Vol 14, No. 4, Winter 2025

University of Tehran Press

Journal of Water and Irrigation Management

Online ISSN: 2382-9931

Homepage: https://jwim.ut.ac.ir/

Identifying technical and non-technical aspects in Water Governance

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Article Info

Article type:
Research Article

Article history:
Received 16 June 2024
Received in revised form
13 July 2024
Accepted 25 July 2024
Published online 10 February 2025

Keywords:
Governance
Sustainable
Management
Water resources

ABSTRACT

This study investigates intricate water governance landscape in Iran, analyzing the challenges in water resource management. It highlights the nation's unique arid and semi-arid geography, identifying factors exacerbating the water crisis such as increasing demand and inadequate policies. Technical elements like rising temperatures and non-technical factors such as public awareness and legal frameworks are explored. The paper stresses unsustainable agricultural water practices and proposes governance reforms, including improved farming methods, upgraded irrigation systems, and enhanced inter-provincial collaboration. It advocates for a holistic water governance approach integrating modern agricultural techniques, natural infrastructure restoration, and robust monitoring mechanisms to address escalating water issues. The study's insights can inform the development of equitable and efficient water management strategies in arid regions.

Cite this article: Taeb, H., Rajaeei, T., & Majdzadeh Tabatabai, M. R. (2025). Identifying technical and non-technical aspects in Water Governance. *Journal of Water and Irrigation Management*, 14 (4), 921-933.
DOI: https://doi.org/10.22059/jwim.2024.378019.1169

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1. INTRODUCTION

Water governance is a critical and multidimensional issue in today's world. The effective management of water resources, balancing environmental sustainability, economic development, and social equity, has become increasingly complex. Globally, various regions confront with water-related challenges, making water governance a topic of importance in contemporary research and policymaking (Ben-Daoud *et al*., 2021). Iran, as a country with a long history of civilization and a diverse range of ecosystems, is no exception to the complexities of water governance. The unique geographical characteristics of the country, marked by arid and semi-arid regions, seasonal water scarcity, and a growing demand for water resources, make water management a deep concern. This article aims to deal with the intricate landscape of water governance in the country, investigating the challenges that shape the management of water resources in the country. By exploring the Iranian context, we hope to shed light on broader issues related to water governance and provide insights into the development of effective strategies for sustainable water management (Saatsaz, 2021). The topic of water governance, holds immense significance and necessitates comprehensive research for several compelling reasons. Firstly, water is an indispensable resource for sustaining life and fostering socioeconomic development. The responsible management of water resources is vital for ensuring access to safe drinking water, supporting agriculture, industry, and energy production, and safeguarding ecosystems. As Iran faces increasing water stress due to factors such as population growth, climate change, and inefficient water use practices, it becomes imperative to study and implement effective governance mechanisms. Secondly, water governance issues are inherently interdisciplinary. They require an intricate understanding of not only the technical aspects related to hydrology and infrastructure but also the social, economic, and political dimensions. In the case of Iran, exploring how these diverse facets intersect and influence water management policies and practices is critical. The challenges faced by Iran in managing water resources are reflected in various regions globally. Understanding the complexities of water governance in the country can provide a model for addressing similar issues in other arid and semi-arid areas. Furthermore, researching water governance in Iran presents an opportunity to evaluate existing policies and propose evidence-based recommendations for sustainable water management. By addressing the pressing issues related to water scarcity and equitable distribution, research in this field can contribute to improve the livelihoods of millions of people in Iran and serve as criteria for global efforts to address water challenges. The importance of investigating water governance, especially in the Iranian context, cannot be overstated. The urgency of the matter, its interdisciplinary nature, and its potential for broader applicability make it a compelling subject for research and policy development in pursuit of a sustainable water future.

Research question

How can sustainable water governance practices be developed and implemented in Iran? Exploring strategies and approaches to establish and enforce sustainable water governance in Iran to address water-related challenges.

2. MATERIALS AND METHODS

Increasing water scarcity is one of the major global challenges today. As local demand for water from agriculture, industry, households and the environment rises above available supply in many regions, the governance of available water resources becomes the key issue to achieve water security at the local, regional and global. In numerous regions worldwide, effective water governance is hampered by inadequate resource management, corruption, absence of suitable institutions, bureaucratic obstacles, limited capacity, and a dearth of new investments. Water governance refers to the structures and processes that define the allocation of water resources, including decisions regarding who receives access to water, when and how it is distributed, and the rights associated with water and its related services. The way water is governed profoundly affects whether these systems are able to deliver intended development outcomes. Water governance assessments can inform water sector reform and contribute to the achievement of development outcomes. Water governance is not only the water sector; it depends on the whole country. Accountability, integrity and participation are required at all levels of the political and public process. If these aspects are lacking, it becomes very difficult for policy experts to implement policy documents. From the practitioner’s point of view, assessment is a first step to trigger changes that are needed to improve sector performance by showing where interventions would have the most impact.

