

**BEYOND WATER SECURITY: DOWNSTREAM HYDRO HEGEMONY,
UPSTREAM SOVEREIGNTY AND THE *SUNGAI MUDA* CONFLICT IN
MALAYSIAN FEDERALISM**

Mohd Firdaus Abdullah^{1*} and Arba'iyah Mohd Noor²

ABSTRACT

This article argues that the *Sungai Muda* conflict reflects the complex interaction between sovereignty, riparian rights, and the governance of strategic resources within the framework of Malaysian federalism. Penang represents a compelling case of how a subnational entity lacking conventional territorial sovereignty over a river basin can nonetheless defend and legitimise its claims through negotiation, administrative efficiency, and strategic adaptation to federal structures. By leveraging institutional effectiveness through the *Perbadanan Bekalan Air Pulau Pinang Sdn Bhd* (PBAPP) and engaging in calibrated domestic diplomacy, Penang has justified its continued access to the waters of the *Sungai Muda*, despite the absence of a clearly codified and consistently applied riparian rights doctrine in Malaysia. In this respect, Penang constitutes a distinctive domestic model that warrants comparative consideration within global resource governance scholarship. Conversely, Kedah, as the upstream state exercising territorial jurisdiction over the *Ulu Muda* catchment, has mobilised its sovereign position to demand distributive justice, recognition of the ecological and fiscal burdens associated with maintaining the watershed, and formalised compensation from downstream beneficiaries. The dispute therefore exposes structural tensions within Malaysian federal governance, where questions of distributive equity, ecological sustainability, and shared responsibility remain insufficiently institutionalised. Drawing upon hydro-hegemony theory and normative frameworks of distributive justice, this study examines how Kedah and Penang articulate and defend competing claims within an asymmetrical federal structure. The article proposes the reform of Malaysia's inter-state water governance architecture through more inclusive and rule-based mechanisms, including formalised compensation schemes for upstream states, the establishment of joint basin management institutions, and the integration of ecological sustainability principles into federal resource policy. In doing so, it seeks not only to advance scholarly debates on strategic resource governance in Malaysia but also to contribute to comparative discussions relevant to federations and river basins worldwide that confront analogous tensions over shared water resources.

Keywords: Hydro-hegemony, Federalism, Water governance, Distributive justice, Upstream–downstream relations

INTRODUCTION

The *Sungai Muda* conflict between Kedah and Penang is not merely a dispute over access to water resources; rather, it reflects how history, power, and a complex federal system shape the governance of strategic resources in Malaysia (Abdullah et al., 2024). *Sungai Muda*, which flows across Kedah and Penang, has become the focal point of contestation between Kedah as the upstream sovereign state and Penang as the downstream state lacking full sovereignty over the water source (Jaseni Maidinsa, 2017). This conflict must therefore be understood not simply as a technical issue of water management, but as a question of distributive justice, ecological stewardship, and the enduring influence of historical relations between the two states on contemporary political dynamics. *Sungai Muda*, now the primary water source for Kedah, Penang, and also Perlis, exemplifies the enduring effects of that historical division. Kedah remains the upstream state controlling the catchment area, while Penang depends on the river for approximately 80 per cent of its raw water supply (Abdullah et al., 2024; Abdullah, 2024). This article argues that the conflict reflects a structural power imbalance inherited from the colonial era (Bonney, 1974). Kedah continues to assert its sovereign rights as the upstream state, whereas Penang, despite lacking full sovereignty over the source, has employed modern strategies, including administrative efficiency and diplomatic engagement, to defend what it frames as its riparian rights (Abd Rani & Md Khalid, 2025).

This article is anchored in two interrelated theoretical perspectives: hydro-hegemony and distributive justice. Hydro-hegemony theory explains how power asymmetries shape control, access, and bargaining positions in shared water systems. While the theory is commonly applied to international river basins, this study adapts it to a domestic federal context by examining how Kedah and Penang mobilise different forms of power in the *Sungai Muda* dispute (Zeitoun & Warner, 2006). Kedah's power derives from its upstream territorial authority over the *Ulu Muda* catchment, whereas Penang's power rests on administrative efficiency, economic significance, riparian claims, and engagement with federal institutions. Distributive justice, meanwhile, is used to evaluate whether the burdens and benefits of water governance are shared equitably between upstream and downstream actors (Rawls, 1971). In this paper, it is operationalised through three analytical dimensions: the ecological burden borne by Kedah in preserving the catchment, the economic benefits gained by Penang from reliable water supply, and the absence of a formal compensation or cost-sharing mechanism within Malaysia's federal water governance framework. Together, these perspectives provide the theoretical foundation for analysing the *Sungai Muda* conflict not merely as a technical water-management issue, but as a problem of power, responsibility, and equity within Malaysian federalism.

Penang faces distinctive challenges, yet it has also demonstrated an exceptional capacity to adapt within Malaysia's federal framework (Loh, 2010). It represents a case in which a political entity without traditional sovereignty over a resource act strategically to safeguard its interests through non-traditional mechanisms, including domestic diplomacy and efficient water governance via the *Perbadanan Bekalan Air Pulau Pinang Sdn Bhd* (PBAPP) (Wan Mansor, 2020). Although riparian principles are not explicitly codified within Malaysian inter-state water law, Penang invokes the concept as a moral and quasi-legal foundation to justify continued access to *Sungai Muda*. Conversely, Kedah, as the upstream sovereign state, leverages its territorial control to demand formal compensation for the costs associated with conserving the *Ulu Muda* catchment area, which is critical to maintaining the river's flow. The eighteenth-century separation of Penang from Kedah continues to exert profound implications for resource governance today. As a politically and administratively distinct territory, Penang relies on Kedah as the upstream state for access to strategic resources, particularly water. The

separation also reflects a complex redistribution of power: under British colonial rule, Penang evolved into a commercial and industrial hub, while Kedah remained largely agrarian, bearing substantial responsibility for environmental preservation and resource conservation (Merican, 2023; Abdullah et al., 2024).

The contemporary dynamics of the *Sungai Muda* conflict illustrate these historical asymmetries. Penang, as a downstream state, has emerged as a significant centre of economic development in Malaysia, contributing substantially to national GDP through its industrial and tourism sectors (Singh, Rasiah & Wong, 2019; Department of Statistics Malaysia, 2023). Yet its dependence on *Sungai Muda* renders it vulnerable to political tensions with Kedah, particularly as demands for formal compensation for the preservation of the *Ulu Muda* catchment area have become increasingly prominent (Ramasaamy, 2017). For Kedah, the catchment is not merely a water source; it is a vital ecological zone contributing to biodiversity and regional ecosystem stability (Azri Azmi, Yusoff & Md. Hanafiah, 2022). This article contends that Penang provides a compelling example of how a political entity lacking conventional resource sovereignty may defend its interests through negotiation, administrative competence, and adaptation to federal structures. In the *Sungai Muda* dispute, Penang has adopted a data-driven and diplomatically calibrated approach to maintain access to water resources. Its invocation of riparian rights provides a normative justification for continued utilisation of *Sungai Muda's* waters. Through the administrative effectiveness of PBAPP, Penang has positioned itself as an efficient and responsible water user. However, this strategy must be situated within a broader normative framework grounded in distributive justice and shared responsibility. Kedah, as the upstream state, continues to shoulder the primary burden of preserving the *Ulu Muda* catchment area. This reality highlights a systemic challenge within Malaysia's federal governance structure; whereby upstream states often bear conservation responsibilities without commensurate support from downstream states that directly benefit from the resource.

