United Nations Educational, Scientific and Cultural Organization

Regional Centre on Urban Water Management (under the auspices of UNESCO)

State of Water Resources in Iran and the World: Challenges and Opportunities of Water Supply

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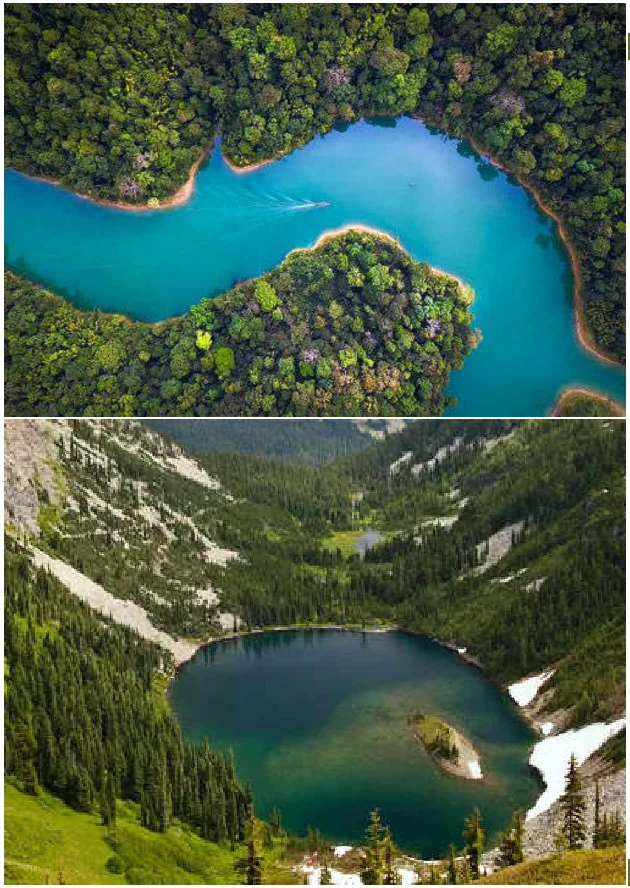
What sources of water are available for supplying water demands?

Renewable water resources

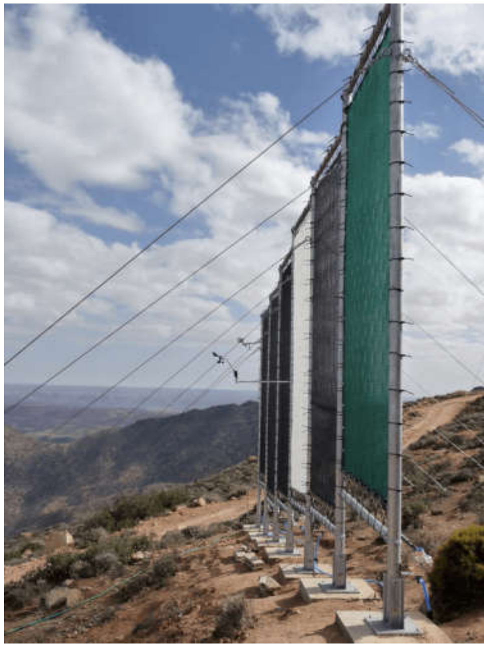
Conventional sources of water



Surface water

Groundwater

Unconventional sources of water

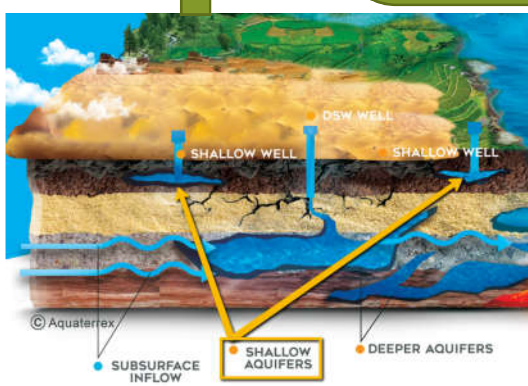


Fog harvesting

Weather modification

Sea water desalination

Wastewater recycling



Rainwater Harvesting

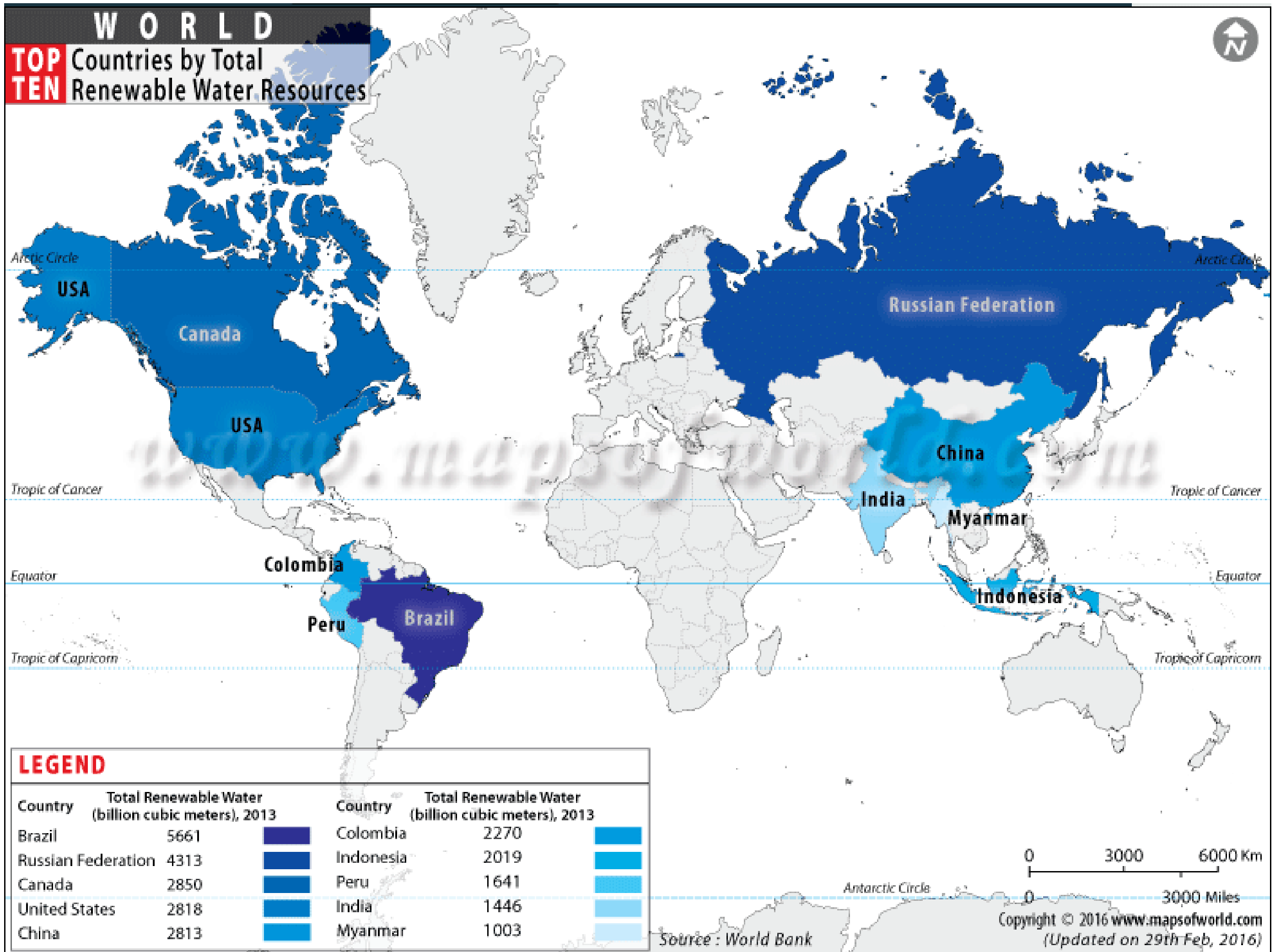
Internal and External Renewable Water Resources

- **Renewable water resources** (internal and external) include:
  - Average annual flow of rivers and recharge of aquifers generated from precipitation (internal), and
  - Water resources that are not generated in the country, such as inflows from upstream countries (groundwater and surface water), and part of the water of border lakes and/or rivers (external).

- **Climate** controls the availability of renewable freshwater resources and the seasonality of available water resources.

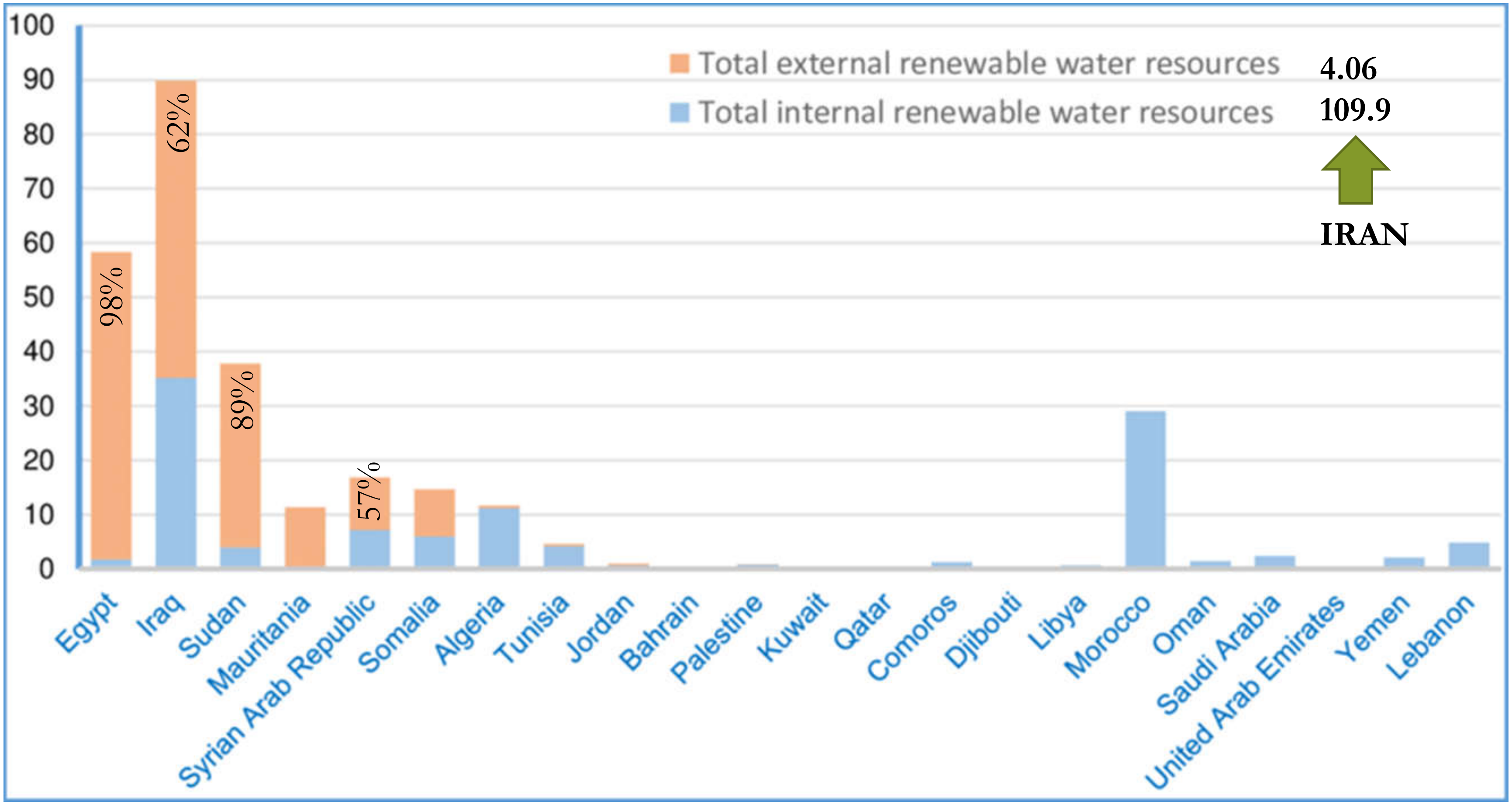
- Change in climate $\Longrightarrow$ Change in renewable water resources

- The world's total renewable water resources was estimated at **54,730 billion cubic meters** per year in 2020.
- Brazil, Russia, Canada, Indonesia, China, Colombia, USA, India and Peru are the countries with the highest total renewable water.
- **Brazil** is the top country by renewable water resources in the world. As of 2020, renewable water resources in Brazil was 5,661 billion cubic meters per year that accounts for 10.34% of the world's renewable water resources.
- **Russia** is estimated to have the second-largest water resources worldwide, with 4,313 billion cubic meters.

