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THE WATER CRISIS IN IRAN: THE PROBLEM OF SUSTAINABILITY AND STRATEGIC REPERCUSSIONS

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Abstract

Over recent decades, Iran has experienced a severe escalation in its water crisis, transforming it from an environmental concern into a structural challenge that threatens economic, social and political stability. The paper argues that the roots of the crisis extend beyond natural water scarcity and climate change, encompassing failures in water governance, weak planning mechanisms, the politicization of environmental policymaking and the neglect of scientific warnings. It seeks to analyze the institutional foundations of the crisis and assess its implications for food security, social stability and infrastructure, while also evaluating the viability and long-term sustainability of proposed alternatives, including water desalination, water transfer projects and demand-management policies.

Employing a public policy analysis approach, the paper concludes that the continuation of current policies is widening the implementation gap and further intensifying the crisis, making water scarcity one of the most serious strategic threats to Iran's future stability.

Keywords: Iran, water crisis, sustainability, water governance, food security, strategic challenges.

Introduction

Despite Iran being situated largely within arid and semi-arid climatic zones, the sharp escalation of the country's water crisis in recent years raises a research problem that extends beyond explanations based solely on natural scarcity. The central question of this paper concerns how the water challenge evolved from a manageable technical issue into a structural crisis affecting the sustainability of urban life in major cities such as Tehran and Isfahan, while also carrying implications for national security.

The paper seeks to address this question by testing the hypothesis that deficiencies in water governance, the politicization of development policies and the marginalization of scientific considerations in public decision-making have been decisive factors in intensifying the crisis and transforming it into a strategic threat to state stability.

Historical Background and Topographical Dimension

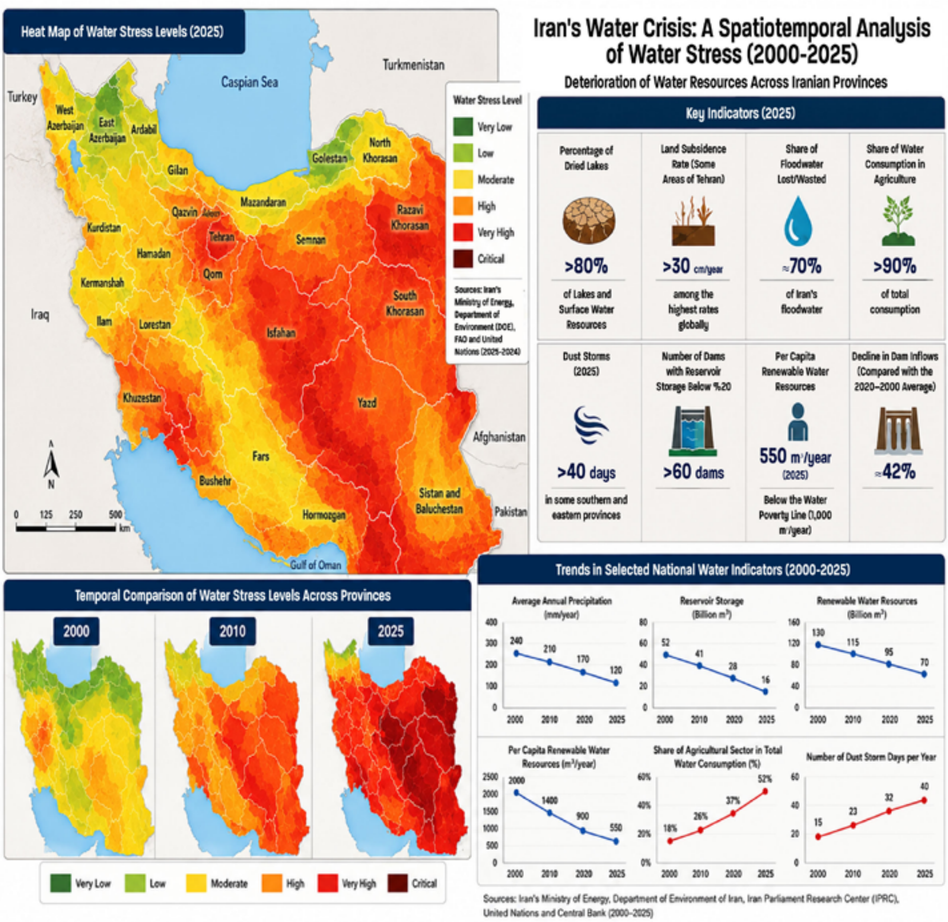
Iran's water crisis predates contemporary developments and is deeply rooted in the country's geographical environment. The Iranian plateau lies within an arid and semi-arid[(1)] climatic belt characterized by irregular seasonal rainfall, stark geographical disparities in the distribution of water resources and high evaporation rates. These conditions have made water an existential issue since the earliest stages of human settlement in Iran. Scarcity was therefore not an exceptional circumstance, but rather the natural context within which urbanization, agriculture and social organization evolved. In ancient times, particularly during the Achaemenid Empire period, Iranians developed the underground canal system known as the *qanat* or *karez*, an engineering innovation designed to transfer groundwater from elevated aquifers to agricultural lands through subterranean tunnels, thereby reducing losses caused by evaporation.[(2)] This system became the foundation of agricultural stability across extensive parts of the Iranian interior and enabled the emergence of cities and productive centers in relatively arid environments. The *qanat* system was not merely a technical solution; it was also associated with a sophisticated framework governing water ownership and distribution. This framework constituted a precise legal and social system regulating water shares and rights of usage, reflecting an early awareness of the importance of effective management of scarce water resources.[(3)]

