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Analysis of the Indus Delta in Light of International and National Environmental Laws: Implications for Pakistan

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Analysis of the Indus Delta in Light of International and National Environmental Laws: Implications for Pakistan

Muneer Hussain, Muskan Hassam, Mashooque Ali and Ghazala Kanasiro[*]

ABSTRACT

The Indus Delta, where the Indus River enters the Arabian Sea, lies at the end of the Indus Basin and is one of the world's largest arid deltas, of immense ecological value. However, the Indus Delta faces unprecedented environmental decline due to upstream water diversions, conventional agricultural practices, excessive water storage, and the adverse effects of climate change, all worsened by weak enforcement of environmental laws and obsolete water management policies. This research critically examines the effectiveness of environmental laws protecting the Indus Delta at national and international levels. Despite robust legal provisions, such as the Pakistan Environmental Protection Act 1997 (PEPA 1997), the Sindh Environmental Protection Act 2014 (SEPA 2014), and treaties, including the Ramsar Convention and the Indus Waters Treaty 1960, the Indus delta remains vulnerable due to weak law enforcement, insufficient institutional coordination, and outdated legal mechanisms. By using a doctrinal research methodology, the study highlights the disconnect between legal protections and ground realities, particularly in relation to newly adopted Article 9A, which recognises the right to a clean, healthy, and sustainable environment. The study recommends stronger law enforcement measures, guaranteeing fixed annual water flows to the Indus Delta, modernising Pakistan's water and environmental laws, creating an independent Indus Delta Protection Authority, enhancing monitoring and effective accountability, and increasing dedicated funding for environmental justice and Delta restoration. The study also adds to the growing discourse on environmental justice and water governance in Pakistan.

Keywords: Indus Delta, Environmental Law, Environmental Justice, Water Rights

JEL Classification Codes: K320, K330

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1. INTRODUCTION

If the misery of our poor be caused not by the laws of nature, but by our institutions, great is our sin.

- Charles Darwin

Water is a basic human right because human life, health, development and survival depend on access to adequate and safe water (Cahill Ripley 2011). The Indus River is Pakistan's largest river system and vital to its agriculture, economy, and ecology. Originating in the Himalayas, it flows through Pakistan into the Arabian Sea via the Indus Delta in Sindh. The delta's health depends on adequate freshwater and sediment flows; therefore, changes in water quantity or quality directly affect its ecosystem, biodiversity, and communities.

The Indus Delta is variously ranked as the world's fifth (Siyal and Hashmi 2019) and 6th (Peracha et al., 2017). Located in Sindh's coastal zone (latitude 23° 59.34' N, longitude 67° 24.34' E), it supports extensive mangroves, biodiversity, fisheries, agriculture, and the livelihoods of millions. However, several environmental issues, such as pollution, deforestation, climate change, and systematically declining sediment, have severely degraded the Delta. Studies indicate it has shrunk by 92% (Ijaz et al., 2018) while mangrove forests, freshwater habitats, and biodiversity continue to decline.