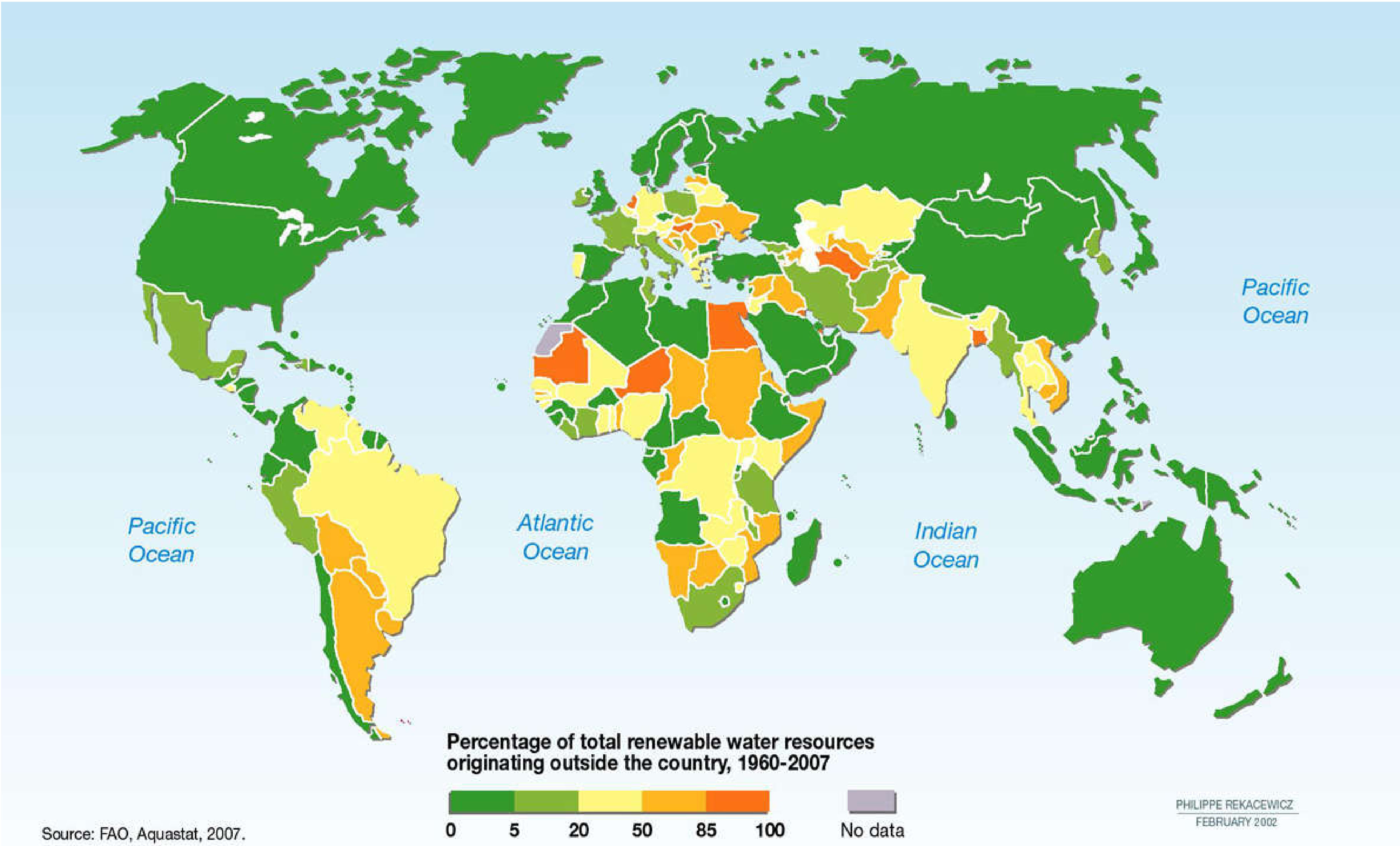


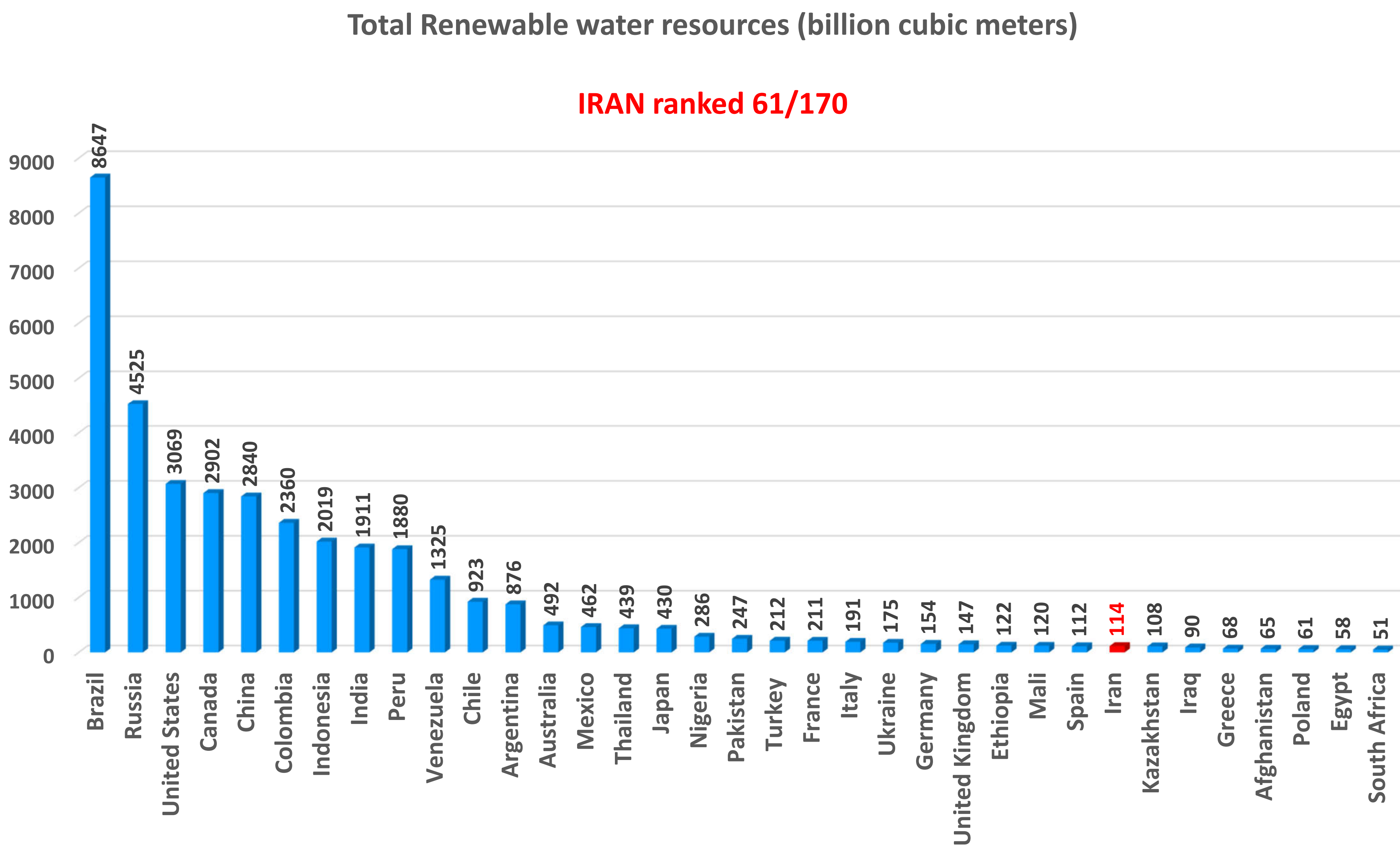
49% of total global renewable water resources

42.5% of the total global land area

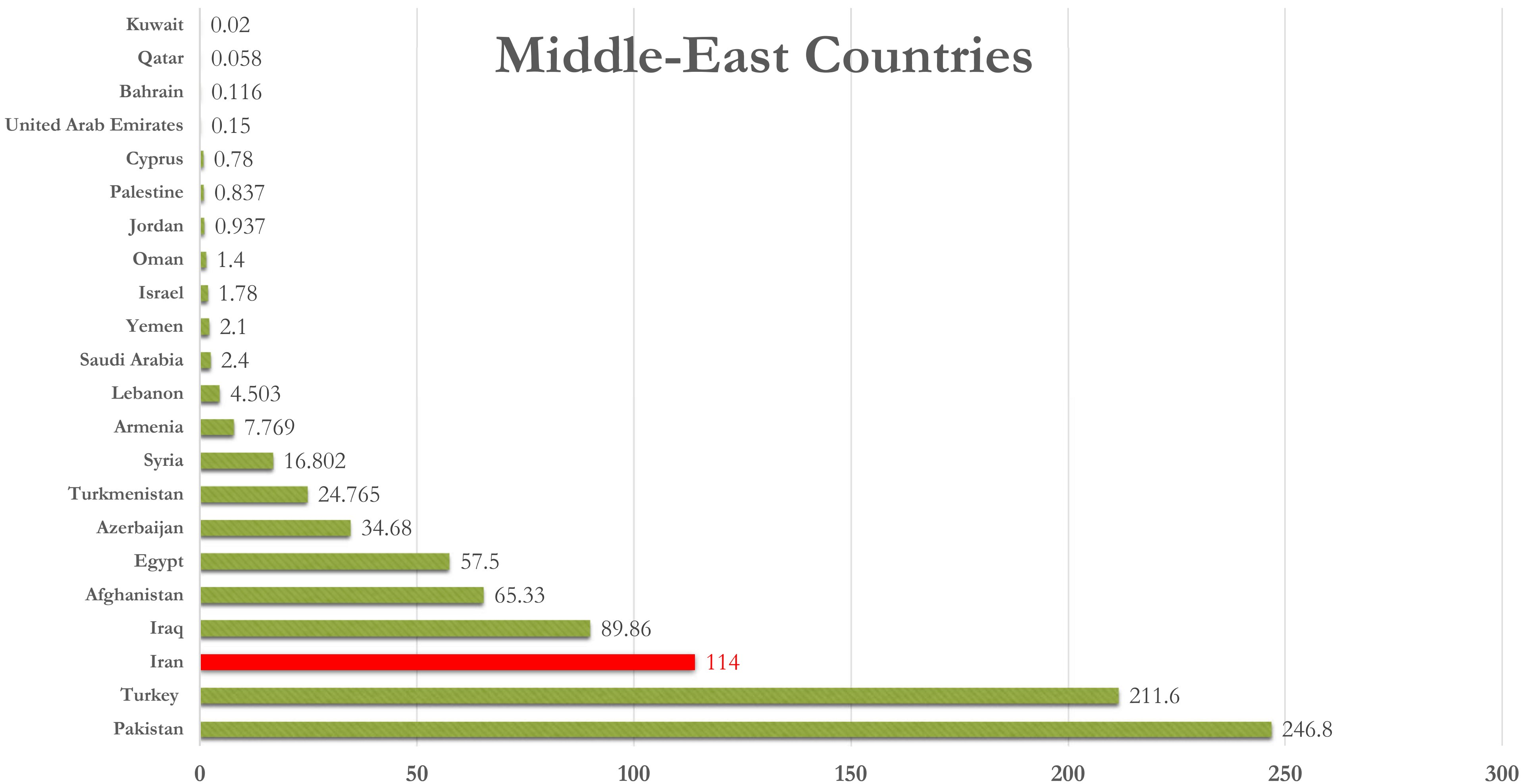


The total external renewable water resources (ERWR) in comparison to the total internal renewable water resources (IRWR) in BCM/year. (FAO, 2018)

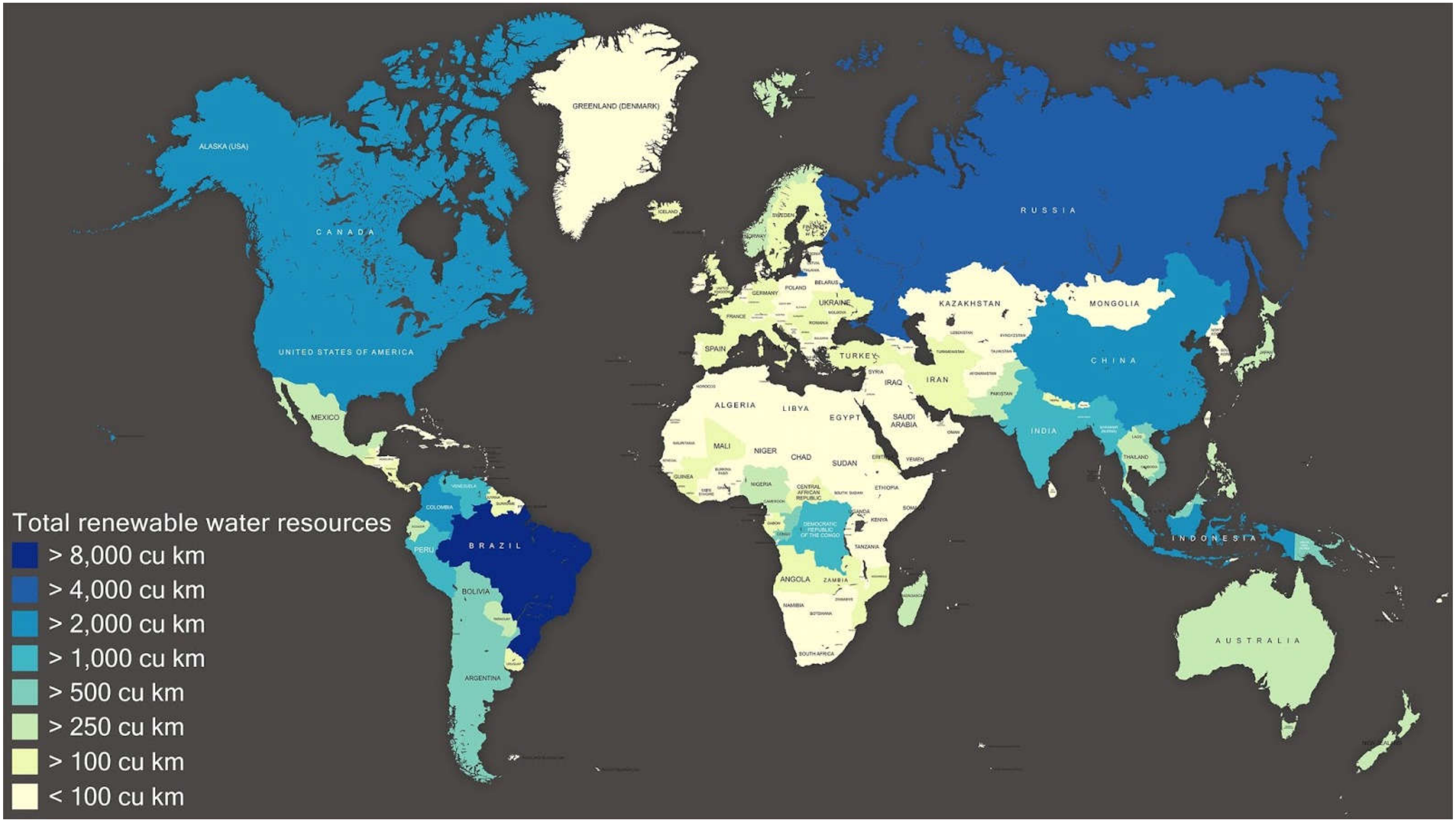

Pacific Ocean
Atlantic Ocean
Indian Ocean
Pacific Ocean
Percentage of total renewable water resources originating outside the country, 1960-2007
0
5
20
50
85
100
No data
Source: FAO, Aquastat, 2007.
PHILIPPE REKACEWICZ
FEBRUARY 2002