During the Islamic and medieval eras, underground canal systems continued to constitute the backbone of agricultural production in Iran. Nevertheless, the country experienced recurring periods of drought that affected various regions and, at times, resulted in population displacement or the decline of entire cities. Responses to these crises generally centered on rehabilitating existing *qanat* networks, excavating new channels or redistributing water resources among villages and agricultural areas.[(4)] Under the Safavid dynasty, the state pursued more organized irrigation policies, expanding irrigation networks in some central regions while continuing to depend primarily on groundwater resources. Although these systems succeeded in maintaining a relative ecological and agricultural balance for centuries, they remained fundamentally dependent on the regularity of rainfall and the natural rates of groundwater recharge.(5)

In the 19th century, the water crisis in Iran deepened as a result of population growth and the deterioration of traditional irrigation canal maintenance in certain regions. Periods of severe drought coincided with economic and political crises, contributing to widespread famines, most notably the famine of the 1870s, which exposed the vulnerability of the agricultural system to climatic fluctuations.(6) Despite these challenges, the responses adopted at the time largely remained within the traditional framework, relying on the repair or expansion of irrigation canals without introducing a fundamental transformation in the philosophy of water management. A major turning point emerged in the 20th century with the introduction of modern drilling technologies and mechanical pumps into the water sector, particularly from the mid-20th century onward. These developments enabled the extraction of increasingly large quantities of groundwater, in some areas exceeding natural recharge rates. At the same time, the government initiated the construction of large dams aimed at storing surface water and regulating seasonal water flows. This transition reflected a broader shift from a philosophy based on adapting to scarcity toward one centered on engineering control over water resources. However, the arid climate and high evaporation rates reduced the efficiency of some of these projects, while pressure on underground aquifers continued to intensify.

During the 1990s, Iran experienced a significant escalation in water stress as a result of recurring droughts and rising temperatures. These developments contributed to declining groundwater levels, the drying up of some historic canal systems and falling water levels in inland bodies of water such as Lake Urmia. These developments suggest that the deeper origins of Iran's water crisis — as a structural imbalance between renewable water resources and human consumption — can be traced to the second half of the 20th century. During this period, rates of extraction began to exceed the capacity of renewable resources to replenish themselves, driven by uncontrolled expansion in groundwater pumping and dam construction, alongside weak institutional coordination. The resulting crisis has generated political, social and economic repercussions, reinforcing the argument that the core of the problem is linked less to the inherent characteristics of Iran's arid climate than to deficiencies in governance and demand management.

Environmental and economic indicators in Iran reveal that the water crisis is no longer merely a problem of resource scarcity, but has evolved into a multidimensional structural crisis that directly threatens the country's national security as well as its social and economic stability. For more than two decades, the country has faced successive waves of drought, accompanied by a sharp decline in precipitation rates and an unprecedented reduction in the storage levels of dams and groundwater reserves. Some of the major dams supplying the capital, Tehran, have fallen to approximately 10% of their storage capacity, while dozens of other dams are now on the verge of drying up.(7) The crisis is further aggravated by the excessive depletion of groundwater resources: more than 70% of Iran's plains have entered critical or "water-prohibited" zones. This has coincided with land subsidence rates in parts of Tehran exceeding 30 centimeters per year — one of the highest rates recorded globally. In addition, estimates indicate that more than 80% of Iranian lakes have dried up, while vast areas of wetlands have been transformed into sources of dust storms.(8)



This situation reflects the expansion of the crisis from a purely environmental issue into a direct threat to the country's economic, urban and public health infrastructure. This is clearly illustrated by the following heat map, which shows the varying degrees of deterioration in water resources across Iran's different regions.

These figures reveal a profound imbalance in the management model of water resources. This imbalance is particularly evident in the continued pursuit of water-intensive agricultural policies, unbalanced urban and industrial expansion and the low efficiency of irrigation and storage networks. Furthermore, economic sanctions have significantly hindered the modernization of water infrastructure and investment in desalination and water recycling technologies. Consequently, the water crisis in Iran is no longer solely an environmental issue; it has become a clear indicator of a broader crisis in governance and comprehensive development that threatens the long-term sustainability of the state and society.

Iran's water crisis represents a complex condition shaped by the cumulative interaction between natural constraints and structural as well as administrative factors, transforming initial climatic scarcity into a prolonged structural crisis. From a geographical and climatic perspective, Iran lies largely within arid and semi-arid zones, with average annual rainfall estimated at approximately 228 millimeters, substantially below the global average. Rainfall distribution across the country is highly uneven, with the highest precipitation levels concentrated in the northern regions bordering the Caspian Sea, while central and southeastern regions experience significantly lower levels of rainfall.

