

INTERNATIONAL JOURNAL OF LAW MANAGEMENT & HUMANITIES

[ISSN 2581-5369]

Volume 7 | Issue 5

2024

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Legal Frameworks for Sustainable Water Resource Management: Integrating Land, Mineral, and Biodiversity Conservation

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ABSTRACT

This paper, titled "Legal Frameworks for Sustainable Water Resource Management: Integrating Land, Mineral, and Biodiversity Conservation," aims to address the complex interplay between legal regulations and environmental sustainability, focusing on water management systems. The legal frameworks that regulate water resource management play a pivotal role in ensuring sustainability. These frameworks establish the rules for water allocation, control water pollution, and protect ecosystems dependent on water. National laws, such as the Water (Prevention and Control of Pollution) Act, 1974 in India and the Clean Water Act in the United States, provide the regulatory foundation for managing water resources sustainably. Furthermore, international agreements like the UNECE Water Convention offer guidelines for cross-border water cooperation and pollution prevention, highlighting the importance of a coordinated approach to water governance. Legal structures also ensure that stakeholders, including governments, industries, and local communities, have clear responsibilities in maintaining water quality and availability.

Keywords: Sustainable, Water, Land, Mineral, Biodiversity Conservation.

I. INTRODUCTION

Water is a vital resource that supports life, economic growth, and ecosystem sustainability. The management of water resources has become increasingly critical in the context of global challenges such as environmental degradation, climate change, and rapid urbanization. According to the United Nations, more than 2 billion people live in countries experiencing high water stress, and this number is projected to rise due to population growth, industrial activities, and agricultural demands.³ Consequently, sustainable water resource management (SWRM) is now central to ensuring water availability for both present and future generations. This part introduces the concept of SWRM and emphasizes the need for robust legal frameworks that

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³ UN-Water. (2020). The United Nations World Water Development Report 2020: Water and Climate Change. United Nations Educational, Scientific and Cultural Organization (UNESCO).

govern the use, protection, and equitable distribution of water resources.

Sustainable water resource management can be defined as the practice of managing water resources in a manner that meets current needs without compromising the ability of future generations to meet theirs. The concept incorporates the efficient use of water, its protection from pollution, and the preservation of natural water ecosystems.⁴ As climate change intensifies, the pressure on water resources grows, manifesting in frequent droughts, unpredictable rainfall patterns, and the depletion of freshwater reserves. Environmental degradation, such as deforestation and pollution from industrial activities, further exacerbates the strain on water resources, leading to conflicts over access, degradation of ecosystems, and loss of biodiversity.⁵ These factors underscore the urgent need for holistic strategies that integrate water management with other environmental concerns.

The legal frameworks that regulate water resource management play a pivotal role in ensuring sustainability. These frameworks establish the rules for water allocation, control water pollution, and protect ecosystems dependent on water. National laws, such as the Water (Prevention and Control of Pollution) Act, 1974⁶ in India and the Clean Water Act in the United States, provide the regulatory foundation for managing water resources sustainably.⁷ Furthermore, international agreements like the UNECE Water Convention⁸ offer guidelines for cross-border water cooperation and pollution prevention, highlighting the importance of a coordinated approach to water governance. Legal structures also ensure that stakeholders, including governments, industries, and local communities, have clear responsibilities in maintaining water quality and availability.

The integration of water management with land use, mineral extraction, and biodiversity conservation is crucial for comprehensive SWRM. Land use laws, for instance, directly impact water resources as deforestation, urbanization, and agricultural expansion often lead to soil erosion, increased runoff, and water pollution.⁹ Mining activities, especially in developing countries, have been notorious for contaminating water sources with heavy metals and other

⁴ Cosgrove, W. J., & Loucks, D. P. (2015). Water management: Current and future challenges and research directions. *Water Resources Research*, 51(6), 4823–4839. <https://doi.org/10.1002/2014WR016869>

⁵ WWF. (2021). *Living Planet Report 2020*. World Wildlife Fund.

⁶ Water (Prevention and Control of Pollution) Act, No. 6 of 1974, India Code (1974).

⁷ Laitos, J. G., & Ruckriegle, H. (2013). The Clean Water Act and the challenge of agricultural pollution. *Vermont Law Review*, 38(4), 1033–1070.

⁸ Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Mar. 17, 1992, 1936 U.N.T.S. 269.

⁹ Kalogiannidis, S., Kalfas, D., Giannarakis, G., & Paschalidou, M. (2023). Integration of water resources management strategies in land use planning towards environmental conservation. *Sustainability*, 15(21), Article 15242

pollutants, prompting stricter regulations.¹⁰ Biodiversity conservation laws, such as those protecting wetlands and forests, contribute to maintaining the natural ecosystems that play a critical role in filtering and storing freshwater. Therefore, legal frameworks must be interconnected and integrated to address the multiple factors influencing water sustainability.

The objectives of this paper are threefold: first, to highlight the importance of sustainable water resource management in the context of current global challenges; second, to examine the role of legal frameworks in governing water resources; and third, to explore the intersections between water management and other environmental regulations, such as those governing land use, mining, and biodiversity. By understanding these intersections, this chapter will demonstrate how an integrated legal approach is essential for ensuring water sustainability.

In conclusion, water is a finite and irreplaceable resource, and its sustainable management is key to supporting life and maintaining ecological balance. Legal frameworks, therefore, must evolve to address the growing challenges posed by climate change, environmental degradation, and competing demands for water. An integrated approach that considers the broader environmental factors, including land use, mineral extraction, and biodiversity conservation, will be essential for future water resource management. This chapter will set the foundation for a deeper exploration of these issues in the following sections of the study.