Total Renewable water resources (billion cubic meters)
IRAN ranked 61/170
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Brazil 8647
Russia 4525
United States 3069
Canada 2902
China 2840
Colombia 2360
Indonesia 2019
India 1911
Peru 1880
Venezuela 1325
Chile 923
Argentina 876
Australia 492
Mexico 462
Thailand 439
Japan 430
Nigeria 286
Pakistan 247
Turkey 212
France 211
Italy 191
Ukraine 175
Germany 154
United Kingdom 147
Ethiopia 122
Mali 120
Spain 112
Iran 114
Kazakhstan 108
Iraq 90
Greece 68
Afghanistan 65
Poland 61
Egypt 58
South Africa 51



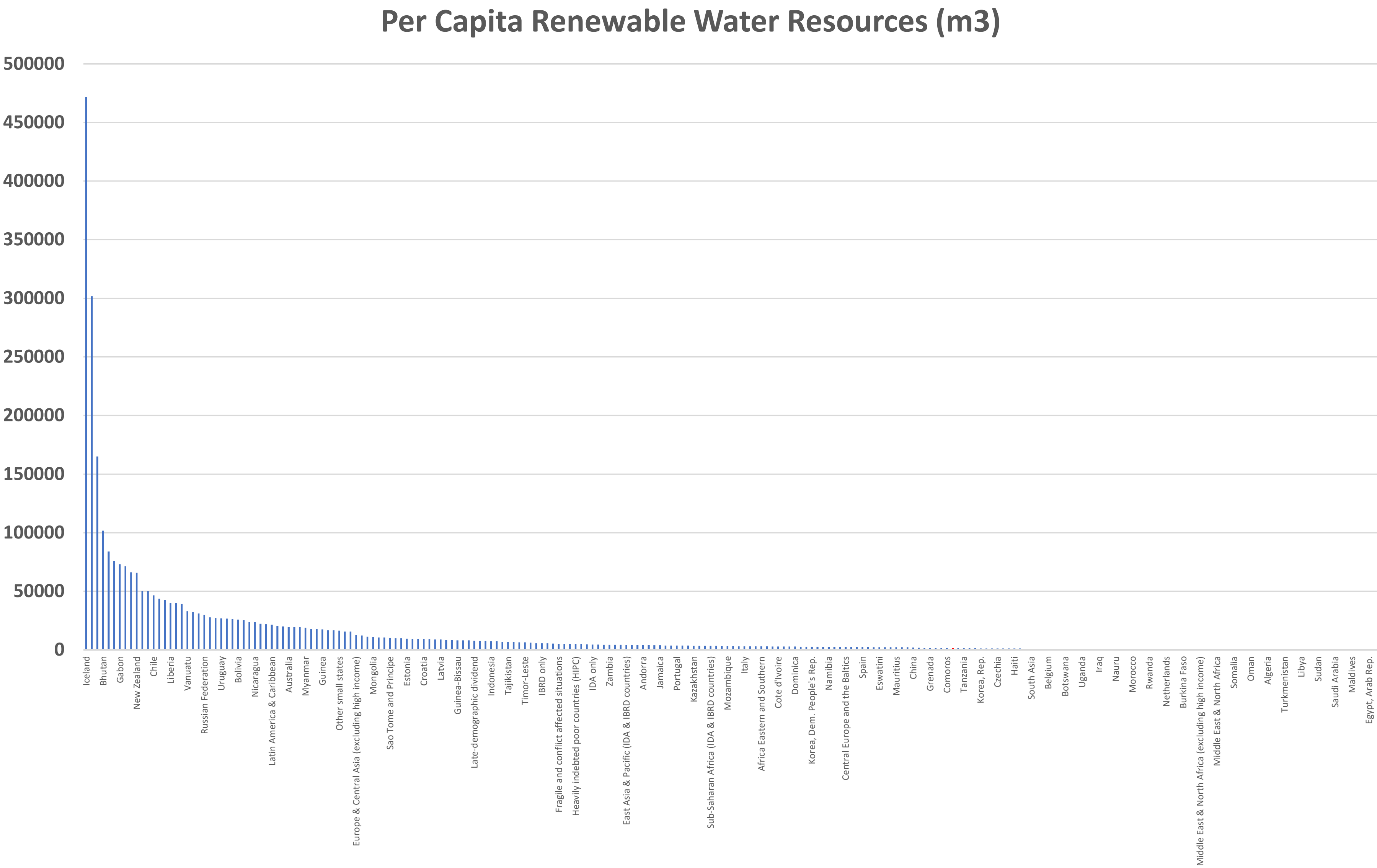
Middle-East Countries
Kuwait 0.02
Qatar 0.058
Bahrain 0.116
United Arab Emirates 0.15
Cyprus 0.78
Palestine 0.837
Jordan 0.937
Oman 1.4
Israel 1.78
Yemen 2.1
Saudi Arabia 2.4
Lebanon 4.503
Armenia 7.769
Syria 16.802
Turkmenistan 24.765
Azerbaijan 34.68
Egypt 57.5
Afghanistan 65.33
Iraq 89.86
Iran 114
Turkey 211.6
Pakistan 246.8
0
50
100
150
200
250
300

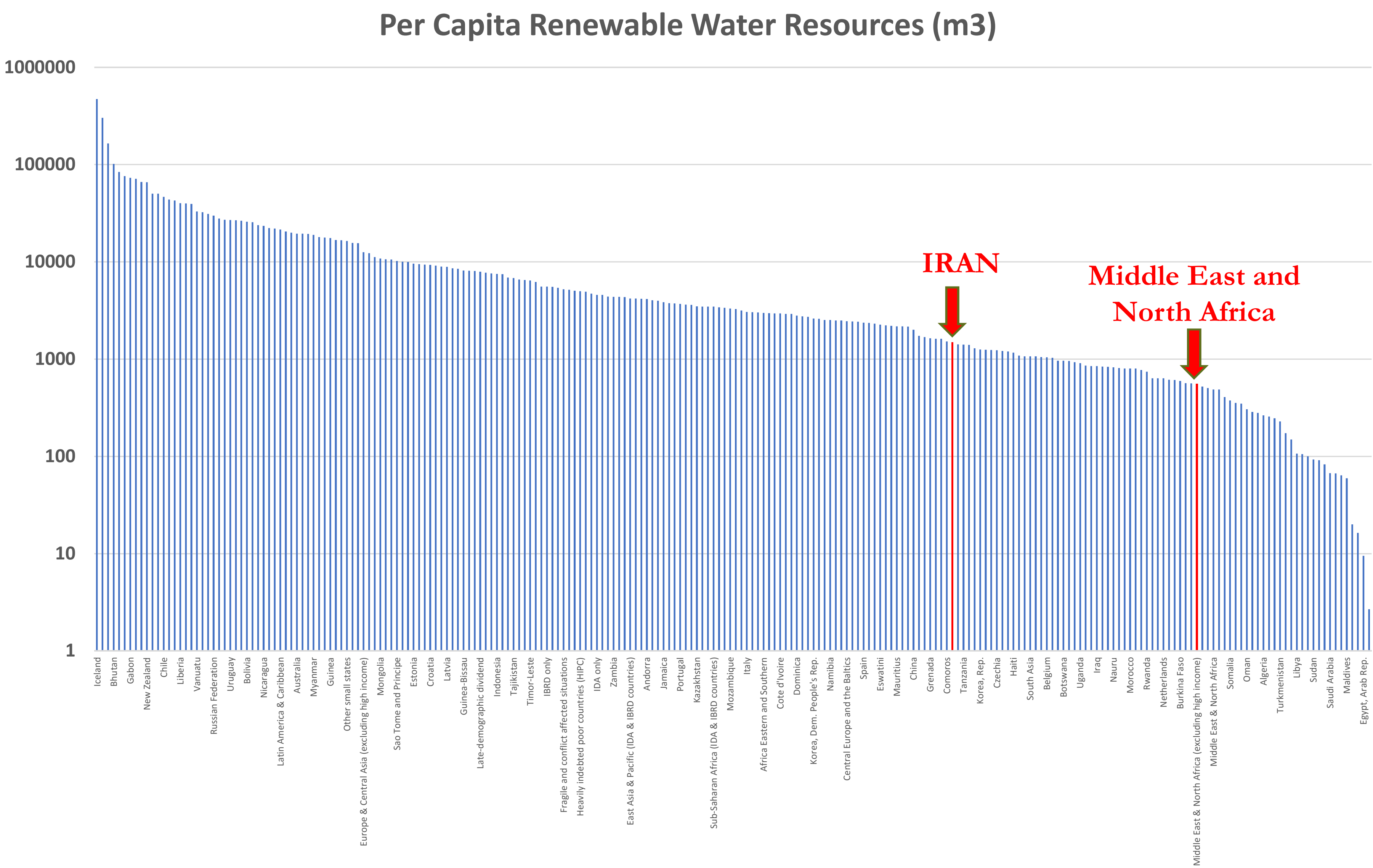


- The Middle East and North Africa is the most water-scarce region of the world.
- Home to 6.3 percent of the world's population, the region contains only 1.4 percent of the world's renewable fresh water.

- Iran's per capita renewable water is currently around 1296 cubic meters per year, which is considered a relatively low amount. (**Rank 156/266 based on World Bank Data**)

- However, it is higher than most countries in the Middle East and North Africa region, such as Saudi Arabia, UAE, Qatar and Kuwait, which have very limited water resources.


Per Capita Renewable Water Resources (m3)
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
Iceland
Bhutan
Gabon
New Zealand
Chile
Liberia
Vanuatu
Russian Federation
Uruguay
Bolivia
Nicaragua
Latin America & Caribbean
Australia
Myanmar
Guinea
Other small states
Europe & Central Asia (excluding high income)
Mongolia
Sao Tome and Principe
Estonia
Croatia
Latvia
Guinea-Bissau
Late-demographic dividend
Indonesia
Tajikistan
Timor-Leste
IBRD only
Fragile and conflict affected situations
Heavily indebted poor countries (HIPC)
IDA only
Zambia
East Asia & Pacific (IDA & IBRD countries)
Andorra
Jamaica
Portugal
Kazakhstan
Sub-Saharan Africa (IDA & IBRD countries)
Mozambique
Italy
Africa Eastern and Southern
Cote d'Ivoire
Dominica
Korea, Dem. People's Rep.
Namibia
Central Europe and the Baltics
Spain
Eswatini
Mauritius
China
Grenada
Comoros
Tanzania
Korea, Rep.
Czechia
Haiti
South Asia
Belgium
Botswana
Uganda
Iraq
Nauru
Morocco
Rwanda
Netherlands
Burkina Faso
Middle East & North Africa (excluding high income)
Middle East & North Africa
Somalia
Oman
Algeria
Turkmenistan
Libya
Sudan
Saudi Arabia
Maldives
Egypt, Arab Rep.



Per Capita Renewable Water Resources (m3)
1000000
100000
10000
1000
100
10
1
IRAN
Middle East and North Africa
Iceland
Bhutan
Gabon
New Zealand
Chile
Liberia
Vanuatu
Russian Federation
Uruguay
Bolivia
Nicaragua
Latin America & Caribbean
Australia
Myanmar
Guinea
Other small states
Europe & Central Asia (excluding high income)
Mongolia
Sao Tome and Principe
Estonia
Croatia
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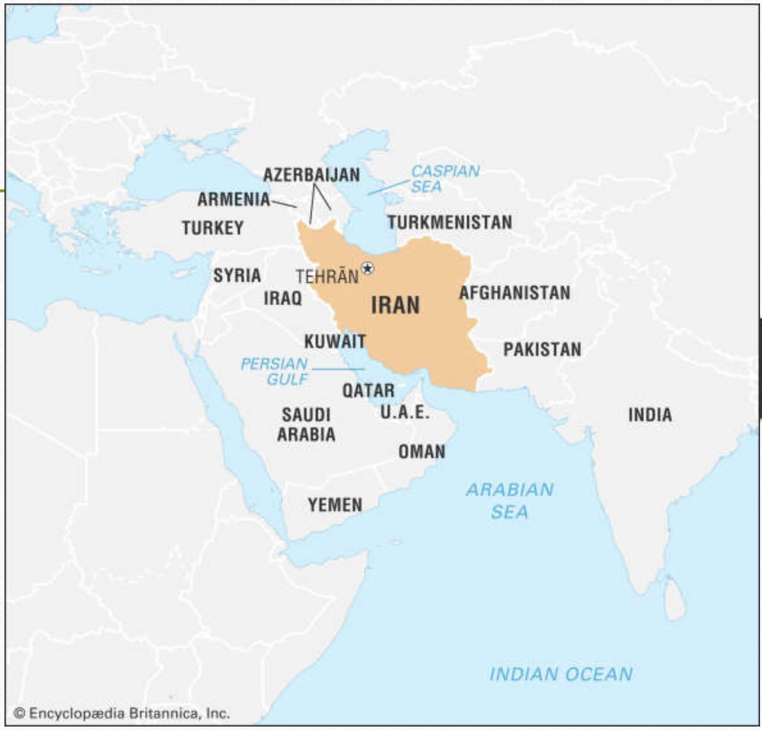
Kazakhstan
Sub-Saharan Africa (IDA & IBRD countries)
Mozambique
Italy
Africa Eastern and Southern
Cote d'Ivoire
Dominica
Korea, Dem. People's Rep.
Namibia
Central Europe and the Baltics
Spain
Eswatini
Mauritius
China
Grenada
Comoros
Tanzania
Korea, Rep.
Czechia
Haiti
South Asia
Belgium
Botswana
Uganda
Iraq
Nauru
Morocco
Rwanda
Netherlands
Burkina Faso
Middle East & North Africa (excluding high income)
Middle East & North Africa
Somalia
Oman
Algeria
Turkmenistan
Libya
Sudan
Saudi Arabia
Maldives
Egypt, Arab Rep.