Table 1: Disparities in Water Resources Across Iran's Major Basins

Name of Basin	Share of Iran's Total Area (%)	Share of Renewable Water Resources (%)
Markazi	52	29
Arabian Gulf and Gulf of Oman	25	46
Caspian Sea Basin	10	15
Hamoon	7	2
Lake Urmia	3	5
Sarakhs	3	3

Source: Food and Agriculture Organization of the United Nations (FAO), I*rrigation in the Middle East Region in Figures: AQUASTAT Survey 2008*, Water Reports No. 34 (Rome: FAO, 2009), 189, https://www.fao.org/4/i0936e/i0936e00.pdf.

The country's hydrological system also suffers from a pronounced temporal imbalance, as precipitation is concentrated mainly during the winter season, followed by long and dry summers. This pattern contributes to elevated evaporation rates and reduces the effective volume of water available for both surface storage and groundwater replenishment. In addition, the mountainous topography of many water basins[9] accelerates surface runoff and weakens the long-term natural recharge capacity of underground aquifers.[10]

However, despite creating a condition of structural water scarcity, these environmental characteristics alone would likely not have evolved into a chronic crisis had they not intersected with broader development policies and patterns of governance. These factors include the succession of different administrations alongside weak coordination among state institutions, the random prioritization of large-scale projects detached from principles of sound resource management and the absence of participatory policymaking and transparent governance mechanisms.

The crisis has also been exacerbated by poor agricultural planning and weak resource management, in addition to unregulated urban expansion, administrative corruption and the lack of effective emergency planning mechanisms for dealing with climate change and recurring droughts in Iran.

Successive Administrative Bodies Characterized By Weak Coordination

The succession of administrations and the multiplicity of institutions involved in water resource management constitute one of the structural roots of the water crisis in Iran. Over time, a governance model emerged that combined formal centralization with a practical fragmentation of decision-making centers and overlapping jurisdictions among the Ministries of Energy and Agriculture, the Environmental Protection Organization, urban planning bodies and local authorities. Water management responsibilities were therefore distributed among institutions with differing sectoral priorities and without an effective coordination mechanism. This institutional fragmentation contributed to inconsistent and fragmented policies, weakened coherence in decision-making and encouraged the prioritization of short-term considerations at the expense of long-term sustainability. In addition, the changing orientations of successive administrations hindered the development of a cumulative reform process grounded in periodic assessment and institutional continuity. Limited transparency and the absence of comprehensive data further obstructed evidence-based planning and reduced the state's capacity to regulate irregular water use, particularly in relation to unlicensed wells. As a result, water governance remained dominated by a fragmented sectoral logic, far removed from an integrated management approach. This dynamic transformed natural scarcity into a chronic institutional crisis that, according to the paper's argument, could have been anticipated had Iranian authorities not continued policies associated with the mismanagement and depletion of natural resources. In this context, researcher Kaveh Madani, director of the United Nations University Institute for Water, Environment and Health, described the situation as a form of "bankruptcy management" resulting from resource mismanagement and depletion.[11]

Focusing on Megaprojects Without Diligence

Water management in Iran has been marked by a pronounced emphasis on large-scale engineering projects within a security-oriented and technocratic framework that treats water resources as an issue tied to national sovereignty and security. This approach prioritized expanding supply through dam construction and increasing water storage capacity.

However, reports have indicated that water reserves in dams supplying Mashhad and eastern regions of the country have fallen to critical levels. The director-general of the Mashhad Water Company stated that reservoir levels in these dams had declined to less than 3% of their total capacity due to prolonged drought conditions.(12) Reports also cited Iranian President Masoud Pezeshkian warning that the continuation of drought conditions could lead to water rationing measures and even force the evacuation of Tehran if the crisis persists. Meanwhile, Abbas Aliabadi, the minister of energy, confirmed that the government might resort to suspending evening water supplies in order to allow dam reservoirs to recover.(13) Despite the scale of these infrastructure projects, the strategy of increasing supply without implementing effective demand management mechanisms has contributed to what may be described as a "bounce-back" effect. The perception of expanded water availability encouraged further growth in water-intensive activities, particularly in the agricultural sector, thereby reproducing water deficits cyclically rather than alleviating the underlying structural pressure on resources.