How an assessment can contribute to making change happen will differ depending on the specific objective and design of the assessment. Exploring water governance is interdisciplinary undertaking that primarily encompasses two dimensions: technical and non-technical analysis. The technical facet deals with physical aspects of the subject and places emphasis on factors such as temperature, desertification, droughts, floods, water resources, groundwater, agriculture, soil erosion, and land use changes. In contrast, the non-technical dimension recurs around social factors, with a particular focus on public awareness, sanctions, and legal aspects, which are the most critical areas of consideration (Fig. 1).

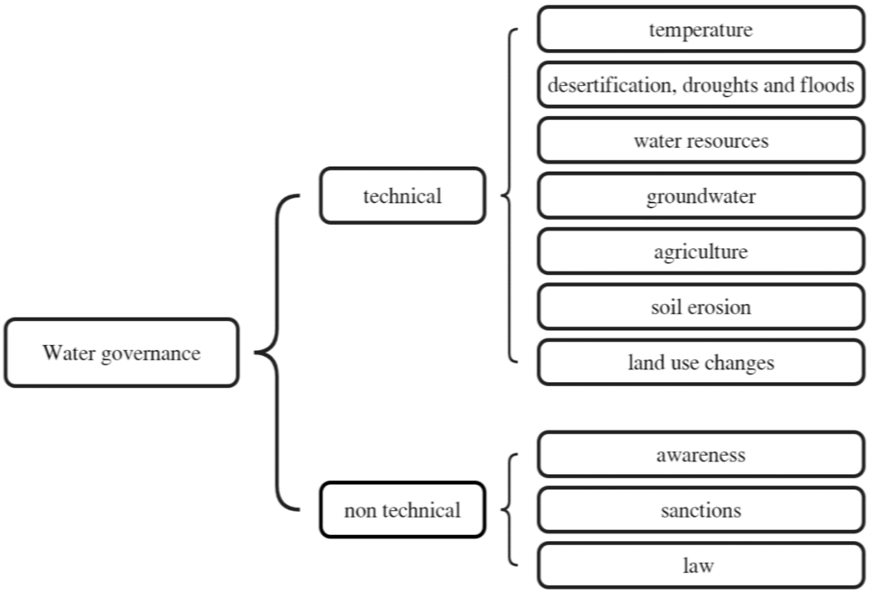

Figure 1. Exploring water governance based on two dimensions, technical and non-technical analysis

The study of water governance represents a comprehensive and interdisciplinary effort. One facet of this study deals with the technical dimension, focusing on the physical aspects of the subject matter. This requires paying considerable attention to various factors.

The technical explores intricate interconnections within the broader ecosystem. By meticulously examining physical parameters, a profound comprehension of the complexities of water governance is achieved, providing a solid foundation for the development of effective policies and sustainable management practices. The non-technical analysis could be even more compelling if it were linked to a specific geographic region, serving as a case study to exemplify the challenges that need to be investigated.

For example, water could be considered as a human right. The United Nations committee on economic, social and cultural rights adopted General Comment No. 15 on the right to water. In 2010, The UNGA adopted water and sanitation as a human right that is essential "for the full enjoyment by all human beings". Countries such as South Africa and Uruguay had already acknowledged water as a human right in their constitutions well before 2010. However, for many other countries, the more urgent issue is how to implement this right in combination with other factors. Therefore, dealing with the water governance in its entirety demands a holistic grasp of both the technical and non-technical dimensions. By identifying the gap between the physical and non-physical aspects and by scrutinizing specific regions through case studies, potent strategies can be developed to confront the urgent water-related issues confronting our world today. attempts have been made to introduce technical and non-technical dimensions related to water governance in Iran as follows:

Temperature

Greenhouse gases are gases in the Earth's atmosphere that trap heat from the sun and contribute to the greenhouse effect. These gases include CO_2, CH4, N_2O, and fluorinated gases (IPCC, 2015). The greenhouse effect is a natural process that helps to maintain the Earth's temperature and make it habitable

(IPCC, 2023). However, human activities, particularly the burning of fossil fuels, deforestation, and industrial processes, have greatly increased the concentration of greenhouse gases in the atmosphere (Yoro and Daramola, 2020).

The concentration of greenhouse gases has increased since the Industrial Revolution and likely will continue to increase in the future Yoro and Daramola, 2020). The process of climate change, particularly changes in temperature and rainfall patterns, is the most important issue in the field of environmental sciences. it has increasing importance due to its scientific and practical aspects (Abbass *et al*., 2022). The earth temperature change in the report of the Intergovernmental Panel on Climate Change has been calculated between 0.3 to 0.6 °C from 1900 to 1995 (Anderson *et al*., 2016). Surveys have shown the continuation of the trend of increasing the average annual temperature in Iran, this has existed in the past decades and will increase even more strongly in the coming decades. By which it may pull the trigger to enhance the extreme events.