II. LEGAL FRAMEWORKS FOR WATER RESOURCE MANAGEMENT

Water is a critical resource in India, supporting agriculture, industry, and millions of livelihoods. With increasing pressure from population growth, industrialization, and climate change, sustainable management of water resources has become a central concern. India's legal framework for water resource management reflects the complexities of its socio-political structure, environmental challenges, and the diverse needs of its states. This part provides an in-depth analysis of the national legal structures that govern water resources in India. It focuses on the key laws regulating water allocation, pollution control, and ensuring water quality, highlighting the significance of these legal frameworks in addressing water-related challenges across the country.

(A) National Legal Frameworks for Water Resource Management

India's legal framework for water management is a blend of ancient customary laws and modern statutory regulations. The Water (Prevention and Control of Pollution) Act (1974) is one of the

¹⁰ Zhang, P., Yang, M., Lan, J., Huang, Y., Zhang, J., Huang, S., Yang, Y., & Ru, J. (2023). Water quality degradation due to heavy metal contamination: Health impacts and eco-friendly approaches for heavy metal remediation. *Toxics*, 11(10), Article 828.

primary laws addressing water pollution in India. Enacted in response to growing concerns over the contamination of rivers and water bodies, this law aims to prevent and control water pollution by regulating industrial and municipal discharges. The Act established the Central Pollution Control Board (CPCB) and corresponding State Pollution Control Boards (SPCBs) to monitor water quality, issue discharge permits, and enforce pollution control measures¹¹. These authorities are tasked with setting water quality standards, ensuring compliance, and taking punitive actions against violators.

The Environment (Protection) Act (1986)¹² further complements the Water Act by providing a more comprehensive legal framework for environmental protection, including water resources. Under this Act, the central government has broad powers to regulate industrial activities that may harm water bodies and to prescribe standards for effluent discharges. Additionally, the National Green Tribunal (NGT), established in 2010 under the National Green Tribunal Act, plays a significant role in addressing environmental disputes, particularly those related to water pollution.

Another critical piece of legislation is the Indian Easements Act (1882)¹³, which governs the rights to groundwater. According to this Act, landowners have the right to extract groundwater beneath their property, a principle that often leads to over-extraction in areas heavily dependent on groundwater for agriculture and industry. While the Easements Act represents a historical approach to water rights, there has been increasing recognition of the need to regulate groundwater usage more effectively, particularly in light of growing water scarcity in various regions of India. The Model Bill for the Conservation, Protection, Regulation and Management of Groundwater (2016) was introduced as a response to the unsustainable extraction of groundwater, proposing measures for equitable distribution, groundwater recharge, and sustainability.¹⁴

(B) International Water Treaties and Conventions

Water, being a transboundary resource, often requires international cooperation. Several treaties and conventions have been established to facilitate cross-border water management and mitigate potential conflicts. One of the key international agreements is the UNECE Water

¹¹ Central Pollution Control Board (CPCB). (2018). Water (Prevention and Control of Pollution) Act, 1974. Retrieved from <http://www.cpcb.nic.in>

¹² The Environment (Protection) Act, No. 29 of 1986, India Code (1986).

¹³ The Indian Easements Act, No. 5 of 1882, India Code (1882).

¹⁴ Ministry of Water Resources. (2016). Model Bill for the Conservation, Protection, Regulation and Management of Groundwater. Retrieved from <http://mowr.gov.in>

Convention (also known as the Helsinki Convention)¹⁵, adopted in 1992. The Convention promotes cooperation in the protection and sustainable use of transboundary watercourses and international lakes, ensuring the equitable sharing of resources between countries. It obligates member countries to prevent, control, and reduce transboundary water pollution and to work towards sustainable water management practices.

Another significant international agreement is the Ramsar Convention on Wetlands (1971)¹⁶, which focuses on the conservation and sustainable use of wetlands. Wetlands play a crucial role in maintaining water quality by filtering pollutants and providing habitat for species that depend on water ecosystems. The Ramsar Convention requires signatory countries to designate wetlands of international importance and to manage them in a way that maintains their ecological character.

The United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)¹⁷, often referred to as the Watercourses Convention, is another key framework that governs the use of international watercourses. The convention aims to ensure the equitable and reasonable use of shared water resources while preventing harm to other riparian states. These treaties highlight the importance of legal mechanisms in promoting cross-border water management and conflict resolution.

(C) Water Rights and Allocation Laws

Water rights in India are largely shaped by state-specific laws and policies, as water is a state subject under the Indian Constitution. This means that individual states have the authority to regulate water usage within their territories, leading to significant variations in water management practices across the country. In addition to the state-level laws, there are certain central policies that influence water allocation at the national level. The National Water Policy (2012)¹⁸ emphasizes equitable access to water as a basic human right and prioritizes drinking water, followed by irrigation, industry, and ecological needs. It also advocates for the integrated management of water resources, recognizing the interdependence of surface and groundwater.

Despite these policies, disputes over water rights and allocation are common in India, particularly between states sharing river basins. The Inter-State Water Disputes Act (1956)¹⁹

¹⁵ Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Mar. 17, 1992, 1936 U.N.T.S. 269 (also known as the Helsinki Convention).

¹⁶ Convention on Wetlands of International Importance especially as Waterfowl Habitat, Feb. 2, 1971, 996 U.N.T.S. 245 (Ramsar Convention).

¹⁷ Convention on the Law of the Non-Navigational Uses of International Watercourses, May 21, 1997, 2999 U.N.T.S. 219.

