the Lower Mekong frameworks, and both countries have been more willing to raise concerns about upstream dam impacts in multilateral forums^[14,15]. Myanmar's trajectory has been shaped less by strategic calculation than by political crisis: the military coup of February 2021 has effectively removed Naypyidaw from constructive participation in regional governance discussions and introduced a further dimension of unpredictability into ASEAN's already complex internal politics. Maritime ASEAN states—Singapore, Malaysia, Indonesia, Brunei, and the Philippines—are not directly affected by Mekong hydrology and tend to view sub-regional water governance through the lens of broader Indo-Pacific competition rather than as an ecological imperative in its own right. The result is an organization in which the states most directly affected by Mekong governance failures are also the states most constrained in their ability to advocate for stronger governance, while the states least directly affected have neither the incentive nor the political standing to push for more assertive institutional responses.

These internal divergences are real and consequential, but they do not exhaust the story of ASEAN's engagement with the Mekong. The organization has developed, over three decades, a set of institutional frameworks

that, while imperfect, provide meaningful platforms for embedding Mekong governance within a regional rather than purely bilateral or great-power-dominated context. The ASEAN Mekong Basin Development Cooperation, established in 1996, was among the first institutional expressions of ASEAN's recognition that the Mekong's development challenges could not be adequately addressed by individual member states or external actors alone and required a regional coordination mechanism that reflected ASEAN's collective interests^[6]. The ACMECS, launched in 2003 under a Thai initiative and bringing together the five mainland ASEAN states, has provided a more operationally focused platform for harmonizing development priorities across the sub-region, including in areas such as agricultural trade, industrial connectivity, and infrastructure development that have direct implications for how the Mekong's resources are used and governed. Teo^[20] and Phan^[21] both argue that these frameworks, however limited in their immediate practical impact, represent an important institutional infrastructure that ASEAN can build on—provided it develops the political will to do so.

The most significant recent development in ASEAN's institutional engagement with the Mekong's geopolitical context is the ASEAN Outlook on the Indo-Pacific, adopted in 2019. The AOIP represents ASEAN's most explicit attempt to articulate a regional vision for managing great power competition in ways that preserve ASEAN's centrality and prevent the organization from being forced to choose between competing external frameworks. Its emphasis on inclusivity, rule-based governance, and sustainable development provides a normative framework within which Mekong cooperation can be situated, and its recognition of the connectivity between maritime and continental Southeast Asian security creates an opening for linking Mekong governance to the broader Indo-Pacific agenda in ways that engage all ASEAN member states rather than only those directly affected by the river's hydrology^[20]. Whether the AOIP translates from normative aspiration into operational governance practice depends, however, on whether ASEAN can develop the institutional mechanisms and the political consensus to give it substantive content—a transition that has not yet fully occurred.

From an environmental perspective, ASEAN's most important potential contribution to Mekong governance

lies in its capacity to set and enforce common standards for environmental impact assessment, data-sharing, and ecological monitoring across the basin. The MRC has attempted to perform this function but has been hampered by its limited authority and China's non-membership. An ASEAN-led governance framework that embedded MRC functions within a broader regional architecture—one that drew on the AOIP's normative commitments, the AMB-DC's development coordination mandate, and ACMECS's sub-regional operational capacity—could provide a more robust institutional foundation for basin-wide environmental governance^[2,5]. Grumbine and Xu^[3] demonstrate that the ecological trade-offs of Mekong dam construction cannot be managed effectively without basin-wide cumulative impact assessments that take into account the interactions among multiple dams rather than evaluating each project in isolation—a form of assessment that requires the kind of cross-border institutional coordination that only a credible regional organization can convene. Minh's^[17] research on renewable energy development in Vietnam's Mekong Delta is directly relevant here, suggesting that investment in solar, wind, and biomass energy can reduce the sub-region's dependence on hydropower and thereby ease some of the political pressure for dam construction that drives ecological degradation—a finding that ASEAN could incorporate into its regional energy planning frameworks.

