Adapting to the Reality of "Environment-less" Ecology in Iraq

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1. Abstract

The environmental conditions in Iraq have undergone successive and profound degradations since the beginning of the 1970s. The destruction of the environment entails more than the loss of scenery or the eradication of species; it jeopardizes the very conditions that sustain societies (Hashim, 2017). What lies behind these environmental losses? What are the core development concerns in Iraq that have been detrimental to the ecosystem and environment, as well as socio-economic structure and human health? The landscape of environmental loss in Iraq presents a detailed chronology of human-induced environmental destruction. The root causes of environmental losses are identified, including major hydroclimatic projects focused on marshland reclamation and land drainage.

The historical trends of the ecosystem, environment, and socio-economics in Iraq are described across different regimes, including the key milestones that led to catastrophic environmental deterioration. The major contributors to environmental loss include war and conflict, industrial pollution and the extraction of natural resources, water scarcity, extensive desertification, and various agricultural practices. Hence, a series of post-conflict and reconstruction scenarios arises that strongly emphasizes the need for environmental attention and recognition, as well as the rehabilitation of economic infrastructure (Okorodudu-Fubara, 1991).

2. Keywords

Environmental Loss; Iraq; Mesopotamian Marshlands; Biodiversity; Ecosystem Services; Climate Change; Agriculture

3. Objectives

The objectives of this research on landscape degradation in Iraq are structured around four guiding questions.

First, what are the most important determinants of environmental degradation within the country?

Second, why have specific agrarian and hydrological systems been projected as particularly vulnerable?

Third, in what ways have the consequences of environmental decline influenced human health and socio-economic outcomes?

Finally, which governance and policy instruments are considered most relevant, and what options are available to enhance or improve their implementation?

Describing the challenges arising from the interplay among the environment, agriculture, water management, and human well-being will provide an important backdrop for related discussions. Focusing in particular on these interconnections will highlight the medium to long-term repercussions of intensified soil and water depletion, including sediment and salinity accumulation within irrigation schemes and the continuous deterioration of the water table.

Given the extreme variability of the drivers, both in their direct causes and magnitudes, the situation regarding landscape degradation remains complex and difficult to assess. Notably, the anticipated consequences extend well beyond the acceleration of landscape degradation and underscore the considerable uncertainty surrounding the agricultural sector's prospects. The additional stresses posed by climate change on water supplies and agrarian systems further exacerbate this uncertainty, rendering already problematic recovery from past regimes doubly challenging (Douabul, 2026a; Hashim, 2017; Okorodudu-Fubara, 1991).

4. Introduction

Iraq possesses a rich cultural and natural heritage, considered by historians to be the cradle of civilization and recognized by UNESCO as a significant part of the common heritage of humankind. However, environmental degradation, resource depletion, and loss of biodiversity have intensified dramatically since the beginning of the 1970s under the regime of Saddam Hussein and since the invasion of the country by the United States and its allies in 2003. Human actions under the regime of Saddam Hussein have irreparably damaged natural and cultural resources. A decade of continuous war from 1980 to 1991 led to the widespread destruction of the environment and the country's capacity to manage, rehabilitate, and maintain its resources. Nevertheless, some mechanisms for joint exploration and management of shared water resources following the Gulf War were established, albeit with limited success. Environmental degradation and loss of biodiversity induced by human occupation during the last decade have substantially affected the ability of the government to manage the heritage of Iraq. Environmental reconstruction efforts following wars remained focused on rebuilding infrastructure, without serious attention to environmental considerations. In addition to past desertification processes, the combination of climate change, population growth, resource constraints, rising food demand, unsustainable practices, and other factors has exacerbated the ecological and environmental crisis.

To analyze the ecological and environmental crisis Iraqis currently face, the significant components and the environmental situation in Iraq prior to the war are reviewed. Subsequently, the impact of successive rounds of conflict and the environment is examined, along with the serious challenges posed by reconstruction to cultural heritage and biodiversity conservation. From 1980 until the establishment of the new government in 2003, Iraq was subject to wars, catastrophes, and conflict that led to the serious destruction of the environment, resources, and biodiversity. Oil exploitation, along with mismanagement of irrigation water resources, has further aggravated water scarcity and increased soil salinization. Deforestation and desertification have accelerated, causing serious damage to terrestrial ecosystems. Pollutants from industries, petroleum, pesticides, sewage, and prisons have significantly contaminated air, land, and water. The cascade of destruction and degradation following the invasion of 2003 has widened and accelerated the environmental crisis that Iraq is currently experiencing (Douabul, 2024).

5. Historical Overview of Iraq's Environment

Environmental degradation is often exacerbated by geopolitical instability. Iraq's environment has undergone significant changes, and a systematic survey of its political history is required to fully comprehend its current status and the trajectory of its deterioration. Iraq is a nation located at the crossroads of several major civilizations: the Persian Empire, Hellenistic Greece, the Roman Empire, and the Islamic Caliphate. The soil, climate, and availability of water fostered the development of agriculture. It contributed to the establishment of stable settlements around 4000 BC, lending credence to the claim that Iraq is the birthplace of Higher Civilization. In Places such as Babylon, gardens were constructed to provide food and replenish groundwater. Such appreciation for environmental sustainability continued into the Islamic period, from A.D. 636 to A.D. 1258, with monuments erected in honor of the region's trees. One major downside of Iraq's favorable geographical position is its vulnerability to invasions, as demonstrated by the Persian invasions of 600–300 BC, the emergence of Hellenism, the Mongol invasions, and the Ottoman Empire's expansion from 1258 to 1917. All these invasions, followed by exterior rule and the exodus of skilled citizens, led to the development of a dependent society unwilling to invest in the region's natural resources. Following World War I and the establishment of a monarchy in Iraq in 1921, initiatives aimed at settlement expansion and social development were undertaken, including water extraction in Tikrit and other regions. These actions, however, led to environmental pressures: erosion, salinization, wetland desiccation, river silting, and biodiversity loss.