¹⁸ Ministry of Water Resources. (2012). National Water Policy 2012. Retrieved from <http://mowr.gov.in>

¹⁹ The Inter-State Water Disputes Act, No. 33 of 1956, India Code (1956).

provides the legal mechanism for resolving disputes between states over the distribution and usage of river waters. Notable examples include the long-standing

i) **Cauvery Water Dispute** between Karnataka and Tamil Nadu²⁰

The Cauvery River originates in the Western Ghats of Karnataka and flows southeast through Tamil Nadu before emptying into the Bay of Bengal. The river is crucial for agriculture, drinking water, and hydroelectricity in both states.

The dispute has its roots in agreements made during the British colonial period, particularly the 1892 and 1924 agreements, which allocated water usage among the states. In 1990, the central government constituted the Cauvery Water Disputes Tribunal to adjudicate the conflict. The tribunal delivered its final award in 2007, allocating water shares among the states, but the implementation of this award led to further disputes. The Supreme Court of India has intervened several times, issuing orders regarding the implementation of the tribunal's award and addressing grievances from both states. In 2018, the Supreme Court modified the tribunal's award, increasing Karnataka's share and maintaining Tamil Nadu's allocation. The main points of contention revolve around the quantity of water allocated to each state, especially during periods of drought. Farmers in Tamil Nadu argue that they need more water for irrigation, while Karnataka seeks to manage water scarcity in its regions.

dispute has significant political implications in both states, often leading to tensions, protests, and accusations between political parties.

ii) **Krishna Water Dispute** involving multiple states.²¹

The Krishna Water Dispute involves several Indian states—primarily Karnataka, Andhra Pradesh, and Telangana—over the sharing of the waters of the Krishna River, which flows across these states. The Krishna River originates in the Western Ghats of Maharashtra and flows through Karnataka, Andhra Pradesh, and Telangana before merging with the Bay of Bengal. The river is vital for irrigation, drinking water, and hydroelectric power generation in the regions it traverses. The dispute has its roots in the inter-state agreements made during the mid-20th century, particularly the Krishna Water Disputes Tribunal, established in 1969, to resolve water-sharing issues. The tribunal's first major decision in 1976 allocated the water shares among the states. However, the allocation was contentious and led to further disputes, particularly as the demand for water increased with population growth and agricultural needs. The bifurcation of Andhra Pradesh in 2014 to create Telangana added another layer of complexity to the dispute,

²⁰ Karnataka v. Tamil Nadu, (2007) 10 SCC 1 (India).

²¹ State of Andhra Pradesh v. State of Karnataka, (2000) 6 SCC 50 (India).

as it altered the dynamics of water sharing. Both Andhra Pradesh and Telangana claim rights to the Krishna River, leading to heightened tensions. The Supreme Court has been involved in various cases concerning the implementation of the tribunal's awards and has issued orders to maintain the status quo on water distribution among the states. Issues often arise over the allocation of water during dry seasons, with each state asserting its claims based on historical usage and projected needs. The ongoing construction of dams and irrigation projects by the states has also led to conflicts. Efforts have been made for cooperation through the Krishna River Management Board, established in 2014, to manage water distribution more effectively among the states. The dispute remains politically charged, with accusations of water mismanagement, protests by farmers, and demands for better allocation practices.

These disputes highlight the challenges of managing shared water resources in a federal system, where competing claims often lead to conflict. The creation of tribunals under the Inter-State Water Disputes Act has been a critical step in resolving these conflicts, though implementation of tribunal decisions remains a contentious issue.²²

(D) Pollution Control and Water Quality Standards

Pollution control is a central focus of water management laws in India, given the alarming levels of contamination in many rivers and water bodies. The Water (Prevention and Control of Pollution) Act sets strict guidelines for industrial and municipal discharge, and industries are required to obtain consent from the SPCBs before discharging any effluents into water bodies. This consent is granted based on compliance with water quality standards, which are regularly monitored by the CPCB and SPCBs. Despite these regulations, enforcement remains a significant challenge, with many industries failing to adhere to prescribed standards due to corruption, lack of infrastructure, or inadequate penalties.

In response to the growing pollution crisis, the Namami Gange Programme was launched in 2014 as an integrated initiative to clean and rejuvenate the Ganga River. This flagship project, under the National Mission for Clean Ganga (NMCG), focuses on controlling pollution, improving sewage treatment infrastructure, and restoring the ecological health of the river.²³ The success of Namami Gange has been mixed, with some improvement in water quality in certain stretches of the river but continuing challenges in others. Nevertheless, it serves as an example of the government's commitment to addressing the severe pollution of India's water

²² Iyer, R. R. (2019). *Water and the laws in India*. Sage Publications India.

²³ National Mission for Clean Ganga, Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, 2011.

bodies.

The Environmental Impact Assessment (EIA) Notification (2006)²⁴ under the Environment (Protection) Act also plays a critical role in regulating activities that may impact water resources. Industries, infrastructure projects, and other developmental activities that have the potential to harm water bodies are required to undergo environmental scrutiny through the EIA process. This ensures that preventive measures are in place to protect water resources from industrial pollution, deforestation, and other harmful activities.

III. INTERCONNECTIONS BETWEEN WATER AND LAND USE LAWS

Water and land use are deeply intertwined, as the way land is utilized significantly influences the availability, quality, and sustainability of water resources. Poor land management practices, such as deforestation, unregulated urbanization, and intensive agriculture, can lead to the degradation of water resources through pollution, reduced water retention, and the over-extraction of surface and groundwater. In India, where land and water are essential to both livelihoods and ecosystems, it is crucial to adopt legal strategies that address the integrated management of these resources. This part explores how land use laws intersect with water management policies, focusing on agriculture, urban development, and the prevention of land degradation. It will also highlight the need for coordinated legal instruments that foster sustainable land and water use, with examples of successful policies and case studies.

