International Law and Management of Shared Water Resources in Eastern and Northeastern Iran

1. Hossein Zamani: PhD Student, Department of Law, South Tehran Branch, Islamic Azad University, Tehran, Iran
2. Ahmad Montazeri*: Assistant Professor, Department of Law, South Tehran Branch, Islamic Azad University, Tehran, Iran
3. Fatemeh Fathpour: Assistant Professor, Department of Law, South Tehran Branch, Islamic Azad University, Tehran, Iran

***Correspondence: e-mail: a_montazeri85@yahoo.com**

Abstract

Water crises, regardless of the country in which they occur, are considered global crises and easily transcend geographical borders. The water issues and challenges faced by the Islamic Republic of Iran with its eastern and northeastern neighbors are no exception to this crisis. The water crisis in the cities of eastern and northeastern Iran is of particular importance for environmental protection and necessitates the implementation of necessary measures to revive this vital resource. Iran possesses significant transboundary rivers such as the Helmand, Harirud, and Atrak, which are shared with Afghanistan, Pakistan, and Turkmenistan. Therefore, in accordance with the international legal framework for the protection and exploitation of shared water resources in eastern and northeastern Iran, the present study was conducted using a descriptive-analytical method. The research data indicate destructive impacts and environmental damages, among other challenges. The findings of the study show that shared water borders have influenced the environment, economy, culture, politics, and security of Iran, Afghanistan, and Turkmenistan. The obstruction of the natural flow of international rivers has inflicted extensive environmental hazards, economic losses, socio-cultural damages, and political-security challenges on the region and the affected countries. The weakening of the region's natural ecosystems, due to its extensive consequences in various dimensions, has significantly endangered the national security of the affected countries. Managing shared water resources requires international cooperation to prevent conflicts. The legal and political status of shared water resources in eastern and northeastern Iran includes disputes over water rights, environmental pollution, and climate change. By applying the principles of international law, including absolute territorial sovereignty (each country has sovereignty over its own waters), the community of interest doctrine (countries have the right to jointly use international waters), and the principle of limited territorial integrity (usage must not cause harm to neighboring countries), more sustainable management of water resources is possible, ensuring both economic needs are met and the environment is preserved.

Keywords: International law, shared water resources, east, northeast, Iran, regional cooperation, environmental protection.

Received: 14 May 2024
Revised: 05 June 2024
Accepted: 21 June 2024
Published: 01 July 2024

Copyright: © 2024 by the authors. Submitted for possible open access publication under the terms and conditions of Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

Citation: Zamani, H., Montazeri, A., & Fathpour, F. (2024). International Law and Management of Shared Water Resources in Eastern and Northeastern Iran. *Legal Studies in Digital Age*, 3(3), 25-37.

1. Introduction

Water, this unique liquid, is not only the foundation of life on Earth but also plays an unparalleled role in the survival and health of all living organisms. However, this valuable resource is divided into two main categories based on usage and quality: potable water and non-potable water, and understanding their differences is essential for sustainable utilization. Although approximately 70 percent of the Earth's surface is covered by water, only 2.5 percent is fresh water, with the remainder belonging to oceans and saltwater lakes (Bay, 2007; Chenari et al., 2024).

Access, demand, usage, and management of water are highly complex due to the intersection of multiple political, social, legal, physical, environmental, and biogeochemical factors. In today's world, water as a geopolitical element significantly influences relations between countries. British geographer Peter H. Gleick identified six sources of tension over water resources, including landlocked countries' desire to access open waters through neighbors, disputes over water boundary interpretations, changes in the course of border rivers, conflicts over the exploitation of shared lakes, upstream water diversion, and artificial cloud seeding (Schonberg & Letzen, 2021).

On the other hand, several multilateral agreements designed to promote cooperation over international rivers were drafted and signed during the 20th century. However, despite these agreements, the threat of water wars still looms over how countries sharing river basins interact, potentially leading to numerous geopolitical conflicts in the next two decades. Forecasts indicate that international rivers will continue to present challenges such as disputes over water rights among states, making international water treaties, protocols, and bilateral or multilateral agreements essential tools for reducing conflicts and disputes (Samai et al., 2020).

International rivers have historically been a source of political disputes in international relations, especially in the geopolitically sensitive regions of the Middle East and Asia. Today, with changing climatic conditions, water has become an essential and irreplaceable political-security factor. Without a doubt, the majority of hydro-political conflicts worldwide are concentrated in the Middle East due to the significance of permanent international rivers as crucial water sources in this arid region. Consequently, the relationships between Middle Eastern countries regarding water access are closely linked to their political and economic interactions (Motaghi et al., 2018).

Over the past century, security, stability, and development have become dependent on available water resources, with Iran-Iraq hydro-political relations being influenced by Iraq's water scarcity crisis, its geographical position, and Turkey's water policies. These factors, with varying degrees of influence, are recognized as theoretical drivers in bilateral relations. Additionally, six interrelated subsystems—socio-cultural, economic, geographical, political-legal, environmental, and technological—consistently affect these relations, necessitating joint cooperation for water resource management. Recognizing the growing importance of water as a vital and limited resource, understanding and analyzing these factors can help reduce tensions and enhance bilateral and regional cooperation.

Hydro-political relations between Iran and Iraq are shaped by a complex and intertwined set of factors that cannot be analyzed independently. The identified six subsystems function as a single system, where changes in any one subsystem can have extensive impacts on the entire system. Moreover, Iraq's water crisis, its geographical location, and Turkey's water management actions on the Tigris and Euphrates rivers have been identified as primary drivers requiring special attention in future policymaking. To mitigate tensions and foster cooperation, Iran and Iraq must collaboratively seek sustainable and equitable solutions for managing shared water resources (Aftabi et al., 2025).

