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INDEPENDENT STRATEGIC ANALYSIS OF AUSTRALIA'S GLOBAL INTERESTS

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The Iranian Water Crisis

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Key Points

- Iran is facing a serious and protracted water crisis.
- Due to long-term government mismanagement and lack of planning, achieving water security in Iran will require significant policy reform and strong governance.
- Unmetered access and widespread dam development have altered Iran's natural water systems, causing degradation, reduced land productivity, shrinking lakes and whole communities left without access to water.
- Real water savings can be made through targeted campaigns and initiatives addressing domestic water wastage and irrigation efficiency.
- While President Rouhani has emphasised the need for water reforms in Iran, it is unlikely that planned changes will significantly alter Iran's water insecurity in the short term.

Summary

In 2013 faced with a critical shortage of water, the Iranian government called for water conservation and greater water use efficiency nation-wide. Despite imminent shortages, water use in Iran remains inefficient, with domestic use 70 per cent higher than the global average. Iran has a national population of 75 million people, 12 million of whom reside in the capital; demand for water is rapidly increasing, even as major lakes and groundwater

resources begin to shrink. Population growth, more frequent droughts and the effects of climate change are creating the 'perfect storm' for future water insecurity. We are left with the question, are the proposed changes too little, too late?

Comment

Security in the Middle East continues to focus on the political and geostrategic priorities of regional states, but a greater challenge has now presented itself, in the form of natural resource scarcity and vulnerable water supplies. Issa Kalantari, former Iranian Minister for Agriculture has stated in an interview that the water crisis in Iran is the biggest problem threatening the state. Overshadowed in global current affairs by Iranian politics and the negotiations over its nuclear program, the looming water crisis presents a formidable challenge.

Natural Resources

Located in one of the most arid regions in the world, Iran has an annual average precipitation rate of 252 millimetres, approximately one third of the global average. Exacerbating the severity of water shortages, as much as 70 per cent of precipitation is lost to evaporation. Estimates suggest that lower-than-average precipitation in 2013 caused a 30 per cent reduction in the volume of water in dams across the country, with only five exceeding 90 per cent capacity. According to the Institute for Forest and Pasture Research, groundwater levels have dropped two metres in recent years across 70 plains, affecting as much as 100 million hectares. According to the UN Development Program, the level of Iran's per capita water resources are predicted to fall to as little as 816m³ in 2025, down from 2,025m³ in 1990.

Iran is divided into six key and 31 secondary catchment areas. Besides the Persian Gulf and Gulf of Oman Basins, all of Iran's basins are located in the interior, where renewable freshwater sources are limited. Close to half of Iran's total renewable water is located in the Persian Gulf and Gulf of Oman Basins, representing one quarter of its land mass. Conversely, the Markazi Basin covers more than half of Iran's land mass, but holds less than one-third of the available freshwater.