Desertification, drought and floods

Desertification is a process by which drylands areas are degraded. More than 250 million people are suffered from the effects of desertification and more than 70% of drylands are currently subject to desertification (Emadodin *et al*., 2019a). Moreover, approximately one billion people around the world are at risk of the consequences of desertification (Emadodin *et al*., 2019a). Extensive tracts of land in marginal regions of global deserts have undergone degradation, with approximately 12 million hectares estimated to be experiencing desertification annually (AbdelRahman, 2023). Desertification poses a highly undesirable situation for agricultural land and human settlements, representing a significant environmental peril on a global scale (Emadodin *et al*., 2019a), as well as for Iran (Emadodin *et al*., 2019a). In the country, approximately 0.33 million km^2 is covered by desert and around one million km^2 of land is also at risk of desertification (Emadodin *et al*., 2019a). Desertification, the process of fertile land transforming into desert due to various factors, is influenced by a combination of anthropogenic activities and natural phenomena. factors affecting desertification maybe categorized in 4 groups being displayed in Fig. 2.

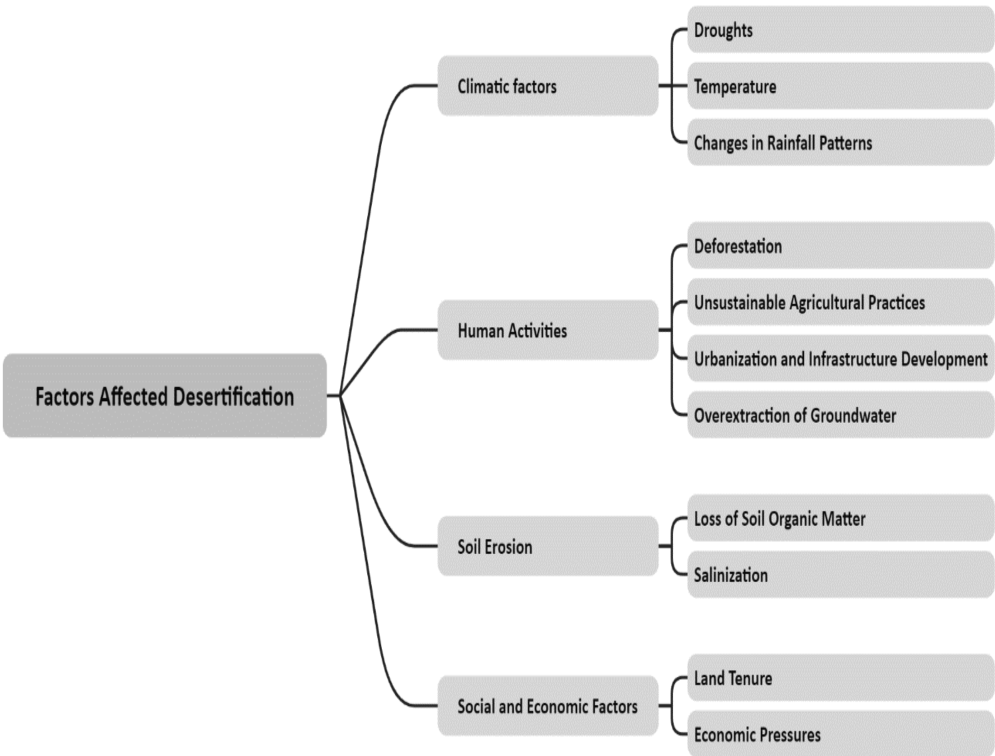

Figure 2. Factors affecting desertification

Bearing in mind that drought and desertification often form a feedback loop where drought exacerbates desertification, and decertified land, in turn, can lead to more severe drought conditions. Drought serves as a primary natural catalyst for desertification in Iran, where the multi-decadal average annual precipitation stands at 247 mm.

Although geography and weather are the major drivers of flooding, some anthropogenic activities such as land use or land cover changes, deforestation, urbanization, and inappropriate agriculture and development practices can also influence the occurrence and frequency of floods (Barros *et al.*, 2021). However, the incidence of river and flash floods has been dramatically recently increased by natural and anthropogenic changes so that the largest floods were occurred in the 1980s and 1990s (Alborzi *et al.*, 2022).

In total, it is estimated that more than 11 million people across the country have been affected by extreme floods in this period, loss of lives as many as 130 people, injuring 80 people, damaging or destroying 6300 buildings, on average, per year (Khankeh *et al.*, 2020). this could be very well exemplified by 2018 flood which occurred in four different basins nearly all over the country in March and April (about 30 days). Fig. 3 displays volume of runoff in Karoon, Karkhe, Dez and Gorgan basins. It is noticed that the volume of runoff resulted from the storm during 21 March to 20 April is tremendously high (STWC, 2019).