Given the political, social, and environmental challenges associated with access to and optimal management of freshwater resources, water diplomacy can serve as a tool for reducing tensions and facilitating cooperation among countries sharing water resources. A water diplomacy roadmap aids in structuring relationships between countries and various institutions, leading to water sustainability through effective collaborations, agreements, and dialogues. Indeed, water diplomacy, as an evolving and developing process, requires further theoretical and scientific support. However, by expanding its conceptual framework and providing an appropriate roadmap, it is possible to foster sustainable cooperation and reduce tensions related to transboundary

water resources. This process not only enhances international relations but also contributes to environmental preservation and equitable access to water resources (Chenari et al., 2024).

Ensuring adequate water supply is a fundamental challenge for every country. In recent years, the excessive extraction of groundwater by farmers and industrial users has become a global concern. While countries have the right to utilize their groundwater resources, governments are obligated to adhere to the principle of equitable and reasonable utilization. Iran, with its complex borders and numerous neighboring countries, faces significant challenges in water resource management, with insufficient studies conducted on shared aquifers with neighboring countries. Iran's rights and obligations concerning transboundary waters necessitate a balance between national sovereignty and international responsibility. Water disputes can only be resolved through commitment to legal principles, technical cooperation, and abandoning unilateral approaches. According to Darji et al. (2024), Iran needs to redefine its strategy based on "collective water security" to simultaneously meet domestic needs and promote peaceful coexistence with its neighbors (Darji et al., 2024).

Environmental crises, particularly those related to water resources, transcend geographical boundaries and have wide-ranging impacts on various countries. The Tigris and Euphrates rivers, as two critical international rivers, play vital roles in the environment, economy, culture, politics, and security of Middle Eastern countries. These rivers not only affect Turkey, Iraq, and Syria but also have profound impacts on Iran, Jordan, Saudi Arabia, Kuwait, and other Gulf countries, visible in environmental, economic, cultural, political, and security dimensions. Projects such as Turkey's GAP project and the construction of the Ilısu Dam have disrupted the natural flow of the Tigris and Euphrates, leading to the drying of the Mesopotamian marshes, including the Hawizeh Marshes, one of the largest and most valuable natural ecosystems in the Middle East.

The drying of wetlands and reduced flow in the Tigris and Euphrates have resulted in dust storms, endangering human health, degrading soil, reducing biodiversity, and weakening regional ecosystems. Reduced access to freshwater and the drying of wetlands have adversely affected regional economies, particularly agriculture, fisheries, and water-dependent industries, leading to increased unemployment, poverty, and social inequalities. Large-scale migration due to environmental and economic crises has caused profound cultural and social damages, as local communities dependent on water and wetlands have lost their livelihoods and been forced to migrate. The weakening of natural ecosystems and water scarcity-induced tensions have jeopardized national security in the region, potentially escalating social unrest, local conflicts, and even international tensions (Kamran & Ansarizadeh, 2024).

The significance of the Helmand River for Iran's national security and economic development has led to its securitization in Iranian discourse, with the Taliban perceived as a threat to water and border resources. This has elevated water and border disputes from technical and political levels to security concerns. The Helmand River, as one of the most important border water sources between Iran and Afghanistan, lies at the center of these disputes. Reduced water flow due to dam construction and water projects in Afghanistan, particularly under Taliban rule, has raised serious concerns in Iran, negatively impacting agriculture, the environment, and the economy of eastern Iran. Securitizing water and border issues may prompt Iran to take urgent and exceptional foreign policy and regional actions, including diplomatic pressure, political maneuvers, and even military measures to protect its national interests, potentially affecting long-term Iran-Afghanistan relations (Bay, 2007; Chenari et al., 2024).

The Taliban's return to power and the securitization of water issues have posed significant challenges to regional cooperation between Iran and Afghanistan. Mutual distrust and differing political and security priorities have hindered the achievement of sustainable agreements on water resource management (Sayad Roshvanlou et al., 2024). Water scarcity, exacerbated by climate change, directly influences inter-state disputes. The reduction of freshwater resources and rising demand intensify competition and tensions among neighboring countries. Transboundary powers and international actors can exacerbate water disputes by influencing regional policies, supporting one party, or applying political pressure. Inefficient water management, non-compliance with international water law, and uncoordinated water projects by upstream countries can increase tensions. Ideological differences between countries can hinder bilateral and multilateral cooperation, preventing stable water-sharing agreements. Political instability and weak governance in neighboring countries can escalate water disputes, as unstable governments may struggle to fulfill international commitments or maintain consistent negotiation stances (Imanpour et al., 2023).

Many Middle Eastern countries, including Iran, share water borders with neighboring states, where natural factors such as river course changes due to erosion and sedimentation can provoke conflicts. Water transfers across international borders are often prohibitively expensive. Shared water borders in eastern and northeastern Iran, including transboundary rivers and shared water resources with Afghanistan, Pakistan, and Turkmenistan, underscore the importance of regional cooperation in water management and environmental conservation. Effective coordination among governments is essential for the optimal and equitable use of these resources, ensuring water supply for agriculture, urban, and industrial sectors while preventing resource wastage.

Some of the most important shared rivers and water resources include:

1. **Helmand River**: The most significant border river between Iran and Afghanistan, originating in Afghanistan and ultimately flowing into Iran's Hamoun Lake.
2. **Harirud River**: Originates in Afghanistan, traverses Iran, and enters Turkmenistan.
3. **Atrak River**: Originates in Razavi Khorasan, flows through Turkmen Sahra, and enters Turkmenistan.
4. **Shared Aquifers**: Groundwater resources forming shared aquifers with neighboring countries (Niroomandfard & Shahidi, 2018).

Given the numerous transboundary and international rivers and their biological and strategic significance for Iran, this article seeks to answer the fundamental question: to what extent has the analysis of international law contributed to the protection and sustainable utilization of shared water resources in eastern and northeastern Iran, particularly regarding transboundary cooperation and conflict resolution among countries?