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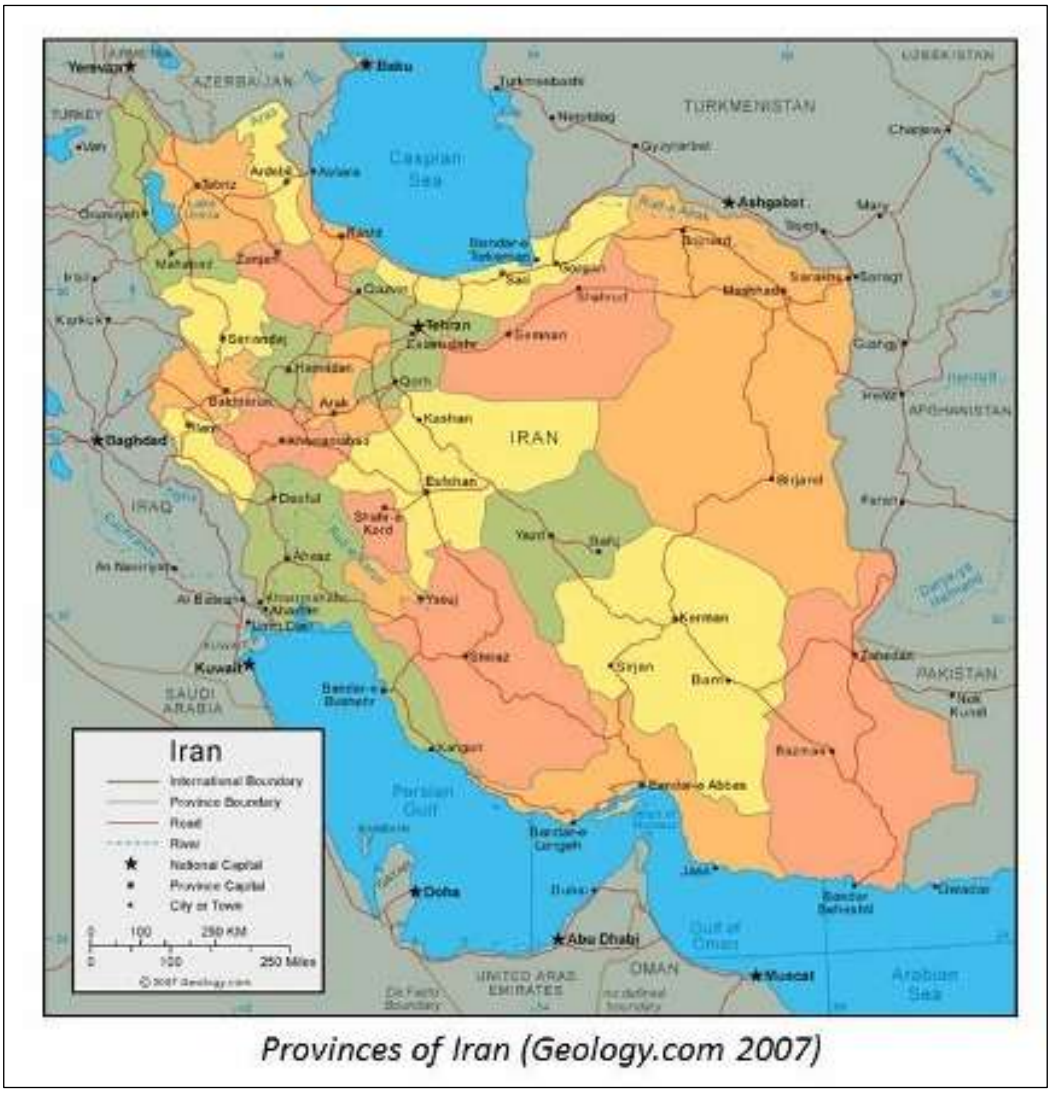

Provinces of Iran (Geology.com 2007)

Over 84 per cent of Iran is arid or semi-arid; over 50 per cent of the country is either desert or mountain; and 16 per cent of the Iranian landmass has an elevation of 2000m or more above sea level. Streams are seasonal, causing flooding during spring and drying during summer, leading to significant variability in freshwater access for those reliant on surface water resources. Due to high evaporation of surface water, Iranian's have, for centuries, used traditional methods of water transport and access to supply their freshwater resources. More than 2000 years old, the *Qanat* is still used in Iran today and is designed to access and transfer groundwater without the use of lifting devices. Wells are sunk every 20 to 50 metres along the system, with a tunnel then built to link the wells on a slope from higher ground. Groundwater flows naturally down the tunnel till it reaches a surface point at the end, either in a town or city, or by creating an artificial desert oasis.