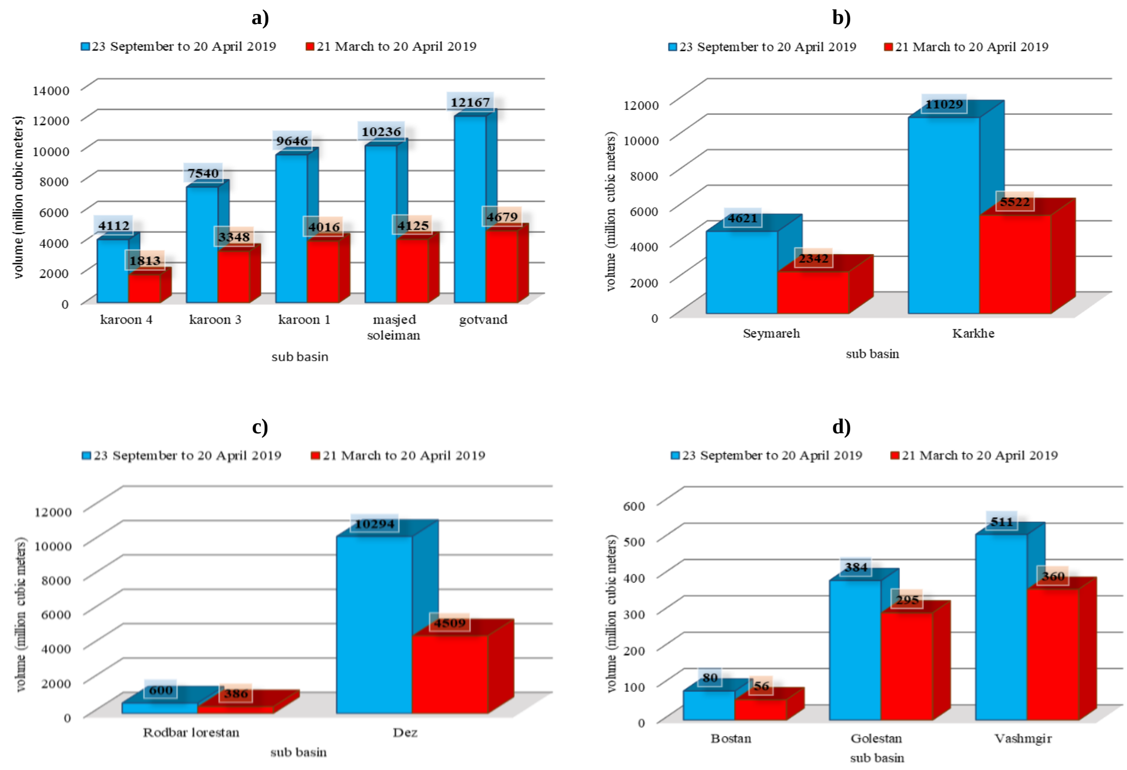

Figure 3. Volume of runoff in A) Karoon, B) Karkhe, C) Dez and D) Gorgan basins (STWC, 2019)

Water resources

In 1982, the first water law after the revolution was issued by the Parliament (Saatsaz, 2020). Based on the "Law of Fair Water Distribution," the Ministry of Energy was responsible for allocating and assigning licenses for water use in domestic, agricultural, and industrial sectors. The Ministry of Agriculture was appointed to allocate water among farmers and collect water fees (Saatsaz, 2020). Considering the water law, the regulated price of groundwater resources was between 0.25 and 1.0%, and for surface water was between one and 3% of the commercial value of the crop yields, respectively (Abbaspour *et al.*, 2009). The 1982 law indicates that groundwater abstraction should be in accordance with the crop water demand and cropping pattern. The Ministry of Health and Medical was responsible for the guidelines setting up in drinking water quality standards, monitoring, and control of the drinking water characteristics from source to sink. The duty of the Department of Environment was water pollution control, preparation-related policies and the laws for the environmental protection and improvement, and assessing environmental impacts of national plans, particularly irrigation and hydropower projects (Abbaspour *et al*., 2009). During the 8-year war, Iran was faced with an unprecedented rise in population, urbanization, and hence, food demand. The food demand growth in the 1980s, however, was a complex issue and under the influence of many interacting factors. One of the major reasons for the increase in the demand for food, which subsequently led to an increase in the demand for water, is that Iran has received a large wave of refugees from Afghanistan and Iraq since the 1980s (Pilehvar, 2023). In addition to demographic shifts, Iran's inflation rate has risen due to the extension of international sanctions and political barriers hindering the acquisition of appropriate technologies for food production, processing, storage, and distribution (Saatsaz, 2020). Therefore, it is essential to consider water resources as technical factors would directly influence water governance.