2. Theoretical Foundations

Shared water resources refer to water sources that are common to two or more countries, regions, or administrative units. These include rivers, lakes, groundwater, and even seas that span different geographical territories. Managing these resources requires cooperation and international agreements because of the political, economic, and social complexities involved. Shared water resources, such as rivers, lakes, and groundwater lying between or passing through multiple countries, are particularly significant in hydro-politics, where issues of resource allocation, sustainable management, and conflict prevention are paramount. Examples of such shared water boundaries include:

• Shared rivers: Rivers that cross two or more countries or serve as natural boundaries between them (e.g., the Nile, the Tigris and Euphrates, and the Danube).

• Shared lakes: Lakes located along the borders of two or more countries (e.g., Lake Victoria in Africa).

• Shared groundwater: Aquifers that extend beneath the borders of two or more countries (e.g., the Nubian Sandstone Aquifer System between the United States and Mexico).

• Shared seas and oceans: Regions of seas and oceans that lie within maritime boundaries shared by multiple countries (e.g., the Persian Gulf among its coastal states).

3. Challenges and Issues of Shared Water Resources

1. **Water Scarcity and Drought**
2. Arid and semi-arid climatic conditions in eastern and northeastern Iran result in chronic water shortages. Decreasing rainfall and increasing temperatures in recent years have intensified this problem.
3. Frequent droughts, as reported by the Iran Meteorological Organization, have lowered groundwater levels and reduced river flows in the last two decades (Iran Meteorological Organization, Annual Report on Drought, 2021-2023).
4. **Excessive Exploitation of Groundwater**
5. The drilling of unauthorized wells and uncontrolled extraction of groundwater have caused a sharp drop in water tables, leading to the drying of qanats and springs.
6. Overexploitation has resulted in land subsidence in areas like the Mashhad and Sarakhs plains, causing irreparable damage to infrastructure (Ministry of Energy, Report on Groundwater Resources Status, 2022).
7. **Inefficient Water Resource Management**

8. Inequitable allocation of water among agricultural, industrial, and municipal sectors in some regions has led to social and economic tensions.
9. Despite efforts to expand modern irrigation systems, a large portion of agricultural land is still irrigated using traditional methods, causing significant water wastage.
10. **Environmental Degradation and Aquatic Ecosystems**
11. Key wetlands like the Hamoun Wetlands in eastern Iran face desiccation because of reduced inflows and climate change, resulting in biodiversity loss and increased dust storms.
12. Pollutants from industrial and agricultural wastewater have reduced water quality in rivers and groundwater (Department of Environment, Report on the Status of Iran's Wetlands, 2022).
13. **Transboundary Tensions**
14. Disputes over shared water resources, such as the border rivers Harirud and Helmand between Iran and Afghanistan, have created political and social strains. Reduced flow in these rivers—partly due to dam construction and climate change in Afghanistan—has caused water shortages in Iran's border regions (Islamic Consultative Assembly Research Center, Study of Transboundary Water Challenges, 2023).
15. **Climate Change**
16. Higher temperatures and lower rainfall in eastern and northeastern Iran have cut surface and groundwater supplies. These conditions have also led to greater evaporation and decreased soil moisture (Institute of Climatology, Report on Climate Change in Iran, 2022).

4. Strategies and Approaches for Managing Shared Water Resources

• **International Treaties and Agreements**: Formulating and signing treaties that enable fair division and sustainable governance of water resources. An example is the Indus Waters Treaty between India and Pakistan (UN Water, 2015).

• **International Organizations and Institutions**: Creating and reinforcing bodies tasked with managing and monitoring shared water resources, such as the International Commission for the Protection of the Danube River (ICPDR).

• **Regional Cooperation**: Strengthening regional partnerships for more effective water resource management, the execution of joint projects, and the exchange of data and expertise. An example is the Nile Basin Initiative.

• **Developing Dispute Resolution Mechanisms**: Establishing legal frameworks and arbitration processes for resolving interstate water conflicts, including recourse to international courts and mediation (Naderi et al., 2023).

5. Principles of International Law in the Exploitation and Protection of Shared Water Resources

Bordering countries must use shared water resources in equitable and reasonable ways, respecting each other's rights, and avoiding any action that could cause significant harm. They are expected to cooperate in managing border rivers and to negotiate settlements in case of disputes. Compliance with these principles and rules ensures that riparian states can utilize shared water resources sustainably and fairly, thus avoiding conflicts and environmental problems (Bahrami Jaf et al., 2023).

5.1. The Doctrine of Absolute Territorial Sovereignty Over an International River

This doctrine holds that a portion of an international river flowing within a state's borders can be treated like national waters, allowing that state to unilaterally alter the flow or use it as it pleases. Often embraced by upstream states, it is sometimes called the Harmon Doctrine. According to it, upstream states assign no usage rights to downstream states concerning international rivers crossing multiple countries.

Originating from an 1812 United States Supreme Court ruling involving two American vessels, "John McFadden" and "William Greathouse," this doctrine was later asserted in 1895 by Attorney General Harmon in a dispute between the United States and Mexico over the Rio Grande. According to the Harmon Doctrine, Mexico lacked grounds to object to how the United States was utilizing water in the border river, regardless of detrimental effects such as reduced water supply and damage to Mexican farmers (Baripour et al., 2022).

Although legal experts like Calvo, Huber, Bousc, and Van Wyck favor this doctrine, others including Scismarian, Schind, and McKay accept it only with caveats. It permits a state to use international rivers within its territory for its citizens without regard for downstream consequences, nor any obligation to consult other nations, simply because that state is geographically upstream. Hence, absolute territorial sovereignty represents the maximal interpretation of national sovereignty, meaning states can exercise authority over all persons, property, and activities within their domain. Yet many international law scholars reject this theory. Oppenheim, for instance, stresses that no single adjacent state can unilaterally alter the natural flow of shared waters to the detriment of others, while Hyde argues that diverting an international stream—whether for sanitation, irrigation, or hydroelectric power—constitutes a significant disruption of its natural course (Baripour et al., 2022).