(A) Impact of Agriculture and Urbanization on Water Resources

Agriculture, is the largest consumer of water in India, plays a critical role in shaping the country's water resources. However, unsustainable agricultural practices, such as excessive irrigation, chemical-intensive farming, and monoculture cropping, have led to the depletion of groundwater and the contamination of surface waters with pesticides and fertilizers²⁵. The National Water Policy (2012) recognizes the importance of aligning water management with agricultural practices, advocating for the adoption of water-efficient technologies such as drip irrigation and regulated groundwater extraction.²⁶ The linkage between agricultural land use and water is further governed by laws like the Environment (Protection) Act (1986), which sets pollution control standards to mitigate agricultural runoff.

²⁴ Ministry of Environment, Forest and Climate Change. (2016). Environmental Impact Assessment Notification, 2006. Government of India. Retrieved from <http://moef.gov.in>

²⁵ Dhawan, V. (2017). Water and agriculture in India: Background paper for the South Asia expert panel during the Global Forum for Food and Agriculture (GFFA).

²⁶ Government of India. (2012). National Water Policy (2012). Ministry of Water Resources. Retrieved from <https://www.indiawaterportal.org/articles/national-water-policy-2012-revised-version>

Urbanization, too, has a profound impact on water resources. Rapid, often unplanned urban growth has led to the encroachment of water bodies, increased surface runoff, and reduced groundwater recharge. Cities generate large quantities of wastewater, much of which is discharged untreated into rivers and lakes. Urban planning laws such as the Town and Country Planning Act (1973)²⁷ regulate land development and can play a role in safeguarding water bodies from urban encroachment. Despite these frameworks, enforcement remains inconsistent, with many urban areas still lacking adequate infrastructure for wastewater treatment and sustainable land-use planning.²⁸

(B) Land Degradation and Its Effects on Water Bodies

Land degradation, including deforestation, soil erosion, and desertification, has direct consequences on water resources. Forests play a crucial role in regulating the water cycle by aiding in groundwater recharge and maintaining the health of river systems. Deforestation, driven by agricultural expansion, mining, and infrastructure development, reduces the capacity of land to retain water, leading to increased runoff and siltation of rivers and lakes.²⁹ The Forest Conservation Act (1980)³⁰ aims to curb deforestation by regulating land diversion for non-forest uses and promoting afforestation projects, but implementation has been a challenge due to competing land-use priorities.

Soil erosion, particularly in hilly regions, further compounds the problem by washing away fertile topsoil into water bodies, leading to sedimentation and the disruption of aquatic ecosystems. The National Action Programme to Combat Desertification (2001)³¹ seeks to address land degradation through sustainable land management practices, emphasizing the importance of soil conservation measures to maintain water quality. Despite these efforts, many regions in India continue to suffer from land degradation, negatively impacting their water systems.

(C) Legal Instruments for Integrated Water and Land Use Management

In India, the fragmented nature of laws governing land use and water management often hinders effective integration. While there are laws addressing water pollution, land degradation, and urban planning, these sectors are usually governed by different agencies, making coordination

²⁷ The Town and Country Planning Act, No. 40 of 1973, India Code (1973).

²⁸ Ministry of Water Resources. (2016). Model Bill for the Conservation, Protection, Regulation and Management of Groundwater. Retrieved from <http://mowr.gov.in>

²⁹ Aggarwal, S., Paul, V., & Bandyopadhyay, S. (2020). Land use and water management in India: Policy analysis and implications. *Environmental Policy Journal*, 45(3), 287-301.

³⁰ The Forest (Conservation) Act, No. 69 of 1980, India Code (1980).

³¹ Ministry of Environment, Forest and Climate Change. (2001). National Action Programme to Combat Desertification. Government of India. Retrieved from <http://moef.gov.in>

challenging. The need for integrated legal instruments that consider both land and water use has been increasingly recognized, particularly in the context of climate change and sustainable development. The National Water Policy (2012) calls for the adoption of basin-level management practices that consider both land and water resources within a holistic framework. Additionally, the National Mission for Clean Ganga (NMCG) promotes watershed management, recognizing that the health of rivers is closely tied to the management of the surrounding land.

Legislation such as the Environmental Impact Assessment (EIA) Notification (2006) mandates that large-scale land use changes, including industrial and infrastructure development projects, undergo environmental scrutiny, ensuring that the potential impacts on water bodies are considered before granting project approval. By integrating land use planning with water resource management, the EIA process seeks to minimize the negative effects of land degradation on water systems. However, gaps remain in the consistent application of such integrated approaches, with many projects still proceeding without adequate consideration of their long-term impact on water resources.

India has seen several successful examples of integrated land and water management, where coordinated legal and policy measures have led to sustainable outcomes. One notable example is the Rural Watershed Development Programme under the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). This program focuses on restoring degraded land and improving water availability through community-driven watershed projects, including afforestation, soil conservation, and rainwater harvesting. The program has led to significant improvements in groundwater levels and agricultural productivity in several drought-prone regions.³²

Another example is the Catchment Area Treatment (CAT) Plans implemented for hydropower projects in the Himalayan region.³³ These plans focus on reducing soil erosion and sedimentation by rehabilitating degraded forests and promoting sustainable land-use practices in the catchment areas of rivers. Such efforts have helped improve water quality in river basins while promoting ecological sustainability in the surrounding lands.

In urban contexts, initiatives such as the Smart Cities Mission aim to incorporate sustainable

³² Singh, P., Behera, H. C., & Singh, A. (2010). Impact and effectiveness of watershed development programmes in India: Review and analysis based on the studies conducted by various government agencies and other organisations. Centre for Rural Studies, National Institute of Administrative Research, Lal Bahadur Shastri National Academy of Administration.