- Iran's renewable water per capita: 1,290 cubic meters per year (as of 2021)
- Global average renewable water per capita: 1,700 cubic meters per year (as of 2021)
- Saudi Arabia's renewable water per capita: 91 cubic meters per year (as of 2021)
- Kuwait's renewable water per capita: 23 cubic meters per year (as of 2021)

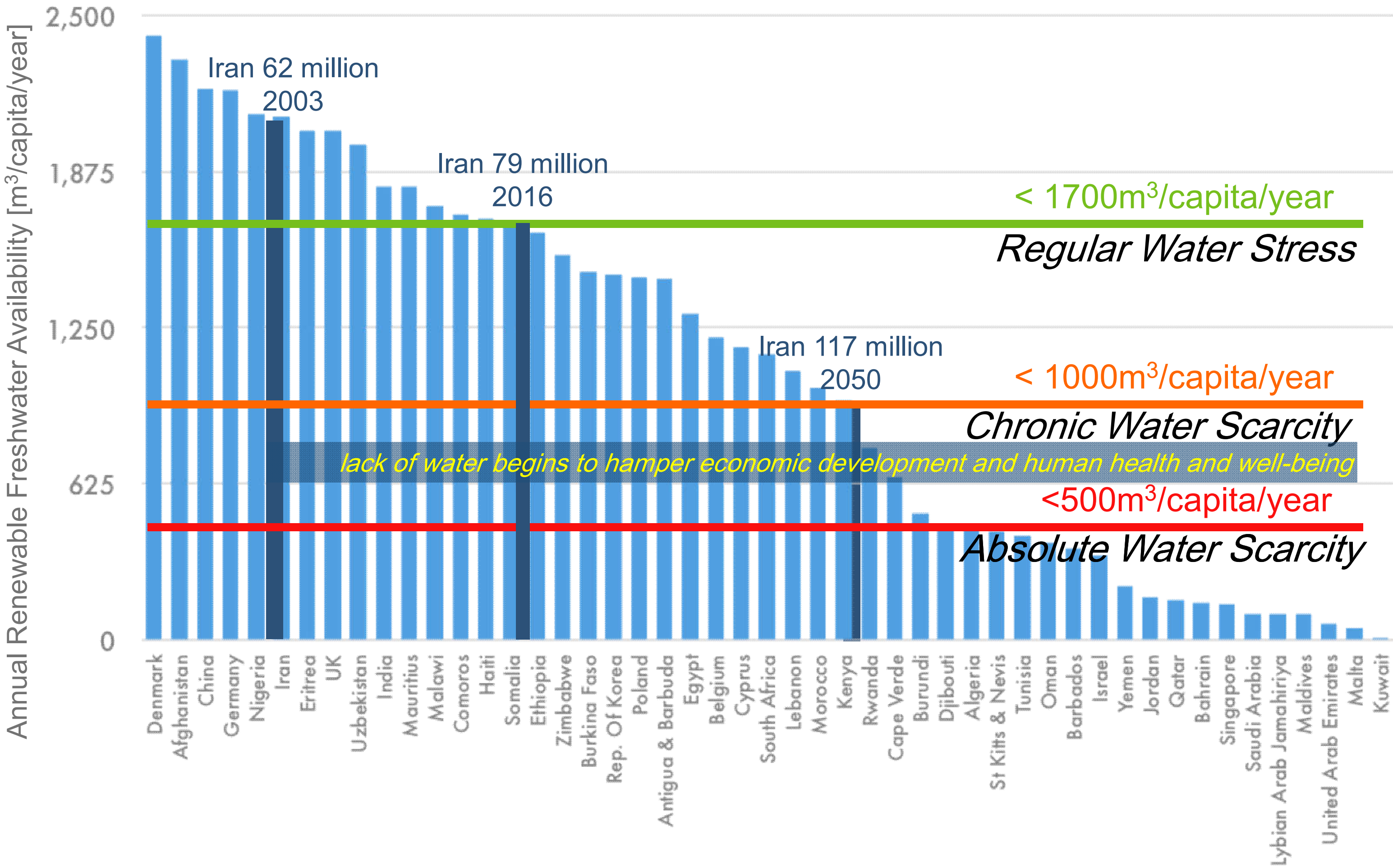
- According to the Aqueduct Country Rankings 2021 published by the World Resources Institute, Iran has a water stress score of 4.46. This score ranks Iran as the 24th most water-stressed country in the world out of the 164 countries included in the ranking.

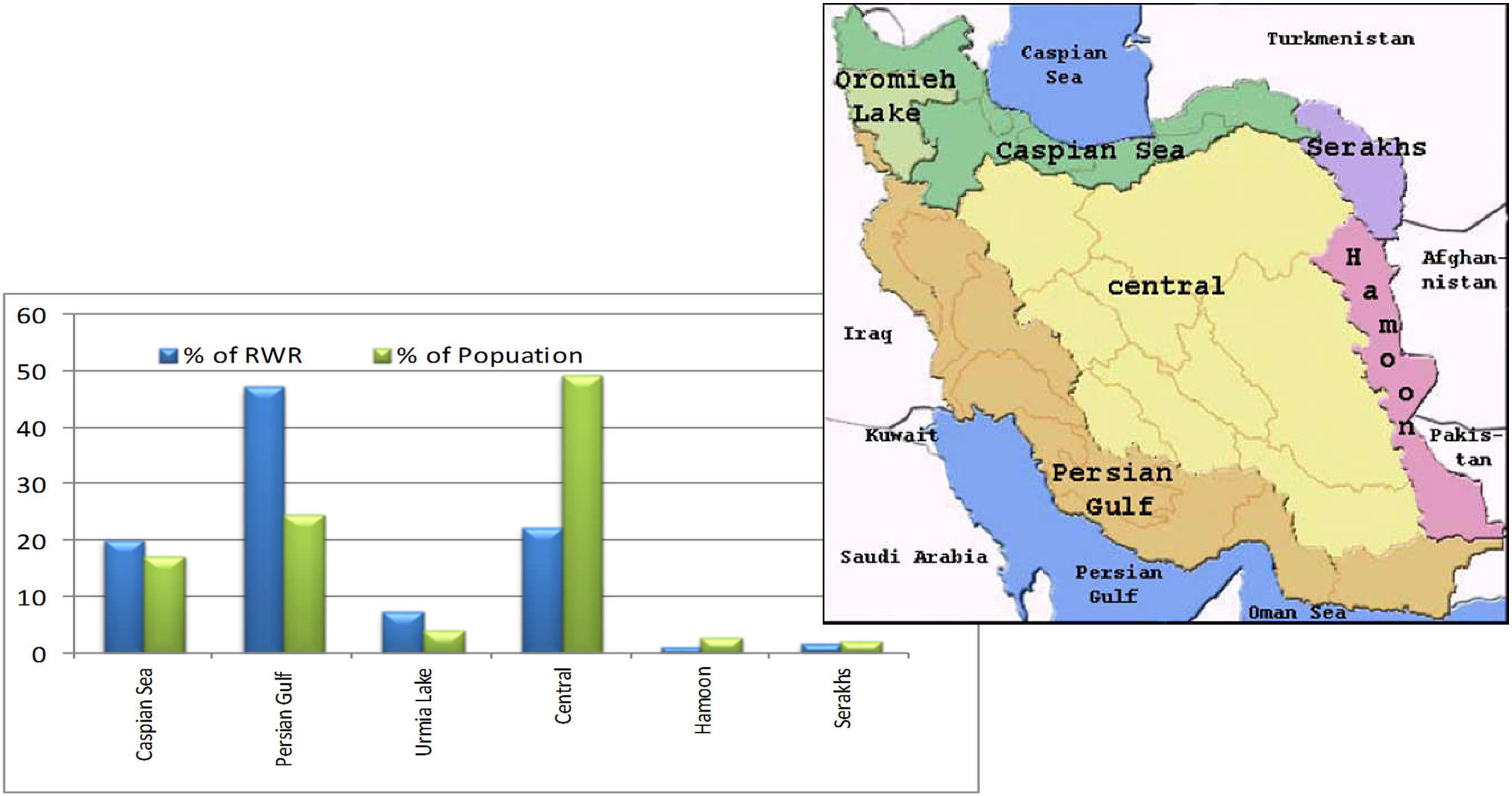


- Falkenmark's Water Stress Index (WSI), also known as the Falkenmark indicator, is a measure of water availability per capita for a country or region.
- According to the WSI, a country is considered to be **under water stress** if the annual water availability per person falls below **1,700 cubic meters**.
- If the annual water availability per person falls **below 1,000 cubic meters**, the country is considered to be **under water scarcity**,
- if it falls **below 500 cubic meters**, the country is **under absolute water scarcity**.
- The WSI provides a useful tool for understanding water scarcity and stress at the country or regional level, and can be used to inform water management and policy decisions.

Malin Falkenmark – a Swedish hydrologist

Water Scarcity vs Population Growth





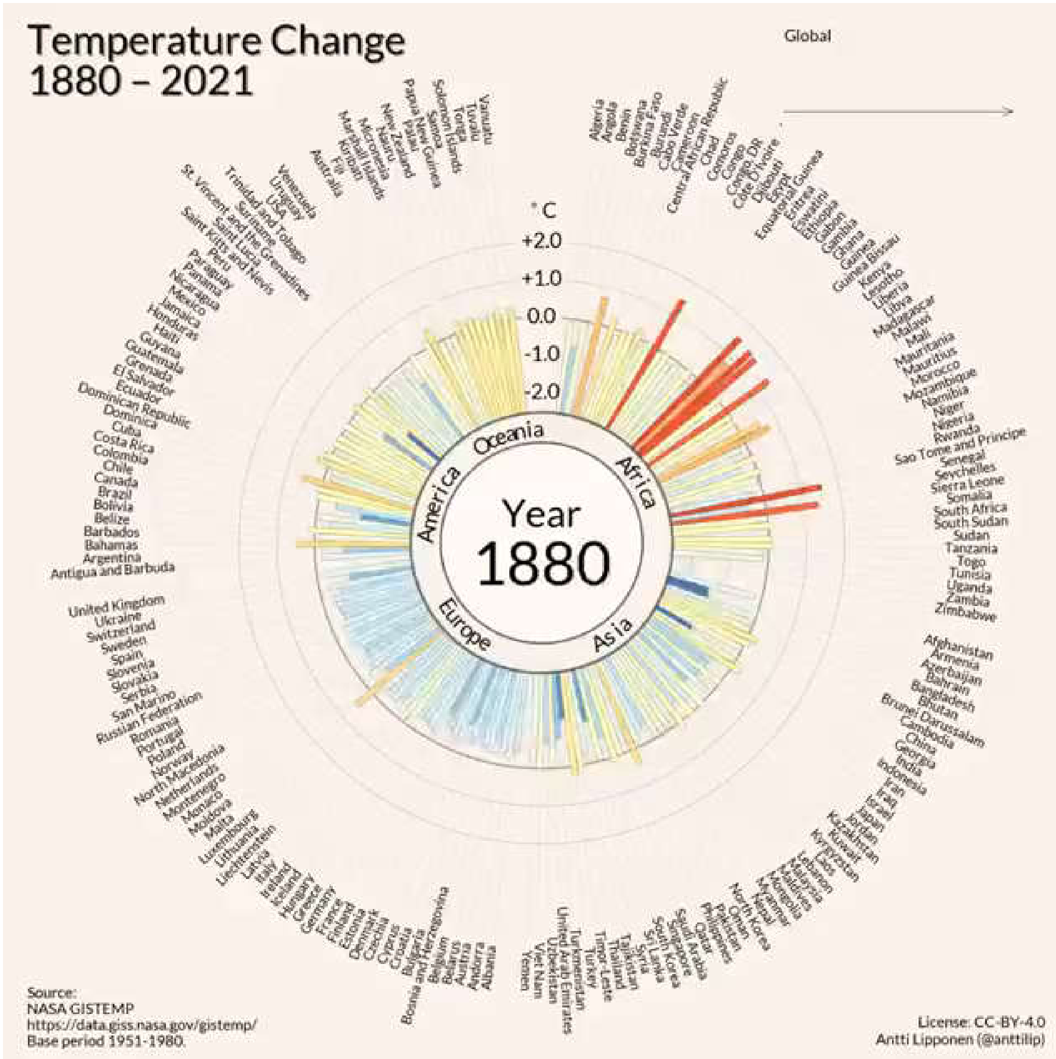
Percent of area, population, and total Renewable Water Resources (RWR) of major basins in Iran

Climate Change Impacts

- Climate change has significantly impacted the availability of renewable water resources in many countries around the world. The amount of renewable water resources have been affected by changes in temperature, precipitation patterns, and the melting of glaciers and ice caps.

- Overall, the effects of climate change on renewable water resources are complex and vary by region. However, it is clear that changes in precipitation patterns and temperature have significant impacts on the availability and quality of water resources in many countries around the world.

- Before 2000, many countries had relatively stable water resources, with annual precipitation patterns remaining relatively consistent from year to year. However, after 2000, there has been a noticeable shift in many regions, with some areas experiencing increased precipitation while others experiencing droughts and water shortages.