The geopolitical dimension of ASEAN's role is simultaneously its most important and its most contested. The argument for ASEAN's centrality in Mekong governance rests on the proposition that only a regional institution with established relationships with all major external actors—China, the United States, Japan, and others—can prevent the sub-region from becoming simply a theater for great power competition in which smaller states are reduced to choosing sides. Kittikhoun^[19] and Ha^[16] both identify this as the central governance risk: that the intensification of U.S.–China rivalry will fragment ASEAN unity and undermine the collective governance capacity that the Mekong urgently needs. ASEAN's response to this risk must be more than rhetorical affirmations of centrality; it must take the form of concrete institutional actions that demonstrate the organization's capacity to set governance terms that external partners are expected to respect rather than simply accommodate. This means, among other

things, developing common ASEAN positions on environmental impact standards for externally financed infrastructure projects, establishing transparent data-sharing protocols that apply to all basin management actors, including China, and building the technical capacity within ASEAN institutions to monitor compliance with agreed environmental standards independently rather than relying on data provided by the states whose behavior is being assessed.

The socio-hydrological dimension of ASEAN's role has received the least attention in existing governance discussions but may ultimately be the most important for long-term resilience. Sivapalan and colleagues^[23] demonstrate that governance frameworks that fail to account for the adaptive responses of communities to hydrological change are likely to generate outcomes that are technically sound but socially illegitimate and therefore politically unsustainable. ASEAN's governance frameworks have historically been designed around the interests and perspectives of member-state governments rather than the communities most directly affected by the Mekong's management—a design choice that reflects the organization's intergovernmental character but that creates a significant governance deficit when the communities most affected by basin management decisions are precisely those with the least political voice in the governments that represent them. Building mechanisms for community participation, local knowledge integration, and adaptive social protection into ASEAN's Mekong governance frameworks is therefore not merely a matter of procedural inclusivity; it is a substantive governance imperative if ASEAN's institutional responses are to keep pace with the socio-hydrological changes that are already transforming life along the river.

In sum, ASEAN's role in Mekong governance is both more constrained and more consequential than either its critics or its advocates typically acknowledge. It is more constrained because the organization's internal divergences, its non-interference principle, and its lack of formal authority over basin management create real limits on what it can achieve through collective action. It is more consequential because, as the comparative evidence from other transboundary river systems suggests, the presence of a credible regional institution committed to inclusive, rule-based governance is one of the most consistently important factors distinguishing basins where cooperation

has succeeded from those where rivalry has prevailed^[26,27]. The Mekong's governance trajectory will be shaped, in no small measure, by whether ASEAN chooses to invest in developing that credibility or allows the pressures of great power competition to erode it further.

4.6. Toward Integrated Governance: Policy Implications and Reform Pathways

The analysis presented in the preceding sections points toward a set of policy implications that are neither simple nor comfortable, but that follow with reasonable clarity from the evidence. The Mekong Basin's governance challenges are not primarily technical problems awaiting technical solutions; they are political problems embedded in structural power asymmetries, institutional inadequacies, and competing developmental imperatives that no single actor—not ASEAN, not the MRC, not the United States, not China—can resolve unilaterally. What follows is therefore not a blueprint for governance reform but an analytically grounded assessment of the directions in which reform must move if the Mekong is to remain a source of ecological resilience and regional cooperation rather than deteriorating further into a frontier of environmental crisis and geopolitical contestation.