³³ Ministry of Power. (2019). Catchment Area Treatment Plans for Sustainable Hydropower Development. Government of India. Retrieved from <http://powermin.nic.in>

water management into urban planning. Cities like Surat and Pune have implemented projects that integrate green spaces, water recycling systems, and stormwater management infrastructure to reduce the strain on local water resources.³⁴ These examples underscore the importance of holistic approaches that link land use planning with sustainable water resource management.

The interconnections between land use and water management in India are critical to ensuring the long-term sustainability of natural resources. Agriculture and urbanization place immense pressure on water systems, while land degradation exacerbates these challenges by reducing water availability and quality. This part has explored the legal frameworks governing land and water use, emphasizing the need for integrated approaches that align land management practices with sustainable water resource goals. By examining the impact of land use on water, as well as highlighting successful policies and legal instruments, this chapter lays the foundation for further discussions on improving the coordination between land and water management in India.

IV. MINING LAWS AND THEIR IMPACT ON WATER RESOURCES

Mining activities, while essential for economic development and the extraction of valuable minerals, have profound and often detrimental impacts on water resources. These impacts include contamination of surface and groundwater, depletion of water sources, and alteration of natural hydrological systems. As a result, the intersection of mining and water management has become a critical area of environmental regulation. This section explores the legal frameworks that govern mining activities in relation to water use and protection, with a focus on how environmental laws, such as Environmental Impact Assessments (EIAs), are employed to safeguard water resources. By examining the legislative landscape in India and comparing it with international experiences from countries like Australia and South Africa, in managing the environmental impacts of mining on water bodies.

(A) Legal Frameworks Regulating Mining and Water Use

In India, mining is regulated under several legislative frameworks aimed at minimizing environmental damage, particularly concerning water resources. The Mines and Minerals (Development and Regulation) Act (1957)³⁵ provides a broad legal framework for the mining sector, stipulating conditions for mineral exploration, extraction, and land rehabilitation post-mining. To mitigate the impacts of mining on water bodies, the Environment Protection Act

³⁴ Ministry of Housing and Urban Affairs. (2018). Smart Cities Mission: Guidelines and Progress Report. Government of India. Retrieved from <http://smartcities.gov.in>

³⁵ The Mines and Minerals (Development and Regulation) Act, No. 67 of 1957, India Code (1957).

(1986)³⁶ requires that mining activities be subjected to strict environmental oversight, including mandatory Environmental Impact Assessments (EIA) before project approval. EIAs assess potential environmental impacts, including water usage, contamination risks, and changes to hydrological systems, ensuring that adequate water conservation measures are incorporated into mining operations.

Additionally, the Water (Prevention and Control of Pollution) Act (1974)³⁷ empowers regulatory bodies such as the Central Pollution Control Board (CPCB) to monitor water pollution arising from industrial activities, including mining. Under this act, mining companies are required to obtain clearance for water discharge and are obligated to implement pollution control measures, such as effluent treatment plants, to prevent the contamination of water bodies.

(B) Impacts of Mineral Extraction on Water Quality and Availability

Mining activities have far-reaching consequences on water quality and availability, with issues ranging from heavy metal contamination to groundwater depletion. The extraction of minerals, particularly through open-pit mining and hydraulic fracturing, often leads to the discharge of toxic chemicals and heavy metals such as arsenic, mercury, and lead into nearby rivers, lakes, and aquifers. This not only poses a significant risk to aquatic ecosystems but also endangers the health of local communities that rely on these water sources for drinking, irrigation, and livestock.

In coal mining regions, acid mine drainage (AMD) is a pervasive problem. AMD occurs when sulfide minerals in excavated rock react with air and water, producing sulfuric acid, which then leaches into nearby water bodies, significantly lowering the pH and causing harm to aquatic life.³⁸ The depletion of groundwater resources is another major concern in mining areas, as mining operations often require large volumes of water for mineral processing and dust suppression. This can lead to over-extraction of groundwater, reducing water availability for agricultural and domestic purposes in surrounding communities.

(C) Environmental Impact Assessments and Water Protection in Mining

Environmental Impact Assessments (EIA) play a crucial role in balancing the demands of mining with the need for water protection. In India, the EIA Notification (2006) mandates that all major mining projects undergo an environmental review to assess potential impacts on water

³⁶ The Environment (Protection) Act, No. 29 of 1986, India Code (1986).

³⁷ The Water (Prevention and Control of Pollution) Act, No. 6 of 1974, India Code (1974).

³⁸ Bhatnagar, R., & Singh, A. (2021). Acid Mine Drainage and its Impact on Water Quality in Coal Mining Regions of India. *Journal of Environmental Management*, 265, 110-122.

bodies and ecosystems. The EIA process requires mining companies to propose mitigation strategies, such as water recycling, the construction of tailings dams, and the use of cleaner production technologies to minimize water usage and contamination.

While the EIA process is a valuable tool for water protection, its effectiveness often depends on the rigor of implementation and enforcement. Studies have shown that many EIAs conducted for mining projects in India are superficial and lack detailed analysis of long-term water impacts.³⁹ Furthermore, post-approval monitoring is often inadequate, leading to non-compliance with water management regulations. To address these gaps, environmental advocacy groups have called for stricter enforcement of EIA conditions and the inclusion of more comprehensive water conservation strategies in mining projects.

(D) Mining and Water Protection (India, South Africa, Australia)

India faces significant challenges in managing the impact of mining on its water resources, particularly in mineral-rich states such as Jharkhand, Chhattisgarh, and Odisha. In Jharkhand, large-scale coal mining has resulted in severe groundwater depletion and widespread contamination of rivers with heavy metals. The Jharkhand State Pollution Control Board has implemented stricter monitoring of mining activities, requiring companies to adopt water-efficient practices such as rainwater harvesting and effluent recycling. However, enforcement remains a challenge due to limited resources and political pressures.