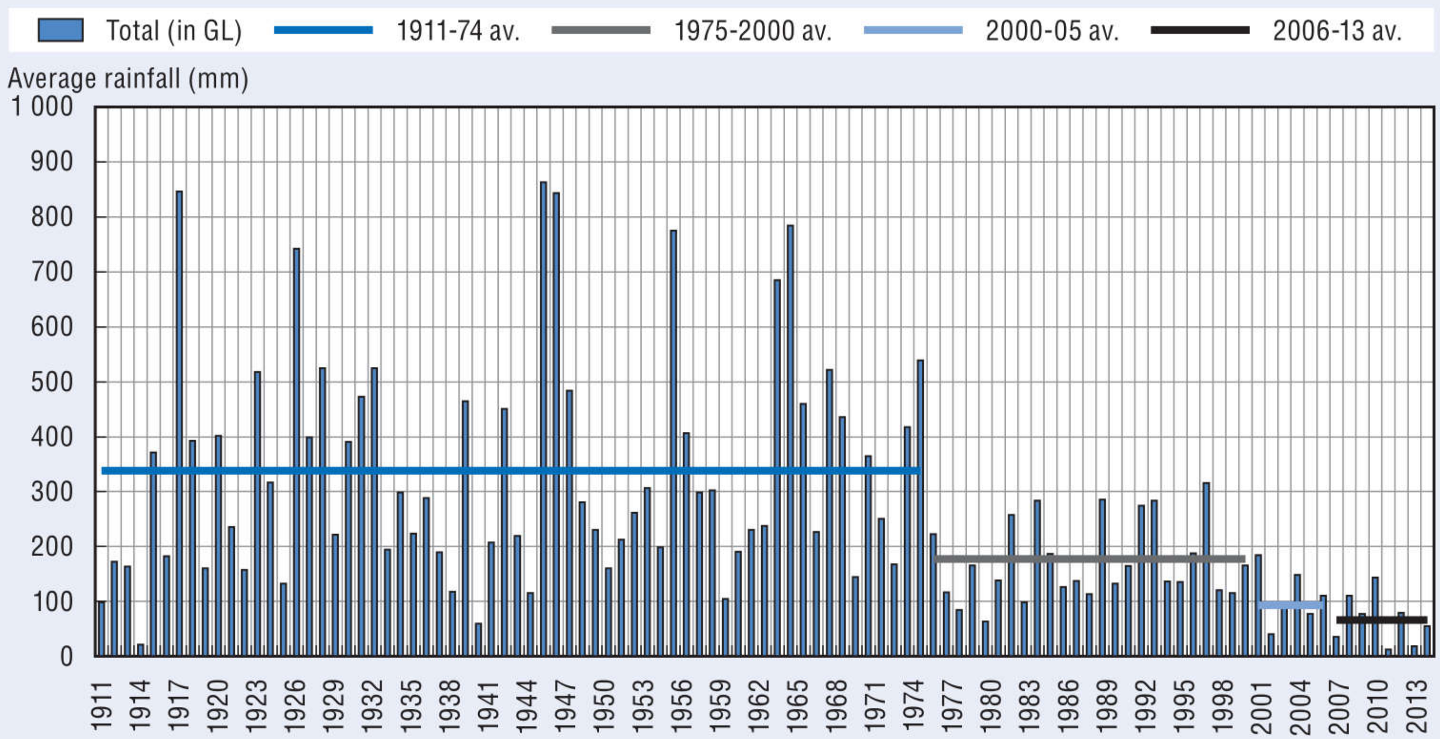


Temperature Change
1880 – 2021
Global
°C
+2.0
+1.0
0.0
-1.0
-2.0
Oceania
Africa
America
Europe
Asia
Year
1880
Source:
NASA GISTEMP
https://data.giss.nasa.gov/gistemp/
Base period 1951-1980.
License: CC-BY-4.0
Antti Lipponen (@anttilip)

One of the most common mistakes made when considering how best to manage water allocation is to assume that the impact of climate change on water supply will be gradual.

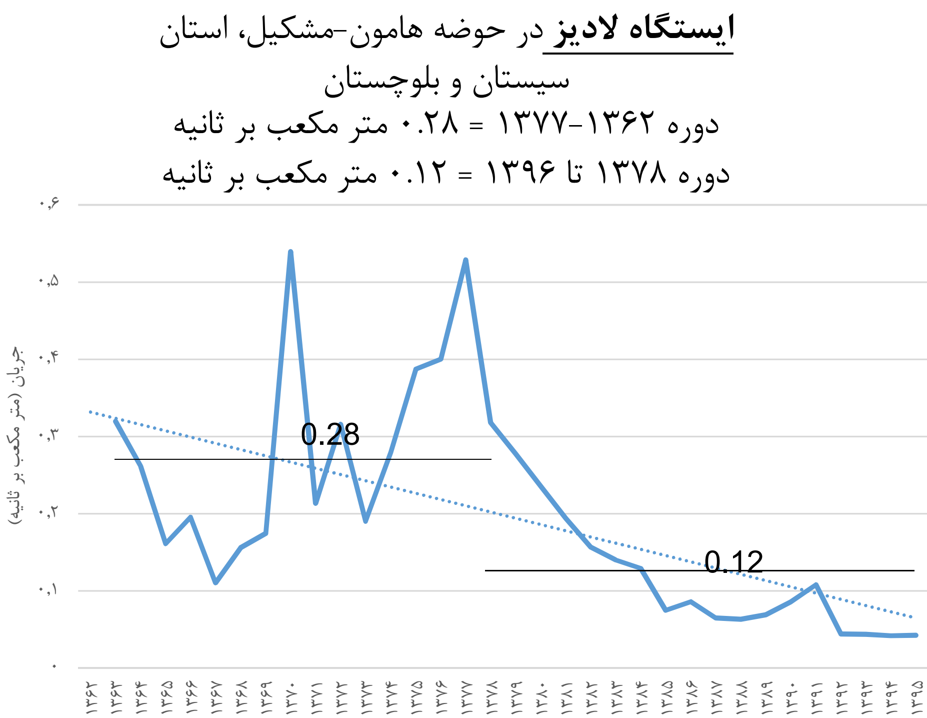
Experience has shown that **sudden climatic shifts** can occur.

Figure 1.4. **Historical trends in streamflow into Stirling Dam**



Notes: Streamflow is from May of labelled year to the following April. In order to provide an accurate historical comparison streamflow from Stirling, Wokalup and Samson Brook Dams are not included in this data as these dams only came online in 2001. Inflow is therefore modelled on Perth dams pre-2001.

Source: Water Corporation of Western Australia (2014), *www.watercorporation.com.au/water-supply-and-services/rainfall-and-dams/streamflow/streamflowhistorical.*

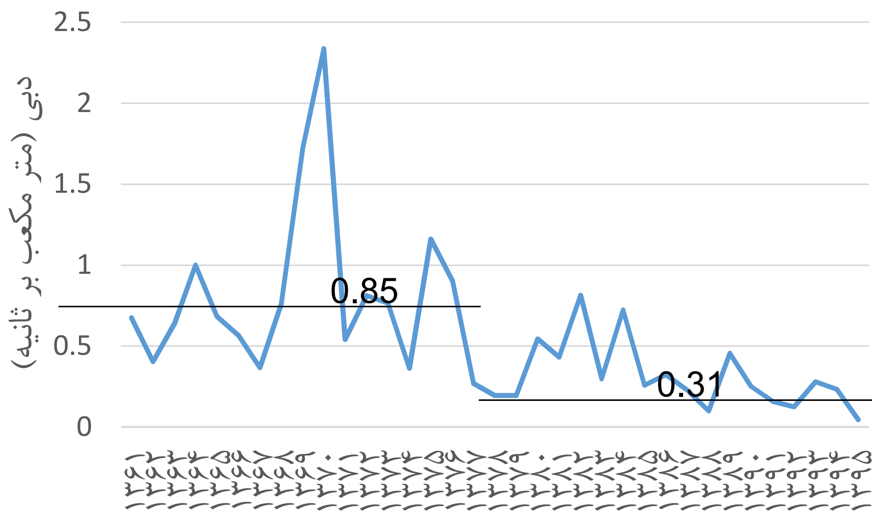


- این ایستگاه تحت تأثیر آبخوان قرار ندارد.
- همچنین تحت تأثیر جریان ورودی از محدوده‌های دیگر قرار ندارد.
- مساحت حوضه بالادست ایستگاه حدود 1480 کیلومتر مربع است که عمدتا از ارتفاعات تشکیل شده است
- همچنین تحت تأثیر بهره‌برداری از سدها قرار ندارد

ایستگاه ایرج آباد در حوضه کویر مرکزی در استان خراسان رضوی

دوره ۱۳۶۱-۱۳۷۸ = ۰.۸۵ متر مکعب بر ثانیه

دوره ۱۳۷۹ تا ۱۳۹۶ = ۰.۳۱ متر مکعب بر ثانیه

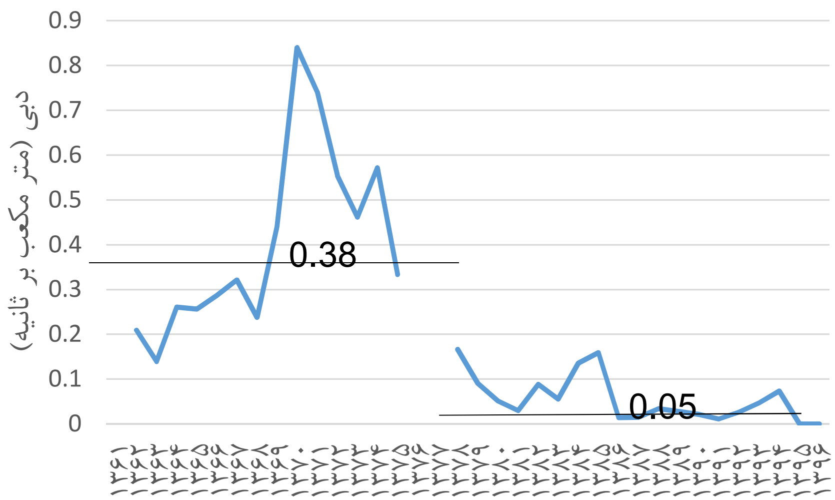


- مساحت حوضه بالادست ایستگاه ۷۵۰ کیلومتر مربع است که عمدتا از ارتفاعات تشکیل شده است
- توسعه اراضی زراعی در بالادست ایستگاه محدود است.

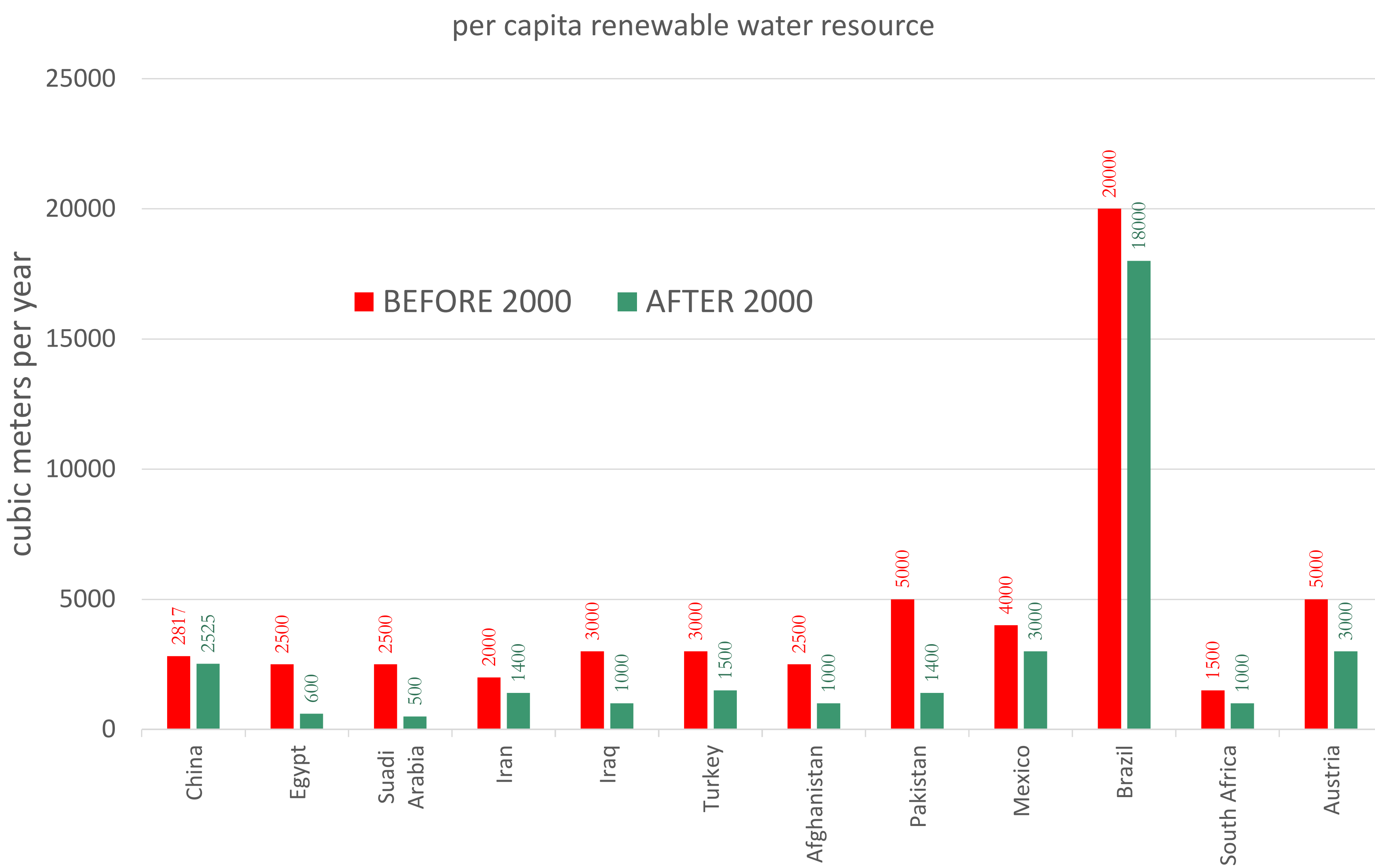
ایستگاه غار شیشه در حوضه قره قوم در استان خراسان رضوی

دوره ۱۳۷۸-۱۳۶۲ = ۰.۳۸ متر مکعب بر ثانیه

دوره ۱۳۷۹ تا ۱۳۹۶ = ۰.۰۵ متر مکعب بر ثانیه



- این ایستگاه تحت تأثیر آبخوان قرار ندارد.
- همچنین تحت تأثیر جریان ورودی از محدوده‌های دیگر قرار ندارد.
- مساحت حوضه بالادست ایستگاه حدود ۷۵ کیلومتر مربع است که از ارتفاعات تشکیل شده است
- همچنین تحت تأثیر بهره‌برداری از سدها قرار ندارد



per capita renewable water resource
cubic meters per year
BEFORE 2000
AFTER 2000
25000
20000
15000
10000
5000
0
China
Egypt
Suadi Arabia
Iran
Iraq
Turkey
Afghanistan
Pakistan
Mexico
Brazil
South Africa
Austria
2817
2525
2500
600
2500
500
2000
1400
3000
1000
3000
1500
2500
1000
5000
1400
4000
3000
20000
18000
1500
1000
5000
3000

Using an ensemble of climate models and socioeconomic scenarios, WRI scored and ranked future water stress—a measure of competition and depletion of surface water—in 167 countries by **2040**.

