Climate Centre

Country-level | Climate fact sheet

Iran

1. Country overview

Iran, officially the Islamic Republic of Iran, is an arid and mountainous country in Western Asia, with a population of approximately 83 million people (World Bank n.d.). The centre of the country is a high altitude and sparsely populated desert plateau, with the major cities, including the capital of Tehran, lying at the edges.

Iran is ranked 78 on the Notre Dame Global Adaptation Initiative (ND-GAIN) index. This indicates that, although adaptation needs exist, Iran is well positioned to meet these due to a lower vulnerability and higher readiness to adapt (ND-GAIN 2020).

Figure 1: Map of Iran. Source: Encyclopædia Britannica

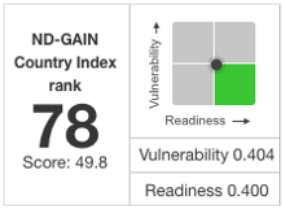

Figure 2: Iran's ND-GAIN Ranking (ND-GAIN 2021).

1.1 Climate

Iran is home to a large diversity of different climate regions across the country. In the east and south, there are arid desert regions that receive little rainfall over the course of the year. In these regions, temperatures peak in June and July, often hitting 40°C during the day and dropping to 25°C at night. During the winter of December and January, temperatures drop below 10°C at night (International Research Institute for Climate and Society (IRI) n.d.).

In the northern part of the country, along the Caspian Sea, summer temperatures are much less extreme, hitting 30°C on the warmest days. The south-western part of the country is the Zagros Basin, and the mountainous part of this region experiences winter temperatures below 0°C. The southern coastal areas are more temperate, with summer days about 25–35°C and winter days 15–25°C. Most of the rainfall in this region falls in the winter and spring (IRI n.d.).

More than 82 per cent of the country is classified as arid or semi-arid (Amiri and Eslamian 2010). The average annual precipitation in the country is only approximately 250 millimetres

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(mm) – less than a third of the world's average (Amiri and Eslamian 2010). Nonetheless, flooding is a major hazard across Iran (both flash flooding after heavy rainfall and riverine flooding), which affect large parts of the country every year (Vaghefi *et al.* 2019). Iran is already the sixth most natural hazard-prone country in the world, frequently experiencing landslides, floods and droughts (Mousavi *et al.* 2020).

1.2 Climate change

Historical Climate	Projected climate
Temperature	
There has been a significant increase in average temperatures across Iran over the last century. This has amounted to about 1°C, meaning that the climate today is more than 1°C hotter in Iran than it was 100 years ago (IRI n.d.).	Temperatures are expected to rise across the country. This includes both average and extreme temperatures. Maximum temperatures could rise by 5°C by the end of this century, depending on the rate of climate change (World Bank Group n.d.).
Between 1995-2010 warm days has increased in frequency with 12 days/decade and maximum temperatures increased by 0.031°C (Solitani *et al.* 2016). Historically, around 18 days per year are extremely hot (Vaghefi *et al.* 2019)	Depending on the climate change scenario, extremely hot days may occur 30-90 days per year by 2050 (Vaghefi *et al.* 2019).
Precipitation	
In the past, there have been several periods of rainfall swings towards drier and wetter conditions in specific decades (Modarres and Sarhadi 2009). In particular, the northern central part of the country saw a significantly wet period in the 1970s.	There is low confidence in rainfall projections in Iran with climate change. Some studies show a potential decrease in rainfall (Mansouri Daneshvar *et al.* 2019). The dry belt along the south-west border is projected to expand and the central plateau may also experience more dry periods (Vaghefi *et al.* 2019).
There have not been major rainfall trends in the country in the last century (IRI n.d.), although some regions have seen a slight decrease in precipitation (Mansouri Daneshvar *et al.* 2019) – mainly due a slight reduction in heavy rainfall events (Alizadeh-Choobari and Najafi 2018).	Even if some areas see decreases in rainfall over the course of the year, it is likely that there will be more extreme rainfall events (World Bank Group n.d.).
	As a result of warming in Iran, dust storms and thunderstorms are projected to increase in frequency and intensity (Alizadeh-Choobari and Najafi 2018a).

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2.Humanitarian sectors and climate change

2.1 Water and habitat

Water

There are six major river basins in Iran: Harmun, Sarakhs, Central Plateau/Markazi, Persian Gulf, Urmia Lake and the Caspian Sea basin. As a result of high evaporation and unequal distribution of water resources, water is scarce in Iran. Climate change and climate variability combined with water management challenges are driving wide-spread loss of water sources in Iran: the lakes Urmia, Hamun, Parishan, Shadegan are at risk of disappearing, and groundwater levels are declining annually as a result of over abstraction (Vaghefi *et al.* 2019; Moridi 2017).