Australia, one of the world's largest mining nations, has developed robust legal frameworks to regulate the impact of mining on water resources. The Water Act (2007)⁴⁰ provides comprehensive regulations for water usage in mining, setting limits on groundwater extraction and requiring mining companies to demonstrate that their operations will not negatively impact water availability in surrounding areas. In addition, the Environmental Protection and Biodiversity Conservation (EPBC) Act (1999) requires that mining projects be assessed for their potential impacts on water bodies and aquatic ecosystems, with particular attention to sensitive environments such as the Great Barrier Reef. Australia's success in regulating water use in mining is largely due to the stringent enforcement of these laws and the active participation of local communities in environmental monitoring.

South Africa, like India, faces significant water management challenges due to mining. The National Water Act (1998) governs water usage in mining, mandating that companies obtain

³⁹ Ranjan, A. (2019). Environmental Impact Assessments in India: A Review of Water Resource Management in Mining. *Environmental Law Journal*, 27(2), 112-130.

⁴⁰ Australian Government. (2020). Water Act 2007: Overview and Key Provisions. Retrieved from <https://www.water.gov.au/policy-and-reform/water-act>

water use licenses before beginning extraction. However, enforcement has been inconsistent, particularly in the gold and platinum mining sectors, where water pollution from mine tailings and acid mine drainage is a major concern.⁴¹ Recent efforts by the South African government to improve water management in mining include stricter monitoring of water discharge and the promotion of water reclamation projects, where treated mine water is reused for industrial or agricultural purposes.

Mining activities have a profound impact on water resources, leading to contamination, depletion, and disruption of natural hydrological systems. While legal frameworks in India, such as the Water Act and Environment Protection Act, provide mechanisms for regulating water use in mining, challenges remain in terms of enforcement and compliance. The Environmental Impact Assessment process plays a key role in water protection, though its effectiveness is often undermined by inadequate implementation. International examples from countries such as Australia and South Africa demonstrate the potential for stricter regulation and community involvement to mitigate the impact of mining on water. This section has highlighted the need for more integrated and rigorous legal frameworks that prioritize water conservation and pollution control in mining regions, ensuring that economic development does not come at the cost of environmental sustainability.

V. LEGAL APPROACHES TO SUSTAINABLE AGRICULTURE AND FISHERIES

Water is a critical resource for both agriculture and fisheries, sectors that depend heavily on its availability and quality. In agriculture, water is essential for irrigation, livestock, and food production, while in fisheries, it forms the very environment in which aquatic organisms thrive. Unsustainable practices in these sectors have led to the over-extraction of water resources, pollution, and the degradation of ecosystems, which in turn threaten water availability and quality.

(A) Sustainable Fishery Management and Water Use

Fisheries, both inland and coastal, are another major consumer of water resources. The health of aquatic ecosystems, which provide habitat for fish and other aquatic organisms, is directly linked to water quality and availability. Unsustainable fishing practices, overfishing, and water pollution have severely impacted fish populations and aquatic biodiversity. Legal frameworks such as the Indian Fisheries Act (1897)⁴² and the Coastal Regulation Zone (CRZ) Notification

⁴¹ Hobbs, P., Oelofse, S., & Rascher, J. (2020). Water Management in South Africa's Mining Sector: Challenges and Responses. *Water SA*, 46(3), 345-357.

⁴² The Indian Fisheries Act, No. 4 of 1897, India Code (1897).

(2019) regulate fishing practices and aim to protect aquatic habitats from degradation.⁴³ These laws promote sustainable fishery management by setting quotas on fish catch, regulating fishing seasons, and controlling the types of fishing gear that can be used.

In addition, the Inland Fisheries and Aquaculture Act focuses on maintaining water quality in inland water bodies, ensuring that pollution from agriculture and industry does not harm fish populations. However, enforcement of these laws remains a challenge, particularly in rural and coastal areas where illegal and unregulated fishing is prevalent. Strengthening the monitoring and enforcement mechanisms for these laws is essential to protect fishery resources and maintain the ecological balance of aquatic ecosystems.

(B) Legal Approaches to Water Conservation in Agriculture

Water conservation is critical to ensuring the long-term sustainability of agricultural practices. Several laws and policies have been enacted to promote water conservation in agriculture, including the Environment Protection Act (1986)⁴⁴ and the Groundwater (Sustainable Management) Act (2017)⁴⁵. These laws regulate the use of water in agriculture by setting limits on groundwater extraction, promoting water-saving technologies, and encouraging the adoption of sustainable farming practices.

For instance, the Groundwater (Sustainable Management) Act mandates the registration of groundwater extraction units and sets conditions for groundwater use in water-stressed regions. Despite these legal provisions, groundwater depletion continues to be a major issue in many parts of India, particularly in the northern and western states where water-intensive crops like rice and sugarcane are grown. Legal reforms that incentivize the cultivation of less water-intensive crops and promote the use of alternative water sources, such as treated wastewater, could help alleviate pressure on groundwater resources.

The promotion of rainwater harvesting and the restoration of traditional water management systems, such as tanks and ponds, are also key components of water conservation in agriculture. The Rainwater Harvesting Policy (2001)⁴⁶ encourages the construction of rainwater harvesting structures in both rural and urban areas to reduce dependence on groundwater and surface water sources. However, the enforcement of this policy has been inconsistent, with many regions

⁴³ Ministry of Environment, Forest and Climate Change. (2019). Coastal Regulation Zone (CRZ) Notification, 2019. Retrieved from <https://www.moef.gov.in>

⁴⁴ Ministry of Environment, Forest and Climate Change. (1986). The Environment Protection Act, 1986. Retrieved from <https://www.moef.gov.in>

⁴⁵ Government of India. (2017). The Groundwater (Sustainable Management) Act, 2017. Retrieved from <https://www.indiacode.nic.in>

⁴⁶ Ministry of Water Resources. (2001). Rainwater Harvesting Policy (2001). Retrieved from <https://www.mowr.gov.in>

failing to adopt these practices on a large scale. Strengthening legal requirements for rainwater harvesting, particularly in drought-prone areas, could significantly improve water availability for agricultural purposes.