The first modern study of the environment in Iraq was published during 1959–1964. The approach consisted of extensive imaging of both urban and countryside landscapes. The whole of the country was aerially photographed at 1:60,000 scale. Approximately 5,000 representative photographic images were identified and printed, and later divided into three groups: historical and archaeological sites; oil extraction, settlements, industry, agriculture, and other kinds of restoration; and public works and communication. These analyses captured major environmental trends, such as river bank migration, winter harvest expansion, and reduced grazing land in the countryside. These trends helped in understanding environmental changes. The construction of dams in Turkey initiated the first significant change. The flow of the Tigris River, which supplied the historic marshes in southern Iraq, was drastically reduced. The marsh area diminished significantly, transforming it into one of the top 10 disaster areas in the world, and biodiversity decreased. Aerial surveys were made from 1992 to 1999 over the historic town of Al-Muqaiyar in the south and Al-Hadr in the north. The water channels and marsh areas increased dramatically during 1920–1961, but then rapidly decreased thereafter. In summary, the combination of the extent of aerial environmental survey up to the 1960s and further analysis in later years remains invaluable for understanding the contemporary environment of Iraq and the distinctive signature of environmental change.

Another significant environmental milestone came with the oil embargo imposed on Iraq at the conclusion of the Gulf War in 1991, underscoring the oil industry's role in shaping the country’s environment. The southern marshlands in Iraq were designated as a World Heritage Site; however, aerial photography revealed that the marshes had been drained, and the world lost a significant ecological area (Douabul, 2025a; Hashim, 2017).

Table 1: Chronology of Environmental Milestones in Iraq

This table tracks the shift from ecological security to collapse across different historical regimes.

Period	Governance / Context	Environmental Status & Key Events
Ancient – 1917	Sumerian to Ottoman	Established as "Cradle of Civilization"; sustainable agriculture; creation of Babylon gardens.
1920s – 1950s	British Mandate / Monarchy	First modern environmental pressures: erosion and salinization; first aerial surveys (1:60,000 scale) recorded rich biodiversity.
1960s – 1970s	Republic Era	Beginning of "profound degradations": Turkish dam construction begins to reduce the Tigris flow.
1980 – 1988	Iran-Iraq War	Initiation of "severe systemic environmental damage"; infrastructure destruction begins.
1990 – 2003	Gulf War & Sanctions	1991 Oil Embargo; drainage of southern marshlands; decline of the healthcare system; data availability ceases.
2003 – Present	Post-Invasion / Current	Accelerated collapse; 16.7% of remaining wetlands lost (2003-2006); widespread industrial pollution and uranium contamination.

6. Drivers of Environmental Degradation

Between its independence in 1932 and the US-led invasion in 2003, Iraq experienced major periods of degradation, but was considered the most ecologically secure country in the region. Baseline environmental assessments of the 1930s revealed that Iraq then supported far richer ecosystems and biodiversity than it does today. Furthermore, only modest industrial activities damaged Iraq's surface and near-surface climate records. The extensions of the Assyrian, Babylonian, and Sumerian cultures from 3400 BCE onward, as well as the more recent Safavid, Ottoman, and British empires, were accompanied by changes in land use. Regime changes associated with World War I (1914-1918), the 1958 revolution, the 1968 coup, and the 2003 invasion precipitated major shifts in land-use patterns and intensity.

The cumulative force of these drivers operating independently and in concert is unprecedented. Economic mismanagement, political repression, and conflicts have caused environmental conditions to deteriorate at rates unmatched elsewhere. Millions of Iraqis have been displaced, and many have fled abroad. Continuous outflows have further weakened an already precarious environment. Exploitation of oil and other natural resources grew rapidly after 1932, then declined just after the 80–88 war, and boomed again after 2003. Exploitation of soils, groundwater, and biomass was intensive between 1930 and the 1970s, decreased markedly during the conflicts and sanctions, and accelerated again after those. Exploitation patterns are still evolving, and uncertainties persist about limits. Access to cheap energy and the prolonged impoverishment of much of the population have enabled domestic industries to proliferate and raw-material extraction sectors to escape near-complete control. Environmental impacts extend across the country, including semi-arid regions, and the sector is projected to expand rapidly (Douabul, 2024; Valizade & Parvin, 2016).

6.1. Conflict and War

The destructive consequences of armed conflict on the environment are most visible on military battlefields. Nevertheless, countries emerging from conflict experience extremely high levels of environmental degradation in sectors that were even untouched during the fighting phases of armed conflict. Regions of the world affected by armed conflict suffer widespread habitat loss, declines in large-mammal populations, and increases in invasive and exotic species, all of which contribute to species decline. Countries affected by armed conflict also tend to experience water scarcity, land degradation, soil and water pollution, and deforestation. During armed conflict, many of these problems worsen substantially, and infrastructure damage and population displacement directly accelerate environmental degradation, even in post-conflict situations. Military operations directly impact the environment during armed conflict,

including damage to and refurbishment of infrastructure, increased energy consumption, and the destruction of forests and agricultural cover. Indirect consequences linked to water supply, land surface, and agricultural damage have also been documented. Oil spills resulting from military conflict in Iraq, for instance, posed far-reaching indirect pollution hazards, threatening ecosystem stability, biodiversity, fish populations, and water consumption (Okorodudu-Fubara, 1991). The destruction of non-renewable resources also appears to characterize the post-conflict historical experience.