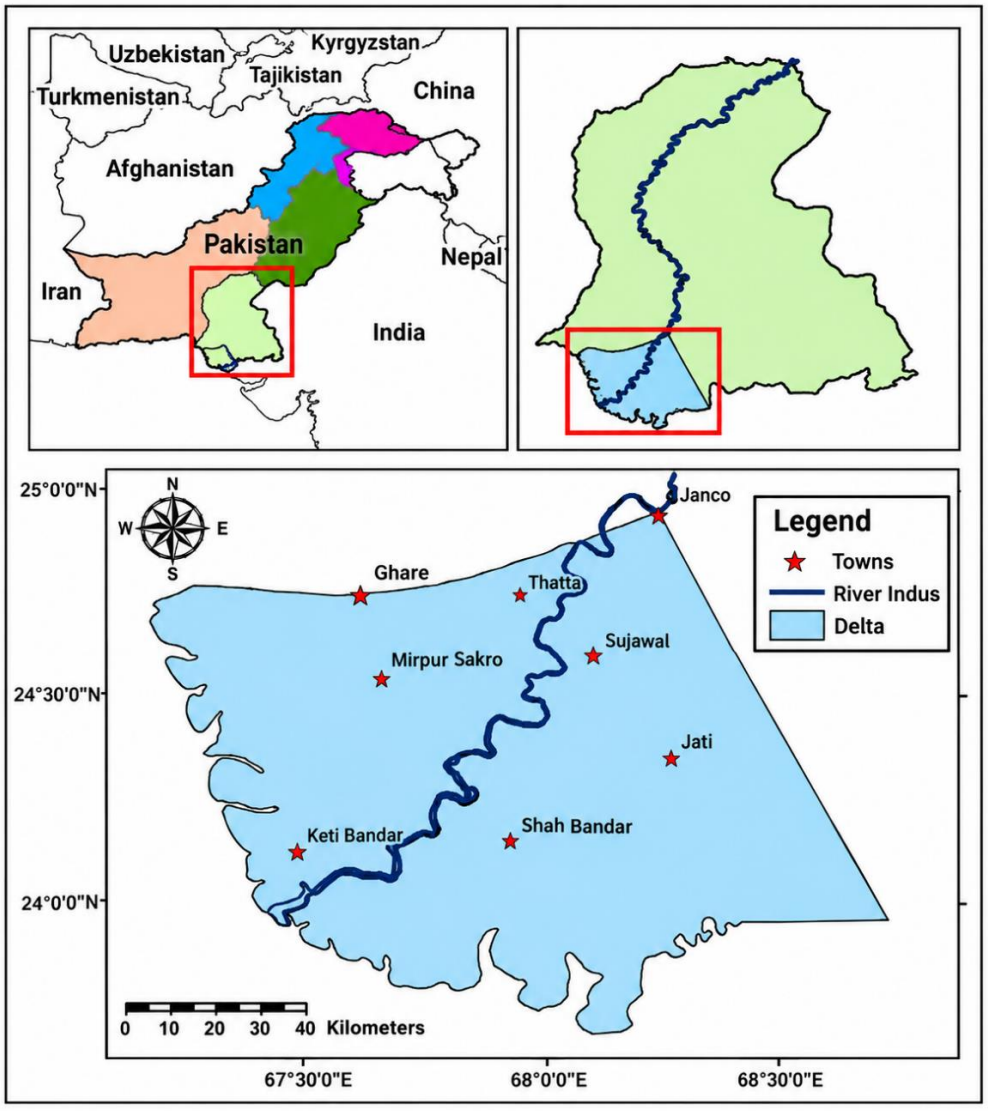
The degradation of the Indus Delta results from interconnected factors, including upstream water diversions, excessive water storage in reservoirs like dams, barrages and link canals, reduced sediment flows, water-intensive agriculture, pollution, climate change, and inadequate freshwater flows towards the sea. Disrupting ecological processes, they contribute to seawater intrusion, salinity, erosion, and habitat loss. Although mangrove restoration programmes have improved mangrove cover, the Delta remains vulnerable to freshwater shortages, sediment deprivation, and climate change (Shaikh et al., 2025). The Intergovernmental Panel on Climate Change (IPCC 2022) likewise identifies river deltas as highly climate-vulnerable, requiring integrated legal and governance responses. Experts, including Siyal (2018), have warned that without adequate freshwater flows, the Delta faces potentially irreversible ecological degradation.

The Delta's environmental degradation is not solely an ecological or hydrological problem but also a challenge of environmental governance and law. Despite Pakistan's substantial laws, including the Pakistan Environmental Protection Act (PEPA) 1997, the Sindh Environmental Protection Act (SEPA) 2014, constitutional protections like Article 9A, and international commitments such as the Ramsar Convention and the Convention on Biological Diversity (CBD), the persistent decline indicates their weak implementation, institutional fragmentation, and poor federal-provincial coordination.

While considerable literature examines the Delta's ecological decline, few studies combine environmental law, constitutional law, and human rights, a critical gap in understanding how inadequate legal enforcement and governance undermine fundamental rights and

contribute to the delta's degradation. This research contributes to the existing literature by creating a link between the effectiveness of environmental and water laws, constitutional environmental rights, and the delta's ecological state. It identifies gaps between the laws and the practices and suggests pragmatic legal and policy reforms to protect the Indus Delta and its communities and bolster environmental governance.

Figure 1: Location Map of Indus Delta



Source: Siyal (2018).

This study will address the following research questions:

- What environmental laws and regulations exist in Pakistan to protect the Indus Delta?
- What are the recommendations to improve the effectiveness of Pakistan's environmental law enforcement to curb the Indus Delta's decline?

By addressing the above questions, the following objectives are developed:

- Identify Pakistan's existing environmental laws and regulations regarding Indus Delta's protection.
- Recommend measures for effective environmental law enforcement in Pakistan to prevent the Delta's decline.