This article advances three interrelated arguments. First, it argues that the *Sungai Muda* dispute is not merely a technical issue of water security, but a hydro-hegemonic conflict shaped by Malaysia's asymmetrical federal structure, in which upstream ecological responsibility and downstream economic dependence are unevenly distributed. Second, it contends that Penang represents a distinctive form of downstream strategic agency: although it lacks conventional sovereignty over the *Ulu Muda* catchment and the upper reaches of *Sungai Muda*, it has defended continued access to the river through administrative efficiency, riparian reasoning, domestic diplomacy, and adaptive engagement with federal institutions. Third, the article argues that Kedah's demand for compensation should not be reduced to a narrow fiscal claim, but should instead be understood as a broader demand for distributive justice, ecological recognition, and institutionalised burden-sharing within Malaysian federalism. The contribution of this article is therefore twofold. Empirically, it foregrounds the *Sungai Muda* conflict as a critical case for understanding inter-state water governance in Malaysia. Conceptually, it extends hydro-hegemony analysis beyond conventional international river-basin conflicts by demonstrating how hegemonic and counter-hegemonic strategies also operate within domestic federal systems. By focusing on Penang as a downstream actor without conventional resource sovereignty, the article contributes to wider debates on strategic resource governance, riparian entitlement, ecological stewardship, and federal reform. It further proposes that a durable resolution requires more than episodic negotiation: Malaysia needs formalised compensation mechanisms, a joint basin-management institution, and a federal water-governance framework grounded in shared responsibility, distributive fairness, and long-term ecological sustainability.

Methodologically, this article adopts a qualitative historical-policy analysis. The study draws on documentary sources, including archival materials, legal documents, official reports, policy statements, media releases, government publications, and secondary academic literature. Key sources include Act 325, records relating to water development in the Muda region, PBAPP and PBAHB statements, Kedah state water governance materials, government statistical reports, and scholarly works on federalism, riparian rights, hydro-hegemony and water governance. These materials are analysed thematically to examine how Kedah and Penang construct competing claims over *Sungai Muda*. The analysis focuses on four interrelated themes: upstream sovereignty, downstream dependency, distributive justice, and institutional gaps in Malaysian federal water governance. Rather than treating the dispute as a technical water management problem, the methodology enables the article to interpret *Sungai Muda* as a historically constituted and politically contested strategic resource.

The Historical Separation of Penang and Its Implications for Strategic Resource Governance

The conflict surrounding *Sungai Muda* cannot be fully understood without revisiting the eighteenth-century separation of Penang from Kedah. This episode was not merely a geopolitical realignment; it produced a structural legacy that continues to shape the governance of strategic resources in Malaysia, particularly water. The separation began in 1786, when Sultan Abdullah Mukarram Shah of Kedah was long believed to have ceded Penang to the British East India Company in exchange for military protection. More recent historiographical interventions, however, challenge this conventional narrative, arguing that no lawful cession occurred and that Francis Light effectively occupied the island without legitimate sovereign consent (Merican, 2023). Regardless of the interpretive position adopted, the episode institutionalised a durable asymmetry of power. Kedah remained ecologically burdened as a territorial hinterland, while Penang evolved into a colonial entrepôt and later an industrial hub under British administration (Gin, 2015; Abdullah et al., 2024).

This territorial division reconfigured political and administrative boundaries in ways that structured the relationship between Kedah as the upstream state and Penang as the downstream beneficiary. Kedah, exercising sovereignty over the *Sungai Muda* basin and its catchment areas, assumed a decisive role in safeguarding the ecological sustainability of the river system. Penang, by contrast, became progressively dependent on *Sungai Muda* as its principal source of raw water (Japan International Cooperation Agency, 2000; PBAPP, 2021). Since 1973, water from *Sungai Muda* has been formally abstracted to meet Penang's domestic and industrial demands (PBAPP, 2021). This dependency significantly accelerated Penang's economic growth, enabling it to emerge as one of Malaysia's most industrialised and GDP-contributing states. Yet this asymmetrical interdependence has also generated recurring political and fiscal tensions, particularly over responsibility for preserving the *Ulu Muda* forest reserve, the critical catchment sustaining the flow of *Sungai Muda* (Department of Statistics Malaysia, 2023)

Sungai Muda is more than a hydrological asset. It constitutes the economic lifeline of both states and a symbolic axis of power that reflects the structural dynamics between upstream and downstream polities (Weng, 2005). More than 80 per cent of Penang's raw water supply is derived from *Sungai Muda*, a dependency that underpins its industrial expansion and export-oriented economy (PBAPP, 2021). However, this reliance has intensified political contestation, especially when Kedah demanded RM50 million annually as compensation in recognition of its ecological stewardship over *Ulu Muda*. From Kedah's perspective, this claim represents not

merely a fiscal request but a normative appeal grounded in distributive justice within a federal framework (New Straits Times, 2020; World Wide Fund for Nature Malaysia, n.d.). The Kedah and Penang (Alteration of Boundary) Act 1985, commonly referred to as Act 325, introduced a further layer of complexity. By designating *Sungai Muda* as the formal boundary between the two states, the Act entrenched the river as both a legal demarcation and a site of contestation. Kedah maintains that this delineation affirms its sovereign authority over the upstream catchment, including *Ulu Muda*, which forms the ecological backbone of the basin. Penang, conversely, invokes riparian principles to assert its entitlement to continued access to the flow of *Sungai Muda* as a matter of both moral legitimacy and legal right. The persistent dispute underscores the limitations of Act 325 in addressing foundational questions of equitable distribution, shared responsibility, and cooperative governance across state lines (Act 325, 1985).

The political and administrative separation between Kedah and Penang has also produced a structural gap in water governance responsibilities. Kedah bears the primary burden of conserving the *Ulu Muda* catchment, a region critical not only for raw water supply but also for broader ecological stability across northern Peninsular Malaysia. The preservation of this forested watershed entails substantial financial costs and long-term sustainable management strategies (Ramasamy, 2017). Yet Penang has historically enjoyed direct economic gains from *Sungai Muda* without a formalised mechanism for contributing to catchment maintenance (Singh, Rasiah & Wong, 2019). This asymmetry reinforces a power imbalance in which the upstream state shoulders environmental costs while the downstream state captures economic dividends. The historical legacy of separation continues to inform contemporary political narratives. For Kedah, *Sungai Muda* symbolises sovereign authority and territorial integrity. For Penang, it represents a vital riparian entitlement indispensable to domestic welfare and economic competitiveness. Kedah's formal compensation claims reflect an effort to recalibrate federal relations in line with principles of environmental justice and fiscal equity. At stake is not merely revenue allocation, but the redefinition of upstream–downstream relations within Malaysia's constitutional and federal architecture. The issue extends beyond fiscal redistribution to encompass ecological sustainability. The *Ulu Muda* catchment faces mounting pressures from logging and land-use change, threatening the long-term viability of *Sungai Muda*. The absence of a clearly institutionalised inter-state governance framework exacerbates these risks. Ecological degradation in the upstream region would not only undermine Kedah's environmental integrity but also expose Penang to acute water insecurity. Thus, the conflict reveals structural vulnerabilities embedded within Malaysia's fragmented water governance regime (PBAPP, 2020).