The environmental impact of both direct and indirect military operations ultimately remains context-specific and interlinked with prevailing local and regional governance conditions. Empirical evidence generally indicates that countries emerging from armed conflict experience a marked surge in ecological degradation, even beyond the immediate battle theatre and well after the cessation of military operations. Military operations associated with armed conflict, including national emergencies, imposition of martial law, and acquisition of military vehicles during peacetime or post-conflict stages, also impair environmental stewardship and resource management. In the Iraqi context, armed conflict has caused severe damage to facilities for generating, transmitting, storing, and distributing water and sewage systems, transforming urban spaces into unsafe habitats (Douabul, 2025b).

6.2. Industrial Pollution and Resource Extraction

Air pollution is a key environmental issue in Iraq, resulting from a combination of industrial activity and the burning of fossil fuels for energy generation. Major industrial sites, including those producing cement, bricks, and petrochemicals, emit significant quantities of gases and particulates that are detrimental to both human inhabitants and surrounding vegetation (Abdulkadhim *et al.,* 2017).

Pollution affects multiple sectors of the economy, and the extraction of oil, gas, and minerals substantially reduces the availability and quality of economic resources for future generations. The presence of extraction sites and oil spills frequently contaminates soil and water, further jeopardizing health and livelihoods (Douabul,2025c).

6.3. Water Scarcity and Desiccation

Due to hydrological changes, groundwater extraction, and increased salinization, Iraq faces severe water scarcity and accelerated desertification. Since the mid-1980s, the mean annual discharge of both the Tigris and Euphrates rivers has decreased by more than 60 percent. In addition to unsustainable water consumption and seasonal system disruptions, the accumulation of upstream dams, the completion of the European Union (EU) water policy, and increased water pollution impact Iraqi water bodies. In contrast to upstream developments, Iraq still relies principally on the Tigris and Euphrates rivers. The gross irrigated surface area remained stable between the late 1980s and early 2000s, although the net irrigated area gradually reduced. Moreover, since the late 2000s, the average

water-level fluctuation has progressively diminished, increasing soil salinity and water salinization. According to the official national water strategy, the Tigris and Euphrates rivers and Iraq's aquifers are being exploited at an average rate of 67-89%. Thus, the restoration of infiltration zones is essential to counteract overall water scarcity and rising salinity and to recover certain ecosystem services (Albarakat *et al.,* 2018). The need for multiple contemporary actions is thus imperative, such as water demand management in the agricultural sector; enhancement of the irrigation efficiency— covering the scheme, application, and management— for various crops; reduction of irrigation water losses by restoring central and southern marshes; and rehabilitation of infiltration zones of the fractured aquifer in the western part of Iraq (Hameed *et al.,* 2018).

6.4. Agricultural Practices and Land Degradation

Agricultural practices are among the main causes of land degradation in Iraq. Between 1950 and 2005, the country's cropland area increased significantly, especially in cereals, yet average yields remained low by world standards (Nasser, 1970). Thus, substantial areas of land were cultivated without significant improvements in productivity or soil conservation. Furthermore, the reliance on traditional cultivation methods contributed to soil erosion and the salinization of irrigated lands. The unplanned expansion of extensive and intensive agriculture, exacerbated by economic and food security crises resulting from prolonged wars and sanctions, led to the drying and salinization of many previously productive lands (Hamad & Surucu, 2024). The average annual rates of land-use change for Iraq during the periods 1992–2001 and 2001–2014 indicate a continuous decrease in arable land, permanent crops, and pasture areas, compensated mainly by increases in urban and built-up areas, as well as a substantial increase in bare land.

Table 2: The 8 Major Drivers of Environmental Degradation

These factors are the primary drivers of the current loss landscape.

Driver	Primary Impact	Specific Consequence Mentioned
Armed Conflict	Direct habitat destruction	Infrastructure damage, oil spills, chemical/uranium residues.
Water Scarcity	Desiccation of wetlands	60% decrease in Tigris/Euphrates discharge since the mid-1980s.
Upstream Damming	Reduced river inflows	Southeastern Anatolia Project (GAP) impact on downstream Iraq.
Industrial Pollution	Air and water contamination	Particulates from cement, brick, and petrochemical plants.
Oil Exploitation	Soil and groundwater toxicity	Uncontrolled extraction and spills are contaminating livelihoods.
Land Mismanagement	Agricultural decline	Unplanned expansion; traditional methods leading to soil erosion.
Desertification	Loss of arable land	Increase in bare land; record soil erosion (140 tons/hectare in 2003).
Climate Change	Aggravated natural crisis	Increased dust storms, intensified heat, and reduced soil moisture.