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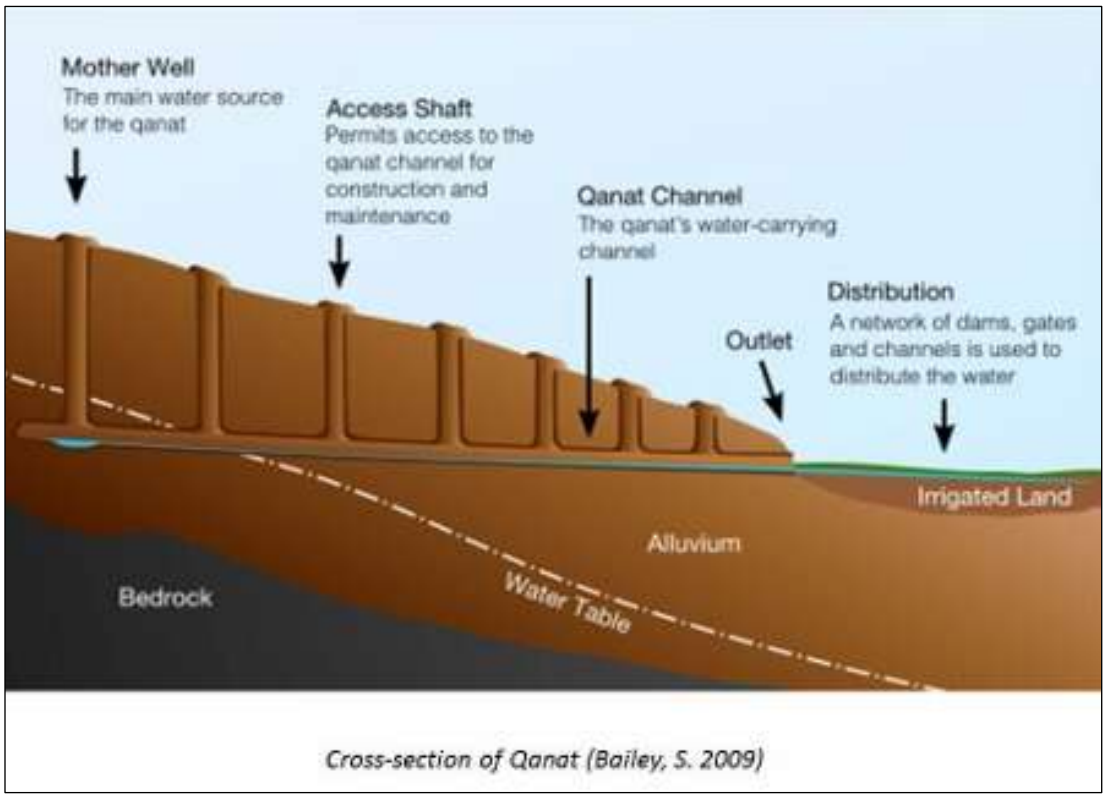

Cross-section of Qanat (Bailey, S. 2009)

Beyond being a remarkable engineering feat, *Qanats* were conceived as a social and political management arrangement, where the construction and maintenance was communal and water entitlements were allocated based on the level of participation in the *Qanat* and the required use of water. With each community responsible for its own *Qanat,* the system encouraged equitable and sustainable use of water to ensure access was not disrupted. The amount of water drawn from a *Qanat* was never more than the annual recharge rate of the groundwater supply.

Modern Water Management

Following the White and Islamic Revolutions in Iran, water supply was transferred from communal to centralised (governmental) management. Modern day water issues can be traced back to the 1960s and 70s. Water policies in Iran during this period focused on control and supply, using engineering and infrastructure rather than the traditional community management and delivery. With this change came the construction of hundreds of dams, with little or no concern for ecological integrity and sustainable water management. The diversion of rivers and streams from one catchment to another became common-place, and more and more wells were sunk to access groundwater. The perception in cities that water was plentiful encouraged wasteful use.

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While in Iran is treated as communal property, surface water is based on a priority permit system, whereby regional water resource managers allocate water supplies[1]. Groundwater rights correlate with land ownership (private) and landowners are free to pump water from wells located on their own land provided they have prior permission from the government. Set water withdrawals are outlined in the permits provided to landowners. With little to no metering to ensure withdrawal limits are not breached however, groundwater extraction within Iran has led to a 50 per cent reduction in groundwater availability and significant issues with salinity, as water tables continue to fall.

Water Governance – Economic Policies

Economic policies focused on land reforms, economic development in the desert and water pricing over the last 50 years, have exacerbated water scarcity in Iran. The redistribution of land to peasant farmers following the Islamic Revolution, led to a transformation in Iran's agricultural system. Irrigation rapidly expanded beyond the capacity of traditional water systems and cultivation intensified, leading to increased fertiliser and pesticide use. Across Iran well operations have caused water tables to fall significantly in irrigated areas, leading to a scenario of competitive deepening.

The priority permit system for surface water gives urban residential and commercial users first priority to water access, followed by industry, then agriculture and, finally, environmental flows. Upstream users are given priority over downstream users, leaving little water for downstream irrigators and food producers in times of drought. During 2008 and 2009 Iran experienced severe drought, which led to the evacuation of 50 villages in Kerman province due to water scarcity. Internal displacement will rise in the coming decades, as prolonged drought conditions, increasing water scarcity and climate change impacts exacerbate this crisis situation.