2. LITERATURE REVIEW

Existing literature identifies declining freshwater flows as the primary cause of ecological degradation in the Indus Delta. Bux Mallah (2013) attributes declining fisheries, land loss, and community displacement to upstream water diversions and seawater intrusion, while Hadi (2019) contends that large-scale hydraulic infrastructure has disproportionately affected lower-riparian Sindh. Historical corroboration by Memon (2025) also shows that upstream-diversion concerns date back to 1927 when official records warned that extra withdrawals could put Sindh at risk without adequate environmental flows. Linking changing river hydrology with ecological loss, these studies focus on environmental and socioeconomic impacts instead of assessing the effectiveness of Pakistan's environmental legal framework and its interaction with international obligations.

Examining constitutional environmental rights in Pakistan, some researchers highlight inadequate environmental justice, mainly for those facing water scarcity due to legal barriers and social inequalities (Khuhro et al., 2024). Newly adopted Article 9A also recognised the right to a healthy and sustainable environment, showing Pakistan's alignment with global environmental principles. Nonetheless, Rajper et al. (2025) indicate the absence of effective liability and accountability mechanisms, along with weak enforcement, pointing to institutional and legal reforms together with public participation. Correspondingly, Iqbal et al. (2025) consider jurisdictional barriers, weak enforcement, and unsatisfactory accountability as limiting climate and environmental justice, thereby pointing out a gap between practical implementation and constitutional recognition.

The enforcement of PEPA 1997 remains poor due to weak institutional capacity, ambiguity in legal mandates and limited funding (Shaikh et al., 2025). Judicial enforcement faces challenges, as there are expertise gaps, weak climate litigation and political interference (Amin and Farrukh 2023), highlighting the need for specialised benches, stronger institutions, and judicial training to improve climate litigation.

Analysis of the Indus Delta under national and international environmental laws shows that the Indus Waters Treaty (IWT) treats water and the river as just commodities, thus allowing

dams and infrastructure projects while lacking adequate environmental safeguards (Raman 2018). The study recommends environmental impact assessments, better monitoring, and reporting. Similarly, Bibi et al. (2023) identify gaps in Indus Basin water laws and call for reforms to improve water sharing, sustainability, and interprovincial and riparian cooperation.

The above review shows that existing literature has examined the Delta from an ecological, hydrological, constitutional, or policy standpoint. However, limited research has examined how Pakistan's water laws, environmental statutes, constitutional framework, and international legal obligations work together to safeguard the Indus Delta. Through an integrated doctrinal analysis of national and international obligations, this study assesses the collective protection of the Delta and addresses this gap.

2.1. Existing Environmental Laws

2.1.1. International Treaties and Declarations

i) Universal Declaration of Human Rights (UDHR)

The Universal Declaration of Human Rights (UDHR) is a landmark document in the historical context of human rights. Its Article 25 particularly protects the environment, affirming that '*Human rights and environmental protection depend on each other. A safe, clean, healthy and sustainable environment is important for the full entitlement of human rights, such as the rights to life, to the complete accessible standard of physical and mental health, to sufficient standard of living, to decent food, to safe drinking water and sanitation, to housing, to participation in cultural life and to development, as well as the right to a healthy environment itself'* (Tang and Spijkers 2022).

ii) 1971 Ramsar Wetlands Convention

The Convention on Wetlands (Ramsar Convention) provides the framework for the conservation and prudent use of wetlands. Pakistan became a signatory to it on 23 November 1976. By March 2013, Pakistan had designated nineteen Ramsar sites, covering 1.34 million hectares, including the Indus Delta and eight others in Sindh (Ramsar Convention 1971).

iii) 1973 Convention on International Trade in Endangered Species (CITES 1973)

CITES regulates international trade of wild animals and plants to prevent threats to their survival. It promotes cross-border cooperation for biodiversity conservation and protects over 40,000 species. Pakistan acceded to CITES on 20 April 1976, making its wildlife-protection framework relevant to the Indus Delta which supports endangered species like the Indus River dolphin and mangrove-dependent fish (CITES 1973).

iv) 1951 International Plant Protection Convention (IPPC 1951)

IPPC, a crucial global treaty, protects plants from the spread and introduction of pests. For the Delta's mangroves, which are prone to diseases, invasive species, and environmental stresses, implementing IPPC standards can strengthen national and regional conservation efforts and support wider ecological goals (IPPC 1951).

v) 1960 Indus Water Treaty (IWT 1960)