Groundwater

The Iranian Water Resource Management Company (IWRMC) has documented a significant increase in groundwater extraction within the country. Extraction levels surged from approximately 16,517 million cubic meters in 1972 to about 61,093 million cubic meters in 2014. This rise can be attributed to heightened human consumption, changes in land use, expansion of agricultural irrigation, and rapid population growth and urbanization since 1975. Consequently, groundwater over-extraction has quadrupled, leading to an average annual decline in the groundwater table of around 0.51 meters (Moridi, 2017). Iran has been facing persistent challenges related to the inefficiency of its water distribution system, particularly within the agricultural domain (Fooladmand and Sepaskhah, 2004). The assertion is made that focusing on food production without concurrently enhancing irrigation efficiency constitutes a primary factor contributing to the excessive depletion of groundwater in Iran. In this context, excessive aquifer overdraft is defined as a situation wherein the total withdrawal of water by human activities surpasses the natural replenishment rate over a specified timeframe (Moridi, 2017). Groundwater overdraft is characterized by a situation where groundwater reserves fail to replenish fully, even during hydrologically wet years. Approximately 76% of Iran's aquifer area, covering about 77% of the country's total land area, is experiencing excessive overdraft. Despite the challenge in characterizing this significant impact due to inconsistencies in the temporal and spatial characteristics of data pertaining to groundwater storage and land subsidence, we strongly advocate for further research in this domain. Additionally, land subsidence resulting from excessive groundwater extraction diminishes soil stability, posing a critical concern in densely populated areas.

Agriculture

Food security plays a significant role in the national security of a country and nowadays providing food security is the most serious challenge for human society (Darzi-Naftchali and Karandish, 2019). The Food and Agriculture Organization (FAO) emphasized that food security without water security cannot be achieved (Karandish, 2021). Water management is the main component of water security in the agricultural sector and is necessary for the achievement of food security by increasing the production of three stable foods i.e. wheat, maize, and rice in the world (Karandish, 2021). Agriculture stands as the largest consumer of freshwater globally, accounting for a significant 92% of total global water usage annually (Karandish, 2021). Perpetuating the current pattern of agricultural water consumption poses a threat to the sustainability of future food security (Maghrebi *et al*., 2020). Hence, mitigating the vulnerability of sustainable crop production to water scarcity is emerging as a global concern (Maghrebi *et al*., 2020). Therefore, numerous researchers have endeavored to identify strategies to enhance food security amidst water scarcity conditions. Expanding irrigated lands without surpassing sustainable freshwater availability is feasible only on 25% of the global croplands (Nouri *et al*., 2023). Nonetheless, the efficacy of these practices varies depending on the location and warrants investigation on a case-by-case basis. Agriculture contributed only 5–16% to Iran's Gross Domestic Product (GDP) from 1979 to 2020 (Akbari *et al*., 2022), Despite accounting for 92% of gross freshwater withdrawal and 97% of net water year abstraction (Moshir Panahi *et al*.,2020). The low value added per unit of water consumed strongly indicates the low water productivity in agriculture, a finding corroborated by previous research (Moshir Panahi *et al*., 2020). Therefore, in addition to managing water consumption in the agricultural sector, governance should take operational steps to reduce water waste in the sector. A situation that will be improved with the implementation of the cultivation model plan.

Soil erosion

Human requirements in the twenty-first century, such as foods, fibers, clean water, and clean air, cannot be met without healthy soil (Löbmann *et al*., 2022). Soils are an essential component of earth system functions that facilitate the supply of essential ecosystem services (Dazzi and Lo Papa, 2022; Löbmann *et al*., 2022); however, the soil may be degraded by human activities and environmental stressors (Wassie, 2020). Population increase, deforestation, and overgrazing are the three major factors that cause and exacerbate soil erosion (Wassie, 2020). Erosion has many negative effects that are of real deep concern for a variety of reasons. Primarily, the erosion-induced removal of the fertile top layer of soil (topsoil) adversely impacts soil fertility and crop productivity. Secondly, erosion reduces reservoir capacity and functionality while degrading downstream water quality (Kumawat *et al*., 2021). which could influence directly nexus. Additionally, soil erosion leads to an increase in pollutants and sedimentation in streams and rivers, leading to the obstruction of these waterways and a decline in biodiversity (Allafta and Opp, 2022). Moreover, erosion transports sediment-laden water downstream, leading to the deposition of sediment layers that decrease the carrying capacity of streams and rivers, potentially resulting in flooding (Allafta and Opp, 2022). Finally, erosion disrupts the land, reducing its capacity to support vegetation that can absorb climate-warming carbon dioxide.
In Iran, where a majority of the basins are situated, the soil erosion rates are twenty times higher than the global average. The cost of soil erosion treatment in Iran ranges between USD 56 billion and USD 112 billion, surpassing the nation's annual oil earnings, for instance, USD 53.6 billion in 2014(Allafta and Opp, 2022). Additionally, degraded areas often have reduced capacity to retain water, potentially exacerbating the occurrence of floods. For example, significant flash floods occurred in the Shatt Al-Arab basin in 2019(Allafta and Opp, 2022) The devastating floods resulted in the destruction of livelihoods and incurred billions of dollars in damages in Iraq and Iran. Soil erodibility denotes the inherent susceptibility of soil to erosion by rainfall and runoff, representing the interplay of physical and chemical soil attributes affecting detachment, transport, and infiltration capacity. Key contributors to erosion include rainfall intensity, slope characteristics, soil properties, land cover management, and soil conservation practices