The impacts of climate change on Iran's water resources are putting strain on an already scarce resource. For example, in 2018, precipitation levels fell by 25 per cent and the impact was even felt in the usually water-rich areas of the country in the north and northwest (Carnegie Endowment 2018). As a result, water levels at the country's many dams had fallen by approximately seven cubic kilometres (km^3) – a reduction of 33 per cent compared to the previous year (Carnegie Endowment 2018). Droughts are a known issue in this arid environment, but projected reductions in precipitation, groundwater and surface water levels are increasing the risk of severity and frequency of these phenomena. Snow cover has been decreasing in the mountainous regions, which has implications for rivers that are fed by snowmelt (Aalinejad, *et al.* 2016). Furthermore, already more than 80 million people in the country are feeling the impacts of desertification, which is estimated to be taking over 12 million hectares (ha) every year (Emadodin *et al.* 2019).

In the past few decades, Iran has become the world's third-largest dam builder after China and Japan. The result of this has been the drying of many rivers in Iran and its neighbouring countries – an issue that is creating additional tension in the region and worries of water-related conflict (Brussels International Center n.d.). For instance, protests occurred in 2005 on the now dammed Karoon River about these dams that diverted water away from the southern province of Khuzestan towards the city of Rafsanjan (Unrepresented Nations and Peoples Organization (UNPO) 2005).

Poorly built dams increase water evaporation, therefore reduce irrigation potential as well as hydroelectricity production (Financial Tribune 2017). Furthermore, research has argued that the water consumption of Iran's agricultural sector is strikingly inefficient; approximately half as efficient as the world average (Financial Tribune 2017). This has notably been linked to the large infrastructure work on the country's rivers, much of it excessive compared to the amount of water and precipitation. Increased demand intersected with manifestations of climate change – such as floods, droughts and dust storms – has a significant impact on water quality by increasing sedimentation, the number of nitrates and phosphates present in the water, and a range of waterborne diseases. Combined with changes in riverside erosion levels, watershed degradation and saline intrusions, all have the effect of reducing the amount of potable water that can be used for human and animal consumption (Moridi 2017).

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Energy

Iran is a major producer of oil and gas, and a founding member of OPEC (the Organization of the Petroleum Exporting Countries). It is a net exporter of these resources; oil exports, in fact, correspond to 15.8 per cent of the country's gross domestic product (GDP) (Roche and Dienst 2018). As a result of this, Iran is among the leading greenhouse gas emitting countries in the world (Mansouri Daneshvar *et al.* 2019).

Electricity use per capita is quite low compared to global averages, at around 3,000 kilowatt-hours (kWh)/capita; this demand is mainly met by natural gas at 61 per cent and oil at 37 per cent (Roche and Dienst 2018). Finally, some have argued that high levels of energy lost due to mismanagement of energy infrastructure have been a key pattern in the energy sector (Moshiri and Lechtenböhmer 2015). Stranded assets are of particular concern here, as will be highlighted later. Climate change, and specifically rising temperatures and more frequent heat waves, are projected to significantly increase energy demand for cooling and require longer periods of continuous supply (Roshan *et al.* 2012).

Notably to address these issues, an energy subsidy reform has been undertaken since the early 2000s. The 2010 law on energy consumption patterns and its 2014 reform have led to a rise in domestic energy prices, the creation of new energy service providers and the promotion of energy efficient technologies (Roche and Dienst 2018). Similarly, the reformed law on energy consumption patterns aimed to feed-in renewable energy reform following the target of reducing energy intensity by 30 per cent by 2015 (Roche and Dienst 2018).

Infrastructure

The manifestations of climate change put key parts of Iran's national and private infrastructure at risk. In particular, important ports and industry are built on the coast of the Caspian Sea and vulnerable to erosion and saline intrusion, which, along with hydrometeorological hazards, pose a significant threat to these assets. Additionally, around 75 per cent of Iran's population lives in an urban setting (Enayatrad *et al.* 2019) and, therefore, depends on infrastructure which can be particularly vulnerable to the impact of natural hazards such as heatwaves and flooding due to high population density and limited infrastructure. Notably, Tehran has a population density of 11,800 people per kilometre (km) (Tehran Times 2019). However, Iran's vernacular architecture is particularly well-adapted to extreme heat, however. Research has shown that the technique of building with mud bricks in the Iranian Plateau is more energy efficient, cooler and has components of water and ice storage which make them particularly well-adapted and sustainable to the climate, in contrast with many modern buildings (Kazemi and Shirvani 2011).