The Indus Waters Treaty is an agreement between India and Pakistan, brokered by the World Bank, for the allocation of Indus Basin waters (Indus Waters Treaty 1960). Some studies argued that IWT overlooked Sindh's concerns as the lowest riparian. However, IWT was signed during the One Unit Scheme, when West Pakistan was treated as a single province and Sindh lacked separate representation, which makes such concerns over Delta protection relevant given Sindh's separate status as a lower-riparian province. Thus, concerns about procedural fairness and environmental rights are raised by Palijo (2003), who argues that Sindh was excluded from negotiations. Palijo relates this to the principle of '*audi alteram partem'*, recognised in cases including *Mst. Qaisra Illahi (PLD 1995 Peshawar 22), Maryam Tousif (PLD 1990 SC 666) and Dr Nusratullah Chaudhry [1994 Lah 353 (358)],* where courts held that *the rule of natural justice, audi alteram partem, is a well-established legal principle that applies not only to court proceedings but to all actions affecting a person's rights, property, or interests.*

2.1.2. Pakistan's National Laws

i) Constitution of Pakistan 1973

The Constitution provides the basic legal framework for fundamental rights. The twenty-sixth Constitutional Amendment, passed in October 2024, introduced Article 9A, recognising the right to a clean, healthy, and sustainable environment as a fundamental right. It states, *'9A. Every person shall be entitled to a clean, healthy and sustainable environment.'*

Relevant provisions include Articles 9 (security of person), 14 (dignity), 19A (right to information), 25 (equality), 155 (water-supply complaints), 199 (High Court jurisdiction), and 184(3) (Supreme Court jurisdiction). In Shehla Zia v WAPDA, the Supreme Court linked environmental protection with fundamental rights. The Eighteenth Amendment further devolved resource management, such as water, to the provinces, highlighting the state's duty to safeguard the environment.

ii) The Pakistan Environmental Protection Act 1997

The PEPA 1997 expands Pakistan's environmental protection by unifying earlier laws, including those on factories, wildlife, and canals. Though applicable to the Indus Delta, its

implementation remains weak and ineffective (Pakistan Environmental Protection Act 1997).

iii) The Canal and Drainage Act 1873

The Canal and Drainage Act 1873, later amended several times, such as in 1952, 1965, 1968 and 1970, remains one of the principal statutes governing irrigation and water distribution in Pakistan and regulating pollution in the Indus Basin. This Act provides for a fine of PKR 500 or one month imprisonment, or both, for those who pollute canal waters (Canal and Drainage Act 1873).

iv) The Factories Act 1934 (Amendment 2012)

The Factories Act 1934, along with the Provincial Factory Rules 1952, regulates industrial waste and workplace hazards. It requires proper waste disposal, controls dust, smoke, and toxic substances, and provides penalties for violations. Section 33Q empowers provincial governments to regulate factories posing serious health risks, supporting worker safety and public health (Factories Act 1934).

v) The Forest Act 1927

The Forest Act 1927 empowers provinces to stop activities harmful to forests, such as clearing forests, farming, hunting, or cutting trees in reserved areas. Under Section 5, any such actions breaking government rules are completely prohibited to protect forest resources (Forest Act 1927).

vi) Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020

The Sindh Wildlife Protection Act 2020, along with its 2022 Rules, is intended to preserve Indus River species, especially the dolphin. Article 21 of the Act and Article 36 of the Rules list the actions that are considered cruel to wildlife. The act also addresses degradation of dolphin habitats and illegal fishing practices, which are punishable offences (Sindh Wildlife Protection, Preservation, Conservation and Management Act 2020).

vii) The 1991 Water Apportionment Accord

The 1991 Water Apportionment Accord (WAA) provides the primary inter-provincial framework for Indus water sharing by establishing the Indus River System Authority (IRSA) to regulate and monitor water allocations. Sindh, as the lower riparian province containing the Indus Delta, was given 48.76 million acre-feet (MAF). Article 7 recognises the need for minimum water escapage below the Kotri Barrage to control seawater intrusion. It records Sindh's position that 10 MAF was the optimal requirement, while noting differing estimates and calling for further research to determine the minimal downstream flow. The International Panel of Experts later assessed downstream flow requirements and proposed environmental release of 5,000 cusecs (3.62 MAF) annually along with 25 MAF once every five years, to sustain the Indus Delta's ecological health.

Thus, the WAA provides an essential institutional foundation for linking inter-provincial water allocation, environmental flows, and Delta's protection.