WRI found that 33 countries face extremely high water stress in 2040

Chile, Estonia, Namibia, and Botswana could face an **especially significant increase in water stress by 2040**.

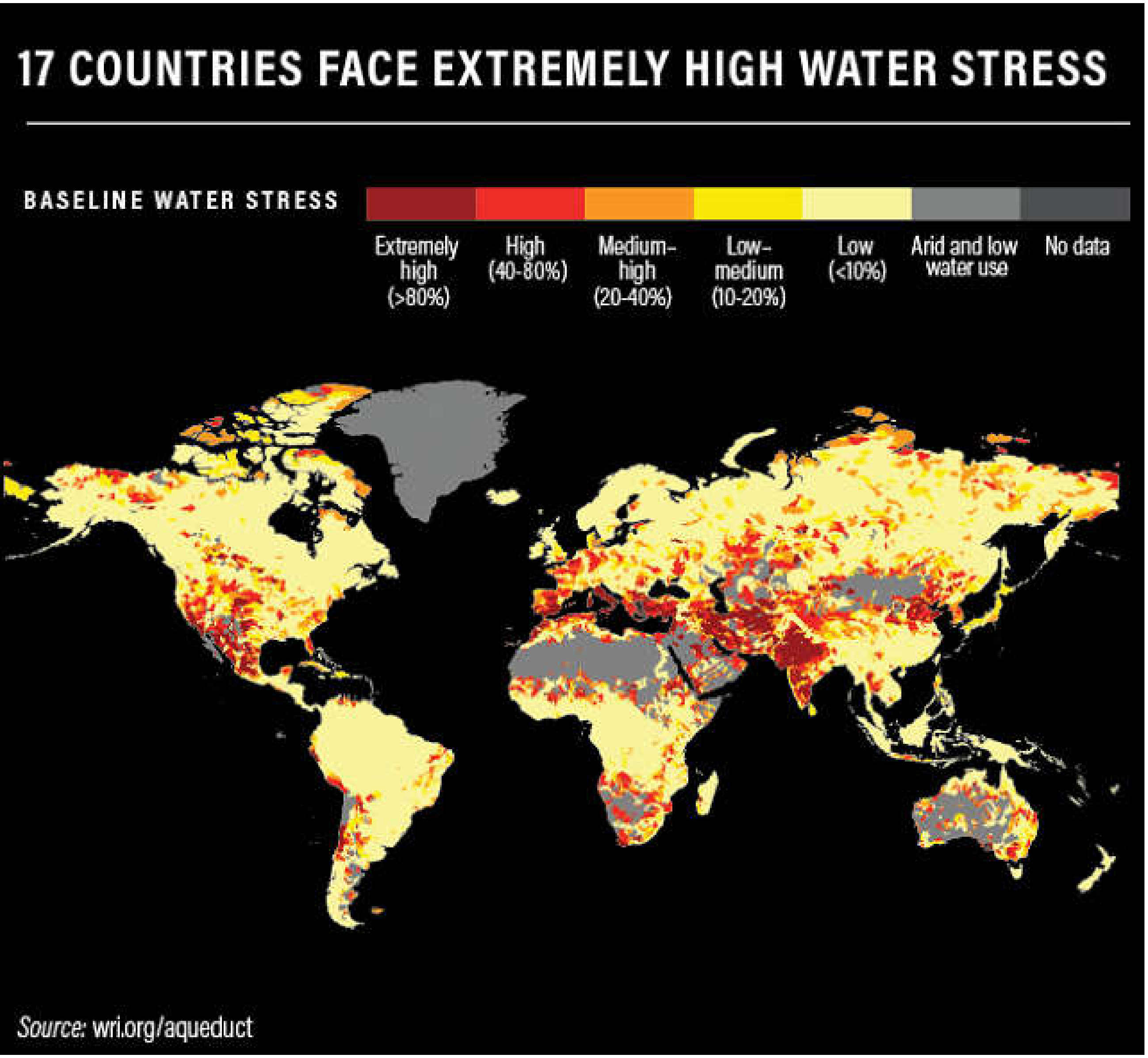
Water Stress by Country: 2040

RANK	NAME	ALL SECTORS
1	Bahrain	5.00
1	Kuwait	5.00
1	Qatar	5.00
1	San Marino	5.00
1	Singapore	5.00
1	United Arab Emirates	5.00
1	Palestine	5.00
8	Israel	5.00
9	Saudi Arabia	4.99
10	Oman	4.97
11	Lebanon	4.97
12	Kyrgyzstan	4.93
13	Iran	4.91
14	Jordan	4.86
15	Libya	4.77
16	Yemen	4.74
17	Macedonia	4.70

RANK	NAME	ALL SECTORS
18	Azerbaijan	4.69
19	Morocco	4.68
20	Kazakhstan	4.66
21	Iraq	4.66
22	Armenia	4.60
23	Pakistan	4.48
24	Chile	4.45
25	Syria	4.44
26	Turkmenistan	4.30
27	Turkey	4.27
28	Greece	4.23
29	Uzbekistan	4.19
30	Algeria	4.17
31	Afghanistan	4.12
32	Spain	4.07
33	Tunisia	4.06

http://ow.ly/RiWop

WORLD RESOURCES INSTITUTE



EXTREMELY HIGH BASELINE WATER STRESS

1. Qatar
2. Israel
3. Lebanon
4. Iran
5. Jordan
6. Libya
7. Kuwait
8. Saudi Arabia
9. Eritrea
10. United Arab Emirates
11. San Marino
12. Bahrain
13. India
14. Pakistan
15. Turkmenistan
16. Oman
17. Botswana

12 out of the 17 most water-stressed countries are in MENA region.

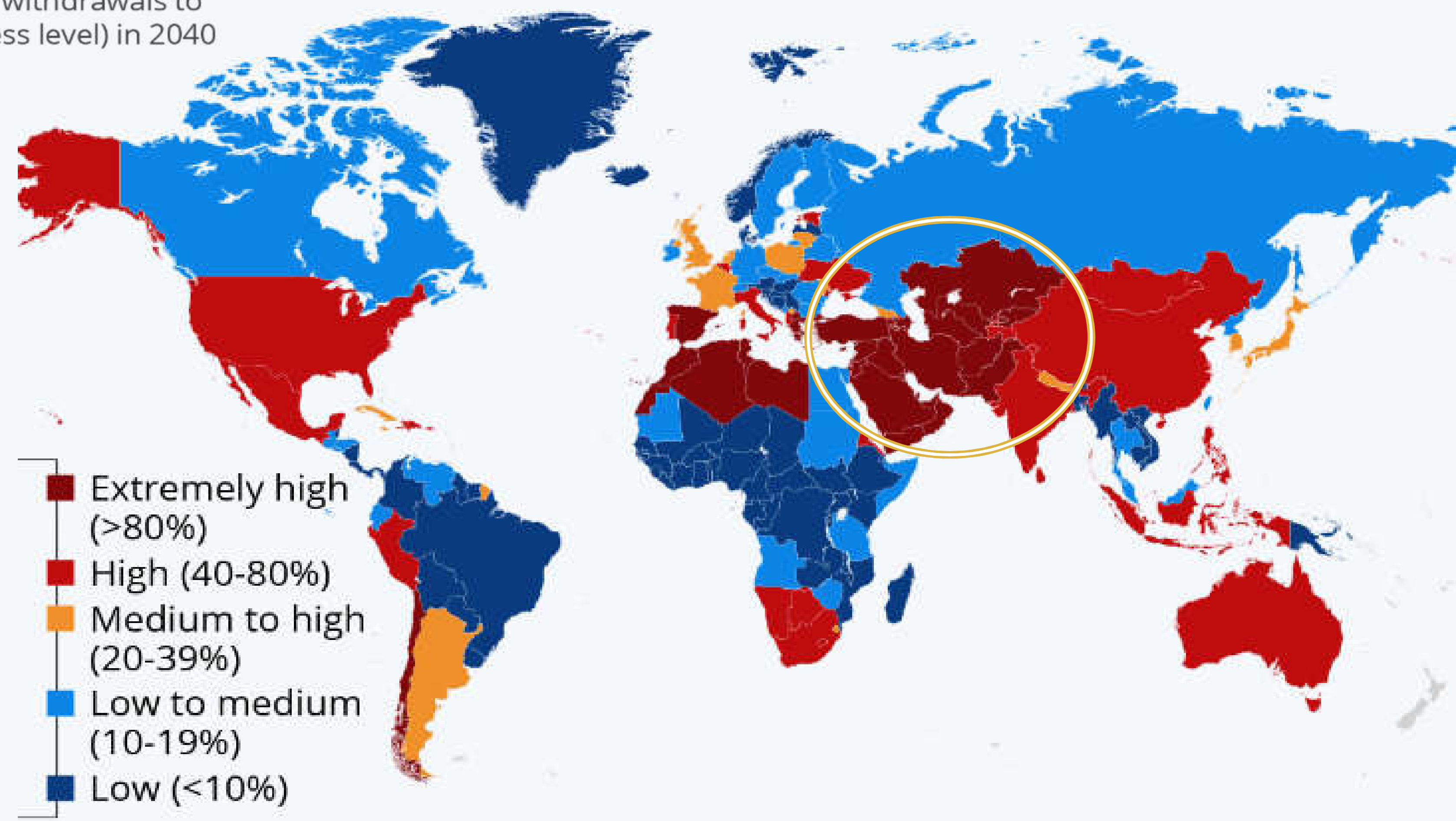
Most of the region has arid-semi-arid climate and therefore the region naturally has low renewable water resources.

Growing demands have pushed countries further into going the increase water scarcity intensity.

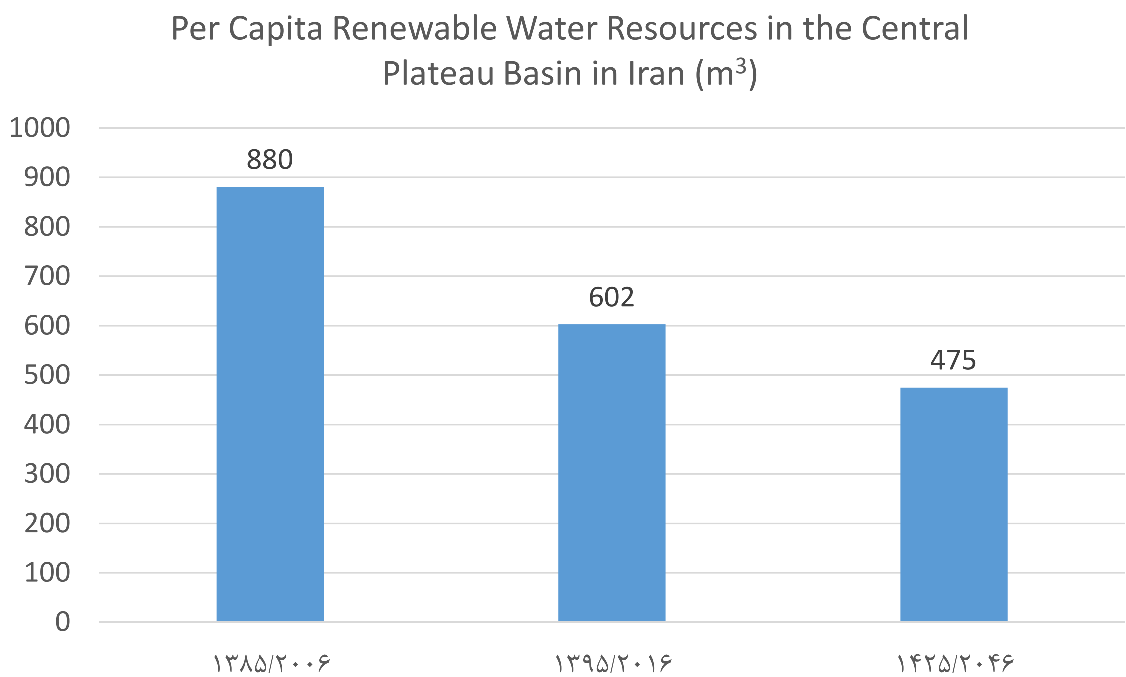
The World Bank found that this region has the greatest expected economic losses from climate-related water scarcity, estimated at **6-14% of GDP by 2050**.