5.2. The Theory of Community of Interest Among Riparian States in an International River

Under this theory, all riparian states of a border or international river possess a common, undivided right to its use. Initially termed the doctrine of "innocent passage," Hugo Grotius argued that rivers cannot be deemed as free as the seas but must be subject to shared sovereignty. Faraham encapsulates this concept: "A river running through multiple territories is in the collective ownership of all those territories."

In the 1929 Oder River case, the Permanent Court of International Justice declared that with a single river passing through or forming borders between multiple countries, fairness and responsible utilization involve more than merely granting an upstream state a right of passage. Rather, a mutual interest among all riparian states must be recognized. This shared interest leads to joint legal rights, the primary feature of which is complete equality among riparian states concerning access to the entire river flow, disallowing any single state advantages over others. The fundamental aim of common or innocent passage in international law is to safeguard commerce and other uses such as fishing, navigation, and power generation. Nevertheless, states must honor the principle of good neighborliness while utilizing a shared river (Swatuk, 2021).

5.3. The Theory of Limited Territorial Integrity

According to this theory, downstream states have a valid claim to the continued natural flow of water from upstream territories, while upstream states must not restrict this flow. In the 1947 Wuerttemberg v. Baden ruling, the German Supreme Court found that states' sovereign rights regarding rivers crossing their territories are limited by the obligation not to harm other members of the international community.

Downstream states generally endorse this approach, which clashes with the Harmon Doctrine's premise of full sovereignty over water resources located within a single state's borders. The Harmon Doctrine contradicts modern principles of international water law, which emphasize collaborative efforts and equitable resource distribution.

For instance, in a case between the Swiss cantons of Zurich and Schaffhausen in 1878, the Swiss Federal Supreme Court ruled the diversion of river water illegal and confirmed equal rights among the cantons regarding water usage, prohibiting diversions, dam building, or similar acts that infringe on another canton's territorial sovereignty. Under this theory, riparian states must allow rivers to flow in their natural course and refrain from causing any diversion. Scholars such as Max Huber and Oppenheim see the 1905 Sweden-Norway agreement, the 1946 Iraq-Turkey treaty, and the 1921 Iran-Soviet Treaty of Friendship as examples of this principle (Ebrahimi et al., 2022).

5.4. The Theory of Limited Territorial Sovereignty

Also referred to as the theory of restricting the free use of waters, it argues that absolute territorial sovereignty and total territorial integrity are unachievable. Contrary to the theory of absolute territorial sovereignty—where all people, property, and resources within a state's borders are fully under that state's ownership—this approach insists that states must avoid harming neighboring states when using shared waters.

Limited territorial sovereignty posits that riparian states have reciprocal rights and duties concerning international waters, each enjoying equal rights to conventional and beneficial uses of those resources within its boundaries. It is also known as equal sovereignty or territorial unity. By advocating "reasonable and equitable utilization," this doctrine is more comprehensive than absolute territorial integrity, requiring states to protect the environment and refrain from actions damaging to neighbors.

This position is grounded in a 1978 draft statement by the United Nations Environment Programme, as well as the 1972 Stockholm and 1992 Rio Declarations, which emphasize that states must not harm other nations' environments and must compensate if damage occurs.

In the view of this theory's advocates, countries do not possess exclusive rights to rivers originating within their borders if those rivers' watersheds span additional territories. Kartdori notes that no government creates rivers and thus has no basis for modifying or diverting them in ways that harm neighboring states. Influenced by Von Bar, the 1911 Madrid Resolution of the Institute of International Law incorporates principles such as forbidding the alteration of a river's path without mutual consent, prohibiting significant pollution or any measure substantially delaying flow, guaranteeing navigation rights, and banning any action that generates flooding in other countries. The 1911 Madrid Conference reinforced these ideas in its preamble, stating that each state must respect the territorial sovereignty of every other state and refrain from using its territory in ways that cause cross-border harm (Kavyani Fard et al., 2022).

6. Security and Law Enforcement Implications of Iran's Border Rivers

The security consequences arising from water scarcity in Iran's border regions may affect the political system, the population, or even the entire territory. Iran's border rivers can produce significant security and law enforcement outcomes for various reasons, including the rivers' geographic and strategic location, water-related issues, and interactions among neighboring countries. Effective management of these challenges requires meticulous planning, international cooperation, and strengthened security and surveillance infrastructure. Some of these outcomes include:

1. **International Cooperation**: Managing border rivers necessitates international collaboration. Bilateral or multilateral agreements can improve relationships and reduce tensions. Successful agreements may serve as positive examples for other regions experiencing conflict.
2. **Economic Security**: Border rivers can play an important role in the economic development of border regions. Developing river ports, agriculture, and tourism can improve economic conditions and reduce social insecurity.
3. **Political Divisions**: Border rivers may function as political and geographical dividing lines. Any alteration to river flows or related infrastructure could shift borders and provoke political tensions (Ghorbani Sepehr, 2020).

6.1. Livelihood Vulnerability

Border regions in Iran have lost their economic viability, and most border residents face serious livelihood challenges. Since part of Iran's national economy relies on agriculture, water shortages and the recent multi-year droughts—which are likely to worsen in the coming years—could become major threats to Iran's national and economic security. Agriculture contributes about 11.4% to the country's gross domestic product, accounts for 25% of employment, 23% of non-oil exports, 80% of the nation's food supply, and meets 90% of industrial raw material needs (Mahkuyi et al., 2014). These figures show that a significant share of Iran's economy depends on agriculture, and as the water crisis intensifies, agriculture's contribution may diminish to the extent that it destabilizes the country's security (Ghorbani Sepehr, 2020).