Aquifer extraction through the drilling of wells is a key contributor to the decline in Iran's water resources. Iranian environmentalist, Eskander Firouz, believes Iran's growing population and expanding agricultural sector have led to unsustainable aquifer withdrawal. As many as 500,000 water wells are operating in Iran, many without a license or permission to do so. Iranian Energy Minister, Hamid Chitchian, estimates that at least 100 billion cubic metres of water have been extracted from aquifers in recent years, leading to the salination of farmland wells and reduced groundwater access.

[1] Nikouei A & Ward F (2013) "Pricing irrigation water for drought adaptation in Iran," *Journal of Hydrology* 503 (2013) pp. 29-46

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Water pricing also plays a significant role in Iran's water situation. Groundwater is free to all users, with no price charged even for irrigation. Further, government subsidies have reduced energy prices significantly, meaning groundwater extraction is cheap, which has encouraged the overexploitation of water. According to the United States Institute of Peace, Iran pumps four billion cubic meters of groundwater annually, which is not replenished.

Since his inauguration as President in late 2013, President Rouhani has repeatedly highlighted the need to address Iran's water crisis; stating that the country faces a critical national security issue. Years of government mismanagement and a lack of long-term planning, has led to the current decline in Iran's water resources. It will take considerable restructuring and strong governance to begin to rectify the water crisis.

Water Infrastructure

Iran is now placed third globally in dam building; there are more than 500 dams currently operating, with approximately 100 more under construction and 400 in the design or feasibility stages[2]. The impact of these dams in Iran has been significant and negative; they have produced significant shrinkage in water bodies and reductions in downstream access to water. Three of Iran's lakes, Lake Maharlu, Lake Bakhtegan and Lake Parishan, have dried and turned to desert according to the Habitats Office of the National Department of Environment. All of these lakes are Ramsar sites and have faced irreversible ecosystem destruction. Once the second largest lake in Iran, Lake Bakhtegan has dried completely, due to the combined effects of prolonged drought and dam construction along the Kor River. Lake Urmia meanwhile is following a similar path, with a 70 per cent surface water reduction over the last 20 years. There are an estimated 40 dams on the 14 rivers emptying into Lake Urmia. Water loss in Lake Urmia has led to increased salinity (identified by the light blue water in the below images), which has affected the survival of fish species and habitat. The lake is the largest in the Middle East and the third largest saltwater lake in the world, according to NASA.

[2] Zafarnejad, Z (2009), "The contribution of dams to Iran's desertification," *International Journal of Environmental Studies,* vol. 66 (3), pp. 327-341

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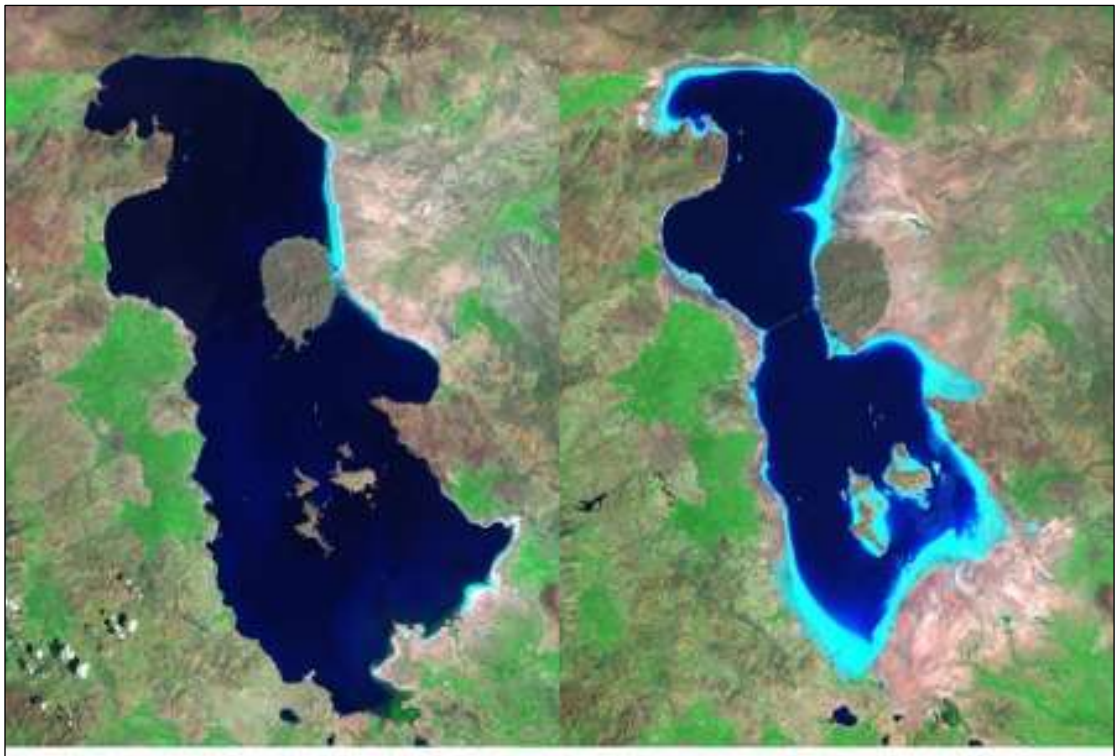