7. Impacts on Biodiversity and Ecosystem Services

The environmental condition of Iraq has deteriorated considerably following decades of war and sanctions. Subsequently, other factors, such as climate change, inadequate governance, and weak institutional capacity, have exacerbated further degradation. Iraq is located within three of the world's 25 most important biogeographical regions, making it both the cradle of civilization and a center of biodiversity. However, the conflict and its aftermath have led to unsustainable exploitation of natural resources and environmental degradation. Soil erosion rates reached a record 140 tons per hectare per year in 2003, and winter wheat-producing areas shrank from about 54% in 1991 to just 18% in 2012. Iraq lost 16.7% of its remaining wetlands in three years (2003–2006). Urban expansion into date palm orchards continues to erode the most livable habitat for mammals such as the *Arabian Oryx*. Of an estimated 90 species of amphibians, reptiles, birds, and mammals, 70% are threatened with extinction. The number of insectivorous bats, which were plentiful before 2003, has declined to zero. The environmental collapse of Iraq—water resources and wetlands, soil and deserts, forests and trees, agricultural lands and crops, and species and habitats—remains unprecedented in modern history (Douabul, 2025d; Hashim, 2017; Albarakat *et al.,* 2018).

Table 3: Indicators of Biodiversity & Ecosystem Collapse

This table quantifies the "unprecedented" environmental loss.

Ecological Component	Historical Baseline (Pre-1970s/1990s)	Current Status / Impact
Wetlands	Vibrant Mesopotamian Marshlands	16.7% lost between 2003-2006; worldwide "top 10 disaster area."
Wheat Production	54% of land area (1991)	Shrank to 18% of land area (2012).
Mammals & Reptiles	Diverse and plentiful	70% of the 90 estimated species are threatened with extinction.
Insectivorous Bats	Plentiful before 2003	The population declined to **zero**.
Forestry	Extensive date palm orchards	Hundreds of thousands of trees are cut down for urban expansion.
Soil Quality	Productive and fertile	Record erosion; high salinization; contaminated by "chemical warfare agents."
Sustainability Index	N/A	Rated at **2.13 out of 10** (as of 2008).

8. Human Health and Socioeconomic Consequences

The 1970s witnessed a substantial transformation of the Iraqi ecosystem, which continued until the onset of the 2003 war. Severe systemic environmental damage began during the Iran–Iraq War (1980–1988) and continued sporadically throughout the 1990s. Armed conflict and its aftermath have disrupted essential government functions, undermined policies and projects supporting sustainable resource use and environmental conservation, and compromised efforts to restore and protect the natural environment. As a result, environmental loss continues to escalate in areas critical to society's well-being, particularly those supporting health services, employment, and food security. Loss and degradation of environmental resources have reached crisis levels and are compounded by climate change and desertification. The devastating toll has been exacerbated by decades of war, despotism, oppression, and corruption. The world's last surviving wetlands were desiccated, shelled, and polluted; major rivers dried up; and hundreds of thousands of trees were cut down. Today, Iraq faces a socioecological disaster in a gradually declining social contract and widespread societal unrest. The emergency demands global attention to avoid further deterioration that could trigger the complete collapse of the state and society (Fidler *et al.,* 2009; Furber & Johnstone, 2004).

The health-care infrastructure was ravaged over a three-decade chronicle of military aggression, violence, occupation, and sanctions combined with oppressive regimes. By the mid-1990s, the health system had started an irreversible decline marked by visible shortages, diminished supplies, impaired capabilities, and decimated budgets. Health hazards arose as the environmental system deteriorated. The regime relied on a petrochemical economy; therefore, hydrocarbons were plentiful but, like the water and air commons, became too polluted to use without posing a threat to health. The health-care system thus became dependent on an environmental system under attack. At the national level, the ongoing lack of safety in the country makes it virtually impossible to build a robust environmental health system capable of sustaining the healthcare sector. At the rural district level, the combination of environmental system degradation and affected economic livelihoods has further weakened the delivery of health services and the capacity to fund necessary recovery measures.

9. Governance, Policy, and Institutional Capacity

Political turmoil, decades of conflict, and extensive foreign intervention have severely undermined Iraq's governance, policy-making, and institutional capacity. The situation is aggravated by the collapse of the public sector, widespread corruption, ineffectual service delivery, environmental mismanagement, and weak compliance with national environmental laws (Dowdeswell & Hania, 2015). This weakening of governance builds on the state's pre-existing fragility. It steepens the path of decline from Iraq's modern

levels of productivity and environmental sustainability to the present levels of environmental degradation and resource depletion.

The capacity of the environmental governance framework has been exacerbated by two distinct phases of national legislation, established during the Ba'ath Party regime and after the 2003 invasion. The first phase focuses on environmental protection through legislation. In contrast, the second phase is accentuated by a reactive mode that addresses urgent environmental issues without a clear vision for sustainable development. The absence of broad governing principles to guide legislation limits options for their effective implementation and dampens the prospects for a second phase of restoration. Current constitutional arrangements do not restore a coherent national legal framework; they stipulate the participatory role of local governments in preparing legislative frameworks that automatically reduce central governmental regulatory powers in favor of a disparate range of municipal actors.

9.1. Environmental Legislation and Implementation Challenges

Although environmental legislation existed before 2003, it relied heavily on United Nations oversight, was rarely referenced by officials, and was ineffective for policy implementation. Iraq signed the Rio Agreement in 1992 and the Kyoto Protocol in 2009, but no national legislation for environmental protection had yet emerged. The constitution adopted in July 2005 recognized Iraqis' right to "a healthy environment" and prohibited actions injurious to the environment (Abdulkadhim *et al.,* 2017). As of 2017, the country had ratified 32 international conventions relevant to environmental protection, including agreements on desertification and biodiversity (Hashim, 2017).