6.2. Environmental Crisis

Water shortages and excessive exploitation of water resources in Iran have caused extensive environmental repercussions, notably desertification and rising dust storms. This crisis adversely affects not only the environment but also population levels and local livelihoods. Over the last 30 years, Iran's desert land area has grown by about 30%, an annual increase of approximately 1%. Contributing factors include declining water resources, overextraction of groundwater, and climate change. Land desiccation, ground subsidence, and deforestation have intensified dust storms that now affect southern, southwestern, and even central provinces. Wetlands like Hamoun and Zayandeh-Rud are drying up due to insufficient water supplies, exacerbating desertification. Falling groundwater levels have triggered land subsidence in many parts of Iran, resulting in irreversible environmental damage. Prolonged water scarcity and desertification in Iran may depopulate certain provinces. This trend is exacerbated by rising temperatures, declining rainfall, upstream dam projects in neighboring countries, and inadequate environmental policies. Higher temperatures and lower precipitation have drained water resources, negatively impacting

agriculture and local livelihoods. Dam construction by neighboring countries, such as Turkey's GAP project, has cut water flow into Iran, especially affecting provinces like Khuzestan. Domestic mismanagement of water resources and the absence of comprehensive drought-mitigation programs are contributing factors to this crisis. Dust pollution threatens public health and disrupts everyday life. Provinces such as Khuzestan, Kermanshah, Ilam, Lorestan, Bushehr, and Bandar Abbas have been hit severely by water shortages. Besides endangering livelihoods, poor air quality may force people to migrate. Sistan and Baluchestan is particularly vulnerable, having endured a prolonged drought that has led to the evacuation of many villages. Continuing this scenario threatens local economies as well as people's lives, underscoring the need for comprehensive plans to manage transboundary water resources and prevent large-scale depopulation (Ghorbani Sepehr, 2020).

6.3. Social Insecurity

Water shortages can undermine social stability, both directly and indirectly. These shortages not only harm the environment but also various aspects of everyday life, causing public dissatisfaction and social unrest. Declining freshwater resources exacerbate competition among diverse stakeholders, potentially sparking local and interregional conflicts. Reduced water availability adversely affects agriculture, industry, and power generation, leading to diminished crop yields, escalating prices, constrained food access, and growing public discontent. Limited access to safe, clean water can facilitate the spread of disease, eroding public confidence in healthcare systems and lowering living standards. The loss of natural resources due to desertification, habitat destruction, and reduced biodiversity has negatively impacted local communities, further fueling social insecurity. As dissatisfaction with existing economic, social, and health conditions grows, the likelihood of protests increases, as people are less willing to tolerate these hardships.

6.4. Forced Migration

Iran's water crisis is not solely an environmental dilemma but also a socio-economic one that can lead to large-scale migration, potentially straining infrastructure and resources in destination areas and intensifying social conflicts. Population growth in these new locations can overwhelm systems for water, electricity, education, and healthcare, decreasing overall quality of life. The influx of newcomers may worsen ethnic and cultural tensions, as well as widen social inequalities. Many rural migrants end up on the outskirts of large cities, aggravating social problems such as theft, corruption, insecurity, and drug trafficking. Approximately 26,000 villages in Iran have been abandoned, indicating unplanned relocations that have disrupted local economies and led to a loss of human capital (Ghorbani Sepehr, 2020).

7. Methodology

This applied research employs a descriptive-analytical approach. Data and information were gathered through library research, including books (both English and Persian), journals (English and Persian), reputable documents and reports from the Ministry of Foreign Affairs and the Presidential Office, and online sources. Library materials, newspapers, and the archives of programs and bulletins from the Ministry of Foreign Affairs and the Presidential Office were used to evaluate the findings.

8. Findings

Iran, with its arid and semi-arid climate, faces significant challenges in water resource management. These challenges not only affect the environment but also influence the economy and everyday life for the public. The following section examines precipitation trends and the underlying causes of water scarcity in the country:

8.1. Rainfall Conditions

The annual average rainfall in Iran is around 230 millimeters, substantially below the global mean, reflecting arid conditions. Rainfall distribution is uneven, with some regions—like the Caspian Sea coast—receiving about 1,280 millimeters, while the central plateau receives less than 100 millimeters. Since the start of the current water year (2024) until late February, national

precipitation levels have been approximately 114.9 millimeters, showing reductions compared to the long-term average and the previous year. Declines of up to 50 percent have been reported.

8.2. Harirud River

Harirud is one of the most vital transboundary rivers shared by Iran, Afghanistan, and Turkmenistan, providing crucial water for agriculture, drinking, and environmental needs. Its basin covers roughly 112,200 square kilometers, with 35 percent in Afghanistan, 44 percent in Iran (the Qaraqum region), and 21 percent in Turkmenistan. The river arises in Afghanistan, crosses the Iran-Afghanistan border, and flows into Turkmenistan. It sustains agriculture in Herat (Afghanistan), Mashhad (Iran), and southern Turkmenistan. Iran and Turkmenistan collaborated in constructing the Doosti Dam, which supplies agricultural water to Mashhad. Although Iran and Afghanistan currently lack a formal agreement on sharing Harirud's waters, Afghanistan has constructed infrastructure such as Salma Dam, affecting downstream flows to Iran and Turkmenistan. Repeated droughts and reduced rainfall have strained Harirud's water resources. Afghanistan's reliance on inexpensive electricity from Iran and Turkmenistan could, in turn, be influenced by the water crisis. New dams and climate change may reduce or even halt water flows into Iran and Turkmenistan, potentially drying wetlands and intensifying desertification downstream. Absent cooperation, political tensions and diminished trust could escalate (Papli Yazdi & Vosooghi, 2019).