Uncontrolled Urban Growth in the Absence of Integrated Policymaking

Rapid urban expansion and accelerating population have intensified the imbalance between water supply and demand in Iran. While urban and industrial water needs have continued to rise, the volume of renewable water resources has remained relatively stable. Press reports indicate that per capita renewable water availability has steadily declined, approaching the water stress threshold defined by the Falkenmark Index (1,700 cubic meters per year per person). This decline is attributed to population growth and the expansion of major cities such as Tehran and Mashhad, without corresponding improvements in integrated water management planning. Additional reports highlight the impact of rapid urbanization on water supply networks and infrastructure, noting that increasing pressure on surrounding basins has exceeded their natural replenishment capacity.(14) This situation is closely linked to the absence of effective participatory water governance policies. Mechanisms for involving local communities, farmers and municipalities in water-related decision-making have remained limited, weakening compliance with conservation measures and contributing to a growing trust deficit between the state and society. Consequently, population growth combined with weak urban planning and the lack of transparent participatory governance has transformed demographic pressure from a manageable challenge into a prolonged structural crisis.(15)

Table 2: Iran's Renewable Fresh Water

Year	Annual Renewable Water Availability (cubic meters per capita)
1956	7000
2000	2001
2018	1700
2025	1300
Future	750

Source: Kaveh Madani Larijani, "Iran's Water Crisis: Inducers, Challenges and Counter-Measures" (paper presented at the 45th Congress of the European Regional Science Association, Vrije Universiteit Amsterdam, Amsterdam, Netherlands, August 23–27, 2005), 9–10.

Climate Change, Recurrent Drought and Poor Agricultural Planning

The shift from natural water scarcity to a structural water crisis in Iran is closely associated with development choices adopted since the second half of the 20th century. The country pursued a development model that prioritized agricultural expansion and the goal of food self-sufficiency. This approach led to a steady increase in irrigated land, alongside major investments in dams, irrigation networks and inter-basin water transfer projects, collectively raising overall water demand to levels approaching the limits of available renewable resources. It is estimated that the agricultural sector accounts for approximately 90% of total water withdrawals — significantly higher than the global average — reflecting a structural imbalance in sectoral water use. In response to rising demand, reliance on groundwater sources increased substantially, with around 60% of irrigation now dependent on groundwater extraction. This situation, combined with subsidies for energy used in pumping, reduced the effective cost of water and weakened incentives for conservation, contributing to the widespread expansion of both legal and illegal wells and the progressive depletion of aquifers.(16) These dynamics have been accompanied by clear environmental degradation, including declining groundwater levels and the emergence of phenomena such as land subsidence and soil salinization, which have reduced the resilience of the water system. At the same time, climate change and recurring droughts have intensified these pressures, as rainfall patterns have become more erratic and generally declined, limiting the capacity of water basins to recover and complicating long-term planning amid growing agricultural and industrial demand.(17)

Administrative Corruption and Political Loyalties

The Iranian water crisis underscores a strong administrative and political dimension, with institutional corruption and governance failures identified as key drivers of unequal water distribution across regions, reflecting political and economic priorities rather than hydrological necessity.

For example, Iran's Isfahan Province experienced widespread protests by farmers who accused the authorities of diverting water from the Zayandeh River away from agricultural lands toward industrial uses and other regions, particularly Yazd. These diversions contributed to a severe local crisis and reduced water availability, even as drought conditions worsened.

In response, some protesters reportedly damaged water pipelines in protest against what they viewed as violations of their water rights. Meanwhile, Iranian authorities were compelled to shut down certain facilities and dispatch water tankers to supply Yazd, reflecting the prioritization of industrial development and politically or economically strategic cities. This dynamic has contributed to recurring social tensions.(18) Analytical assessments further suggest that inter-basin water transfers have not been guided solely by technical or climatic considerations, but have also been shaped by networks of political and economic interests. These arrangements have tended to favor central industrial centers, including heavy industries in Isfahan and Yazd, at the expense of agricultural regions and local communities, thereby deepening perceptions of injustice and weakening public confidence in state water governance.(19)

Proposed Solutions and Strategies for Remediation

With the worsening water crisis in Iran and its growing economic, social and environmental consequences, the government and research institutions have proposed a set of technical and administrative measures aimed at reducing pressure on water resources and improving water security in the medium and long term. These proposals include expanding desalination capacity, applying cloud seeding technologies, promoting water recycling and wastewater treatment and modernizing agricultural irrigation systems.(20) However, an assessment of these options shows significant differences in their economic feasibility, environmental impact and capacity to ensure long-term sustainability. This makes it necessary to evaluate them within the broader framework of integrated water resources management.

Desalination as a Strategy to Enhance Water Supply

Desalination has become an increasingly prominent option in water policy debates in Iran, particularly in light of declining domestic water resources and recurring droughts across many basins. In this context, the government has proposed large-scale projects to transfer desalinated water from the Arabian Gulf and the Sea of Oman toward the Iranian plateau to supply cities and industrial zones.

A notable example is an approximately 800-kilometer pipeline designed to transport desalinated water from the Sea of Oman to the central plateau, including major industrial facilities in Isfahan Province, such as the Mobarakeh Steel

Complex.[21] This initiative is intended to reduce pressure on inland river systems affected by recurrent droughts, particularly the Zayandeh River, which has experienced a significant decline in flow in recent years.