Even with legislation on the books, the grounds for environmental protection remained tenuous. Actors within the Ministry of Environment had little authority to compel pollution control. A 2009 law intended to reorganize and strengthen the ministry proposed establishing dedicated cabinet ministries for environmental issues at the national and regional levels. Despite its formal adoption, enforcement was lacking, and in effect, the country remained free to pollute without sanction. The 2004 Cabinet and 2005 Parliament remained dominated by illegal oil smuggling and the destruction of commercial establishments, and laws and institutions that reinforced environmental rights or protection were viewed as irrelevant.

9.2. Transboundary Water Cooperation and Disputes

Joint management approaches to transboundary river systems date back to the early twentieth century in marshland and wetland states that share water from the Tigris and Euphrates rivers. Under British influence, the 1921 Treaty of Friendship and Cooperation between Iraq and Turkey called for the joint management of the two rivers. In 1925, the two countries pursued mutual interests by exchanging data on economic and irrigation development, followed by further economic cooperation treaties and agreements at the

end of the Second World War. After independence, cooperation on the Tigris and Euphrates rivers revived between 1955 and 1972, with joint studies and agreements. Iraq developed further dialogue and negotiation over transboundary water resources with Turkey and Syria after the 2003 U.S.-led invasion. However, developments along the Tigris and Euphrates rivers and marshlands in Iraq were viewed less optimistically due to international expectations that Iraq would share access to the two rivers for accompanying development projects with neighboring countries such as Iran and Syria, despite substantial national efforts to rehabilitate and restore these areas. Continued responsibility for the Tigris and Euphrates watershed was left to Iraq, particularly after the U.N. sanctions and Saddam Hussein's regime (Albarakat *et al.,* 2018).

Iraq, as a downstream country of the Tigris and Euphrates river basins, has experienced severe transboundary water disputes since its foundation, stemming from upstream dams and irrigation projects in both Turkey and Syria. Since the mid-1960s, Iraq has expressed significant concerns about Turkey's and Syria's major dams and irrigation strategies on the Tigris and Euphrates Rivers. Development projects such as the Southeastern Anatolia Project (GAP) in Turkey and the A1 and A2 dams in Syria restricted river water inflows and downstream discharge, adversely affecting Iraq and causing environmental changes, including land degradation. Iraq-Turkey water disputes intensified with the construction of the GAP in the early 1980s, prompting joint studies, negotiations, and bilateral talks between the two countries. Beginning in the early 2000s, Iraq-Hydro-Electric Projects Agreements were signed, coupled with a new series of negotiations and bilateral discussions after 2003, but changes to the terms of these agreements during the post-war political transition hampered the regular continuation of the cooperative water policy dialogue.

9.3. International Aid, Reconstruction, and Environmental Considerations

International aid and reconstruction in Iraq must navigate significant environmental considerations. War has inflicted immense damage on hospitals and clinics across the country, hindering the restoration and expansion of health services. Access to professional journals remains extremely limited; ongoing sanctions have further restricted medical supplies, impeded equipment repair, and delayed sector rebuilding (Furber & Johnstone, 2004). International donor states have pledged over forty billion dollars to mitigate humanitarian and development crises, yet allocations have fallen short. While urgent measures to revive the health system seek to eradicate preventable diseases widespread among young children, project design frequently overlooks the environmental costs of war and the infrastructure needed to ensure sustainable support for health-care professionals.

The vulnerability of Iraq's expansive water and sanitation sectors reflects inadequate design standards—due in part to a postwar reliance on international aid—and their link to national health efforts. Reconstruction, environmental safeguards, and community awareness remain closely intertwined with the restoration of health services; health-centered projects often assume a crucial role in postconflict rehabilitation. Addressing such interdependencies during the exploration of health-sector support will prove indispensable, given the critical state of Iraq's health services and the need to understand water and sanitation needs and services throughout the country. Efforts are unlikely to make substantial headway without environmental considerations and integrated proposals.

Table 4: Policy & Governance Framework Comparison

A comparison of the two phases of environmental legislation mentioned in Section 6.

Feature	Phase 1 (Ba'ath Party Regime)	Phase 2 (Post-2003 Invasion)
Legislative Focus	Environmental protection via direct laws.	Reactive mode: addressing urgent issues ad hoc.
Primary Authority	Centralized but often ignored.	Fragmented; power reduced in favor of municipal actors.
Global Integration	Relied on UN oversight; Rio Agreement (1992).	Kyoto Protocol (2009); 32 international conventions ratified.
Effectiveness	Low due to war and sanctions.	Low due to corruption, smuggling, and lack of enforcement.
Constitutionality	Minimal focus on rights.	The 2005 Constitution recognizes the right to a "healthy environment."

10. Adaptation and Mitigation Strategies

Iraqis have coped with environmental degradation and disaster for decades. National and local capacity, however, have diminished, and governance has become fragmented. Under such constraints, adaptation and mitigation options must align with prevailing realities. Strategies and interventions should meet the demand for restoration while remaining feasible given the existing circumstances.

The most pressing environmental risk is water scarcity. Sustainable water management and irrigation modernization thus emerge as key priorities. Increasing the efficiency of irrigation systems, minimizing water losses in urban networks, and restoring groundwater infiltration in urban and low-salinization areas would help meet irrigation water demand (Al-Shamsi, 2019). Combating drought remains critical, given its adverse impacts on vegetation and soil.