The most fundamental implication of the WEF nexus analysis is that the Mekong's governance frameworks must be redesigned around the recognition that decisions made in one resource domain inevitably generate consequences across all others, and that governance arrangements which treat energy, food, water, and environmental management as separate policy silos will systematically generate outcomes that are suboptimal from a basin-wide perspective. The current institutional landscape of the Mekong—characterized by a weakened MRC, a China-dominated MLC, an ASEAN framework that has not yet fully engaged with sub-regional water governance, and a U.S. partnership that emphasizes environmental standards without possessing the institutional leverage to enforce them—is precisely such a siloed arrangement, and its inadequacy is reflected in the compounding ecological deterioration that the basin is experiencing. Allan^[22] argues that managing nexus trade-offs effectively requires institutional arrangements that internalize the cross-domain consequences of resource management decisions—arrangements that

give downstream food security interests a formal voice in upstream energy development decisions, that require environmental impact assessments to account for cumulative basin-wide effects rather than evaluating individual projects in isolation, and that create financial mechanisms for distributing the costs and benefits of river management more equitably among riparian states. Translating this principle into the Mekong's specific institutional context means, at a minimum, strengthening the MRC's technical capacity and expanding its mandate to include cumulative impact assessment across the entire dam cascade, developing binding environmental flow standards that constrain dam operations during critical ecological periods, and creating compensation mechanisms through which upstream states that benefit from dam electricity revenues contribute to the food security and livelihood costs borne by downstream communities^[24].

The socio-hydrological analysis points toward a complementary set of implications that operate at the community rather than the institutional level. Sivapalan and colleagues^[23] demonstrate that governance frameworks built around the interests and perspectives of governments, without adequate mechanisms for incorporating the knowledge and priorities of the communities most directly affected by hydrological change, tend to generate technically sophisticated but socially illegitimate outcomes that fail to achieve their stated objectives. In the Mekong context, this means that any serious governance reform must include mechanisms for community participation in basin management decisions, systems for integrating local ecological knowledge into environmental monitoring and impact assessment, and adaptive social protection programs that support the livelihoods of communities whose traditional resource base is being undermined by dam construction and climate change. The research of Minh^[17] on renewable energy development in Vietnam's Mekong Delta illustrates one dimension of this challenge: the transition away from hydropower dependence requires not only investment in alternative energy technologies but also deliberate policy choices about how the economic benefits of that transition are distributed among communities that have historically depended on the river's ecological services. Without such choices, the energy transition risks replicating the distributional injustices of the dam-building era in a different tech-

nological register.

The comparative case study analysis identifies the Danube model as the most instructive reference point for Mekong governance reform, while also drawing important lessons from the Indus, Nile, and Amazon experiences. The International Commission for the Protection of the Danube River, established under the 1994 Danube River Protection Convention, demonstrates what legally binding institutional cooperation, full riparian membership, and transparent environmental governance can achieve over time: water quality in the Danube has improved significantly since the International Commission for the Protection of the Danube River (ICPDR)'s establishment, cross-border data-sharing has become routine, and disputes over water management have been resolved through institutional mechanisms rather than bilateral confrontation^[26]. The key features of the ICPDR that are most directly transferable to the Mekong context are its legally binding character, its inclusion of all riparian states as full members with equal procedural standing, its transparent reporting requirements that create public accountability for member states' compliance with agreed standards, and its technical working groups that build the shared scientific understanding necessary for cooperative management. The principal obstacle to applying the Danube model to the Mekong is, of course, China's unwillingness to accept the kind of binding multilateral accountability that ICPDR membership entails—an obstacle that is fundamentally political rather than technical and that requires a diplomatic strategy rather than an institutional blueprint.

The Indus Waters Treaty offers a more sobering but ultimately more realistic reference point for this diplomatic challenge. The treaty, brokered by the World Bank in 1960 between India and Pakistan, has survived more than six decades of bilateral conflict, two major wars, and persistent political hostility between the two signatories—demonstrating that durable water-sharing agreements are achievable even between states locked in deep strategic rivalry, provided that the agreement is designed around concrete and verifiable commitments rather than aspirational principles, and that it includes effective dispute resolution mechanisms backed by credible third-party mediation^[27]. The lesson for the Mekong is not that a comprehensive basin-wide treaty is immediately achievable—it manifestly is

not—but that targeted, technically specific agreements on discrete governance questions, such as minimum environmental flow standards during drought periods or protocols for advance notification of dam operations that significantly affect downstream flows, may be more achievable in the near term than comprehensive institutional reform, and may build the trust and institutional habits necessary for more ambitious cooperation over time.