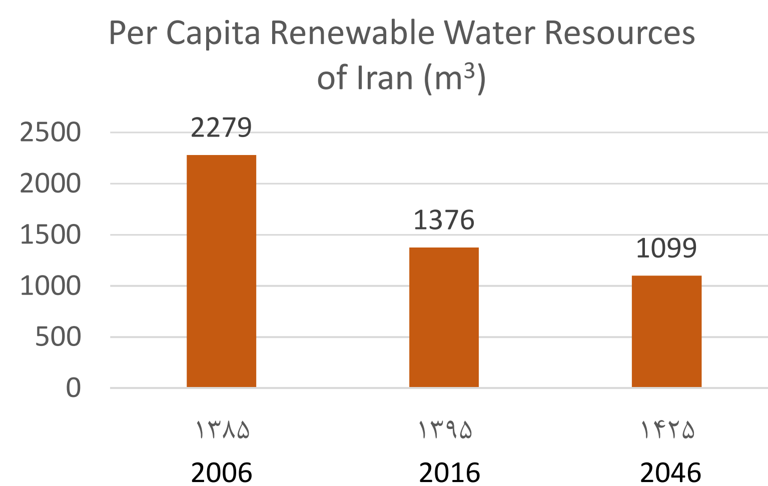
Where Water Stress Will Be Highest by 2040

Projected ratio of water withdrawals to water supply (water stress level) in 2040

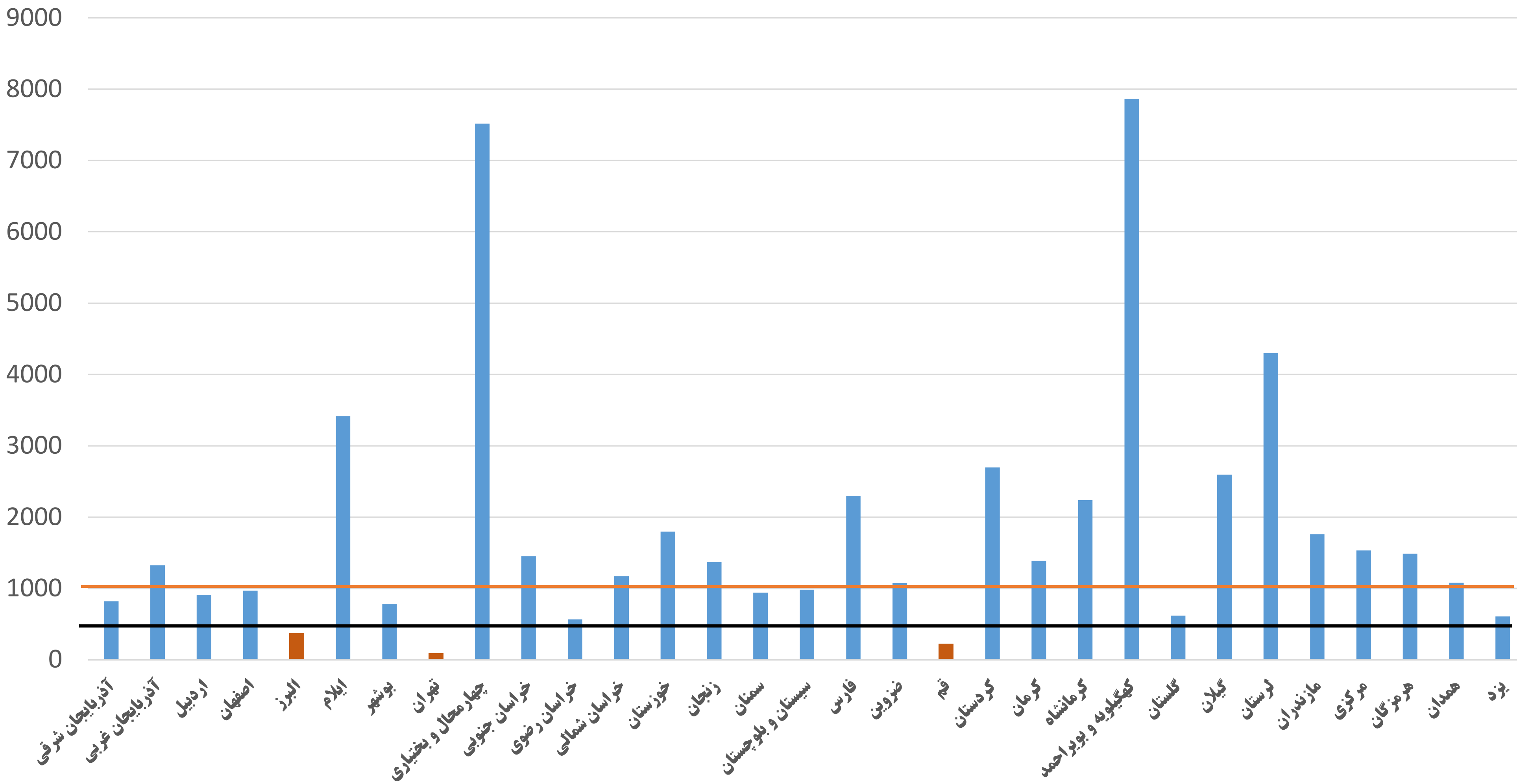


Source: World Resources Institute via The Economist Intelligence Unit


Per Capita Renewable Water Resources in the Central Plateau Basin in Iran (m3)
1000
900
800
700
600
500
400
300
200
100
0
880
602
475
۱۳۸۵/۲۰۰۶
۱۳۹۵/۲۰۱۶
۱۴۲۵/۲۰۴۶


Per Capita Renewable Water Resources of Iran (m3)
2500
2000
1500
1000
500
0
2279
1376
1099
۱۳۸۵
۱۳۹۵
۱۴۲۵
2006
2016
2046

Per Capita Renewable Water Resources of Provinces in Iran (m^3)



Groundwater:
A Major Source of Water Supply

Share of Groundwater Supply (Global vs. Iran)

- Globally, ground water is the source of one third of all freshwater withdrawals, supplying an estimated 36%, 42% and 27% of the water used for domestic, agricultural and industrial purposes, respectively.

- In **Iran**, groundwater supplies around 62%, 48%, and 49% of domestic, agricultural and industrial water withdrawals.

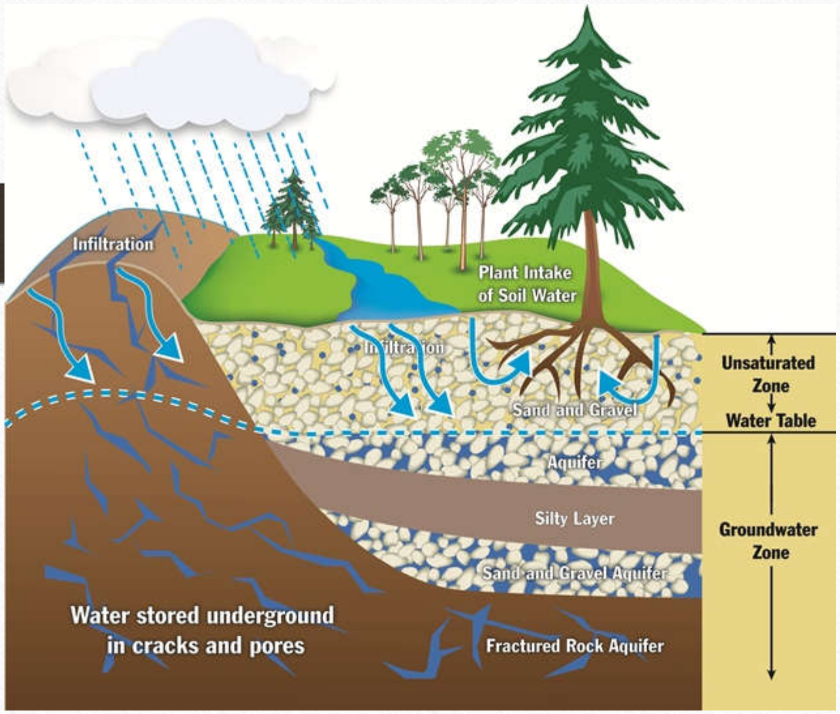
-

48% Groundwater dependency

Country	Total groundwater withdrawals (km^3)	Total renewable groundwater resources (km^3)	Percent of withdrawals to total renewable groundwater resources	Percent national share of global withdrawals
India	190	419	45.3	28.9
United States	110	1,300	8.5	16.7
Pakistan	60	55	109.1	9.1
China	53	828	6.4	8.1
Iran	53	49	108.2	8.1
Mexico	25	139	18.0	3.8
Saudi Arabia	21	2.2	954.5	3.2
Italy	14	43	32.6	2.1
Japan	14	27	51.9	2.1
Bangladesh	11	21	52.4	1.7
Brazil	8	1,874	0.4	1.2
Turkey	8	68	11.8	1.2
Uzbekistan	7	9	77.8	1.1
Germany	7	46	15.2	1.1
Egypt	7	2	350.0	1.1
France	6	100	6.0	0.9
Spain	5	30	16.7	0.8
Bulgaria	5	6	83.3	0.8
Argentina	5	128	3.9	0.8
Libya	4	0.5	800.0	0.6
Rest of the world	76	6,135	1.2	11.6
Total	658	11,282	5.8	100.0

[a] Sources: FAO, AQUASTAT (**http://www.fao.org/nr/water/aquastat/main/index.stm**; 40, 41).

Classification of Ground Water Resources



Renewable: Recharges in a relatively short period of time by rain

Deep water:

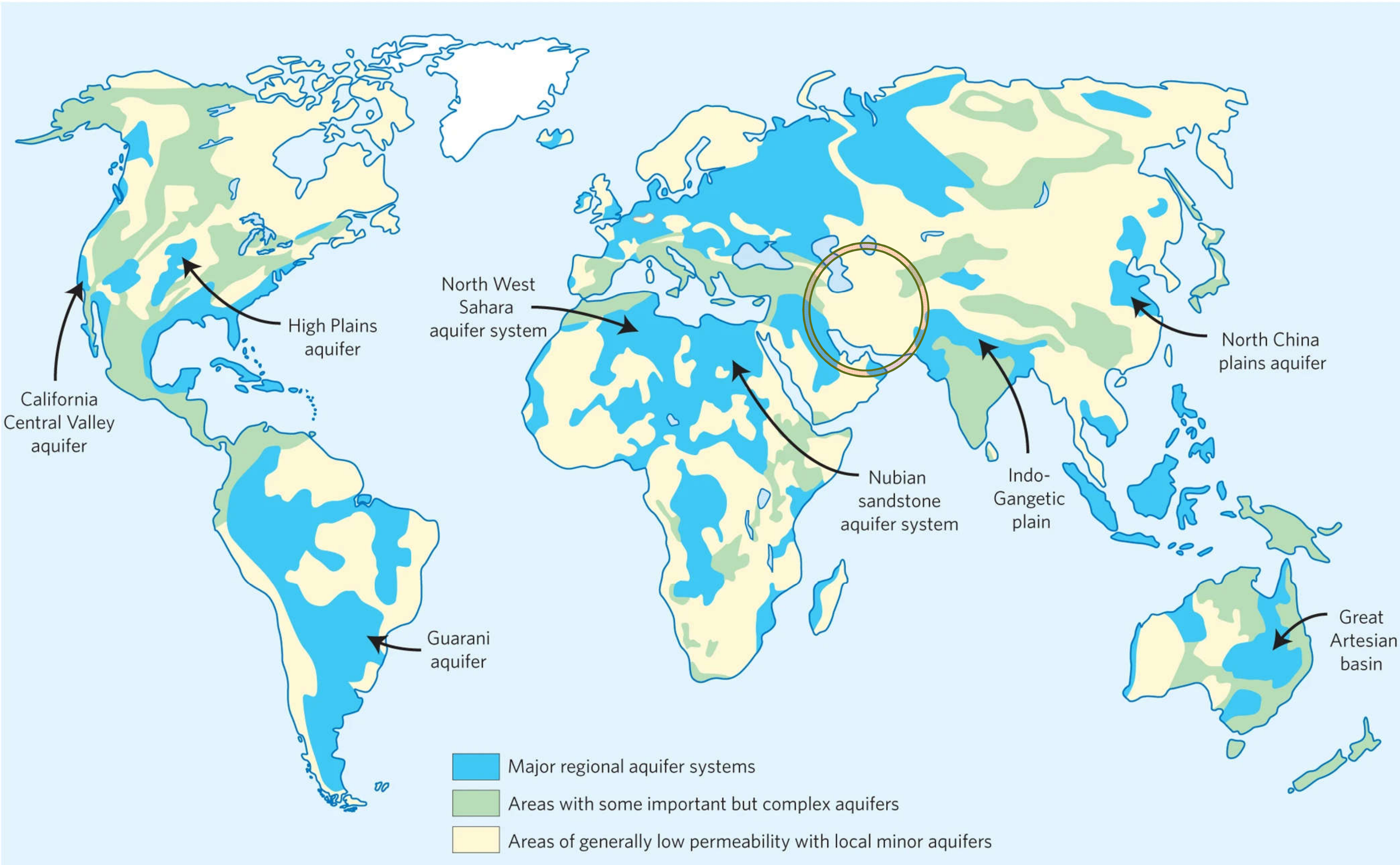
- Water resources located deep underground
- Replenished through natural processes like infiltration and percolation
- Generally renewable but sustainability depends on factors like recharge and extraction rate

Fossil water (Paleowater):

- Water resources trapped underground for thousands or even millions of years
- Typically non-renewable and not replenished over human timescales
- Associated with aquifers formed during previous geological periods

Key difference:

- Age and origin of the water
- Deep water is renewable and can be sustainably managed
- Fossil water is non-renewable and typically mined or extracted for a limited time


North West
Sahara
aquifer system
High Plains
aquifer
California
Central Valley
aquifer
North China
plains aquifer
Nubian
sandstone
aquifer system
Indo-
Gangetic
plain
Guarani
aquifer
Great
Artesian
basin
Major regional aquifer systems
Areas with some important but complex aquifers
Areas of generally low permeability with local minor aquifers

Importance of deep water:

- Increasing importance in many countries, particularly in the Middle East where water scarcity is a significant challenge

Exploration and exploitation:

- Several countries in the Middle East investing in exploration and exploitation of deep-water resources
- Saudi Arabia, the UAE, and Kuwait among the most

Concerns:

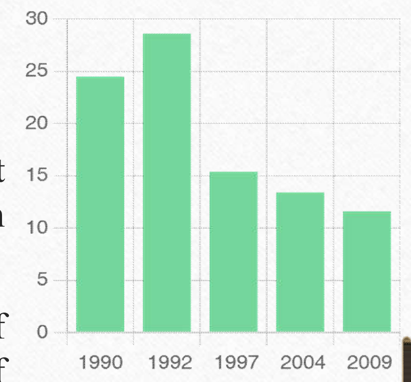
- Quality and sustainability of deep and fossil water need to be addressed for long-term viability