2.1.3. Pakistan's National Policies

i) The 2018 National Water Policy (NWP 2018)

The National Water Policy (NWP) 2018 establishes a framework for sustainable water management and the Delta's protection. *Section 5.2* requires respect for lower riparian rights under 1991 Accord, while *Section 6.3* emphasises environmental flows, river ecology, wetlands, Ramsar sites, and fisheries. *Sections 20.5.1* and *20.5.2* identify seawater intrusion as a severe hazard to coastal agriculture, citing that about two million acres in Thatta, Badin, and Sujawal had been affected, and require environmental flows to mitigate it and protect aquatic habitats. Thus, the NWP recognises lower-riparian rights, environmental flows, and freshwater availability as significant for Delta protection (Ministry of Water Resources 2018).

ii) The 2021 National Climate Change Policy

The National Climate Change Policy (NCCP) 2021 acknowledges the Delta's vulnerability to climate-related impacts. *Section 3(7)* notes seawater intrusion and its impact on mangroves, fish breeding sites, and coastal agriculture. Therefore, the policy acknowledges the saline-water intrusion as a serious danger to Delta's ecological and socioeconomic viability (Ministry of Climate Change 2021).

iii) The 2005 National Environmental Policy (NEP 2005)

The National Environmental Policy (NEP) 2005, recognises the importance of freshwater flows to marine ecosystems. *Section 3.1(k)* requires action to *'monitor sustained freshwater flows into the marine eco-systems*', aiming to address the ecological deterioration of the Indus Delta.

3. METHODOLOGY

Data for this research is entirely drawn from secondary sources:

PEPA 1997, the Sindh Environmental Protection Act 2014; the Pakistani Constitution (with particular attention to Articles 9, 9A, 14, 19A, 155, 184(3) and 199), judicial decisions from higher courts on environmental rights, interprovincial water disputes, and fundamental rights. International agreements include the Universal Declaration of Human Rights (United Nations 1948) and the Indus Waters Treaty 1960.

Rather than quantitatively measuring ecological impacts, this study adopts a doctrinal research methodology to analyse statutes, constitutional provisions, case law, and international treaties regarding environmental protection and water governance. Relevant research articles, reports and surveys from the World Wide Fund for Nature (WWF), the

International Union for Conservation of Nature (IUCN), the United Nations Environment Programme (UNEP), Mehran University of Engineering and Technology (MUET) and civil society organisations are also used.

4. RESULTS AND FINDINGS

4.1. Findings on Indus Delta

The study found that delta communities face serious environmental and socio-economic challenges, including displacement, migration, water pollution, contaminated drinking water, malnutrition, and poverty. These problems are primarily linked to reduced freshwater flows (see Table 1), seawater intrusion, environmental degradation, and inadequate institutional responses. Communities emphasise adequate freshwater flows, effective implementation of the 1991 Water Apportionment Accord, improved water governance and avoiding upstream dams and diversions as essential for protecting their livelihoods and Delta's ecological sustainability.

4.2. Findings on International Treaties & Conventions

The study finds that Pakistan is a signatory to several international environmental and human rights treaties relevant to Indus Delta, such as the UDHR, the IPPC, the Ramsar Convention, and the CITES. However, continued environmental degradation, declining freshwater availability, and wetland loss highlight gaps in environmental governance and implementation, raising concerns about effective fulfilment of Pakistan's international commitments to human rights and wetland protection.

The findings indicate gaps in implementing Pakistan's CITES commitments, reflected in historic mangrove and biodiversity loss. Pakistan's mangrove forests reportedly declined from around 280,470 hectares in the mid-1980s to roughly 86,727 hectares in 2003 (IUCN Pakistan 2005). However, recent restoration efforts have contributed to recovery, with mangrove cover increasing from approximately 44,486 hectares in 1988 to 106,637 hectares in 2024 (Sanaullah et al., 2025). Government agencies, provincial forest departments, WWF, and IUCN have contributed to these restoration efforts.

The study also finds that although the Indus Waters Treaty 1960 regulates transboundary water sharing between India and Pakistan, it does not adequately address downstream provincial concerns within Pakistan, resulting in limited protection of the Delta.

4.3. Findings on Pakistan's National Laws

The study finds that Pakistan has a comprehensive environmental legal framework, including constitutional provisions under Articles 9, 14, 19A, 25, 155, 199, and 184(3), with Article 9A, introduced in 2024, recognising the right to a clean, healthy, and sustainable environment. Key laws include PEPA 1997, the Canal and Drainage Act 1873, the Factories Act 1934, the Forest Act 1927, the Sindh Wildlife Act 2020 and the 1991 Water Apportionment Accord. Although PEPA 1997 stipulates Environmental Protection

Agencies (EPAs), Initial Environmental Examinations (IEEs), National Environmental Quality Standards (NEQS) and Environmental Impact Assessments (EIAs), compliance is weak due to a lack of institutional cooperation and enforcement lapses.