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2.2 Economic security

As noted above, Iran's economy is deeply tied to fossil fuel exports. Under the pressure of sanctions by the United States, however, this economic sector is suffering (see notably Aslan *et al.* 2020). Combined with the global energy transition that is moving away from fossil fuels, this is leading to worries about stranded assets[1], which may become ever-more important as oil prices rise and further impact the country's economy and energy supply.

Agriculture comprises 8 per cent of the country's GDP and supplies approximately 17 per cent of its employment (Financial Tribune 2020; IndexMundi n.d.). The sector is diverse, producing staple agricultural crops, forest harvest and livestock; the main crops are cereals of which wheat is the most important (Britannica n.d.). As seen above, drought is a common and severe phenomenon in Iran. Scarcity of water resources and ineffective distribution leads to projections of decreased cereal production between 10–30 per cent under different climate change scenarios. Similarly, rainfed wheat production is projected to decrease by 27 per cent by 2025 and 36 per cent by 2050 (Nassiri-Mahallati *et al.* 2006; Moradi *et al.* 2008).

The economic impact of a severe drought like the country experienced in 1999–2000 would be an equivalent reduction of 4.4 per cent of GDP (Salami *et al.* 2009; Moradi *et al.* 2008); droughts have even been calculated to have caused damages of approximately 7 billion US dollars in 2005–2008 Moradi *et al.* 2008). In the same period, it is estimated that 4,131.7 billion Rials (over 98 million US dollars) was spent the fight against drought in the country (Moradi *et al.* 2008; United Nations Framework Convention on Climate Change (UNFCCC) 2003).

As a result of climate risks and because of a dependence on international trade and limited agricultural productivity, Iran is considered to be a particularly food insecure country. In fact, it has been calculated that up to 49 per cent of households in the country can be considered food insecure (Behzadifar *et al.* 2016). Food prices and shortages are rising, a trend particularly dramatic in Tehran – reports indicate that prices have increased by 50–100 per cent in 2019, making many staple foods and meat out of the reach of many households (Gharagozlou 2019).

1 Stranded assets are defined as resources or infrastructure that once were valuable but are no longer, often due to external factors such as changes in technology, habits, acceptability etc. These assets are understood to be at the end of their economic life; no longer valuable enough to meet the owner's rate of return. Currently, the term is often used to refer to fossil fuel assets that have not yet been extracted and have lost their investment value, notably due to the energy transition.

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2.3 Health

Iran's health expenditure is 6.7 per cent annually (World Health Organization (WHO) 2015). Increased risk of morbidity and mortality due to climate change will put pressure on the country's healthcare system and infrastructure, despite significant progress made in the last few years (Mehrdad 2009).

More specific impacts of climate change on the health sector in Iran include the heightened incidence and risk of infectious and vector-borne diseases. Malaria is a particular burden in Iran and is one of the most widespread diseases in the country – in 2002–2017, the country had a reported 134,273 cases (Vatandoost *et al.* 2019). Research has shown that incidence of malaria has decreased over the same period, from 0.24/1,000 in 2002 to 0.01/1,000 by 2017, moving towards the government's goal of elimination by 2025 (Vatandoost *et al.* 2019). Similar patterns have been seen for leishmaniasis (Khanjani 2016). However, scientists and the government have raised concerns about climate change impacts on these vector-borne diseases and, in particular, in the expansion of their range (Khanjani 2016; WHO, 2015) – seasonal changes, increased urbanization and population increases are all linked to increased risk of these types of diseases (see, for instance, the WHO n.d.).

Water-borne diseases are also highly climate-sensitive. For instance, caseloads of cholera have decreased significantly since the 20th century, but many regions remain vulnerable to new outbreaks due to flooding and decreases in water quality as well as increased population density (Masoumi-Asl et al 2019). Climate models show that increased temperatures of 1–1.4°C in many of the country's provinces will be linked to increased hospitalizations for diarrhoea and cholera (WHO 2015). According to the WHO, currently, 12.7 per cent of diarrhoeal deaths in children under 15 years old are attributable to climate change. In a high greenhouse gas (GHG) emission scenario and without significant investment in adaptation, it is estimated that this proportion will rise to about 17.5 per cent by 2030 (WHO 2015). The impacts of climate change on food security and water-borne diseases combined pose risks to nutrition. For instance, in 2011, Iran had a prevalence of 4.1 per cent of underweight children; with the impacts of climate change on food insecurity, this number is projected to increase significantly unless effective adaptation plans are put in place (WHO 2015).