The Nile Basin's experience provides the most direct cautionary lesson for the Mekong. Ethiopia's unilateral construction of the Grand Ethiopian Renaissance Dam, proceeding without a binding agreement with downstream Egypt and Sudan despite years of negotiation, has generated a geopolitical crisis that has destabilized relations among the three countries and demonstrated the consequences of allowing major upstream infrastructure to proceed in the absence of effective multilateral governance^[26]. The parallel with the Mekong is imperfect—China's upstream dam construction began decades ago rather than being a current source of acute crisis—but the underlying governance failure is structurally similar: an upstream state with the physical capacity to reshape a shared river system has exercised that capacity unilaterally, and the institutional frameworks designed to ensure downstream consultation have proven inadequate to constrain it. The Nile case suggests that the window for establishing effective governance before irreversible upstream infrastructure is in place is narrow, and that the cost of failing to establish such governance—in terms of ecological damage, geopolitical tension, and foregone development opportunities—is very high. For the Mekong, that window has already largely closed with respect to China's Lancang dams, but it remains open with respect to the ongoing construction of lower basin dams in Laos and Cambodia, where ASEAN's influence is potentially more significant and where effective governance intervention could still prevent some of the most damaging cumulative impacts.

The Amazon experience rounds out the comparative picture by highlighting the governance dimensions that technical and institutional analysis tends to underemphasize. The Amazon's management challenges have consistently demonstrated that governance frameworks lacking legitimacy in the eyes of the communities most directly affected—and in the Amazon context, that means indig-

enous and traditional communities whose territories encompass much of the basin—tend to fail not because they are technically inadequate but because they lack the social foundations necessary for effective implementation. In the Mekong context, this lesson translates into a recognition that governance reform driven exclusively by governments and international institutions, without meaningful participation from fishing communities, smallholder farmers, and other river-dependent populations, is unlikely to generate the durable social contracts necessary for long-term resilience. ASEAN's governance frameworks have historically been designed around the interests of member state governments, and expanding them to incorporate community voices will require both institutional innovation and political will that the organization has not consistently demonstrated.

Against this comparative backdrop, ASEAN's most important contribution to Mekong governance reform would be to act as the institutional entrepreneur capable of convening the diplomatic process through which incremental governance improvements become possible. This means, in concrete terms, using the AOIP framework to develop a common ASEAN position on environmental standards for basin infrastructure that applies equally to Chinese BRI projects and U.S.-supported initiatives, embedding Mekong governance within the AMBDC and ACMECS frameworks in ways that give sub-regional environmental concerns greater institutional weight in ASEAN's collective agenda, and investing in the technical capacity within ASEAN institutions to monitor basin-wide environmental conditions independently and transparently. It also means managing the diplomatic relationship with China in ways that create incentives for Beijing to move gradually toward fuller participation in multilateral governance—not through confrontation, which ASEAN neither desires nor is positioned to sustain, but through the patient construction of governance arrangements that make Chinese participation sufficiently attractive and the costs of non-participation sufficiently visible to shift Beijing's calculus over time.

The scale of this agenda should not be underestimated, and intellectual honesty requires acknowledging that ASEAN's track record in translating governance aspirations into operational realities has been uneven at best.

The organization's founding commitment to non-interference, while serving important functions in maintaining ASEAN's cohesion across its diverse membership, creates a structural bias against the kind of binding, enforceable governance that the Mekong's challenges require. Overcoming that bias without fracturing the consensus that gives ASEAN its political legitimacy is perhaps the most difficult governance challenge the organization faces—and it is a challenge that admits no easy solution. What the evidence does suggest, however, is that the costs of inaction are rising faster than the costs of institutional reform, and that the window within which ASEAN can establish its relevance as a Mekong governance actor is narrowing as the basin's ecological deterioration advances and the great power competition that shapes its governance intensifies. The question is not whether ASEAN can afford to take on this challenge, but whether it can afford not to.