Lake Urmia – Left, August 1985 & Right, August 2010 (NASA, 2011)

Apart from surface water loss, damming has led to a deterioration of water quality, both upstream and downstream. It has also increased the desertification and salinisation of land. Iran's Forest, Range and Watershed Management Organization reported in mid-2013 that more than two-thirds of Iran's land is rapidly turning into desert. As ground water tables drop, salt-water intrusion is affecting irrigation water and leading to greater soil salinity. This is a double-edged sword; irrigated systems result in greater crop yields and this has encouraged planners and policy makers to focus on the expansion of irrigation through dams and associated infrastructure. According to the Soil and Water Research Institute of Iran, however, the increased salinity has led to patchy crop stand, retarded growth and even leaf burn in areas where poor quality water has been sprayed.

Agriculture

Agriculture accounts for over 90 per cent of water use in Iran. The government's policies on food self-sufficiency and agricultural development have contributed to the high water consumption rates of the industry. According to Iranian Ecologist, Mohammad Darvish, this process has led to drastic shortages in water. Water scarcity is restricting development and increasing uncertainty in this industry, which is one of the key sectors in Iran's economy. The result has had a significant impact on Iran's economy. The agricultural industry accounts for

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approximately 13 per cent of Iran's GDP and 23 per cent of employment, states *The Diplomat*. As more agricultural land becomes uncultivable, those displaced from the industry will be forced to migrate to the cities, increasing urban migration and the pressures on utility services.

With rainfall restricted to small areas of Iran in the northwest, west and the littoral zone along the Caspian Sea, rainfed cultivation is limited. The FAO estimates, irrigated systems support approximately 89 per cent of agricultural production in Iran. Despite the extensive use of irrigation in agricultural production, the overall efficiency in irrigation is quite low. Irrigation efficiency stands at 33 per cent on average, according to the FAO, leaving significant room for improvement through water use reductions. Inefficient irrigation can increase the incidence of salinisation and waterlogging of agricultural land, leading to reduced productivity and long-term problems with sustainable land use.

According to Iran's National Intelligence Council, Iran is dependent on fossil and imported water due to the lack of significant watersheds. This has led the state to remain heavily reliant on virtual water imports – the importing of water intensive produce – including meat, fruit and vegetables. As water scarcity has increased and drought continues Iran has had to import more food, thus increasing its vulnerability to outside market conditions. In 2008/09 Iran lost an estimated 3 million tonnes of wheat and barley through declining land productivity and drought. Yield losses have been ongoing every year, which has also contributed to Iran spending more on importing food. In 2013 Iran bought 60,000 tonnes of Australian wheat, as the government worked to build up its grain stockpile to offset the effects of recent drought events.

Addressing Iran's policy on agricultural self-sufficiency is critical to effectively managing its water use. Historic underinvestment and mismanagement of resources has led to an unsustainable industry and a burden on available water. Water efficiency in the industry must also be improved. Modernising irrigation and closely monitoring groundwater access are critical steps forward in addressing agricultural water waste.

Climate Change

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Climate change impacts, while not a direct cause of Iran's current water scarcity, will exacerbate water shortages and reduce already limited rainfall. According to Massoumeh Ebtekar, head of Iran's Environmental Protection Organisation, Iran's climate has already warmed by 1.5 to 3 degrees due to greenhouse gas emissions. The seventh biggest greenhouse gas producer in the world, Iran is ranked 114th of 132 countries in the 2012 Environmental Performance Index produced by Yale and Columbia Universities. Of particular concern are Iran's water resources and air pollution.