However, several studies indicate that this approach faces substantial economic and environmental constraints. According to an analysis published by the Stimson Center, desalination combined with long-distance water transfer requires very large investments in infrastructure and energy consumption, in addition to potential water losses during transport across arid desert regions. Environmental concerns are also significant, particularly regarding the discharge of brine produced during desalination into marine ecosystems, which may increase coastal water salinity and negatively affect marine biodiversity. Some researchers argue that while desalination may be suitable for meeting urban and industrial demand in coastal areas, it is considerably less viable for large-scale agricultural use due to its high cost relative to agricultural economic returns.[22]

Cloud Seeding to Enhance Rainfall

In addition to desalination initiatives, Iran has increasingly turned to cloud seeding technology as a supplementary method to enhance rainfall in drought-affected regions. This technique involves dispersing chemical substances into clouds to encourage condensation and increase the likelihood of precipitation. In recent years, Iranian authorities have carried out multiple aerial and ground-based cloud seeding operations across various parts of the country. While some studies suggest that cloud seeding may produce limited increases in rainfall under specific meteorological conditions, its effectiveness remains a subject of scientific debate. The success of such operations depends on the presence of suitable cloud formations with sufficient density and moisture content — conditions that are often absent in areas already experiencing prolonged low rainfall. As a result, many experts argue that cloud seeding cannot serve as a comprehensive solution to the crisis, but rather as a supplementary measure with limited potential benefits in specific cases. From an economic perspective, cloud seeding programs are relatively less costly than large-scale desalination or inter-basin water transfer projects. However, their overall impact remains constrained in the context of a structural water crisis driven by weak governance of water resources and persistently high demand, particularly in the agricultural sector.

Water Recycling and Wastewater Treatment

Reusing treated wastewater is considered a promising option for enhancing water availability without placing additional pressure on natural resources in Iran. Numerous reports indicate that a substantial share of wastewater remains underutilized, with large volumes discharged without adequate treatment, effectively representing a loss of a potentially recoverable water resource that could be reused across multiple sectors. One of the main advantages of this approach is that it is generally less costly than desalination, while also helping to reduce environmental pollution caused by the discharge of untreated wastewater into rivers and lakes. Treated wastewater can be used for irrigating non-food crops or for industrial purposes, thereby easing pressure on freshwater sources. However, expanding wastewater reuse requires significant investment in sewage networks and treatment infrastructure, along with the establishment of a clear regulatory framework defining reuse standards and ensuring water safety. It also necessitates greater public awareness and acceptance of the use of treated water in certain economic activities.

Upgrading Irrigation Systems and Enhancing Water-Use Efficiency in Agriculture

Improving water-use efficiency in the agricultural sector is considered one of the most important responses to the water crisis in Iran, particularly given that agriculture consumes around 90% of the country's total water resources while contributing only about 12% to GDP. A large share of agricultural activity still relies on traditional irrigation methods, such as flood irrigation, which are highly inefficient and result in substantial water losses through evaporation and seepage. Accordingly, many studies advocate transitioning toward modern irrigation systems such as drip and sprinkler technologies, which can significantly reduce water consumption while improving agricultural productivity. However, some researchers emphasize that irrigation modernization must be accompanied by broader agricultural policy reforms. These include reassessing the cultivation of water-intensive crops in arid regions and encouraging crops better suited to local climatic conditions. Without such structural adjustments, improvements in irrigation efficiency may also produce a bounce-back effect, whereby water savings are offset by the expansion of irrigated land, ultimately increasing total water consumption rather than reducing it.

The foregoing review of proposed responses to the water crisis in Iran indicates that none of the available options can be considered a standalone solution. Instead, they must be assessed within a comprehensive water resources management framework. Any proposed solution to Iran's water crisis must include profound structural changes. Rather than merely addressing technical issues, it requires comprehensive institutional reform to strengthen cross-sectoral integration and reshape agricultural policies based on actual water availability. Furthermore, demand management must be reassessed by restructuring price scales, improving irrigation efficiency and strengthening governance mechanisms.

Political, Socioeconomic Repercussions

The water crisis in Iran is no longer a purely environmental issue; it has evolved into a complex phenomenon with wide-ranging political, economic and social consequences. The interaction between limited natural water resources, water-intensive development choices and weak governance has directly affected food and water security, as well as patterns of urban expansion in major cities.

The accelerated depletion of groundwater has intensified land subsidence and aggravated environmental degradation, posing risks to infrastructure and ecological stability.[23] At the same time, the crisis has disrupted industrial sectors and contributed to rising social tensions and protests, increasingly emerging as a factor undermining the country's political and economic stability.