Land use changes

Land cover refers to the physical and biological cover present on the Earth's surface. This includes natural vegetation (like forests, grasslands, and wetlands), as well as man-made features (like urban areas, roads, and agricultural fields) (Mansouri Daneshvar *et al*., 2019). Land cover can be observed and categorized based on satellite images or aerial photographs. Land use pertains to the way humans use the natural landscape. How we assign a piece of land to a particular use, whether it is for agriculture, housing, recreation, commerce, or conservation, falls under land use (Bozorg-Haddad *et al*., 2020). It is more about the socioeconomic functions of land rather than its physical state. Land use patterns can often be influenced by policies, regulations, and other social factors. In this study, we will be discussing Land use. Climate change projections suggest that the Middle East will face a 5–25% decrease in annual precipitation (Nedd *et al*., 2021). Also, land use studies in parts of the Zagros region, including Arasbaran, Bane, Ilam dam catchment, Saman forests, Chaharzebar forests, Ilam province forests, Marivan forests, and Kurdistan region demonstrate remarkable degradation in these regions land use patterns (Balist *et al*., 2022). Land use and its changes have a direct impact on water resources and their quality. Overall, changes in land use can have serious effects on the quantity and quality of water resources. Therefore, when planning for land use changes, special attention should be paid to their impacts on water resources. Prevention of land use is one of the essential tasks of the Ministry of Jihad Agriculture.

Public awareness

The necessity of education on water consumption is a pressing concern, especially in areas where water resources are limited or diminishing. Proper education can lead to significant improvements in the ways individuals and societies value and use water (UNESCO World Water Assessment Programme, 2018). Water consumption in Iran, given its regional situation and the water crisis, poses several challenges.

However, many of these challenges could be reduced or even resolved through educational measures. Some of these issues are listed: lack of awareness of consumption rates, inefficient irrigation methods, usage of modern and efficient appliances, education in schools, focus on cultural building and awareness of water recycling benefits (Seelen *et al*., 2019) In conclusion, the role of education in water consumption is not just a matter of teaching the mechanics of conservation in Water shortage countries but also instilling an intrinsic value and respect for this precious resource. A well-informed and educated society is a key to ensure the sustainable management and use of water resources.

Sanctions

Following the 1978 Revolution, one of the factors contributing to the degradation of water resources in Iran was the pursuit of self-sufficiency in agricultural products, particularly strategic ones like wheat. In response to various sanctions imposed after the revolution, senior policymakers opted for reduced reliance on other nations, leading to intensified exploitation of water resources, even in arid regions. A notable instance of this policy occurred during the period from 2002 to 2010, particularly in 2005, when hydrographs for all aquifers depicted a significant decline. The consequence of this approach has been the depletion of aquifers (Amiraslani and Dragovich, 2023), The desiccation of gardens and farmlands, coupled with ecosystem degradation, has resulted in unemployment within rural farming communities and an influx of migration from countryside to urban areas, thereby heightening security apprehensions (especially the border regions), and protests over the continuing tension over transboundary water systems shared between the Chaharmahal-e-Bakhtiari and Khuzestan provinces and central provinces (Mirzavand and Bagheri, 2020). International economic sanctions have been employed for decades under the presumption that they can normalize behavior and mitigate threats. States, coalitions of nations, and intergovernmental organizations impose sanctions on countries deemed to exhibit abnormal behavior contrary to international norms and perceived as threats to their interests. In the end, international sanctions, particularly those imposed against Iran over the past four decades, are not solely responsible for the country environmental challenges. However, they have undeniably played both direct and indirect roles in exacerbating these issues.j

Law

Effective management of water resources often relies on the interplay between rules, regulations, and monitoring mechanisms. Governments and international bodies may apply the following tools to ensure equitable distribution, conservation, and sustainable use of water (Ahmadov, 2020). Regulation of withdrawals: Laws can define permissible levels of withdrawals from various water sources, including groundwater reserves and surface waters (Ahmadov, 2020). It is essential to understand that the effectiveness of rules, regulations, and monitoring methods relies on their rigorous implementation and the presence of mechanisms to enforce them. Collaborative approaches, involving the public, private sectors, and communities, often yield the best results in water management initiatives. The total water consumption in Iran exceeds 88.5 billion cubic meters (BCM) (Abbasi *et al*., 2015) Of the available freshwater withdrawal, 92.2% (equivalent to 80.67 BCM) is allocated to agricultural activities in Iran, a figure that surpasses the global average for agricultural water usage (70%) and the Middle East average (83%) (Ababaei *et al*., 2014).