The Canal and Drainage Act 1873, initially intended for agricultural productivity, has no provisions on environmental flows, rights, or Delta conservation, stressing the necessity for legal reforms as outdated punishments, including PKR 500 fine or one-month imprisonment, also throttle its effectiveness. Similarly, surging pollution in the Delta indicates implementation gaps in the Factories Act 1934, which governs industrial waste disposal. Besides this, the declining freshwater flows and wetland loss also expose the ineffectiveness of the Forest Act 1927, the Sindh Wildlife Act 2020 and the Sindh Wildlife Rules 2022, threatening species and ecosystems such as mangroves and the Indus River dolphin.

The research indicates that the 1991 Water Apportionment Accord allocated Sindh 48.76 MAF annually through IRSA but did not establish downstream environmental flows as a binding entitlement. Article 7 recognised the necessity for a minimum escapage below Kotri to prevent seawater intrusion and called for further research. The 2005 International Panel of Experts (IPOE) subsequently recommended a perennial flow of 5,000 cusecs (about 3.62 MAF) and periodic flood flows for sediment transport, river morphology, and ecological sustainability but it has not been implemented in practice. Water and Power Development Authority (WAPDA) statistics show extremely erratic flows below Kotri from 2000–01 to 2019–20, ranging from just 0.28 MAF in 2004–05 to 54.53 MAF in 2010–11. Several years recorded exceptionally low flow, including 0.78 MAF (2000–01), 1.93 MAF (2001–02), 2.37 MAF (2002–03), 5.81 MAF (2009–10), 6.01 MAF (2012–13), 6.86 MAF (2014–15), and 9.49 MAF (2017–18) as shown Table 1:

Table 1: Annual Escapage below Kotri Barrage, 2000-01 to 2019-20

Year	Escapage Flow (MAF) Below Kotri	Significance
2000–01	0.78	Extremely Low
2001–02	1.93	Extremely Low
2002–03	2.37	Extremely Low
2003–04	20.18	High
2004–05	0.28	Extremely Low
2005–06	24.53	High
2006–07	21.73	High
2007–08	15.8	Above 10 MAF
2008–09	5.81	Low
2009–10	4.07	Low
2010–11	54.53	Extreme High due to floods
2011–12	13.82	Above 10 MAF
2012–13	6.01	Low
2013–14	18.33	High
2014–15	6.86	Low
2015–16	36.61	High
2016–17	10.57	Fixed
2017–18	9.49	Almost Fixed
2018–19	1.79	Extremely Low
2019–20	12.66	Above 10 MAF

Source: WAPDA and PBS.

4.4. Findings on Pakistan's National Policies

The study finds that Pakistan's national policy framework recognises the need to maintain freshwater flows to the Indus Delta. NEP 2005 requires monitoring sustained freshwater flows into marine ecosystems, while the NWP 2018 recognises lower-riparian rights, environmental flows, and seawater intrusion. Likewise, the National Climate Change Policy 2021 also addresses seawater intrusion and its repercussions on mangroves, agriculture, and fisheries. However, a persistent gap between policy commitments and their implementation remains due to weak enforcement, low environmental flows, competing upstream irrigation demands and poor interprovincial coordination.

4.5. Correlation between International and National Laws regarding Indus Delta

It is found that Pakistan's international human rights and environmental obligations are mostly evident in its constitutional, statutory, and administrative laws. Pakistan's constitutional guarantees of life (Article 9), a clean, healthy, and sustainable environment (Article 9A, 2024), dignity (Article 14), right to information (Article 19A), and equality (Article 25) align with the UDHR, operationalised by PEPA 1997, EPAs, EIAs, IEEs, and NEQS. Similarly, the Forest Act 1927, the 1991 Water Apportionment Accord, PEPA 1997, SEPA and the Sindh Wildlife Act 2020 anchor legal procedures for water allocation,

wetlands and mangrove protections, biodiversity conservation and protection of species such as the Indus River dolphin, corroborating Pakistan's commitments under CITES and the Ramsar Convention. However, frequent habitat and biodiversity loss indicate weaknesses in domestic enforcement. Domestic water governance regulates through the IRSA Act and the Water Apportionment Accord 1991, while transboundary water relations by the IWT 1960, showing the link between Pakistan's international obligations and domestic laws.