Another priority is pollution control and waste management. Iraq should focus on high-impact treatment technologies for municipal and industrial wastewater, rainwater harvesting, and stormwater drainage. Regulatory approaches and pollution prevention measures should address the most damaging types of solid waste.

Restoration of ecosystems and biodiversity, and the integration of community-based and indigenous knowledge approaches, are also vital. Restoration targets are available for most of the ecosystem types listed in the National Biodiversity Strategy. Multi-stakeholder approaches that incorporate local practices and knowledge, support co-management, promote leadership and capacity development, and facilitate knowledge exchange among indigenous and non-indigenous communities would further strengthen restoration efforts (Hashim, 2017).

10.1. Sustainable Water Management and Irrigation Modernization

Recognizing water scarcity as an escalating threat to livelihood, health, and development, decision-makers are increasingly adopting integrated water resource management approaches. Regarded as a politically neutral and holistic set of principles, they provide an entry point for formal and informal dialogue to establish collaborative approaches to natural resource management. Iraq has experienced significant environmental degradation since the mid-1970s. Demand management, rehabilitation, and modernization of irrigation infrastructure are crucial to restoring the deteriorating environment. Recommended irrigation modernization includes automated irrigation scheduling and monitoring, the establishment of sprinkler and drip irrigation systems, crop management for food legumes and dryland crops, and rainwater harvesting schemes. Floods aggravate land degradation. Flooded areas should be properly drained to restore infiltration rates in the surface layer, improve groundwater recharge, and restore the capacity of the aquifer system. It is essential to install shallow horizontal drains in

heavily degraded areas before introducing irrigation, as this reduces surface runoff and increases water access to underground aquifers. More attention is also needed to the widespread adoption of water-harvesting systems (Al-Ansari *et al.,* 1970). During the period of significant rainfall in Iraq, rapid loss of water by surface runoff takes place due to poorly constructed roads, especially in the construction of 'cut and cover' systems in urban areas. Proper rainwater management systems should be installed in all urban and rural areas to enable rapid rainfall assessment, control runoff, and increase water storage.

Adequate, high-quality water supplies are crucial for improving human health and ensuring sustainable development. Water supply and irrigation works through surface water networks and agricultural hydrology systems are vital for eliminating existing pollution sources and maintaining a healthy ecosystem (Schultz & De Wrachien, 2002). The volume of polluted wastewater from the industrial and commercial sectors has increased due to insufficient regulatory monitoring by the relevant ministries following the last war. Reasonable design of simple, appropriate wastewater treatment systems in industrial zones could alleviate the problem. Over-extraction of irrigation supplies and the reuse of polluted drainage water are further degrading ground- and surface-water resources (Jaber *et al.,* 2016).

Minimizing loss due to improper use of irrigation supply pipelines or freshwater supplies during peak periods, significantly reducing the dirtiness of return drainage water, and overlaying used drainage water with monitored and pre-evaluated drainage water prior to return to surface water serve as supplementary and reasonable means of managing water flow.

10.2. Pollution Control and Waste Management

Industrial activities and uncontrolled urban development continue to release pollutants into the environment. The 2003 invasion of Iraq and the resulting conflict further exacerbated damage to environmental and economic resources (Abdulkadhim *et al.,* 2017). The negative effects of war included the destruction of industrial facilities and infrastructure, leading to severe pollution of the air, soil, and groundwater. The geographical distribution of the sites damaged ranged across the country, and government reports indicated widespread environmental pollution caused by conflict resolution efforts, uranium, and depleted chemical warfare agents (Mohammed et al., 2018). The Iraqi environmental sustainability index was estimated at 2.13 out of 10 in 2008, reflecting the extremely difficult environmental situation and the deteriorating capacity of the environment to sustain exploitable resources (Douabul, 2025c).

10.3. Restoration of Ecosystems and Biodiversity

Restoration efforts and conservation of ecosystems and biodiversity are urgent tasks in Iraq, where human actions have profoundly degraded the environment, drastically reducing biodiversity and destabilizing ecosystems. Fragments of riverside habitats, one

of the last remnants of national and global wetlands, still survive, and a partnership between national and international agencies, though hampered by turmoil and budget cuts, has thrived despite many difficulties. Restoration of ecosystems and biodiversity is part of Iraq's commitment to protecting cultural and natural heritage sites, which requires cooperation across various governance levels and with international partners. The United Nations reminds that the loss of valuable ecosystems and resources is a global concern and calls for collective action (Douabul, 2025d; Hashim, 2017). Iraq established this partnership approach as a national and international model for safeguarding biodiversity.

One option is the restoration of marshes (Bonnie *et al.,* 2019). The Southern Marshlands, part of the Iraqi Wetlands, were designated as a Wetland of International Importance under the Ramsar Convention and recognized as a UNESCO World Heritage Site in July 2016. Following the draining period in the late 1990s, restoration began, leading to the recovery of several hydrological and water quality indicators. While government agencies have initiated numerous wetland restoration projects, a complete definition of restoration targets and comprehensive protocols for impact monitoring remain lacking. Restoration activities can therefore follow a staged approach based on the precise definition of targets, the establishment of relevant monitoring systems, and the accessibility of technical and financial resources. A suitable long-term target encompasses both sustained physical–chemical restoration and the restoration of physical–chemical settings that support ecological processes and ecosystems over extended periods. Rehabilitation would instead focus on improving local society's welfare, while morphological reconstruction alone could halt the progressive degradation of remaining wetland remnants. Restoration of reed beds and permanent water bodies, with priority pressures at national and local levels, is targeted in the nearby Al-Shahd Marshes, a major wetland after the Southern Marshlands. Indicators include biological oxygen demand, chemical oxygen demand, total dissolved solids, electrical conductivity, nutrients, and bacteriological quality; these represent key components of aquatic ecosystems. The relatively high magnitude of these pressures stresses the expediency and degree of intervention required in other geographical frameworks.