The Impact on Food and Water Security and Urban Growth

The repercussions of the crisis are not limited to water scarcity alone, but extend to food security, water security and the sustainability of urban growth in major cities in Iran. Analyses suggest that the crisis stems from structural imbalances in resource management and development policies, and has been further exacerbated by prolonged drought and climate change, making its impacts multidimensional and interconnected.[24]

In terms of food security, water scarcity has significantly affected the agricultural sector, which consumes the vast majority of the country's available water — estimated at over 80%–90% of total consumption — while contributing a relatively small share to gross domestic product (GDP). This pattern of intensive water use reduces resource efficiency, limits the extent of irrigable land, increases the risk of crop failure, lowers agricultural productivity and raises dependence on food imports. A report in *Tehran Times* indicated that water scarcity has reduced the flow of rivers and irrigation canals, threatening the productive capacity of local farms and increasing the cost of agricultural production.[25]

At the level of urban water security, major cities in Iran such as Tehran, Isfahan and Mashhad are experiencing severe water shortages as a result of declining dam reserves and ongoing groundwater depletion. In Tehran in particular, some reservoirs supplying the city have fallen to levels below 10% of their capacity. This situation prompted Iranian President Masoud Pezeshkian to warn of the possibility of implementing water rationing measures, and even raised the prospect of evacuating the capital if sufficient rainfall does not occur. These warnings underscore the severity of the crisis and its direct impact on the basic water supply of urban populations.[26]

In terms of urban growth and development, rising water demand in cities across Iran has placed increasing pressure on existing infrastructure, which has struggled to keep pace with expanding needs. Population growth in major urban centers has further intensified demand for essential services such as drinking water, sanitation and energy, all of which require reliable water supplies.

However, declining rainfall, continuous groundwater depletion and weak urban planning have reduced cities' capacity to meet this growing demand, widening the gap between available water resources and the requirements of urban expansion.[27] Overall, these developments indicate that Iran's water crisis has moved beyond a purely technical environmental challenge to become a multidimensional threat to food security, water security and sustainable urban development. This situation calls for comprehensive strategic interventions that go beyond fragmented or temporary measures such as short-term rationing, and instead emphasize long-term institutional reforms and enabling policy frameworks.

Depletion of Groundwater Resources, Inducing Land Subsidence and Environmental Degradation

Groundwater resources represent a vital strategic reserve in Iran, particularly in the context of severe rainfall deficits and recurring droughts. However, this reserve has itself come under unprecedented pressure due to intensive and largely unregulated extraction.

A comprehensive assessment of the crisis indicates that excessive groundwater consumption — driven by intensive agricultural policies, the absence of effective water pricing mechanisms and weak oversight of wells — has led to a significant decline in groundwater levels across many basins. As a result, groundwater has increasingly shifted from serving as a buffer against water scarcity to becoming a central factor in exacerbating the crisis.

Moreover, the agricultural sector, which accounts for approximately 90% of total water withdrawals, relies heavily on groundwater pumping, with groundwater supplying nearly 60% of irrigation needs. This reliance is reinforced by the lack of strict regulatory control over wells and the absence of realistic pricing structures that reflect the true cost of extraction and treatment. Consequently, many farmers have resorted to drilling deep wells to meet their water demands, often without effective regulation or enforcement, contributing to continuous depletion of aquifers in several regions.(28) Data from specialized studies further show that certain groundwater basins in Iran have experienced sharp annual declines at rates exceeding the global average. This trend indicates that the water system has progressively lost much of its natural resilience, becoming increasingly vulnerable to climatic shocks and rising demand pressures.

One of the most significant environmental consequences of groundwater depletion in Iran is land subsidence, defined as the gradual sinking of the ground surface resulting from the loss of water in sedimentary soil layers. Analytical reports indicate that subsidence rates in certain regions have reached historically high levels compared to previous decades, posing serious risks to critical infrastructure such as roads, railways, airports and residential areas. This deformation of land structure represents one of the most severe manifestations of the crisis, as it increases maintenance and reconstruction costs while also threatening public safety.(29)

In addition to subsidence, a range of sensitive ecosystems — including salt lakes and wetlands — are under increasing threat due to declining water levels, rising soil salinity and reduced surface runoff. This environmental degradation not only undermines biodiversity but also contributes to a higher frequency of dust storms affecting both urban and rural areas, with negative consequences for public health and air quality.

Reports also highlight that Lake Urmia — one of the largest salt lakes in the Middle East — has experienced a rapid reduction in its surface area, disrupting local climatic conditions and ecological balance in surrounding regions.

Overall, the depletion of groundwater resources in Iran is no longer merely a response to immediate water needs, but rather a manifestation of deeper systemic challenges, including weak regulatory frameworks, inadequate governance and pricing structures that fail to reflect the real cost of water. These developments have produced serious environmental consequences such as increased land subsidence and ongoing ecosystem degradation, underscoring that Iran's water crisis is not simply a matter of scarcity, but a fundamental environmental transformation affecting both natural systems and human life.