Table 2: Correlative Analysis of International and National Laws about the Indus Delta

S#	Recognised Rights	Common Themes	International Treaties	National Laws	Findings on Law Enforcement	Impact on Indus Delta
1	Healthy Environment	Right to Life	UDHR (Right to Life and Adequate Environment, Articles 2 and 25)	1973 Constitution's Basic Rights (Under Article 9, 14, 19A, & 25)	Weak enforcement of environmental laws	Threat to Life & Health
	Protection of Endangered Species					Threat to Ecosystem & Environment
			CITES, 1973	The Sindh Wildlife Act 2020 and its 2022 Rules (Article 21 and 36)		Threat to Species in the Indus Delta
2	Fresh Water Availability	Rights of Communities & Ecosystem	Ramsar Convention	Article 9A (adopted in 2024), of Constitution (Right to Clean and Healthy Environment)	Weak Implementation and Governance	Fresh Water Reduction
	Biodiversity Conversion					Increasing Pollution
	Food Security			PEPA 1997		Contamination of Indus water
	Clean Water			Canal & Drainage Act 1873		Corruption and Political influence
				The Factories Act		
	Plant Protection and Deforestation		IPPC, 1951	Forest Act 1934 (Amended In 2012)		Risk to mangroves
3	Interprovincial Disputes	Equality in Water Share	Indus Waters Treaty, 1960	Water Apportionment Accord, 1991	Poor Implementation, no binding results	Unequal water distribution, diversions and water theft

Source: Authors' own.

5. DISCUSSION

The Indus Delta's ecological degradation prevails, despite robust laws, such as the Constitution of Pakistan 1973, PEPA 1997, SEPA 2014, the Sindh Wildlife Act 2020 and the Forest Act 1927 and international agreements, including the Ramsar Convention and

the Convention on Biological Diversity. The study indicates the absence of dedicated legislation for the Indus Delta, fragmented environmental governance, overlapping institutional responsibility, limited technical capability, underfunding and weak implementation, as key challenges.

The findings are aligned with previous studies indicating poor governance, upstream water diversions, reduced freshwater and sediment flows as the major causes of Delta's degradation. Bux Mallah (2013), Memon (2025) and Siyal (2018) connect freshwater scarcity with declining livelihoods, seawater intrusion, and biodiversity loss. Moreover, the IPCC Sixth Assessment Report (2022) indicates deltas' vulnerability to the risks from human alterations to river systems and climate change. This research shows that weak compliance, weak political will, underfunding and institutional lapses increase these environmental stresses.

Noting the development of a robust environmental legal framework, including special environmental tribunals, over the past three decades, Amin and Farrukh (2023) concur that the robust constitutional and statutory framework for environmental protection in Pakistan faces not a lack of legislation or tribunals but weak implementation, fragmented institutional responsibilities, and ineffective environmental governance.

The study finds that Pakistan's domestic environmental laws offer a broad legal foundation for environmental protection, including the newly added Article 9A, but it currently lacks penalties for violations and an implementation mechanism. The remaining laws, including the Water Apportionment Accord 1991, SEPA 2014, the Sindh Wildlife Act 2020, the Forest Act 1927 and PEPA 1997, focus on biodiversity and environmental protection by managing water and pollution. However, their effectiveness is affected by weak institutional coordination and overlapping responsibilities, a lack of enforcement capability, and low funding, concerns consistently highlighted by IUCN Pakistan (2005), and WWF-Pakistan as governance and implementation challenges rather than legislative ones.

The connection between Pakistan's domestic legal system and its international environmental obligations is a major finding of this study. Treaties such as the Ramsar Convention, CBD, CITES and IPPC require the protection of wetlands, biodiversity and ecosystems, and these requirements are reflected in laws including Article 9A, PEPA 1997 and SEPA 2014. However, weak institutional coordination, insufficient monitoring, underfunding, and uneven enforcement hamper effective local implementation, demonstrating the need to strengthen both legal implementation and institutional capacity.

The study reveals that ecological sustainability requires adequate environmental flows to the Indus Delta. Fixed allocations, i.e. 48.76 MAF for Sindh, may be insufficient under changing hydrological and climatic conditions; calling for the integration of environmental-flow requirements into water governance; failing to do so weakens Pakistan's capacity to

protect wetlands, mangroves, fisheries and biodiversity and to fulfil constitutional and international commitments.

The annual escapage variability below Kotri shows that the recognition of downstream ecological requirements has not been translated into a predictable and legally enforceable environmental-flow framework. Although the facts do not establish a violation, Article 7 did not make 10 MAF a binding annual allocation. The Murray-Darling Basin Plan and Australia's Water Act 2007 provide comparatively workable legal models by incorporating environmental objectives into basin-wide water management, setting sustainable extraction limits and enabling environmental watering (Water Act 2007). Pakistan could also transform Article 7's recognition into scientifically determined, legally enforceable, and consistently monitored environmental-flow procedure to strengthen the delta's protection.