Despite lacking sovereign control over the catchment, Penang has demonstrated administrative capacity in managing water distribution through the PBAPP. The state is often cited for operational efficiency and comparatively low water tariffs. However, administrative effectiveness at the point of distribution does not resolve the upstream challenge of ecological preservation or the normative question of distributive fairness. Technical efficiency cannot substitute for an integrated basin-wide governance model grounded in shared responsibility (Abdullah et al., 2024). The historical separation of Penang from Kedah, reinforced by boundary formalisation under Act 325, has thus generated a layered legacy of contestation over strategic resources (Act, 1985: Merican, 2023). The *Sungai Muda* dispute exemplifies how colonial-era territorial restructuring continues to shape contemporary federal relations, environmental governance, and inter-state bargaining. Kedah carries the ecological burden of stewardship, while Penang defends its riparian rights through legal and administrative rationality. A durable resolution requires more than episodic negotiation; it necessitates a

formalised cooperative framework and equitable compensation mechanism that recognises upstream ecological services as a public good within Malaysia's federal system. Understanding the historical, legal, and political dimensions of this dispute is essential to crafting a long-term solution that is equitable, sustainable, and institutionally coherent. *Sungai Muda* is not merely a natural resource. It is a historically constituted arena of sovereignty, economic development, and environmental justice that continues to test the resilience of Malaysia's federal governance architecture.

Penang as a Downstream Subnational Actor without Upstream Territorial Control

Penang offers a distinctive example of how an entity lacking traditional sovereign control over a strategic resource can nonetheless act strategically to safeguard its interests in a resource conflict. In the context of the *Sungai Muda* dispute, Penang, despite having no formal sovereignty over the upstream water source, has relied on administrative efficiency, domestic diplomacy, and adaptive engagement with Malaysia's federal system to secure continued access to the river. This case highlights an emerging dimension in the study of strategic resource governance: traditional territorial sovereignty is no longer the sole determinant of authority or bargaining power in disputes over natural resources (PBAPP, 2021).

As previously noted, Penang depends on the *Sungai Muda* for more than 80 per cent of its raw water supply, rendering the river a critical strategic asset for the state's domestic and economic development (PBAPP, 2021). This dependency dates back to 1973, when Penang began abstracting water from the river to meet growing residential and industrial demand (PKR, n.d). With a stable supply from the *Sungai Muda*, Penang has evolved into one of Malaysia's most economically advanced states, with manufacturing, trade, and tourism forming the backbone of its economy. Yet this structural dependence has also generated political tensions with Kedah, the upstream state, particularly when Kedah has sought formal compensation in recognition of its responsibility to conserve the *Ulu Muda* catchment area (Haji Omar, 1978).

One of Penang's principal strategies in defending its position has been the deployment of administrative effectiveness. This effectiveness should not be understood merely as general managerial competence, but as PBAPP's ability to translate downstream dependence into a credible governance argument. Through comparatively low non-revenue water, stable treatment and distribution capacity, demand planning, tariff administration, and public communication, PBAPP has enabled Penang to present itself as a technically responsible user of *Sungai Muda* water. PBAPP has consistently maintained one of the lowest non-revenue water (NRW) rates in Malaysia, recording levels of approximately 18-20 per cent in the early 2010s, compared with a national average of around 35-36 per cent during the same period. This performance has been widely cited as evidence of efficient water management, reinforcing Penang's claim that its continued reliance on *Sungai Muda* is not based on wasteful use, but on an organised system of urban and industrial water governance (Hui, Leng & Weng, 2013; Lai, Chan & Zakaria, 2013). In relation to Kedah, such administrative effectiveness strengthens Penang's argumentative position by shifting the dispute from upstream ownership alone to questions of efficient utilisation, public welfare, and economic necessity. However, this efficiency also produces a structural paradox. While Penang has optimised downstream usage, it has not provided formal financial contributions to the conservation of the upstream *Ulu Muda* catchment in Kedah. In the absence of a clearly institutionalised compensation mechanism, Kedah often interprets Penang's efficiency not as shared stewardship but as a strategy that leaves the upstream state to bear the ecological burden of sustaining the river's flow (Abd Rani & Md Khalid, 2025).

Penang has also invoked the concept of riparian rights as a moral and legal foundation for its access to the *Sungai Muda*. In principle, riparian doctrine recognises the entitlement of downstream users to benefit from the natural flow of a river (Getzler, 2004). Penang maintains that, it is entitled to abstract water without incurring formal obligations to the upstream jurisdiction beyond existing legal frameworks. While riparian principles are well established in international water law, their application within Malaysia's domestic federal structure remains legally ambiguous and politically contested. Kedah rejects Penang's reliance on riparian reasoning, arguing that its territorial sovereignty over the *Ulu Muda* catchment grants it authority to determine how the resource should be managed and shared (Harakahdaily, 2021). From Kedah's perspective, maintaining the ecological integrity of the catchment entails significant financial and opportunity costs, particularly in light of pressures from logging, land use change, and development demands. Kedah contends that it is inequitable for the upstream state to bear the full burden of conservation while downstream beneficiaries derive substantial economic gains without structured compensation (Berita Harian, 2024).

Beyond administrative performance and legal argumentation, Penang has engaged in domestic diplomacy by aligning its claims with the existing federal and state legal framework. This alignment does not mean that Penang has circumvented the law; rather, it has operated within the legal ambiguity produced by Malaysia's fragmented water governance structure. Under Act 325, the Kedah-Penang boundary is defined along the centre line of *Sungai Muda*, allowing Penang to frame abstraction from its side of the river as a territorially legitimate riparian practice (Act 325, 1985). At the same time, federal water services legislation regulates water supply services, operators, tariffs, and service delivery, but does not provide a specific inter-state compensation mechanism for raw water abstracted from a boundary river. This distinction is crucial. Penang's compliance with the federal water services regime strengthens its position as a lawful water service provider, while the absence of a binding compensation framework weakens Kedah's ability to compel payment through a clearly defined statutory mechanism. Consequently, the continuity of Penang's abstraction from *Sungai Muda* has been secured through a combination of territorial interpretation, regulatory compliance, federal institutional recognition, and the framing of water supply as essential to public welfare and national economic stability. Nevertheless, this strategy has intensified political friction with Kedah, which regards the same legal gap as evidence of federal failure to recognise upstream ecological costs and distributive justice (Water Services Industry Act, 2006: Abd Rani & Md Khalid, 2025).