Heatwaves are also projected to increase in frequency and intensity with climate change. Research shows the health impacts of this, especially on those above 65 years of age; people with pre-existing medical conditions, such as heart disease, respiratory illnesses and diabetes; and people who have a disability (Mayruhber *et al.* 2018). In Iran, in a high emissions scenario, the WHO projects that, by 2080, heatwaves will be causing 70 deaths per 100,000, compared to the estimated baseline of under 6 deaths per 100,000 annually in 1961–1990 (WHO 2015). It is important to note here the burden of air and water pollution, particularly on urban communities. Tehran is considered one of the world's most polluted cities. It has been calculated that an approximate 3,600 Iranians died of smog every month in 2007 (Broomandi, *et al.* 2020). In 2011, the government introduced improved public transport services. Combined with increases in fuel prices, it was hoped that air quality would improve – however, Tehran is regularly found on the "dangerous" level of the Air Quality Index (Al Aribya 2017; Jammati *et al.* 2018). With increased temperatures and increased urbanization linked to population increases and rural to urban migration, the situation is only projected to worsen (Jammati *et al.* 2018). A heightened risk of extreme weather events due to climate change is also expected to increase displacement, injury and death due to these hazards (Mousavi *et al.* 2020).

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2.4 Protection

Climate shocks, such as droughts, create internal displacement as people leave their homes in search of economic and social opportunities, creating a significant rural to urban migration. Increased and often unplanned urbanization creates a heightened risk of the impacts of climate change on these communities (Taravat *et al.* 2016).

Displacement into Iran is due to conflict in the region, primarily from Afghanistan and Iraq. In 2019, 979,435 refugees were being hosted in Iran (United Nations High Commissioner for Refugees (UNHCR) n.d.) – over 97 per cent of these people live in Iranian cities or in peri-urban settlements (UNHCR n.d.). These refugee communities face issues of documentation, access to work, and general economic and social vulnerability which put them at greater risk of climate shocks and at greater pressure as this risk increases (Migration Policy Institute 2006). Whether the cause of displacement is climate-related or not, it is clear that internally displaced and refugee populations can be particularly vulnerable to climate shocks, facing additional risks due to precarious living conditions and lack of access to services and resources. They are often more food insecure and impacted by disease outbreaks.

Gender equality intersects with climate change as women and children are particularly vulnerable to the range of climate shocks and impacts, particularly given economic and social barriers to resilience. Globally, women and children are 14 times more likely to die in floods (United Nations Development Programme (UNDP) 2013); and, in Iran child marriage often increases in years of drought (Keshavarz *et al.* 2013). As such, Goal 5 of the UN's sustainable development goals specifically on gender equality becomes a fundamental component of climate change resilience (UNDP 2016).

Around the world, people in detention frequently have heightened vulnerability to natural disasters due to: spatial marginalization resulting from prison locations on hazard-prone land and/or isolation from emergency evacuation services; limited to no connections to social networks which are crucial aspects to hazard resilience; and political marginalization, including lack of policies and services to prevent disaster impacts on imprisoned populations (Gaillard and Navizet 2012). While specific information is not available for Iran, vulnerabilities such as these, coupled with more frequent and intense disasters due to climate change, may leave prison populations in especially precarious positions to hazards such as extreme heat and floods.

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2.5 Policy

Iran is a signatory of the 2015 Paris Agreement but has yet to ratify it (United Nations Treaty Collection 2016). In November 2015, it submitted its first Intended Nationally Determined Contribution (INDC) (UNFCCC 2015) which laid an unconditional pledge to reduce GHG emissions by 4 per cent by 2030, compared to a business as usual scenario. However, the INDC stipulates that this is subject to the removal of the US sanctions and without sanctions thereafter (Roche and Dienst 2018). In terms of national policy, Iran is focusing on reducing its emissions (and, perhaps, its vulnerability to fossil fuel price fluctuations) by bolstering renewable energy sources (Roche and Dienst 2018).

Adaptation commitments in Iran's INDC include: water resource management, comprising infrastructure investments, reducing losses and increasing usage efficiency; improving early warning systems, especially for fire risk as well as sand- and dust-storms; and improving food security (UNFCCC 2015). In 2017, Iran also passed a National Strategic Plan on Climate Change. According to the London School of Economics (LSE), this plan "lays out Iran's strategy for mitigation, water resource management, agriculture, food security, natural resources, biodiversity and human health. It stems from several sectoral documents previously prepared by ministries." (LSE n.d.).

Research has highlighted several barriers to climate change mitigation in Iran; the first being the international trade sanctions, the capacity of institutions to adapt to this new dimension, access to energy-efficient technology to allow GHG emission reductions in the current energy sector, and the second access to sufficient capital to make this happen (Roche and Dienst 2018).

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