Climate change induced temperature and precipitation variability will reduce available freshwater, and increase the incidence of drought conditions. Traditional *Qanat* systems are better equipped to store water and prevent evaporation; while reliance on dams and reservoirs for water supply will lead to greater surface water loss through evaporation and lack of storage capacity. Estimates suggest available water could halve between now and 2050 due to climate change[3]. If this occurs Iran will face severe water insecurity and current tensions are likely to intensify, leading to internal conflict, mass internal displacement and urban migration, and a severely degraded agricultural system. The impacts of such events on Iran's economy, environment, citizens and governance would lead to considerable instability in an already unstable region.

Sourcing Alternative Water

To address water scarcity the Iranian government has adopted the use of inter-basin water transfers. Identifying the uneven distribution of water access as a key contributor to water scarcity, the transfers seek to, by pipeline, transfer water from one lake or system to another where scarcity is present. The concept is not without conflict, in early 2013 a pump diverting water from a river near the town of Isfahan to the city of Yazd led to local protests and clashes with police. The diversion would have left farmers in the area with little water, and week-long protests escalated, as authorities tried to complete the diversion. The city of Yazd, located some 300 kilometres away was forced to ration water and suffered regular water shortages without the supply. Competition over water is likely to increase as scarcity continues, with cities given priority access to water over remote, rural communities.

In 2010 and 2011 protests to protect the shrinking Lake Urmia led to violence and security forces were flown to the region to restore peace. At present, an attempt to address water

[3] Yazdanpanah M (et. al.)(2013), "Water management from tradition to second modernity: an analysis of the water crisis in Iran," *Environment, Development and Sustainability,* vol. 15 pp. 1605-1621.

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loss in the lake, has led to the proposal of an ambitious water-transfer project from the Caspian Sea. Approved by parliament in January 2014, the project will include hydroelectric power stations, water pipes, pumping stations, tanks and a desalination plant. A band aid solution to Lake Urmia's drying, the project risks causing further ecological damage to both sea and lake, and fails to address the root causes of water loss in the area.

The use of treated wastewater will have an important role in meeting future water demand. Iran's use of wastewater is best described as unplanned and uncontrolled. Excluding a handful of cases where cities have actively used treated wastewater in times of drought, wastewater use is most often directly for irrigation. A report by the Environment and Water Research Centre at the Sharif University of Technology in Tehran, has identified a significant number of indirect users are unregulated and withdraw treated water downstream of wastewater discharge points. The majority of these users are rural, using wastewater for irrigation and in some instances domestic consumption, in the absence of alternative sources. Given the lack of national management in the treatment of wastewater, and the potential for reuse which is both economical and environmentally more sustainable, treating and reusing wastewater, while addressing user inefficiencies, should be made a top priority in managing Iran's water scarcity.

Iran's Water Outlook

President Rouhani has outlined his proposal for a National Water Conservation Plan, aimed at reorganising water resources and re-evaluating water projects. Encouragingly, he has stated that to begin addressing water shortages: domestic water use needs to be reduced; the agricultural sector must be made more water efficient; groundwater must be protected; and the drilling of wells regulated. Given the heightened tensions over water insecurity and the increasing civil unrest as water is diverted from towns to cities, the population's response to water restrictions may lead to internal instability, resentment of the government and little or no progress on water conservation. Strong governance will be required if rationing and increased industry efficiency are to succeed.

When these factors are linked with the predictions of climate change impacts on water resources, it is clear Iran is facing an impending water crisis of staggering proportion. Lower precipitation and continued population growth are leading to increased demand for a dwindling supply. Addressing such significant water reductions will require a concerted effort across Iran and urgent government investment to identify potential water sources.

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Wastewater treatment, undervalued thus far in Iranian water plans, may prove to be one of the most cost-effective and realistic options to ensure continued water supply.

The government has been constructing dams to address water shortages since the 1950s, but this will not address the growing gap between demand and supply. With the Caspian Sea Water Transfer given the green light by parliament in February 2013, it also seems inter-basin transfers are likely to continue despite the significant environmental impact these transfers cause. More of the same thinking is unlikely to address shortages in the long-term, no matter what re-directions are taken. Real change will require considerable policy reconstruction, changes in water allocation priorities and a commitment to reduce water wastage across all sectors.

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