5. Conclusions

The Mekong Basin presents one of the most consequential governance challenges in contemporary Southeast Asia. The river is simultaneously an ecological system of extraordinary richness, an economic foundation for tens of millions of people, a socio-cultural landscape whose communities are already adapting at considerable cost to altered hydrological conditions, and a geopolitical arena in which U.S.–China strategic competition is being prosecuted through infrastructure investment, institutional design, and the selective management of environmental information. Any governance framework adequate to the Mekong's complexity must engage all four dimensions simultaneously, and the central argument of this paper is that ASEAN is the only regional actor positioned to attempt that engagement—though whether it will do so effectively remains genuinely uncertain.

The WEF nexus analysis demonstrates that the Mekong's governance failures are not primarily the result of insufficient technical knowledge but of inadequate institutional capacity—the capacity to internalize cross-domain consequences into resource management decisions, to distribute the costs and benefits of basin management more equitably among riparian states, and to give downstream communities a meaningful voice in the governance

processes that shape their livelihoods. The socio-hydrological analysis deepens this picture by showing that communities along the river are active agents whose adaptive responses to hydrological change are already reshaping the basin's social and ecological landscape in ways that existing frameworks have not adequately addressed. The comparative analysis identifies the Danube model as the most instructive reference point for reform, the Indus Waters Treaty as the most realistic near-term template for targeted agreements, the Nile as the most direct cautionary parallel, and the Amazon as a reminder that governance legitimacy ultimately rests on community participation rather than intergovernmental agreement alone.

China's strategy—combining upstream hydrological control, BRI-driven economic integration, and MLC-based institutional consolidation—has fundamentally reshaped the sub-region's governance landscape in ways that are unlikely to be reversed. The United States' engagement through the LMI and MUSP has provided a meaningful alternative partnership and genuine technical capacity, but remains uneven across administrations and embedded within a strategic logic that does not always prioritize ecological outcomes over competitive ones. For ASEAN, navigating between these two external frameworks without fracturing its internal cohesion is both the central governance challenge and the central institutional opportunity that the Mekong now presents.

ASEAN's response must move beyond rhetorical affirmations of centrality toward concrete institutional reforms: common environmental standards for basin infrastructure applicable to all external partners, strengthened MRC technical capacity, patient diplomacy aimed at drawing China into fuller multilateral participation, and governance mechanisms that genuinely incorporate the voices of river-dependent communities. The AOIP provides the normative architecture for this agenda, but translating its principles into operational practice requires political will that the organization has not yet consistently demonstrated.

The limitations of this study—its reliance on English-language sources, its use of secondary materials for comparative analysis, and the qualitative rather than quantitative application of its theoretical frameworks—point toward a clear agenda for future research: multilingual literature reviews, primary fieldwork with basin communities,

quantitative modeling of WEFE trade-offs, and empirical investigation of the conditions under which China might accept fuller participation in multilateral Mekong governance.

What the evidence assembled here ultimately suggests is that the path to effective Mekong governance is long and structurally constrained, but not closed. The comparative record of other transboundary river systems demonstrates that cooperation is achievable even under conditions of significant political complexity and strategic rivalry—provided that the institutional frameworks designed to support it are built with sufficient ambition, inclusivity, and commitment to genuine accountability. Whether ASEAN chooses to build those frameworks, or allows the window for doing so to narrow further, is a political choice whose consequences will be felt not only by the sixty million people who depend on the Mekong today, but by the generations who will inherit whatever ecological and institutional legacy this one leaves behind.

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The data used in this study can be provided upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

AI Use Statement

During the preparation of this manuscript, the authors used AI tools solely for language refinement. No AI tools were used for data analysis, interpretation, or generation of scientific content. All outputs were critically reviewed and edited by the authors. The authors take full responsibility for the integrity and accuracy of the work.

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