8.3. Atrak River

Atrak is a key river in northeastern Iran, originating in the Hezar Masjed Mountains in Razavi Khorasan Province. It traverses the plains of Quchan, Faruj, Shirvan, and Bojnord before reaching the Iran-Turkmenistan border and ultimately flowing into the Caspian Sea. Approximately 669 kilometers long, Atrak plays an essential ecological role in the region. It also forms part of the border shared by Iran and Turkmenistan, serving as a critical water source for irrigation and sustaining diverse plant and animal species. Turkmenistan, with its strategic geopolitical position and substantial energy reserves, wields significant regional influence. Iran's geography includes long frontiers with neighboring countries, with about 22 percent of these borders shaped by 26 small and large rivers. Although Iran's water crisis has attracted much attention, the geopolitical and international dimensions of water's role in diplomatic policy remain less emphasized (Nami et al., 2020).

8.4. Significance of Water in the Middle East and Iran

Iran is situated in a region where water and energy hold extraordinary importance. Water shortages and the arid environment have elevated water to a strategic concern. The region's hydro-political dynamics mean that transboundary water interactions often become political issues. Certain cooperative endeavors—like joint exploitation of the Aras River—do exist, but political complexities can undermine regional stability. Water diplomacy is an emerging concept for administering transboundary water resources and averting disputes. By promoting increased cooperation, water diplomacy can reduce conflicts. Insufficient consideration of water's strategic role in diplomatic decision-making risks irreversible harm, underscoring the need for prioritizing transboundary water concerns. Although Iran as a whole depends only minimally on external water resources (about 7 to 8 percent), certain specific areas—including Sistan, Moghan, and Sarakhs—are significantly dependent. For example, Sistan is nearly entirely reliant on the Helmand River, creating major political implications for Iran's relations with its neighbors and framing water as an issue of national security. Border rivers like Helmand, Harirud, Aras, and Arvandroud have triggered disputes between Iran and nearby nations, particularly the historical disagreements with Afghanistan over the Helmand River. Existing historical records and international treaties have shaped a specific form of hydropolitics that can foster or exacerbate regional conflicts. Water scarcity in the Middle East, especially affecting downstream nations, is one of the main obstacles to regional collaboration (Badi'i Azandahi et al., 2011). About 80 percent of Middle Eastern territory is arid and lacks adequate water supplies, a reality that undermines both environmental sustainability and political stability. Overcoming water scarcity demands detailed planning and management scenarios, guiding Iran's relationships with upstream countries. River usage can result in conflicts or constructive partnerships; for instance, concerns like rising Caspian Sea levels might compel Iran and its neighbors to coordinate environmental measures. Administering transboundary water resources is not purely an environmental problem but a major political concern essential for stable international relations. Consequently, Iran should rank transboundary

water resource management as a top foreign policy priority to uphold regional stability and reinforce amicable ties with neighboring countries (Mojtahedzadeh, 1995).

8.5. Importance of International Rules

International rules help avert conflict, particularly given that shared water resources—rivers and groundwater—are frequently distributed among multiple countries. Without defined legal frameworks, serious disputes could arise. These rules mitigate tensions by establishing principles such as equitable use and peaceful dispute resolution. They also foster sustainable management by setting environmental standards that deter overuse and pollution. Fair access to water is vital for agriculture, industry, and energy, forming the foundation for sustainable development.

8.6. Key Documents and Conventions

- **Helsinki Rules (1966)**: A pioneering document on non-navigational uses of international watercourses, underscoring equitable use, ecosystem protection, and conflict resolution. Although it lacks binding legal force, it laid the groundwork for subsequent binding conventions.
- **Helsinki Convention (1992)**: Adopted under the auspices of the United Nations Economic Commission for Europe, it emphasizes fair utilization and cross-border cooperation. Post-amendment, it extended beyond Europe to include other global regions.
- **New York Convention (1997)**: Codifies three core principles—equitable and reasonable use, the obligation to prevent substantial harm, and international cooperation. Article 6 enumerates criteria (e.g., geography, social needs, and environmental impact) for fair usage.
- **Berlin Rules (2004)**: Highlights equal access to freshwater and prohibits depriving populations of water.

Fundamental Legal Principles

- **Equitable and Reasonable Use**: States must account for geographic, economic, and environmental factors when exploiting water resources.
- **No-Harm Rule**: States must refrain from actions that harm other countries, as affirmed by the Corfu Channel case (1949) in the International Court of Justice.
- **Cooperation Principle**: Essential elements include information exchange, preventative consultation, and collaborative management of shared resources. This principle is endorsed by United Nations resolutions (such as Resolution 3129) and the Rio Declaration (1992).
- **Doctrine of Limited Territorial Sovereignty**: In using shared water resources, states must respect neighboring countries' rights, standing in contrast to the Harmon Doctrine, which advocates absolute upstream sovereignty.

8.7. Practical Examples

The Dispute Between Egypt and Ethiopia Over the Grand Ethiopian Renaissance Dam: By constructing a dam on the Nile, Ethiopia sparked Egypt's concerns over reduced water flow. This dispute illustrates the need for proactive cooperation and conflict-resolution mechanisms.

Helsinki Convention (1992): Successful collaboration among European countries in managing the Danube and Rhine rivers serves as a positive example of applying international rules.

The Gabcikovo-Nagymaros Case (1997): The International Court of Justice, citing the principle of equitable utilization, required Hungary and Slovakia to cooperate in dam management.

9. Conclusion

The principle of equitable and reasonable utilization is acknowledged as a cornerstone of international water law. Under this principle, countries within a shared basin have a right to fair and logical use of water resources in light of factors such as natural conditions (geography and climate), social and economic needs (including population and sustainable development), and

environmental impact on downstream countries. The 1997 United Nations Convention on the Non-Navigational Uses of International Watercourses codifies this principle as a customary international norm.