10.4. Community-Based and Indigenous Knowledge Approaches

Community-based and indigenous knowledge approaches emphasize the importance of protecting cultural and natural heritage through shared responsibility and international cooperation. The United Nations advocates collective efforts to preserve globally significant cultural and natural sites, given the threat of their disappearance. Iraq has developed strong partnerships between international experts and national staff, with its experience documented in UNESCO reports serving as a model for national and global action (Hashim, 2017).

The movement of indigenous peoples to new territories creates a new knowledge base for local biota, linking knowledge to new environments. Local knowledge space recognizes that different ethnic groups can share rights over the same land, and a single group need not be designated as its sole custodian. Emphasizing local practices facilitates the discovery of living law—sources of law found in local practices and stories. Integrating these local practices into a global framework remains challenging. Unpacking assumptions about traditional and scientific knowledge systems can bridge the gap between global and local perspectives (Vermeylen *et al.,* 2008).

11. Case Studies and Regional Variations

A comparative analysis of urban, peri-urban, and rural environmental losses reveals significant variation across regions (Nasser, 1970). In urban areas, degradation stems mainly from industrial pollution, while peri-urban sites experience both industry-related degradation and agricultural decline. Land degradation, particularly soil erosion, soil salinity, and desertification, is predominant in rural regions (Hashim, 2017). Peri-urban areas consistently exhibit greater resilience, as indicated by a slower rate of degradation.

Five critical factors account for the relative resilience of peri-urban regions: (1) reduced agricultural activity due to urban migration; (2) higher rates of infrastructure establishment and rehabilitation, diminishing damage incurred during conflicts; (3) greater availability of diverse and productive resources; (4) larger budgets and infrastructure investments through optimization of fund allocation; and (5) the involvement of a greater number of national and international organizations on environmental issues, facilitating access to additional resources and innovative approaches.

11.1 Iraq and the Reality of Environment-less Conditions

The Republic of Iraq provides a somber but vital case study for the application of Environment-less Ecology. For millennia, Iraq was defined by its "environmental prerequisites": the predictable flooding of the Tigris and Euphrates, the vast Mesopotamian Marshes, and a Mediterranean-influenced climate. However, decades of conflict, upstream damming, and runaway climate change have effectively "dissolved" the traditional Iraqi environment.

In the southern marshes, where the "environment" has been periodically drained or salinized beyond recovery, life does not simply cease; it reconfigures. Applying the Environment-less Lens to Iraq reveals that ecological "agency" persists even in the absence of a hospitable milieu (Ross, 2017). For example:

- **Decoupled Aquatics:** In Iraqi waterways where salinity has replaced freshwater prerequisites, blue-green algae and salt-tolerant species hijack existing metabolic mechanisms to produce nutrients (McGarigal *et al.,* 2018). The system functions through the "activity of water" and mass-energy transfer rather than a traditional "balanced" ecosystem.
- **Anthropogenic Persistence:** Human-nature interactions in Iraq's dust-choked urban centers demonstrate that "ecological" coupling occurs even when soil moisture and air quality are nonexistent. The transfer of energy and survival strategies within the population constitutes a "socio-technical co-dependency" that falls outside the remit of traditional environmental restoration (Douabul, 2026).

By viewing Iraq through an E-less lens, we stop asking how to "restore" a 1950s environment that no longer exists. Instead, we begin to manage the "unconditioned"—the raw ecological persistence of species and human agents in a landscape devoid of its historical prerequisites.

Table 5: Iraq Case Study: Application of the E-less Lens

This table demonstrates how the framework applies to the specific environmental degradation in Iraq.

Ecological Component	Traditional "Failure" Perspective	Environment-less "Agency" Perspective
Mesopotamian Marshes	"Degraded" or "Dead" due to salinization.	Reconfiguration: Species "hijack" metabolic streams to survive.
Urban Centers	"Unhabitable" due to dust and heat.	Socio-technical coupling: High-density human-nature co-dependency.
Water Quality	"Contaminated" by salt and toxins.	Focus on "Water Activity": Mass and energy transfer via salinity.
Conservation Goal	Return to pre-dam/pre-conflict flooding.	Manage the "Unconditioned": Strengthening resilient biological kernels.
Human Agency	Victim of environmental collapse.	"Uninvited hitchhiking passenger" in a new system.