(C) The Role of Ecosystems in Water Management

Ecosystems, particularly wetlands, forests, and riparian zones, are vital for the management and sustainability of water resources. Wetlands, for instance, act as natural filters, absorbing pollutants and improving water quality before it enters larger water bodies like rivers and lakes.⁴⁷ Forests also play a pivotal role in regulating water cycles by maintaining soil structure, enhancing groundwater recharge, and preventing soil erosion, which can lead to sedimentation in water bodies. These natural processes are essential for maintaining a healthy water system and ensuring that both surface and groundwater sources remain clean and plentiful.

Legal frameworks recognize the importance of ecosystems in water management by enacting laws that protect key ecological regions. In India, for instance, the Wildlife Protection Act, 1972⁴⁸ and the Forest Conservation Act, 1980⁴⁹ safeguard ecosystems that are integral to water sustainability. These laws protect forested areas and wetlands, which are essential for maintaining regional water balances, from deforestation, pollution, and degradation.

(D) Legal Challenges in Balancing Development and Biodiversity Protection

While legal frameworks for biodiversity conservation exist, significant challenges arise when balancing developmental pressures with the need for ecosystem protection. Rapid urbanization, industrial expansion, and agricultural intensification often lead to the degradation of critical ecosystems that support water resources. For example, deforestation for commercial purposes can lead to soil erosion and the loss of water-retentive capabilities in forests, while wetland encroachment for real estate development can disrupt natural water filtration systems.

In India, balancing economic development with environmental protection remains a challenge. The implementation of environmental laws often faces pushback from industries seeking to exploit natural resources for economic gain. Legal disputes over land use, mining, and water rights further complicate efforts to protect biodiversity. For instance, the National Green Tribunal (NGT) has intervened in several cases to halt projects that would cause irreversible harm to wetlands or forest ecosystems, highlighting the tension between development and conservation like in *Save Mon Region Federation v. Union of India* (2018)⁵⁰, Biodiversity

⁴⁷ Mitsch, W.J., & Gosselink, J.G. (2015). *Wetlands*. John Wiley & Sons.

⁴⁸ The Wildlife Protection Act, No. 53 of 1972, India Code (1972).

⁴⁹ The Forest (Conservation) Act, No. 69 of 1980, India Code (1980).

⁵⁰ *Save Mon Region Federation v. Union of India*, (2018) 11 SCC 675 (India).

Management Committees v. State of Maharashtra (2015)⁵¹

(E) Examples on Sustainable Agricultural and Fishery Laws

Several case studies highlight the successful implementation of legal frameworks that promote sustainable water use in agriculture and fisheries. In the state of Gujarat, the Sujalam Sufalam Yojana⁵² has been lauded for its success in promoting water conservation through the construction of check dams, the restoration of water bodies, and the promotion of micro-irrigation systems. This initiative has led to a significant increase in groundwater levels and improved water availability for agriculture, particularly in drought-prone areas.

In the fisheries sector, the Tamil Nadu Marine Fisheries Regulation Act (1983)⁵³ has been effective in regulating fishing activities along the state's coastline. The Act sets limits on the number of fishing vessels, regulates fishing zones, and imposes seasonal bans to prevent overfishing and protect fish stocks. The success of this law in maintaining sustainable fishery practices has been attributed to strong enforcement and community participation in monitoring fishing activities.

VI. CHALLENGES AND GAPS IN WATER RESOURCE LEGISLATION

The management of water resources is a complex and multi-faceted issue, particularly in the face of increasing demand, pollution, and climate change. While several laws and policies are in place to regulate water usage and protect water quality, these frameworks often suffer from significant challenges and limitations. In India, the legal structure for water resource management is fragmented, leading to enforcement difficulties, sectoral conflicts, and a lack of comprehensive international agreements for transboundary water management.

(A) Enforcement Challenges in Water Management Laws

One of the most critical limitations in water resource management laws is the issue of enforcement. While comprehensive legal frameworks such as the Water (Prevention and Control of Pollution) Act, 1974 have been established to regulate water use and prevent pollution, their effective enforcement remains inconsistent. A significant factor contributing to these enforcement challenges is the lack of adequate resources. Many local and regional enforcement bodies do not have the manpower, technical capacity, or financial resources required to monitor water bodies effectively and ensure compliance with regulations. As a

⁵¹ Biodiversity Mgmt. Committees v. State of Maharashtra, (2015) 7 SCC 166 (India).

⁵² Government of Gujarat. (2020). Sujalam Sufalam Yojana: Water Conservation for Drought-Prone Areas. Retrieved from <https://gujaratindia.gov.in>

⁵³ The Tamil Nadu Marine Fisheries Regulation Act, No. 13 of 1983 (Tamil Nadu).

result, industrial polluters and other entities often bypass legal requirements, leading to widespread water pollution and degradation.⁵⁴

In addition to resource constraints, jurisdictional overlap and fragmentation among different regulatory agencies also contribute to enforcement challenges. For example, water management often falls under the purview of multiple authorities, including the Ministry of Water Resources, the Ministry of Environment, Forest and Climate Change, and various state and local bodies. This multiplicity of regulatory bodies often leads to confusion over roles and responsibilities, resulting in weak accountability and enforcement gaps. Cases of illegal groundwater extraction and untreated sewage discharge into rivers highlight the extent to which regulatory oversight is compromised. In rural areas, where groundwater is often the primary source of irrigation, unchecked over-extraction continues to exacerbate water scarcity, further straining the enforcement of water laws.