Additionally, under the principle of no significant harm, states must refrain from actions that would seriously damage the interests of other basin countries. This principle has been confirmed in international judicial cases, including the Gabcikovo-Nagymaros (1997) judgment and the Lake Lanoux arbitration ruling. The 1997 Convention places this principle alongside equitable utilization and stresses the importance of balancing the two (Zamani & Barliyan, 2022).

According to the principle of cooperation and prior notification, states should coordinate in managing shared water resources and provide necessary information to neighboring countries before implementing major projects (e.g., dam construction). This principle is reinforced in the Helsinki Rules (1966) and the 1992 European Water Convention. For instance, in its water disputes with Afghanistan, Iran has emphasized adherence to this principle through diplomatic channels.

The principle of limited territorial sovereignty replaces extreme doctrines such as absolute territorial sovereignty (unconditional rights to water within one's territory) and territorial integrity (the right to receive the natural flow of a river). It obliges states to respect the rights of others when exploiting shared resources and to consider the collective interests of the basin. To mitigate tensions, new approaches have been proposed, such as sharing benefits from water projects (e.g., power generation or agriculture) or creating a shared basket of benefits (water-related and otherwise). These methods are particularly useful for resolving complex disputes in arid regions like the Middle East.

Although global instruments such as the 1997 Convention exist, many disputes are settled through basin-specific agreements. Examples include the 1975 India-Bangladesh Treaty on the Ganges River or agreements between Iran and its neighbors. These treaties typically set out technical details and implementation mechanisms.

In light of the principle of conservation—which calls for the sustainable use of natural resources to ensure their availability for future generations—optimal and sustainable management of water resources is crucial to prevent environmental degradation, reduce pollution, and preserve water-dependent ecosystems. Its primary objectives are ecosystem protection, water security, and the prevention of environmental crises (Shafiei Bafti & Soleimani, 2021).

Regarding the central question of how international law contributes to the protection and sustainable utilization of shared water resources in eastern and northeastern Iran—especially with respect to transboundary cooperation and dispute resolution—the study's findings indicate that, despite legal advances, the application of international law principles in these regions faces significant hurdles.

One example concerns ongoing conflicts between Iran and Afghanistan, where adherence to the 1972 Treaty could help preserve wetlands such as Hamoun, promote sustainable dam management, and reduce pollution. However, Afghanistan's failure to honor the treaty's provisions has diminished water flow into Iran, particularly during droughts. Although Iran is reluctant to seek arbitration, customary international law principles can govern bilateral use of international rivers. The Iranian government must first demand Afghanistan's prompt enforcement of the treaty and, if full implementation is not feasible, a joint committee should act to minimize resultant damage. Continuous negotiation between the two countries is viewed as the only viable path to resolving these issues.

Failure to receive Iran's full water share from the Helmand River has led to the complete drying of the Iranian portion of the wetland. The construction of the Kamal Khan Dam in Afghanistan has diverted the river's natural course and curtailed water flow into Iran. Both countries need suitable frameworks to resolve the wetland crisis while meeting environmental requirements. Besides delivering the agreed-upon flow (26 cubic meters per second), Afghanistan must also fulfill its responsibility to protect the region's environment. Iran's Ministry of Foreign Affairs should vigorously pursue this water share, working with the Department of the Environment to ensure that water reaches the Hamoun via its natural course. Collaboration at this level is vital for meeting local agricultural and drinking needs, and for safeguarding the regional environment.

Given the research topic and the aforementioned challenges, the following practical recommendations—anchored in international law and centered on critical areas—are proposed for managing shared water resources in eastern and northeastern Iran:

1. **Establish Transboundary Joint Committees**: Form bilateral or multilateral bodies with stakeholder countries (Iran, Afghanistan, Turkey, etc.) to monitor treaty compliance, exchange data, and resolve disputes; utilize international water law (e.g., the 1997 UN Convention) as the legal foundation. Strengthen water diplomacy by holding regular negotiations focused on equitable water allocation, conflict reduction, and legally binding frameworks. Engage

international organizations (such as UNDP or UN-Water) as neutral mediators. Foster confidence-building measures through joint infrastructure projects (e.g., dams, canals) with shared costs and benefits, and maintain transparent meteorological and hydrological data exchanges.

2. **Implement Integrated Management Programs**: Incorporate economic, social, environmental, and political factors into planning. Rehabilitate aquatic ecosystems (e.g., Hamoun Wetland) by restoring natural river flows, and undertake ecosystem rehabilitation projects to combat desertification via native vegetation and sustainable soil management. Allocate environmental water shares under international agreements.
3. **Innovate and Modernize Water Systems**: Promote smart irrigation and reduce agricultural water loss through methods such as drip irrigation. Employ remote sensing (RS) and artificial intelligence to monitor water resources and forecast droughts. Attract international funding by collaborating with institutions like the World Bank or the Green Climate Fund to finance joint projects. Create a regional water management fund supported by neighboring states.
4. **Encourage Community Participation and Education**: Conduct training workshops for farmers on optimal water consumption practices, and form local associations to monitor project implementation and report violations. Strengthen sustainable livelihoods by developing alternative, low-water industries (e.g., ecotourism), and support high-value, low-water crops.
5. **Fair Water Allocation**: Base water shares on objective indicators (population, environmental needs, historical entitlements), and offer financial incentives for states to curb excessive usage. Address resource deficits by engaging private sector investment in water projects secured through international guarantees, and adopt innovative financial tools such as green bonds.

Successful implementation of these proposals depends on long-term commitment to collaboration, flexibility during negotiations, and the integration of technical, legal, and social approaches. Their effectiveness further relies on stronger regional institutions, transparent decision-making, and active participation of local communities.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

Authors thank all participants who participate in this study.