Impact on the Domestic Front

Iran's water crisis is among the most serious structural challenges facing Iran today. It has moved beyond the scope of an environmental issue to become a multidimensional crisis with economic, social and political dimensions. This situation has been exacerbated by climate change, declining rainfall, excessive groundwater depletion and systemic mismanagement. More than 80% of water resources are consumed in agriculture using traditional and inefficient methods, further widening the gap between supply and demand.(30)

The water crisis has had profound effects on both the industrial sector and local economies. Water-intensive industries such as petrochemicals and steel production have been particularly affected, especially in regions like Isfahan and Khuzestan Province, which depend on limited and unstable water resources. Water shortages have forced many industrial facilities to reduce output or temporarily suspend operations, while others have adopted costly measures such as water recycling or long-distance water transport, increasing operational costs and reducing competitiveness. The crisis has also been aggravated by uneven industrial expansion in already water-stressed areas, placing additional pressure on limited resources rather than alleviating it.(31) Its impact extends beyond industry to the broader economic and social fabric of affected regions. River diversions and inter-basin transfer projects have reduced agricultural activity and caused significant livestock losses, severely affecting local livelihoods, particularly in Khuzestan Province.(32) In Isfahan, repeated drying episodes of the Zayandeh River have led to declines in agriculture and tourism, further deepening economic losses. Sharp reductions in dam storage levels, in some cases falling to less than one-third of capacity, reflect the severity of the crisis and its wide-ranging consequences across multiple sectors.(33)

International studies indicate that a 20% loss of Iran's water resources could result in a potential 7% reduction in the country's future GDP relative to the 2016 baseline, should the contraction of the agricultural sector and associated agricultural employment due to water scarcity persist.(34) In addition, Iran's cash crops that generate significant foreign exchange earnings — such as pistachios, saffron and various fruits — would be severely affected by the water crisis. Notably, horticultural crops including oranges, grapes and tea together account for approximately 60% of the total area dedicated to rain-fed horticultural production. Furthermore, the petrochemical industry, which is highly water-intensive, alone represents more than 30% of Iran's non-oil exports and generates roughly $25 billion in annual revenue. Disruption to this sector would deprive the country of a critical source of foreign exchange, thereby contributing to depreciation of the national currency and heightened inflation rates.

It is well established that Iran generates a portion of its domestic electricity from hydropower, which previously accounted for more than 10% of total production. However, this share has declined significantly due to water scarcity. The resulting water shortages have created a substantial electricity generation shortfall of approximately 25,000 megawatts. Power outages have become a recurrent phenomenon over the past three years. In some cases, the country has even been compelled to import electricity, despite its abundant reserves of fossil fuels.

Impact on Social Stability

On the social front, the water crisis in Iran has emerged as a major driver of public protests in recent years. The country has witnessed repeated waves of mobilization, particularly in 2018, 2021 and 2025, with concentrations in provinces such as Khuzestan Province and Sistan and Balochistan Province. These protests have been largely fueled by water shortages and deteriorating living conditions.

The demonstrations have involved a broad social base, including farmers, workers and students, reflecting the transformation of the issue from a narrow service-related concern into a wider societal problem with human rights dimensions. Protesters have increasingly linked access to water with notions of social justice, indicating a growing environmental and rights-based awareness within society.

These dynamics are closely connected to a broader economic context characterized by high inflation, unemployment and declining purchasing power, making the water crisis a contributing factor to social unrest rather than an isolated issue.(35) Perceptions of unequal resource distribution among regions have also deepened the trust deficit between citizens and the state, as public opinion increasingly attributes the worsening crisis to mismanagement more than to natural conditions, reinforcing its complex political and social character.(36)

On the political level, the water crisis in Iran represents a direct structural challenge to internal stability, falling within the framework of "environmental security," where natural resources become integral to national security calculations. The persistence of the crisis without effective structural solutions risks expanding the scope of social unrest, shifting it from demands for basic services toward broader political demands, particularly as public awareness grows regarding the role of mismanagement in exacerbating the situation.

Competition over increasingly scarce water resources also intensifies regional tensions, especially in marginalized provinces, deepening internal divisions and further weakening national cohesion. In this context, the state's limited capacity to manage water resources efficiently contributes to a gradual erosion of political legitimacy, particularly amid warnings that some cities may approach the so-called "Day Zero"(37) droughts; periods of extreme water scarcity; a scenario associated with the risk of widespread unrest.

The situation is further complicated by economic constraints that limit investment in water infrastructure, thereby reducing the effectiveness of official responses. The political dimension of the crisis also extends beyond national borders, as water scarcity may generate tensions with neighboring countries over shared water resources, while also contributing to internal displacement toward major urban centers, placing additional strain on public services. Consequently, the water crisis has become a key factor in reshaping political balances both domestically and regionally in Iran.(38)

Conclusion

The water crisis in Iran illustrates a complex case in which natural scarcity has evolved into a multidimensional structural crisis through the interaction of environmental constraints with institutional dysfunction and resource mismanagement. The paper concludes that the crisis is no longer solely an environmental challenge, but has become a determining factor influencing economic performance, social conditions and political stability, thereby requiring a comprehensive approach that goes beyond fragmented solutions toward deeper structural reform.