At the same time, Penang's dependence on the *Sungai Muda* exposes it to substantial vulnerabilities. The state remains highly susceptible to supply disruptions if conservation challenges in the *Ulu Muda* catchment are not adequately addressed or if extreme climatic events such as droughts and floods intensify. The catchment area, which sustains the river's flow regime, faces mounting ecological pressure from deforestation, logging, and land conversion. Kedah, as the upstream authority, confronts a persistent dilemma between preserving ecological integrity and pursuing economic revenue generation. For Penang, the absence of a clear and institutionalised governance framework for upstream-downstream coordination magnifies systemic risk. The state exercises no direct jurisdiction over the *Ulu Muda* catchment and is therefore structurally dependent on Kedah's regulatory and conservation decisions. This asymmetry exposes a deeper weakness within Malaysia's federal architecture, where the lack of formalised compensation mechanisms and binding inter-state cooperation has produced a significant accountability gap in strategic resource governance (Abdullah et al, 2024: Berita Harian, 2024).

Despite these constraints, Penang may be regarded as a model of how a polity without traditional sovereign control over a resource can nonetheless defend its interests in a strategic resource conflict. Through administrative competence, legal argumentation grounded in riparian doctrine, domestic diplomatic engagement, and adaptive navigation of federal structures, the state demonstrates that effective power in resource disputes need not rest solely on territorial sovereignty. However, the sustainability of this model raises pressing questions of distributive justice. Without a formal compensation mechanism and a more inclusive institutional framework for upstream-downstream cooperation, tensions between Kedah and Penang are likely to persist. A more equitable and durable resolution would require structured financial transfers to the upstream state in recognition of conservation costs, the establishment of a joint river basin management authority, and the integration of ecological sustainability principles into Malaysia's federal water governance architecture. Only through such reforms can strategically resource security be reconciled with fairness and long-term environmental stewardship.

Kedah and the Symbolism of Sovereignty in the Governance of Strategic Resources

In the *Sungai Muda* conflict, Kedah does not perceive itself merely as an upstream state responsible for river flow management, but as a sovereign political entity asserting authority over the governance of a strategic resource. *Sungai Muda* is not only a critical water supply system; it has become a symbolic artery of Kedah's struggle for distributive justice within Malaysia's federal structure. As a constitutionally recognised state encompassing the ecologically vital *Ulu Muda* catchment area, Kedah bears primary responsibility for safeguarding the watershed that sustains the river's flow. This responsibility, however, is accompanied by substantial economic and ecological burdens (Lembaga Sumber Air Negeri Kedah, 2019). Kedah's claims directed at Penang represent an attempt to institutionalise principles of fairness in the sharing of strategic resources between upstream and downstream jurisdictions. These claims reflect the normative position that upstream states should not shoulder the entire burden of conservation without formal support or compensation from downstream beneficiaries. In this regard, Kedah mobilises its upstream positionality to demand recognition of the preservation costs it incurs, transforming *Sungai Muda* from a purely economic asset into a symbol of sovereign entitlement and political agency (Harian Metro, 2021).

The *Ulu Muda* catchment constitutes a central axis of the dispute, not merely because it sustains the hydrological integrity of *Sungai Muda*, but because it embodies Kedah's ecological stewardship as an upstream state. The catchment supports water security for more than 4.2 million people in northern Peninsular Malaysia, including the population of Penang (PBAHB, 2019). Conservation of this area entails significant financial expenditure and administrative capacity, including forest management, environmental monitoring, and enforcement against illegal logging and unsustainable land use change. Kedah must continuously mitigate threats such as deforestation, encroachment, and extractive activities that risk destabilising river flows and undermining long-term ecological sustainability. Yet this ecological responsibility has not been matched by proportional recognition from either Penang or the federal government. Kedah frequently assumes conservation obligations without a formalised framework of intergovernmental support. In this context, Kedah's demand for structured compensation is not reducible to fiscal necessity; it articulates a broader claim grounded in distributive justice and federal equity. The argument advanced by Kedah is that upstream ecological governance generates positive externalities that downstream states directly

benefit from, and therefore such benefits should be institutionally reciprocated (Oates, 1999; Zeitoun & Warner, 2006; Abd Rani & Md Khalid, 2025).

Sungai Muda thus functions as a symbolic terrain upon which Kedah negotiates its sovereign standing within Malaysian federalism. Kedah asserts that as a sovereign state within the federation, it retains the constitutional authority to determine how its natural resources are managed and shared. The claim extends beyond material compensation and enters the domain of political principle, challenging the implicit asymmetry in which economically stronger downstream states derive sustained benefits without assuming parallel conservation obligations. Penang, as a downstream state, depends heavily on raw water abstracted from *Sungai Muda*, yet it does not directly administer or finance the preservation of the *Ulu Muda* catchment. Kedah frames this asymmetry as a structural imbalance within federal relations. Economically less developed and politically less influential than Penang, Kedah often operates from a comparatively weaker bargaining position. The compensation claim therefore also serves as a corrective instrument aimed at rebalancing inter-state power disparities within Malaysia's federal order (Oates, 1999; Shad Saleem, 2008; Zeitoun & Warner, 2006; Khalid, 2018; Harding, 2022).

As previously noted, one of the central challenges confronting Kedah lies in the economic and ecological costs associated with maintaining *Ulu Muda* as a protected watershed. The catchment is not only hydrologically strategic but also ecologically significant, sustaining biodiversity and regulating regional climatic stability. Preservation entails opportunity costs, particularly in the context of forestry revenues. Logging and land development have historically functioned as important sources of state income. In conditions of fiscal constraint, Kedah faces a structural dilemma between ecological conservation and economic survival. Without institutionalised financial transfers or co-management mechanisms, conservation imperatives can collide with short-term development pressures. This conflict exposes structural limitations within Malaysia's federal framework. The federal system does not provide a clearly articulated mechanism for compensatory transfers in cases of inter-state ecological dependency. As an upstream state, Kedah bears regulatory and enforcement costs that generate downstream water security. However, the absence of a codified intergovernmental arrangement for cost-sharing perpetuates a governance gap. The resulting asymmetry entrenches a model in which ecological stewardship is localised while benefits are spatially redistributed (Khalid, 2018; Berita Harian, 2024).

Kedah's insistence on formal compensation should therefore be interpreted as a demand for institutional reform rather than a narrow fiscal grievance. The state's argument rests on the principle that upstream jurisdictions should not internalise the entirety of conservation costs while downstream jurisdictions externalise the benefits. *Sungai Muda* becomes a locus for articulating a broader critique of distributive imbalance within Malaysian federalism. The dispute also carries moral and ecological dimensions. Kedah contends that stewardship of the *Ulu Muda* catchment is not exclusively a local obligation but a shared responsibility among all stakeholders who depend upon the river system. Compensation, in this framing, functions as a mechanism to operationalise shared accountability rather than as a transactional demand. Without structured cooperation, however, this shared responsibility remains rhetorical rather than institutional (Khalid, 2018; Berita Harian, 2024).