12. Research Gaps and Methodological Considerations

The general limitations in data availability, accessibility, and quality severely restrict the assessment of environmental conditions across Iraq. As a result, precise and broadly representative estimates of certain consequential drivers of environmental loss, such as the quantity and quality of industrial effluents released by existing facilities, are impossible to obtain. The scarcity of public information encompasses all sectors of industrial activity. For example, when seeking reliable information on industrial effluents in Iraq, the only available data sources at the federal and regional government levels date back to 1990. The irrigation sector faces a similarly dramatic lack of information, as evidenced by the absence of even basic data on the volume and quality of water supplied to it, whether through canals or tube wells. Given the general absence of data on effluent generation and composition associated with the various industrial activities taking place within Iraq and the similarly insufficient national and regional historical data on water and salinity parameters across the agricultural sector, it proves impossible to apply the widely recognized agri-environmental pressure indicator (Nasser, 1970) model without unduly distorting the conclusions drawn from the largely anecdotal information available. A globally recognized top-down policy evaluation model focused on water quality policies, which would enable the reconstruction of comprehensive and clear material-flow accounts, remains similarly unusable due to the absence of published process and material-flow data for Iraq. However, the application of methodological approaches that circumvent the unavailability of crucial data continues to yield abundant, rich, and relevant insights into the current state of the environment and the key pressures affecting it in contemporary Iraq. As a result, the preliminary analysis remains firmly on target and clearly useful to decision-makers across the public and private spheres who are keen to devise and implement strategies to ensure sustainable development. Such measures consequently allow the avoidance of further losses and the conception of approaches aligned with broader developmental objectives. It further remains essential, in this context, to ensure that the integrity of the information presented fully conforms to the highest ethical principles, given the nature of the farming practices encountered. Given the limited availability of data sources, verifying the information presented herein is particularly difficult. Scholars across both the agricultural and environmental disciplines are strongly encouraged to conduct further systematic research. Such initiatives would enable consideration of other major, urban areas, practices, and their associated effects and facilitate the comparison of sectors and aspects outlined in significantly greater depth, thus considerably enriching the existing body of knowledge and undertaking the necessary interrogation of potentially sensitive material (Douabul, 2026; AlSadi & AlSadi, 2018).

13. Conclusion

Iraqi environmental loss extends well beyond visual deterioration and ecological changes. Throughout the country, aggregate ecosystem decline and associated reduction in services undermine agriculture, flood control, disease mitigation, and climate regulation (Hashim, 2017). Desertification, water scarcity, and pollution aggravate hardship and instability among already vulnerable populations. Oil-related contaminants, dust storms, and chemical residues add further health hazards (Okorodudu-Fubara, 1991). Land mismanagement and competing claims on natural resources accelerate deterioration. Without timely, substantial investment in restoration, degradation is expected to worsen, with dire humanitarian consequences. Failure to address urgent environmental concerns jeopardizes sustainable economic recovery and undermines stability, national governance, and social cohesion across Iraq (Douabul, 2026).

The loss of environmental services and coping mechanisms not only complicates recovery but also links to strife and insecurities nationwide. Ecosystem conditions are critical to food security and nutrition across rural and urban areas, and land mismanagement increases vulnerability to social and economic shocks. Local and external pressures on public health, food security, water access, education, and social justice magnify threats to governance and stability. Intensified degradation, exacerbating toil on livelihoods, undermines social ties, trust, and confidence in the state, fuelling conflict and insecurity. Strong patterns of heavy metals, organics, nutrients, and hydrometer pollutants illustrate the continued risk to ecosystems, society, and human health posed by long-term economic growth, poverty alleviation, and social stability. Robust action to promote sustainable growth, restore damaged ecosystems and basic community services, and safeguard clean air and water across Iraq is critical and urgent.

14. Recommendations

The operational strategy of Iraq's permanent Ministry of Science and Technology prioritizes environmental preservation within the national sustainable development agenda (Nasser, 1970). Environmental loss and degradation engender an array of governance and resource-based challenges. Land and resource management disputes remain acute within and between communities, and the reliance on low-quality groundwater has increased. Assessments and actions are warranted to respond adaptively to evolving and emerging environmental challenges. As a result of Desertification combating activities, the extent of desertified land has decreased considerably (Hashim, 2017). The preservation of primary wetlands and the Satellite Wetland of Hawr al-Azim are also priorities for inclusion in UNESCO's World Heritage List.

Specific, actionable recommendations for addressing unresolved environmental stressors and improving the management of natural resources, while considering governance challenges, have been assembled. The recommendations cover six key areas: polluted land and water resources; transboundary water management; enhancement of biodiversity; climate change, dust storms, and water logging; risk of environmental disasters; and a strategy for oil sector development and rehabilitation. These recommendations highlight environmentally sound practices for resource rehabilitation and management at the national level. The local implementation priority of fostering biodiversity protection measures emerged from the consultations.

15. Concluding Thoughts and Personal Reflection on the Journey

Environmental loss is one of the many tragic results of years of conflict and war in Iraq. A review of Iraq's historical background suggests several major factors that affect the environment today. Iraq suffers from degradation of its land, water, air, and biodiversity directly attributable to eight major drivers of environmental degradation. Conflict and war are fundamental drivers of degradation. Countering environmental degradation in Iraq requires urgent attention. Multiple measures can be undertaken to help address the problem. Nevertheless, many of the steps, such as pollution control, ecosystem restoration, and sustainable water management, are already part of national strategies and priorities. However, the difficult reality remains that decades of competitive politics, internal conflict, economic sanctions, war, and international isolation have weakened successive governments' ability to enact coherent, effective policies across all areas, including the environment. This situation formed the background for the 2021–2022 survey of the environmental situation in Iraq recently completed by the Arab Council for the Social Sciences, the Environment and Sustainable Development Network, and the United Nations University Institute for Water, Environment and Health (Okorodudu-Fubara, 1991).

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