In this context, the roots of the crisis are linked to the interaction between natural limitations, unbalanced development policies and weak governance structures, which together have intensified water scarcity and transformed it into a chronic condition. The resource management model has revealed significant imbalances, particularly an emphasis on increasing water supply without corresponding attention to demand management, alongside weak institutional coordination and limited strategic planning. The crisis has produced wide-ranging economic and environmental consequences, including reduced agricultural and industrial output, groundwater depletion, ecosystem degradation and land subsidence. It has also contributed to rising social protests and a growing perception of inequality in resource distribution, thereby exerting direct pressure on political stability and perceptions of state legitimacy. At the same time, technological responses such as desalination and cloud seeding have demonstrated limited effectiveness in the absence of structural reforms addressing the underlying drivers of demand. Ultimately, sustainable management requires an integrated water resources management approach that prioritizes efficiency improvements, agricultural policy reform and strengthened transparency and accountability to achieve a more durable balance between available resources and development needs.

Endnotes

(1) The dry belt and the semi-arid belt are two climatic zones characterized by scarce rainfall, high temperatures and high evaporation rates. The dry belt receives very little rainfall (less than about 250 mm annually); deserts and sparse vegetation prevail, and life there depends on limited water resources. It is found across vast areas such as the Sahara Desert, the Arabian Peninsula and Central Asia. The semi-arid belt, by contrast, is a transitional zone that receives relatively higher rainfall (about 250 millimeters – 500 millimeters annually), which allows the spread of grasses and shrubs and limited agricultural activity, while remaining vulnerable to recurrent drought. It appears in regions such as the Sahel zone south of the Sahara and parts of Iran and Central Asia. See: Al-Hassan, Mohamed Ali, & Abdulrahman, Ali Ahmed, *Climate Geography: Climatic Regions and Their Characteristics.* (Cairo: Dar Al-Ma'rifa Al-Jami'iyya, 2015), 142–158.
(2) The transformation of the canal system in the Achaemenid era (6th–4th centuries BCE) into an institutional water policy, where the state encouraged the digging of canals to reclaim land and enhance agricultural stability in arid environments within the empire. Administrative organization and official support contributed to expanding their use and transferring the technology to other regions of West Asia, establishing it as a cornerstone of Achaemenid water engineering. For more see: Fairouz Megdiche-Kharrat, Rachid Ragala, Mohamed Moussa; "Promoting a Sustainable Traditional Technique of Aquifer Water Acquisition Common to Arid Lands: a Case Study of Ghassem Abad Qanat in Yazd Province," (Iran, Water Supply 19, 2, 2019), 527–535.
(3) Water ownership systems in traditional Iranian agricultural communities were based on the principle of regulated shares, where canal water (*qanat/karez*) was distributed according to fixed time schedules or customary proportional entitlements, alongside collective commitment to maintenance and local management. This socio-legal organization enabled the sustainability of the water resource and the regulation of disputes within villages across successive generations. For more see: Ann K. S. Lambton, "Landlord and Peasant in Persia, A Study of Land Tenure and Land Revenue Administration," *Journal of the Royal Asiatic Society* 87, no 1–2 (April 1955): 81–82.
(4) Fahim, Mohamed Hussein, *Climate Geography of Iran and Its Impact on Human Development* (Cairo: Dar Al-Fikr Al-Arabi, 2008), 112–114.
(5) Kazemi, M… *History of Water and Agriculture in Safavid Iran* (Tehran: Tehran University Press, 1385 SH), 45–52.
(6) In the 1870s, Iran witnessed a widespread famine caused by repeated drought waves that led to a sharp decline in agricultural production, rising food prices and extensive loss of livestock and crops, affecting the population's food security. Many families migrated from rural areas to cities in search of food and livelihoods, creating significant social pressures on urban centers. The crisis revealed the fragility of traditional water systems and their reliance on irregular rainfall, exacerbating human and economic losses. For more see Shahram Yousefifar, "Patterns of the Emergence of Cities and Urbanization in the History of Iran" *The History of Iran* 3, no. 1 (Spring 2010): 146–155. [Persian].
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(9) Iran is divided into six main river basins that differ in terms of renewable resources, area and population density — disparities that in some cases do not correspond to the volume of available water, representing one of the structural roots of the water crisis. These basins include: the Central Basin, the Arabian Gulf and Oman Sea Basin, the Caspian Sea Basin, the Hamoun Basin, the Urmia Lake Basin and the Sarakhs Basin. Attempts to redistribute resources among these regions lead to complex social, political and security implications due to their sensitivity to regional balances and local stability patterns. For more see: Mahmoud Hamdi Abu al-Qasim and Fathi al-Maraghi, "The Water Crisis in Iran: Dimensions and Implications Between Topographic Realities And The Regime's Options," *Journal for Iranian Studies (JIS)* 1, no. 4 (September 2017): 119-138, https://bit.ly/4eyNPGP.
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(22) Bita Ghaffari, "Iran Steps Up Cloud Seeding Amid Water Crisis," *Financial Times*, December 9 2025, accessed April 27, 2025, https://2u.pw/qmkhCT
(23) It refers to the continuous depletion of groundwater, recurring droughts and degradation of wetlands, which push ecosystems into a loss of their ability to recover. This results in permanent environmental transformations, including desertification and changes in soil properties and local climate.
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