The protracted nature of the conflict underscores the fragility of cooperative federalism in the management of strategic natural resources. In the absence of a formalised compensation regime or co-governance framework, Kedah must rely on political argumentation and moral

persuasion to secure support (Harian Metro, 2021). *Sungai Muda* consequently transcends its hydrological function and emerges as a symbolic battleground over sovereignty, distributive justice, and ecological sustainability. Kedah perceives *Sungai Muda* as more than a water source; it is a manifestation of upstream sovereignty and the right to equitable recognition within a federal system marked by economic disparity. The demand for formal compensation reflects a principled stance that conservation burdens should not be disproportionately borne by upstream states. Without institutional innovation that clarifies cost-sharing and cooperative governance, the dispute risks perpetuating structural imbalance between upstream and downstream jurisdictions. A more durable and equitable resolution depends upon recognising Kedah's dual role as ecological custodian and sovereign actor within Malaysia's federal architecture.

Imbalances in Malaysian Federal Governance and Their Implications for the Management of Strategic Resources

The *Sungai Muda* dispute between Kedah and Penang provides a critical entry point for examining structural weaknesses in Malaysia's federal governance, particularly in the management of strategic inter-state resources. Legally, the conflict operates within a fragmented framework. Under the Federal Constitution, water supplies and services fall substantially within state competence, subject to federal law, while national reforms through the Water Services Industry Act 2006 and the Water Services Commission Act 2006 regulate water supply services, sewerage, licensing and service standards through federal institutions such as Suruhanjaya Perkhidmatan Air Negara (SPAN) (Ujang et al., 2022). However, these federal statutes do not fully resolve questions of inter-state raw water allocation, upstream catchment compensation, or ecological cost-sharing. At the state level, Kedah relies on its territorial authority and instruments such as the Kedah Water Resources Enactment 2008 to assert control over water resources and catchment governance, whereas Penang relies on the Kedah and Penang (Alteration of Boundary) Act 1985, which places the state boundary along *Sungai Muda*, to justify abstraction from its side of the river. The legal loophole therefore lies in the separation between raw water resources, treated water services, river boundaries and watershed conservation. Penang navigates this ambiguity by combining riparian reasoning, PBAPP's administrative efficiency and engagement with federal regulatory structures, while Kedah contests this position by framing *Ulu Muda* conservation as an upstream ecological service requiring compensation. The dispute consequently exposes an asymmetry of responsibility, whereby Kedah bears preservation burdens without a binding mechanism compelling downstream contribution from Penang.

The escalation of the *Sungai Muda* dispute should also be situated within the political tension between the Kedah and Penang state governments. Although the conflict is grounded in legal ambiguity and ecological dependency, it has been intensified by the contrasting political priorities of the two states. Kedah has framed the issue through the language of sovereignty, upstream stewardship and compensation for the preservation of *Ulu Muda*, while Penang has framed it through riparian entitlement, efficient public water management and the necessity of securing water for domestic and industrial use. These competing positions have often been articulated through public statements and inter-state political exchanges, turning a technical resource-management question into a wider political dispute over fairness, recognition and federal responsibility (Abdullah et al., 2024). Nevertheless, this article does not treat party politics as the primary cause of the conflict. Rather, political tension is understood as an amplifying factor that exposes deeper structural weaknesses in Malaysia's federal water governance, particularly the absence of a binding mechanism for inter-state raw water allocation, upstream catchment compensation and joint basin management.

A fundamental weakness in Malaysian federalism lies in the concentration of authority that diminishes state autonomy in strategic resource governance. Although Kedah exercises territorial authority over the *Ulu Muda* catchment area, it lacks a specific enforceable inter-state instrument to compel Penang to contribute to upstream conservation costs. This is the central area of legal contestation: Penang treats its abstraction from *Sungai Muda* as a riparian and boundary-based entitlement, while Kedah treats the river's continued flow as the product of upstream ecological stewardship that should be financially recognised. This dynamic reveals how centralisation within Malaysia's federal order paradoxically generates inter-state power imbalances, allowing wealthier states to exercise disproportionate leverage in disputes over strategic resources. One of the principal drivers of the conflict is the unequal distribution of responsibility between upstream and downstream states. Kedah bears the primary obligation of safeguarding the *Ulu Muda* catchment, which constitutes the principal source sustaining the *Sungai Muda* basin. The preservation of this ecological zone entails significant financial and regulatory costs, including the monitoring of land use activities, restrictions on deforestation, and the suppression of illegal logging (Oates, 1999; Shad Saleem, 2008; Zeitoun & Warner, 2006; Khalid, 2018; Harding, 2022).

Another critical weakness in the federal system is the lack of institutionalised mechanisms for structured cooperation and compensation in relation to inter-state resource governance. In the *Sungai Muda* dispute, Kedah has proposed an annual compensation of RM50 million from Penang in recognition of its stewardship of the *Ulu Muda* catchment. Penang has rejected this proposal, invoking riparian principles to justify its entitlement to the natural flow of the river without an obligation to provide financial remuneration to the upstream state. The absence of a formalised compensation structure has entrenched the responsibility gap between upstream and downstream actors. In effect, Kedah absorbs the environmental and regulatory costs of conservation while Penang enjoys the economic and social benefits of sustained water supply. This arrangement exposes not only structural flaws in Malaysian federalism but also a failure to embed principles of distributive equity within the governance of strategic natural resources.

The consequences extend beyond political contestation to ecological sustainability. The *Ulu Muda* catchment faces mounting pressures from land use change and logging activities that threaten the long-term viability of the *Sungai Muda* basin. Kedah confronts a structural dilemma: to preserve the ecological integrity of the catchment at significant fiscal cost, or to permit extractive activities that generate short-term revenue. In the absence of sustained financial support from downstream beneficiaries or federal authorities, economic imperatives may override conservation priorities (Oates, 1999; Rahman & Khalid, 2009; Khalid, 2018; Bernama, 2020; Abd Rani & Md Khalid, 2025).

This dynamic illustrates how the lack of an inter-state cooperative framework exacerbates environmental risk. When upstream states are compelled to finance conservation independently, the sustainability of the entire river basin becomes vulnerable to fiscal and political contingencies. Comparative international experience offers instructive lessons. The management of the Colorado River in the United States provides an example of a clearly defined federal framework that allocates rights and responsibilities among participating states. Through codified agreements and institutional mechanisms, states share both the burdens and benefits associated with a transboundary water system. These comparative cases suggest that structured legal frameworks and formalised compensation mechanisms are essential for equitable and sustainable resource governance. We contend that structural deficiencies in Malaysia's federal system constitute a central driver of the *Sungai Muda* dispute. The absence

of formal cooperative and compensatory mechanisms has generated a persistent imbalance of responsibility between upstream and downstream states, compelling Kedah to shoulder conservation burdens without adequate institutional backing. In this context, the *Sungai Muda* functions not merely as a water resource but as a symbol of asymmetrical power within Malaysia's federal architecture. A more equitable and sustainable resolution requires substantive reform of federal governance arrangements. Such reform should include the institutionalisation of formal compensation mechanisms, the establishment of a joint inter-state river basin authority, and the integration of ecological sustainability principles into federal-state relations. Drawing upon comparative experiences from the Colorado basins, Malaysia has the opportunity to recalibrate its federal structure to ensure that strategic resources are governed through shared responsibility, distributive fairness, and long-term environmental stewardship (Ostrom, 1990; Watts & Rovinsky, 1999; Dinar, 2007; Hundley, 2009).