Conflict of Interest

The authors report no conflict of interest.

Funding/Financial Support

According to the authors, this article has no financial support.

References

Aftabi, Z., Kavyani Rad, M., & Kohani, M. (2025). Systematic analysis of factors influencing hydro-political relations of border rivers between Iran and Iraq. *Geographical Engineering of the Land*, *9*(1).

Badi'i Azandahi, M., Goudarzi Mehr, S., & Rahimi Harabadi, S. (2011). The role of morphological changes in the Helmand border river in political relations between Iran and Afghanistan. *Human Geography Research*, *43*(78), 197-220.

Bahrami Jaf, S., Janpour, M., Tan Rosta, M., Zoghi, B. K., & Mousavi, M. R. (2023). A new perspective on the concept of hydro-politics. *Quarterly Journal of Human Geography Research*, *55*(1), 61-78.

Baripour, M., Sadeghian, M. S., Ansarian, M., & Haji Kandi, H. (2022). Methodology of water policy-making in transboundary rivers. *Strategic and Macro Policies*, *10*(38), 408-442.

Bay, Y. M. (2007). *Hydropolitics of Iran Border Rivers*. Tehran: Publications of Abrar.

Chenari, S., Azami, H., Janpour, M., & Ebrahimizadeh, I. (2024). Roadmap for water diplomacy of transboundary rivers: From the current situation to the desired position. *Political Geography Research*.

Darji, A., Rostami, V., & Ghamami, M. M. (2024). Comparative study of the rights and mutual obligations of Iran and its neighbors in protecting shared rivers: An analysis of agreements and international treaties. *Quarterly Journal of Research and Development in Comparative Law*.

Ebrahimi, H., Majid Panahi Mehrabani, M., & Pouyan Beiglari, P. (2022). The impacts of pollution in the Aras border river by Armenia and Azerbaijan on the security and national interests of the Islamic Republic of Iran. *Border Studies Research*, *10*(4), 129-146.

Ghorbani Sepehr, P. (2020). *Analyzing the security consequences of climate change on Iran with a focus on good governance* Master's thesis in Political Geography, supervised by Yashar Zaki, University of Tehran].

Imanpour, S., Hooshang, H., & Simber, R. (2023). Disputes arising from the division of border river waters: A case study of Iran and Afghanistan (1282-1402). *Quarterly Journal of Central Asian and Caucasian Studies*, *29*(124), 29-58.

Kamran, H., & Ansarizadeh, S. (2024). Hydro-politics of the Tigris and Euphrates basin and its environmental consequences for the beneficiary countries. *Geography (Scientific Quarterly of the Iranian Geographic Society)*, *22*(82), 165-181.

Kavyani Fard, M., Motaghi, A., Mokhtari Hoshi, H., & Rashidi Nejad, A. (2022). Explaining the functions of border rivers in hydro-political cooperation: A case study of the Danube River. *Applied Research in Geographical Sciences*, *22*(66), 343-357. https://doi.org/10.52547/jgs.22.66.343

Mahkuyi, H., Jajarmi, K., & Pishgahi Fard, Z. (2014). *Examining the status of water resources, especially freshwater and its scarcity in the Gulf countries* (Vol. 13).

Mojtahedzadeh, P. (1995). Water, environment, and geopolitics. *Middle East Quarterly*, *6*(10), 828-837.

Motaghi, A., Kavyani Rad, M., Zargani, S. H., & Sadrania, H. (2018). Identifying and analyzing the effective factors in hydro-political relations between Iran and Afghanistan in the Harirud watershed. *Subcontinent Studies*, *10*(34), 235-254.

Naderi, M., Goudarzi, M., & Imam Jom'e, S. J. (2023). The impacts of dam construction in Turkey on Iran's national security. *National Security Quarterly*, *13*, 155-184.

Nami, M. H., Khamri, M., & Bijani, A. (2020). A study of the hydro-politics of the Atrak River with an emphasis on the relations between the Islamic Republic of Iran and Turkmenistan from 2000 to 2018. *Strategic Defense Studies*, *18*(82), 383-404.

Niroomandfard, F., & Shahidi, A. (2018). Hydro-politics of Iran and Iraq and optimizing the consumption of shared border waters. *Global Policy Quarterly*, *7*(2), 233-259.

Papli Yazdi, M. H., & Vosooghi, F. (2019). *An overview of Iran's water diplomacy and hydro-geopolitics*. Papli Publications.

Samai, S., Akhbari, M., & Heydari, G. (2020). Regional cooperation of Iran with western neighbors based on water diplomacy (Case study: Iraq and Turkey). *Geography Quarterly (Regional Planning)*, *10*(3), 605-619.

Sayad Roshvanlou, R., Mir Koushesh, A. H., & Mohammadzadeh, A. (2024). The impact of the Taliban's rise to power in Afghanistan on water and border disputes with the Islamic Republic of Iran. *Contemporary Political Essays.*

Schonberg, E. A., & Letzen, S. (2021). *A Comprehensive Approach to Water Diplomacy*. https://dau.url.edu/bitstream/handle/20.500

Shafiei Bafti, N., & Soleimani, S. (2021). The relationship between the principle of equitable and reasonable utilization and the principle of no harm in international watercourse law with an emphasis on the 1997 Convention. *Quarterly Journal of Public Law Studies, University of Tehran*, *51*(4), 1579-1601.

Swatuk, L. (2021). *Global Water Crises and Challenges for Water Security In ACADEMIA, Handbook of Security and the Environment*. https://doi.org/10.4337/9781789900668.00011

Zamani, S. Q., & Barliyan, P. (2022). The concept and scope of the principle of reasonable and equitable utilization of shared water resources from the perspective of international law. *Public Law Research*, *24*(75), 9-44.