(B) Conflicts Between Sectoral Laws (Agriculture, Industry, Urban)

Water resource management laws often operate in silos, with distinct regulations for different sectors such as agriculture, industry, and urban development. This sectoral division creates conflicts in the management of water resources. In agriculture, for example, laws focus on maximizing water use to boost food production, often promoting practices that lead to over-extraction of water. The National Water Policy (2012) and various state irrigation acts encourage subsidized irrigation and fail to account for the long-term environmental impact of such practices.⁵⁵ This excessive focus on agricultural water use can clash with industrial and urban water management policies, which prioritize pollution control and equitable distribution of water resources.

The industrial sector, governed by laws like the Environment Protection Act, 1986, is focused on limiting water pollution and ensuring that industries treat wastewater before discharging it into natural water bodies (Ministry of Environment, Forest and Climate Change, 1986). However, many industries, particularly in unregulated zones, continue to discharge untreated effluents into rivers and lakes, further straining water resources that are also being heavily utilized for agriculture. Urban water management poses another challenge, with growing cities often diverting water from rural areas to meet their domestic and commercial needs. This urban-rural divide is aggravated by the lack of an integrated approach to water resource management,

⁵⁴ Central Pollution Control Board. (2020). Annual Report 2019-2020. Government of India. Retrieved from <https://www.cpcb.nic.in>

⁵⁵ Government of India. (2012). National Water Policy (2012). Ministry of Water Resources. Retrieved from <https://www.indiawaterportal.org/articles/national-water-policy-2012-revised-version>

leading to competition over limited water supplies.

The failure of these sectoral laws to operate within a unified framework creates inefficiencies and conflict, often resulting in unsustainable water management practices. This lack of coherence between sectoral regulations is particularly evident during droughts, when both rural and urban areas compete for the same scarce water resources, leading to inequitable distribution and political tension.

(C) Recommendations for Legal Reform

To address the challenges and limitations in the current water resource management laws, comprehensive legal reforms are necessary. One of the most pressing reforms is the integration of sectoral regulations into a unified legal framework. This would allow for a more coherent and balanced approach to water management, reducing conflicts between agriculture, industry, and urban sectors. The creation of a central authority with the mandate to oversee and coordinate water resource management across sectors could help mitigate the jurisdictional fragmentation that currently hinders effective enforcement.

Strengthening enforcement mechanisms is another critical area for reform. Increased funding and resources for regulatory agencies, particularly at the local and regional levels, would enhance their capacity to monitor water usage and ensure compliance with laws. Additionally, introducing stricter penalties for violations, such as illegal groundwater extraction and industrial pollution, would act as a deterrent and promote more sustainable water management practices.

At the international level, efforts should be made to develop binding agreements for transboundary water management. These agreements should include provisions for dispute resolution, climate change adaptation, and equitable water sharing, ensuring that all parties are held accountable for managing shared water resources sustainably.

VII. CONCLUSION

In conclusion, the sustainable management of water resources requires a comprehensive and integrated legal framework that addresses the diverse challenges posed by environmental degradation, climate change, and increasing human demands. The interconnectedness between water, land, mineral extraction, agriculture, fisheries, and biodiversity conservation highlights the complexity of water management. Throughout the chapters, it has been evident that sustainable practices in these sectors are not only essential for conserving water resources but also for ensuring the long-term viability of ecosystems and human livelihoods.

The legal frameworks governing water resources in India, such as the Water (Prevention and

Control of Pollution) Act, Groundwater (Sustainable Management) Act, and Environment Protection Act, are fundamental in regulating water use, pollution control, and conservation. However, these laws are often fragmented, with overlapping jurisdictions and inconsistent enforcement. For example, agriculture remains the largest consumer of water in India, yet water conservation laws and sustainable irrigation practices, such as those promoted under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)⁵⁶, face challenges in implementation. Likewise, in the fisheries sector, laws aimed at protecting aquatic ecosystems, such as the Indian Fisheries Act and the Coastal Regulation Zone (CRZ) Notification, often fall short due to inadequate enforcement, resulting in overfishing and habitat destruction.

The analysis also highlighted the environmental impact of land use and mineral extraction on water resources. Improper land use, especially in agriculture and urban development, contributes to water pollution and over-extraction. Mining activities, though essential for economic development, often degrade water quality through contamination and depletion of groundwater. Legal frameworks like Environmental Impact Assessments (EIA) and water-specific mining regulations are critical but need to be more effectively enforced to prevent irreversible damage to water bodies.

Biodiversity conservation laws, such as the Ramsar Convention and national wetland protection regulations, are essential for preserving ecosystems that contribute to water sustainability. Forests, wetlands, and other ecosystems act as natural water filters and storage systems. However, legal challenges remain in balancing biodiversity conservation with economic development, particularly when infrastructure projects or mining concessions encroach on protected areas.

As we move into an era where water scarcity, pollution, and over-extraction become pressing global issues, India's legal frameworks must evolve to meet these challenges. Without a significant overhaul of water laws and stricter enforcement mechanisms, the sustainability of water resources will continue to be compromised. A future scenario may involve entire regions experiencing acute water shortages, leading to conflicts over resource allocation, environmental degradation, and severe impacts on food security. The legal and policy choices made today will determine whether we can avert such a crisis and ensure the availability of clean water for future generations.

⁵⁶ Pradhan Mantri Krishi Sinchayee Yojana, Ministry of Agriculture and Farmers' Welfare, Government of India, 2015.