Water Governance Literature and Common Themes in Upstream–Downstream Resource Conflicts

The discussion of international water conflicts in this section is not intended as a systematic comparative analysis. Rather, it is used to situate the *Sungai Muda* dispute within broader scholarly debates on upstream-downstream relations, hydro-hegemony, distributive justice, ecological stewardship and institutionalised cooperation in shared water governance. Existing studies on river basins such as the Nile, Colorado and Mekong show that water conflicts commonly emerge when the ecological burdens of watershed protection and the economic benefits of water use are unevenly distributed among political actors. These cases are therefore useful not as direct comparisons, but as conceptual reference points that help identify recurring themes relevant to the Kedah-Penang dispute. They demonstrate that water governance conflicts are rarely technical disputes alone. Rather, they are shaped by asymmetrical power, legal ambiguity, historical claims, ecological costs and the strength or weakness of cooperative institutions.

A first recurring theme in the water governance literature is the problem of upstream-downstream asymmetry. In many shared river systems, upstream actors occupy a geographically strategic position because they exercise authority over catchments, headwaters or infrastructural interventions that affect downstream flows. However, this geographical position does not automatically translate into political dominance. Downstream actors may also possess economic, institutional or diplomatic leverage that enables them to influence the terms of water access and governance. The Nile basin, for example, illustrates how disputes over river use have required sustained diplomatic engagement and attempts at institutionalised cooperation through mechanisms such as the Nile Basin Initiative (Paisley & Henshaw, 2013). The significance of this literature for the *Sungai Muda* dispute lies not in drawing a direct comparison between international and domestic cases, but in highlighting how upstream-downstream relations often require institutional mechanisms capable of mediating competing claims over access, responsibility and benefit-sharing.

A second theme concerns distributive justice and the uneven allocation of ecological burdens. River governance conflicts frequently arise when one actor bears the responsibility of conserving a watershed while another actor receives substantial economic or social benefits from the continued availability of water. This issue is especially relevant to the Kedah-Penang dispute. Kedah, as the upstream state, bears the ecological and administrative burden of protecting the *Ulu Muda* catchment, which sustains the flow of *Sungai Muda*. Penang, as the downstream state, depends heavily on this flow for domestic supply, industrial growth and economic stability. The problem is not merely one of water abstraction, but of whether the costs

of maintaining the ecological conditions that make water security possible are fairly distributed. The literature on shared water governance therefore helps to frame Kedah's compensation claim not simply as a fiscal demand, but as a demand for recognition of upstream ecological stewardship.

A third theme concerns the importance of formalised institutions and negotiated rules. The Colorado River literature is useful here because it demonstrates how inter-state water tensions within a federal system may be managed through legal agreements, negotiated allocations and institutionalised arrangements among participating states (Robison et al., 2014). The relevance of this example to the *Sungai Muda* case lies in its emphasis on the need for clear rules and cooperative structures. In Malaysia, the absence of a formal inter-state mechanism for allocating responsibility, compensation and ecological protection has allowed the Kedah-Penang dispute to persist. Kedah invokes sovereignty and the conservation burden of *Ulu Muda*, while Penang invokes riparian reasoning, administrative efficiency and downstream dependency. Without an institutional framework that defines mutual obligations, both positions remain politically forceful but legally and administratively unresolved.

A fourth theme concerns power asymmetry in shared water governance. The Mekong literature shows that cooperative institutions may exist, yet their effectiveness can be constrained when power is unevenly distributed among upstream and downstream actors. The Mekong River Commission, for instance, has been discussed as an important but limited mechanism for regional cooperation in a context marked by uneven power and infrastructural intervention (Jacobs, 2002). This theme is relevant to the *Sungai Muda* dispute because the conflict is also shaped by unequal capacity. Kedah possesses upstream territorial authority over the catchment, yet it has limited fiscal and institutional capacity to convert that authority into a binding compensation arrangement. Penang lacks sovereignty over the upstream source, but it possesses strong administrative capacity, economic significance and access to federal-level political channels. The result is a form of domestic hydro-hegemony in which downstream influence is exercised not through territorial control, but through institutional efficiency, economic leverage and strategic positioning within federal structures.

These themes help clarify the analytical significance of the *Sungai Muda* dispute. The conflict should not be understood merely as a disagreement over whether Penang should pay Kedah for raw water. Rather, it reflects a deeper governance problem concerning how Malaysia's federal system distributes the costs and benefits of strategic ecological resources that cross state boundaries. Kedah's claim is rooted in the argument that upstream conservation produces positive externalities for downstream users and should therefore be recognised through institutional and financial mechanisms. Penang's response rests on the argument that downstream access is justified through riparian reasoning, efficient water management and the broader economic importance of water security to the state and the nation. The tension between these positions demonstrates how hydro-hegemony operates within a domestic federal setting, where power is shaped by the interaction of geography, law, economy, administrative capacity and political negotiation.

Drawing from these common themes, the *Sungai Muda* dispute points to the need for a more inclusive and institutionalised framework of inter-state water governance. A sustainable resolution would require more than episodic negotiation between Kedah and Penang. First, a formal mechanism should be developed to recognise upstream ecological services and provide financial support for watershed conservation. Such a mechanism could take the form of a jointly administered conservation fund dedicated to maintaining the ecological integrity of the

Ulu Muda-Sungai Muda basin. Second, a joint river basin authority involving Kedah, Penang, Perlis and the federal government would provide a more stable platform for coordinated planning, data sharing, ecological monitoring and dispute resolution. Third, distributive justice should be incorporated more explicitly into Malaysia's water governance policy so that downstream water security is connected to upstream conservation responsibility. In this sense, the wider water governance literature does not redirect the article away from *Sungai Muda*. Instead, it strengthens the article's central argument that the Kedah–Penang dispute is a domestic hydro-hegemonic conflict shaped by upstream–downstream asymmetry, institutional gaps and unresolved questions of ecological burden-sharing.

CONCLUSION

This article has argued that the *Sungai Muda* conflict between Kedah and Penang is not merely a dispute over raw water abstraction, but a domestic hydro-hegemonic conflict shaped by historical separation, federal asymmetry, upstream ecological responsibility and downstream dependency. By focusing on Penang, the article has shown how a downstream state without conventional territorial sovereignty over the upstream source can nevertheless defend its access to a strategic resource through administrative efficiency, riparian reasoning, domestic diplomacy and strategic engagement with Malaysia's federal structure. Penang's position demonstrates that power in water conflicts is not determined solely by geographical location or formal sovereignty. It may also be produced through institutional competence, economic significance and the capacity to frame water access as a matter of wider developmental importance.