The study finds that mangrove conservation needs restoration and protection of ecological conditions. The data show reduced freshwater flow, sediment deprivation and seawater intrusion have caused a sharp loss, while Sanaullah et al. (2025) report considerable recovery through coordinated restoration. However, without sufficient freshwater flows, efficient pollution management, and robust legal enforcement, mere plantations cannot guarantee long-term viability. Thus, integrating ecological restoration with legal protection is needed for sustainable environmental governance.

Pakistan's later national policies recognise the ecological significance of downstream flows but are ambiguous about legal enforceability. The NEP 2005 called for sustained freshwater flows into marine habitats, while the 2018 NWP recognised lower-riparian water rights and environmental flows. The National Climate Change Policy 2021 also considers seawater intrusion as a risk to agriculture, mangroves, and fisheries. However, implementation limits are linked to the absence of defined ecological flows, binding allocation mechanisms, monitoring and institutional accountability.

By examining the Delta from a structured legal perspective, including constitutional law, environmental laws, international environmental duties, and human rights relationships, this research expands the existing literature, which has mainly focused on climate change, water scarcity, mangrove degradation, and biodiversity loss.

Overall, the results indicate weak implementation, poor institutional coordination, outdated laws and inadequate accountability and monitoring in Pakistan's international and domestic laws. Instead of new legislation, preference should be given to reinforcing existing laws through effective enforcement and coordination, environmental-flow requirements, institutional accountability, adequate resources and public participation and awareness.

6. CONCLUSION

This study concludes by pointing out the dire need for environmental justice as despite existing domestic and international laws, weak implementation continues to worsen the

Delta's degradation. By linking the Delta's ecological fallout with legal flaws, the study advocates for rights-based and sustainable policies to protect the Delta and its communities.

Limited time and data access restricted the study. Government officials and local communities could not be interviewed nor could field observations be undertaken in the Indus Delta. Future research should use empirical, quantitative, or mixed-method approaches to analyse long-term effects of policies on the Indus Delta along with enforcement of environmental laws. As this study is based solely on doctrinal research, distinct methodologies may produce distinct findings that could strengthen environmental and delta justice discourse.

7. RECOMMENDATIONS

As the Indus Delta keeps declining due to poor implementation of existing laws, delayed legal and institutional reforms, and inadequate environmental funding, the following recommendations are proposed:

- **Strengthening Law Enforcement Mechanism**: Weak enforcement of international treaties such as the UDHR, CITES, the Ramsar Convention and the IPPC, and national laws such as Articles 9, 9A, 14, 19A and 25 of the Constitution, PEPA 1997, the Sindh Wildlife Act 2020, the Factories Act 1934 and the Forest Act 1927, continues to expose the Delta to freshwater and mangrove loss, ecosystem degradation and threats to species. Thus, consistent and strengthened enforcement mechanisms of environmental laws are essential to protecting the Delta.
- **Legal Guarantee of Environmental Flows to the Indus Delta**: To mitigate concerns regarding equitable water distribution and environmental flows to the lower riparian, this study recommends:
    a) Sindh's 48.76 MAF share as per the 1991 Water Apportionment Accord should be ensured by managing upstream water diversions and infrastructure to stop deprivation of its agreed share.
    b) Article 7 of the 1991 WAA should be strengthened through scientifically determined ecological-flow requirements below Kotri, supported by continuous monitoring, transparent accountability, and an enforceable compliance mechanism. A percentage-based approach could adjust wet and dry years and maintain sufficient freshwater to curb seawater intrusion and sustain the delta's environmental functions.
- **Modernise Pakistan's Water and Environmental Laws**: Comprehensive revision of several colonial-era laws is required. For example, the Canal and Drainage Act enforces obsolete penalties of PKR 500 or one month's imprisonment, which impairs deterrence. Pakistan should update water and environmental laws to address water distribution, pollution, and ecological degradation, while periodically adjusting

penalties for inflation and connecting them to objective economic indicators so as to strengthen compliance and prevent further degradation of the Indus River and Delta.

- **Establish an independent 'Indus Delta Protection Authority':** A statutory Authority should be established to coordinate federal and provincial institutions, monitor freshwater inflows, oversee restoration, enforce environmental laws, publish annual reports and address matters concerning the delta and its protection.
- **Strengthen Monitoring and Accountability**: A publicly accessible real-time telemetry system should be set up to monitor river flows, canal withdrawals, and delta inflows, improving compliance with the 1991 Water Apportionment Accord and strengthening institutional accountability.
- **Increase Dedicated Funding for Environmental Justice and Delta Restoration**: Federal and provincial governments should establish an Indus Delta Restoration Fund to support mangrove restoration, freshwater management, biodiversity protection, climate adaptation and implementation of environmental commitments.

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