3. DISCUSSION

Agriculture in Iran is based on traditional approach and water consumption in traditional agriculture is very high, but this is not just caused by the traditional methods. however, the Iranian agriculture, mechanized system is not used and if it is so, it is very limited and on a small scale. Iranian water canals are very old, for example, the Parsabad irrigation network of Moghan plain was designed for 50 years, but while passing through span life, their useful life has also ended and any minor failures require major repairs, the cost of which is very high. Therefore, we must move towards new networks, including the use of Nano channels, because there is no water infiltration and the incoming water is used for plants. In rural areas Irrigations are also very traditional. Contribution should be receive from the local NGOs. In order to implement new techniques in this field, help should be taken from the villagers themselves. By creating this the issue could be solved. However, due to cultural limitations, it is suggested to create a combination of cultural, religious and water consumption contexts so that one cultural person, one religious person and

ONE water specialist to be representative in the NGOs. As a result, farmers agrees to implement the expert opinion. Regarding the improvement of water organization in the country, which currently exists regionally, the question arises whether the basin system is more effective or the regional Local Water Authority? The answer is to move towards a basin, because Iran is divided into 6 water basins, which can be increasingly improved with the collaboration of participants. The existing challenge is not only the constructions, but also the cultivation pattern that needs governance. As Iran is a water-scarce country, it exports water in the form of virtual water by exporting some fruits like watermelon, which has high water consumption. Therefore, in practice, Also, in 2018, when the south of the country was flooded and caused heavy losses to the farmers, despite the lack of water in the south, the government allowed the southern farmers to grow rice in Horul Azim wetland, while rice requires a lot of water. The issues raised have shown that water consumption is not properly managed or is exported virtually while the absence of a proper cultivation pattern is evident in the country. The country is located in a reign that consistently suffers from water stress. It is anticipated that World War III may take place for water, which starts in the Middle East. having Known this crisis, wheat is still grown in the country in order to become self-sufficient in this product. This question maybe raised that “what is the cost of self-sufficiency in wheat crop in terms of water loss?”, whereas it is possible to import wheat by selling oil and avoid the consumption of expensive water. on the other hand, we should not sell oil to import water and export virtual water.