This article's main contribution lies in its reconceptualisation of Penang as a non-traditional hydro-hegemonic actor within a domestic federal setting. Penang does not control the *Ulu Muda* catchment, yet it has been able to maintain its claim to *Sungai Muda* through the performance of PBAPP, its emphasis on efficient water governance and its invocation of downstream riparian entitlement. This strategy has enabled Penang to transform structural dependency into political leverage. However, the article has also shown that Penang's administrative effectiveness does not resolve the deeper normative problem at the centre of the dispute. Kedah, as the upstream state, continues to bear the ecological and fiscal burden of conserving the *Ulu Muda* catchment, which sustains water security for Kedah, Penang and Perlis. Kedah's demand for compensation should therefore be understood not simply as a claim for payment, but as a demand for distributive justice and recognition of upstream ecological stewardship.

The *Sungai Muda* dispute exposes a critical weakness in Malaysia's federal governance of strategic resources. Although water resources are tied to state authority, inter-state rivers require coordination beyond individual state boundaries. In the absence of a formalised mechanism for cost-sharing, compensation and joint basin management, Kedah and Penang continue to rely on competing claims. Kedah invokes sovereignty, ecological burden and conservation responsibility, while Penang invokes riparian access, efficient management and downstream dependency. These arguments remain politically powerful but institutionally unresolved. This unresolved condition creates long-term risks not only for inter-state relations, but also for ecological sustainability and regional water security.

A sustainable resolution requires Malaysia to move beyond ad hoc negotiation towards a more rule-based and cooperative model of inter-state water governance. This article proposes that such a model should include formal recognition of upstream ecological services, a

structured mechanism for catchment conservation funding, and the establishment of a joint basin-level institution involving Kedah, Penang, Perlis and the federal government. Such reforms would help transform the *Sungai Muda* dispute from a zero-sum contest over payment into a shared governance framework based on ecological responsibility, distributive fairness and long-term water security. They would also allow upstream conservation and downstream development to be treated as interdependent rather than competing priorities.

In conclusion, the *Sungai Muda* conflict demonstrates that water security in Malaysia cannot be understood through technical supply management alone. It is shaped by history, law, political economy, ecological stewardship and federal institutional design. Penang's experience reveals how a downstream state can exercise strategic agency without sovereign control over the source, while Kedah's position highlights the unresolved burden placed upon upstream custodians of critical water catchments. The future of the *Sungai Muda* basin depends on recognising both realities. A durable settlement must protect Penang's water security while also acknowledging Kedah's conservation role. Only through shared responsibility and institutional reform can the *Sungai Muda* basin be governed in a manner that is equitable, sustainable and consistent with the principles of cooperative federalism.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial support provided by Universiti Kebangsaan Malaysia under the *Geran Galakan Penyelidik Muda* (GGPM-2025-066) titled "*Pembinaan Model Kelestarian Bekalan Air Bagi Menangani Krisis Air di Utara Malaysia*," which enabled the completion of this research.

REFERENCES

- Abdullah, M. F. (2024). Sustainable Development Goals (SDGs) Through the Water Treaty Between Kedah and Perlis (1971-1999): Implications for Water Resource Management and Equitable Resource Sharing in Malaysia and Globally. *Thammasat Review*, 27(2), 197-224.
- Abdullah, M. F., Mohd Noor, A., Chee Seng, T., & Wan Ibrahim, W. K. (2024). The Water War between Kedah-Penang in Malaysia: The Relation in the Management of *Sungai Muda* Raw Water, 1965–1985. *Geopolitics Quarterly*, 20(2), 151-170.
- Abd Rani, M. N., & Md Khalid, R. (2025). Legal frameworks and mechanisms for resolving transboundary water disputes in Malaysia: insights from the Kedah-Penang Muda River dispute. *International Journal of Water Resources Development*, 41(3), 625-646.
- Act 325. (1985). *Kedah and Penang (Alteration of Boundary) Act 1985 (Act 325)*. Malaysian Government. https://www.commonlii.org/my/legis/consol_act/kapoba1985328/
- Azri Azmi, M. A., Yusoff, M. N. & Md. Hanafiah, F. (2022). *Ulu Muda* forest: In the perspective of water catchment management. *Journal of Governance and Development (JGD)*, 18(1), 33-44.
- Berita Harian. (2021, March 13). *Isu air Pulau Pinang mohon campur tangan kerajaan Persekutuan*. <https://www.bharian.com.my/berita/nasional/2021/03/800786/isu-air-pulau-pinang-mohon-campur-tangan-kerajaan-persekutuan>
- Berita Harian. (2024, January 4). *Tiada pembalakan Hutan Simpan Ulu Muda*. <https://www.bharian.com.my/berita/nasional/2024/01/1202484/tiada-pembalakan-hutan-simpan-ulu-muda>
- Bernamea. (2020, December 11). *Penang will not pay RM50m for raw water from Sungai Muda*. <https://www.bernama.com/en/news.php?id=1911013>

- Bonney, R. (1974). *Kedah 1771-1821: the search for security and independence*. Oxford University Press.
- Department of Statistics Malaysia. (2023). *Gross Domestic Product (GDP) by State, 2023* (PDF). <https://www.dosm.gov.my/portal-main/release-content/gross-domestic-product-gdp-by-state-20232023>
- Dinar, S. (2007). *International water treaties: Negotiation and cooperation along transboundary rivers*. Routledge.
- Dinar, S. (2009). Power asymmetry and negotiations in international river basins. *International Negotiation*, 14(2), 329-360.
- Getzler, J. (2004). *A history of water rights at common law*. Oxford University Press.
- Gin, O. K. (2015). Disparate identities: Penang from a historical perspective, 1780-1941. *Kajian Malaysia-Journal of Malaysian studies*, 33(Supp. 2), 27-52.
- Gomez, E. T., & Jomo, K. S. (1999). *Malaysia's political economy: Politics, patronage and profits*. Cambridge University Press
- Haji Omar, A. (1978). *Peasants, institutions, and development in Malaysia: the political economy of development in the Muda region*. Ph.D thesis, Cornell University.
- Harakahdaily. (2021, May 17). *Hiruk pikuk isu sumber air Kedah-Pulau Pinang*. <https://harakahdaily.net/2021/05/17/hiruk-pikuk-isu-sumber-air-kedah-pulau-pinang/>
- Harding, A. (2022). *The constitution of Malaysia*. Bloomsbury Publishing.
- Harian Metro. (2021, November 14). *RM100 juta nilai pampasan pengekalan hutan Kedah*. <https://www.hmetro.com.my/mutakhir/2021/11/780078/rm100-juta-nilai-pampasan-pengekalan-hutan-kedah>
- Hundley, N. (2009). *Water and the West: the Colorado River Compact and the politics of water in the American West*. Univ of California Press.
- Hui, L. C., Leng, P., & Weng, C. N. (2013). A Study of Non-Revenue Water Management in Penang as an Example of Good Water Governance. *Prosiding Seminar Hasil Penyelidikan Sektor Pengajian Tinggi Ke-3 2013 Sains Sosial dan Kemanusiaan, Universiti Utara Malaysia, Sintok, Vol. 2, 1007-1015*.
- Japan International Cooperation Agency (JICA). (2000). *The study on water resources management and supply in the northern region of Peninsular Malaysia* (Final report). https://openjicareport.jica.go.jp/pdf/10312262_01.pdf
- Jacobs, J. W. (2002). The Mekong River Commission: transboundary water resources planning and regional security. *Geographical Journal*, 168(4), 354-364.
- Jackson, J. H. (2003). *Sovereignty – Modern: A New Approach to an Outdated Concept* (working paper). Georgetown University Law Center. https://scholarship.law.georgetown.edu/context/facpub/article/1108/viewcontent/Jackson_sovereignty_HEIN.pdf
- Khalid, R. M. (2018). Federalism concepts and issues in managing the Malaysian water sector. *International Journal of Engineering & Technology*, 7(3.30), 163-168.
- Jaseni Maidinsa. (2017). *Media Statement by Dato' Ir. Jaseni Maidinsa, Chief Executive Officer, PBA Holdings Bhd (PBAHB) and Perbadanan Air Bekalan Air Pulau Pinang Sdn Bhd (PBAPP): Sungai Muda, There Is No Basis For Kedah To Demand Raw Water Charges From Penang*. Perbadanan Bekalan Air Pulau Pinang Sdn Bhd (PBAPP).
- Lai, C. H., Chan, N. W., & Zakaria, N. A. (2013). Non-revenue water management in Malaysia: A review of selected water service providers in Malaysia. *Geografi*, 1(2), 7-17
- Lembaga Sumber Air Negeri Kedah. (2019). *Program journey of water – Sungai Muda* (LSANK). <https://www.lsank.gov.my/media/LSANK2019.pdf>
- Loh, F. K. W. (2010). Restructuring federal–state relations in Malaysia: from centralised to co-operative federalism?. *The Round Table*, 99(407), 131-140.