In the field of water resources and underground water, Iran is a country that has limited rainfall, so water consumption should be optimized. In fact, optimal use means that the source of water should be consumed based on the inflows, however, it is not consumed on the bases of inflows and much more than that is consumed. the surface water resources are not sufficient for all purposes. Since around 1989 and after the 8-year Iran-Iraq war, the use of surface water has become more and more increasing so that it could not meet the demand for drinking, and moved towards the withdrawal of underground water. The government started issuing permissions for the withdrawal of underground water by drilling deep well. This issue led to the development of agricultural products without a proper cultivation pattern which ended with a dramatic reduction in the underground water level and drying natural wetlands in the country, including Gavkhoni, Horul Alazim and Lake Urmia. Instead, water table should have been recharged in order to overcome the sharp decrease in the water level, but the restoration of the ground water was made on a very small scale. In this respect, application of satellite images and GIS could come into practice to locate areas being appropriate for ground water artificial recharges. The Ministry of Agricultural Jihad conducted a limited study in the 90s, but because the initial cost was heavy for the government, only a few were implemented and the case was not followed any further. In the field of surface water, after the revolution of 1978, Iran built many multi objective reservoir dams with the purposes of irrigation or agriculture, flood control and electricity generation without paying attention to the phenomenon of climate change. The increase in temperature due to the phenomenon of climate change has led to evaporation and even changes in the water quality of the dams. If water governance is managed in basin scale rather than regionally, each basin can be directly responsible to monitor water from upstream source of the river entering the reservoir in place of only paying attention to the quantity of water in the dam. In the upper reaches of the rivers, with increasing in grazing and farming, the pastures have been used up and never restored. Also, with the use of chemical fertilizers in the agricultural industry and hence the loss of plant roots, the quantity of soil surface erosion has increased greatly. With the drying of pastures and vegetation, soil erosion increased in the basin and the sediments entering the rivers increased significantly. These sediments have entered the reservoirs and caused a dramatic reduction in the useful life of the reservoirs. Currently, rivers are managed by regional Water Boards. this may be exemplify by Karun River which passes through 3 provinces, each province has its own management which may sometimes cause conflict of interests inter-provincially. By changing from regional management to integrated management of the basin, erosion can be controlled at 3 levels in the river: 1. the local and basin level 2. the regional level 3. The national level Water governance is one of the current debates about floods. A flood or flowing water can become a blessing. While it damages the infrastructure, it can be exploited for its use. Floods in Iran are divided into 3 categories: plain, urban and coastal floods. Plain floods inundate flood plains, which means that it originates from upstream where there is steep slope. When this flood way reaches a low land where flood plain forms longitudinal slope is suddenly decreased and leads to distributional of water laterally in the flood plain. Urban flooding is caused by land use change in cities. For example, Urban flooding in City of Shiraz in 2018 was the consequents of main channel narrowing. This was reflected by a dramatic reduction in channel width while passing through the Koran Gate area, the change of river riparian to open market decrease river capacity dramatically. Among the examples of urban flooding, one can mention the Qomroud river that passed through the center of Qom. From 1980 to 2000, due to climate change and changes in land use, the water in the river was very low. Qom Water Authorities decided to channelizes the river and convert the flood plains into parking lots in both sides of the river. In 2006, a flood occurred in Qomroud river which was the consequents of channelization. This events are robust illustration of urban flooding which are mainly man-induced. Therefore, it is wise to have an insight how sustainable management of urban development should be defined to be dominated by water governance. In fact, the responsibility before flood occurrence is with the Ministry of Energy, during and after the flood with several organizations, including the Ministry of Interior, Environment Organization, Crisis Organization, Red Crescent, etc. But the description of the duties of these organizations is not clearly defined. The presence of a good governance should communicate the description of duties to these organizations and tell what position each of them has during and after the flood and what action they should take. Among other issues that should be considered in water governance is the issue of the cause of floods in cities, which cities are known as flood cities and where are the flood prone areas of these cities. It is important to identify How to sustainably govern in densely populated areas. In these areas, prioritization should be conducted by extracting risk maps and population distribution. This is initially undertaken for areas with high population density from which governance determines the importance of attention to the region. In water governance argument and in the field of flood control and management, the important issue is how to control it first, then how to manage it. A large number of rivers in the north of Iran and in low land areas had natural wetlands in the past. These wetlands have become agricultural lands. Under the influence of climate change and decrease in rainfall, the conversion of natural wetlands into agricultural lands caused no water storage during floods. Therefore, the restoration of natural wetlands will play a significant role in flood control. For example, in the 2018 flood in Gorgan River, if the wetlands that were around this river were restored in the past, it could reduce the intensity of the flood. Also, with the construction of coastal reservoirs in the north and south of Iran, it is possible to store the incoming flood water, and since the water is salty in the south of the country, it is possible to feed the underground water and rehabilitate the wetlands and obtain fresh water. This issue will also be effective for controlling and sand storm. Therefore, the construction of coastal reservoirs could play an effective role in flood control. As a result, it can be deduced that moving towards restoration and rehabilitation of wetlands as well as stablishing storage dams to feed underground water in sloping areas is effective in controlling floods while controlling water at the end of the path will be much more effective by costal reservoirs.

4. CONCLUSION

The current state of agriculture in Iran reveals a reliance on traditional methods with high water consumption. While issues such as outdated irrigation networks and limited mechanization persist, there is a need for a shift towards modern techniques, including Nano channels, to optimize water use. Rural areas face traditional irrigation challenges, and local NGOs can play a crucial role in implementing new methods with the active involvement of villagers. To address water management at a broader scale, a transition from regional to basin-level governance is recommended, considering division of the country into six large river basins. The over-extraction of underground water, exacerbated by the post-war shift to deep wells, has led to a dramatic drop in water levels, impacting natural wetlands. To counter this, there is a suggestion to utilize satellite image and GIS for targeted artificial groundwater recharge. Additionally, the construction of multi-purpose reservoir dams has overlooked climate change impacts, leading to issues such as sedimentation and water quality declining. Basin-scale management is suggested for more effective monitoring and collaboration among different regions.

Urban flooding, mainly attributed to man-induced factors like channel narrowing and land-use changes, emphasizes the need for sustainable urban development governed by water management principles. The occurrence of floods, whether plain, urban, or coastal, necessitates a comprehensive approach, including infrastructure reinforcement, early warning systems, and post-flood management, with clear delineation of responsibilities among relevant organizations.In flood-prone areas, a proactive strategy involves prioritization based on risk maps and population distribution, followed by technical and managerial infrastructural reinforcement. The restoration of natural wetlands and the construction of coastal reservoirs emerge as effective measures in flood control and water resource management. Overall, a holistic approach to water governance, incorporating modern agricultural practices, basin-level management, and sustainable urban development, is crucial for addressing the country water challenges and mitigating the impact of floods.

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