- Malaysia. (2006). Water Services Industry Act 2006 (Act 655). Laws of Malaysia. Suruhanjaya Perkhidmatan Air Negara.
<https://www.span.gov.my/document/upload/66ILUPtM99inqSJ4o7YLUgOrK4IrZtOq.pdf>
- Merican, A. M. (2023). *The Avatar of 1786: decolonizing the Penang story*. Penerbit USM.
- New Straits Times. (2020, December 10). *Penang tells Kedah: We're not paying a single sen for water from Sg Muda*. <https://www.nst.com.my/news/nation/2020/12/648424/penang-tells-kedah-were-not-paying-single-sen-water-sg-muda>
- Oates, W. E. (1999). An essay on fiscal federalism. *Journal of economic literature*, 37(3), 1120-1149.
- Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
- Paisley, R. K., & Henshaw, T. W. (2013). Transboundary governance of the Nile River Basin: Past, present and future. *Environmental Development*, 7, 59-71.
- Perbadanan Bekalan Air Pulau Pinang Holdings Berhad (PBAHB). (2019, July 22). *Save Ulu Muda for the NCER* [Report]. https://pbahb.com.my/pdf/news/2019/22072019_PBAPP_Save_Ulu_Muda_for_the_NCER_ENG.pdf
- Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd. (PBAPP). (2020, December 31). *15.3% of the Ulu Muda water catchment area will be destroyed by 2025?* [Media release]. https://pba.com.my/pdf/news/2020/31122020_PBAPP_15pc_of_UluMuda-destroyed_2.pdf
- Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd. (PBAPP). (2021, August 23). *Proposed Kulim airport project must not jeopardise water supply in Penang* [Media release]. https://pba.com.my/pdf/news/2021/23082021_PBAPP_KedahAirport_ENG.pdf
- Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd. (PBAPP). (2021, May 3). *Think Ulu Muda to manage Sungai Muda: A proposed solution for long-term water security and inter-state cooperation* [Report]. https://pba.com.my/pdf/news/2021/03052021_Think_Ulu_Muda_to_Manage_Sg_Muda_BM.pdf
- Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd. (PBAPP). (2021). *Raw water risks*. <https://pba.com.my/raw-water-risks/>
- Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd. (PBAPP). (2021, May 3). *Think Ulu Muda to manage Sungai Muda* [Media statement]. https://pba.com.my/pdf/news/2021/03052021_Think_Ulu_Muda_to_Manage_Sg_Muda.pdf
- PKR(n.d.). PKR(N2TM) W 37/121 Vol 8 (432) *Pinjaman No.4 Mal Dari Pembangunan Asia (Perjanjian Tripartite) (Loan No.4 Mal from Development Asia (Tripartite Agreement)*.
- Shad Saleem, F. (2008). Document of destiny: The constitution of the federation of Malaysia. *Petaling Jaya: Star Publications Malaysia Berhad*.
- Singh, C., Rasiah, R., & Wong, Y. T. (Eds.). (2019). *From free port to modern economy: Economic development and social change in Penang, 1969 to 1990*. Penang Institute & ISEAS–Yusof Ishak Institute.
- Rahman, S. A., & Khalid, R. M. (2009). Water resource management in Malaysia: Legal issues and challenges. *International Journal of Sustainable Development and Planning*, 4(3), 258-264.
- Ramasamy, V. (2017, 12 September). *Logging in Ulu Muda Forest Reserve: Is Penang's water security under threat?* Penang Institute. <https://penanginstitute.org/publications/issues/1008-logging-in-ulu-muda-forest-reserve-is-penangs-water-security-under-threat/>

- Rawls, J. (1971). *A Theory of Justice*. Harvard University Press.
- Robison, J., Bratschovsky, K., Latcham, J., Morris, E., Palmer, V., & Villanueva, A. (2014). Challenge and response in the Colorado River Basin. *Water Policy*, 16(S1), 12-57.
- Ujang, Z., Ching, K. T., Md. Noh, M. N., Ramli, R. I., Aris, A., Tukiman, K., & Hamid, H. (2022). *Air dan pembetulan di Malaysia, sejarah serta perspektif*. Kementerian Alam Sekitar dan Air, Institusi Penyelidikan Air Kebangsaan Malaysia, Jabatan Perkhidmatan Pembetulan.
- Wan Mansor, W. M. N. H (2020). PBAPP Sila Bayar RM50 Juta Setahun Sebelum Komen: MB Kedah. *Sinar Harian*.
<https://www.sinarharian.com.my/article/114074/EDISI/PBAPP-sila-bayar-RM50-juta-setahun-sebelum-komen-MB-Kedah>.
- Watts, R. L., & Rovinsky, D. J. (1999). Comparing federal systems in the 1990s. *The American Review of Canadian Studies*, 29(2), 367.
- Weng, C. N. (2005). Sustainable management of rivers in Malaysia: Involving all stakeholders. *International Journal of River Basin Management*, 3(3), 147-162.
- World Wide Fund for Nature Malaysia (WWF-Malaysia). (n.d.). *Payment for ecosystem services for the Ulu Muda Forest Complex*.
<https://www.wwf.org.my/?31586%2FPayment-for-Ecosystem-Services-for-the-Ulu-Muda-Forest-Complex-Report>
- Zeitoun, M., & Warner, J. (2006). Hydro-hegemony—a framework for analysis of trans-boundary water conflicts. *Water Policy*, 8(5), 435-460.

¹ Center for Research in History, Politics and International Affairs, Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia, Malaysia. mfa@ukm.edu.my

² Department of History, Faculty of Arts and Social Science, Universiti Malaya, Malaysia. arbaiyah@um.edu.my

Corresponding Author*