Libya

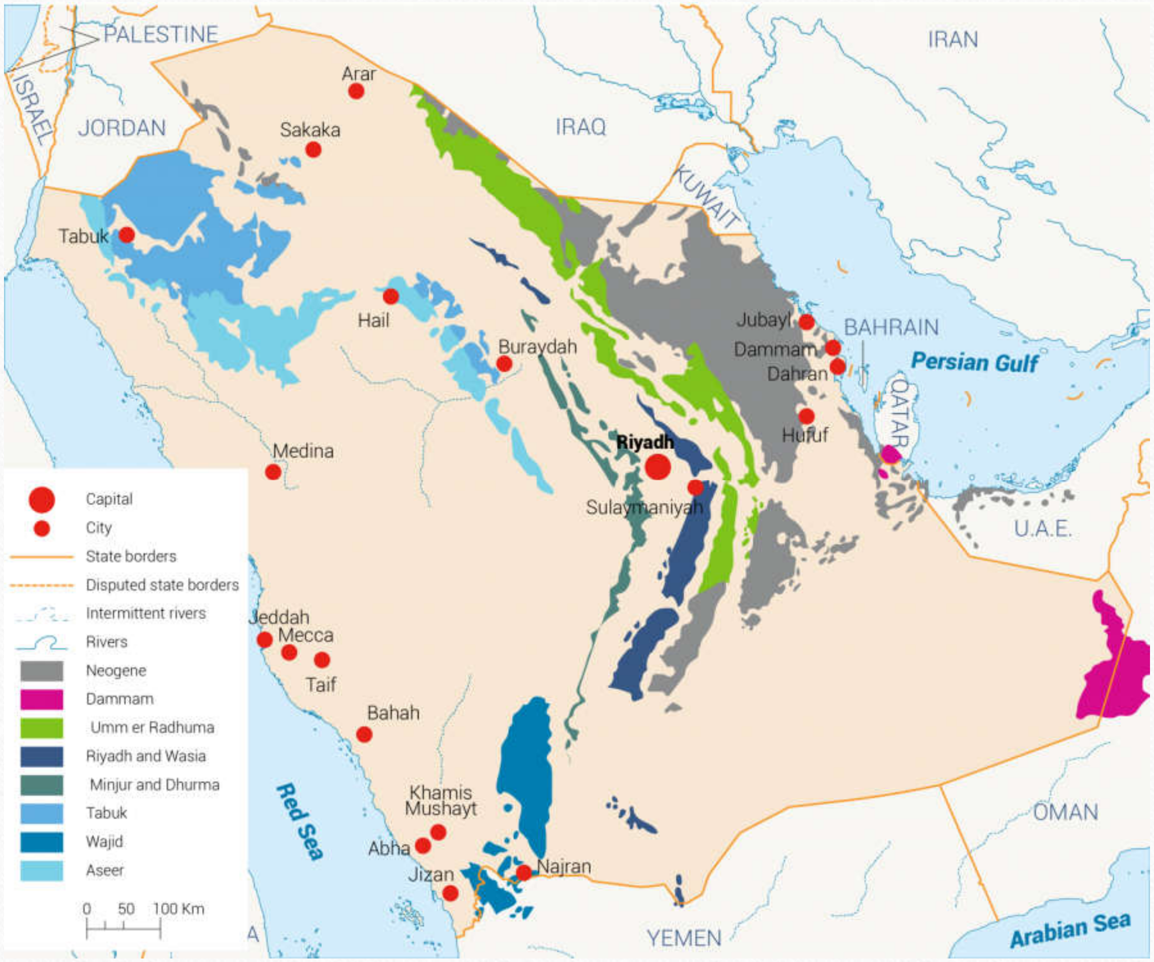
- **Age:** 10,000 to 1,000,000 years old
- **Creation:** Nubian Sandstone Aquifer System, a vast reservoir of "fossil water" to which water was percolated into the sandstone before the end of the last ice age, when the Saharan region enjoyed a temperate climate.
- **Volume** of Nubian Sandstone Aquifer System is estimated as 150,000 km^3 (twice of Caspian Sea)
- **Non renewable:** Some believe this aquifer might not last through the 21st century. Some say it may last in 250 years, some say 650 years, ….
- **Size:** 4000 km of pipe line (4 m diameter) 6 million m^3 / day = 2,190 million m^3 / year

Saudi Arabia

- Saudi Arabia has invested heavily in the exploration of deep-water resources
- Rub al-Khali desert has a vast aquifer system with significant reserves of deep water
- The Saudi desert was sitting on top of some 500 billion m^3 of fossil water, but in recent years, an estimated 21 billion m^3 has been taken out every year to support modern intensive farming. **Less than 50 years to dry the whole aquifer**
- Saudi Arabia has achieved its goal of becoming completely self-sufficient in a number of foodstuffs, including meat, milk and eggs. In fact, the country has become an exporter of wheat, dates, dairy products, eggs, fish, poultry, vegetables and flowers to markets around the world.
- There are 522 dams around the country, with a capacity of 2.3 billion cubic meters (BCM) to facilitate the storage and recharge of 970 million cubic meters of surface runoff (1.6% of Iran's RWR).
- The total renewable groundwater is estimated to be 2.8 BCM/yr (5.7% of Iran's RWR).
- Both renewable and non-renewable groundwater is used primarily in the agricultural sector, which constitutes about 85% of total groundwater withdrawal.



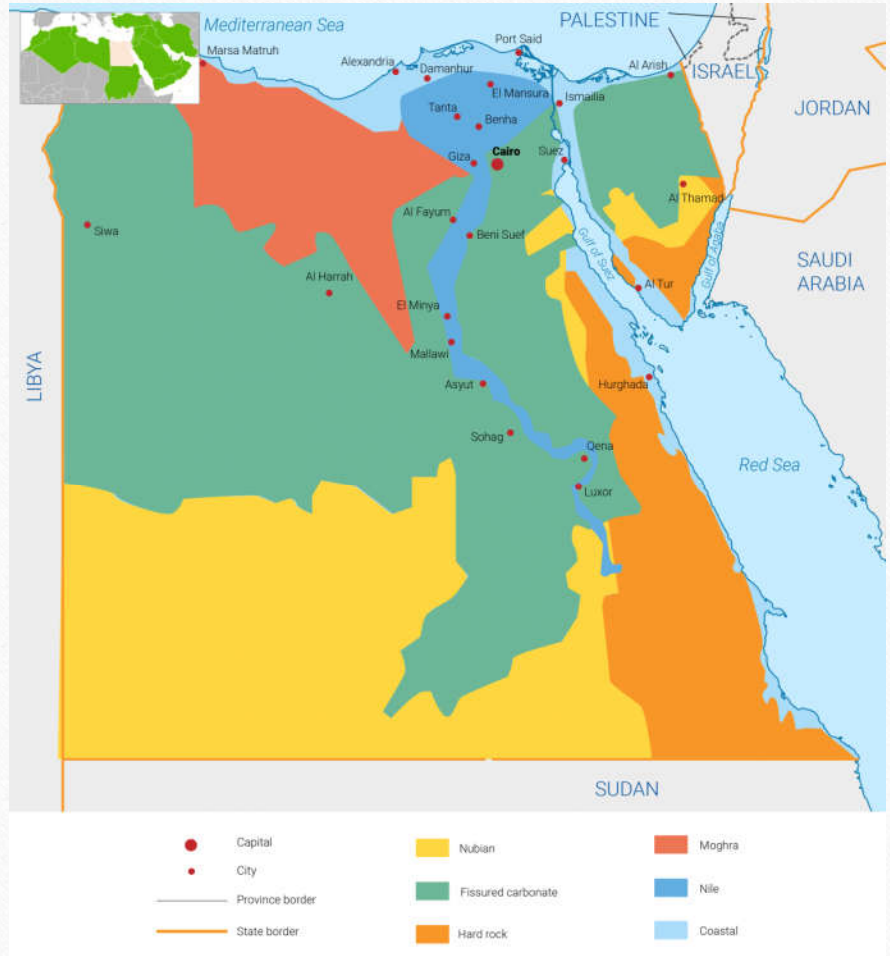
Fossil groundwater withdrawal rate in KSA between 1990 and 2009



PALESTINE
ISRAEL
JORDAN
IRAQ
IRAN
KUWAIT
BAHRAIN
QATAR
U.A.E.
OMAN
YEMEN
Persian Gulf
Red Sea
Arabian Sea
Arar
Sakaka
Tabuk
Hail
Buraydah
Jubayl
Dammam
Dahran
Hufuf
Riyadh
Sulaymaniyah
Medina
Jeddah
Mecca
Taif
Bahah
Khamis Mushayt
Abha
Jizan
Najran
Capital
City
State borders
Disputed state borders
Intermittent rivers
Rivers
Neogene
Dammam
Umm er Radhuma
Riyadh and Wasia
Minjur and Dhurma
Tabuk
Wajid
Aseer
0 50 100 Km

Egypt

- The Nile River supplies about 93% of Egypt's annual renewable water resources. A share of 55.5 billion cubic metres per year (BCM/yr) is allocated to Egypt according to the Nile Water Agreement (1959).
- Egypt has huge natural mineral water resources estimate around 40,000 BCM. However, most of them have not yet been significantly exploited. The main obstacles in utilizing this resource, which represents approximately 8% of water resources, are the great depth (up to 1,500 metres in some areas) and deteriorating water quality at increasing depth.



Quality and sustainability of deep-water resources

- Economic challenges
- Environmental impacts
- Legal and institutional frameworks
- Technological advancements

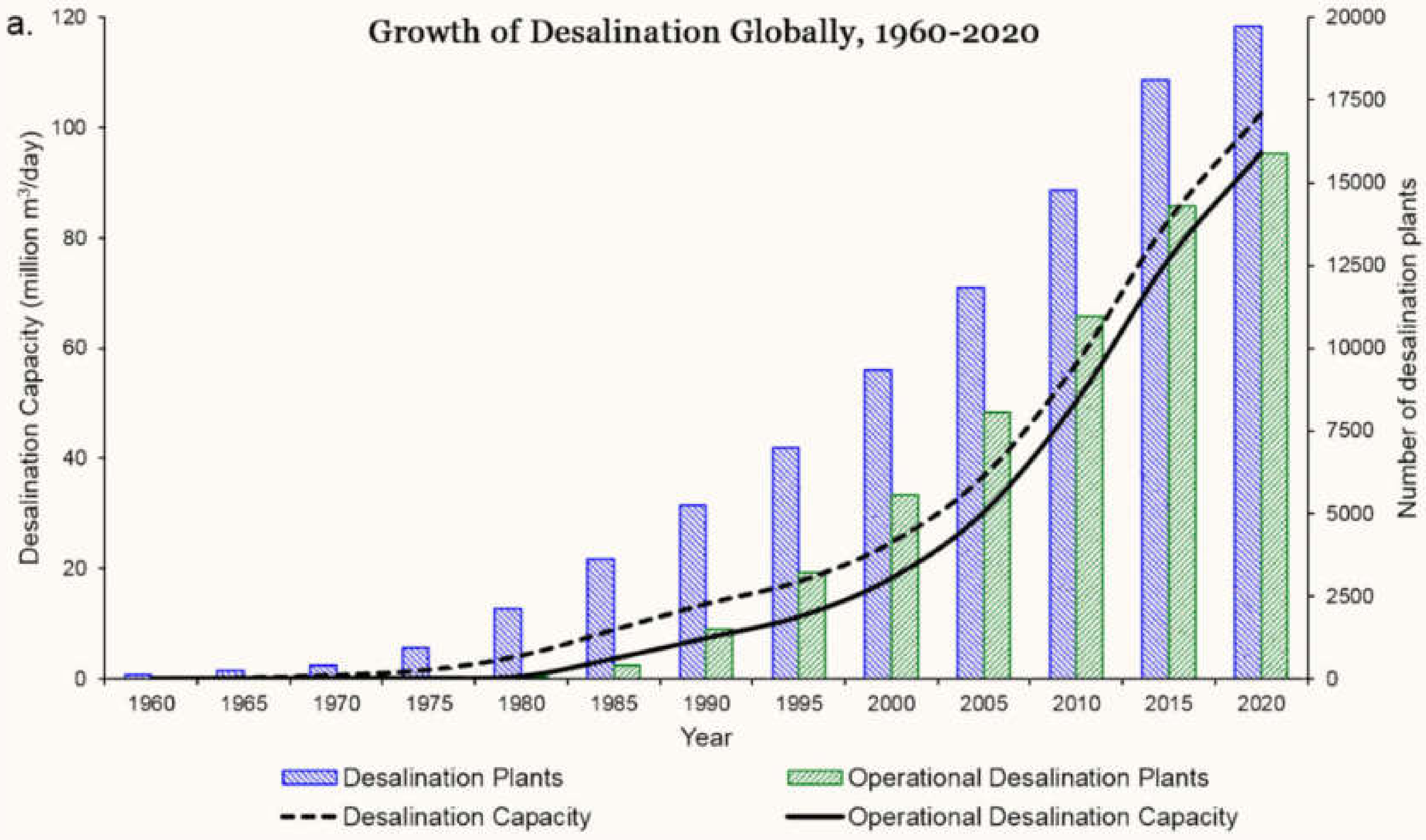
- Deep water resources have low salinity and high purity in some aquifers but in some aquifers they contain various contaminants. For example, UAE sits on around 640 BCM but only 3% is fresh.
- The high cost of extracting and treating deep water is a major challenge, making it economically unviable for some countries.
- Exploitation of deep-water resources can have environmental impacts, such as habitat destruction and displacement of marine life, as well as negative effects on marine environments due to the discharge of brine and waste products.
- Legal and institutional frameworks governing the use of deep-water resources are still evolving, leading to conflicts over ownership and management of resources.
- Despite these challenges, the exploitation of deep-water resources remains a promising option, particularly for countries with limited freshwater resources.
- Technological advancements continue to improve the efficiency and sustainability of deep-water extraction and treatment processes, making it likely that the use of deep-water resources will continue to expand in the future.

Fossil water is a finite resource

- Middle east resources of fossil water
- Extraction and usage
- Depletion and environmental impacts
- Sustainability concerns

- Fossil water is a finite resource that has accumulated in underground aquifers over thousands or millions of years.
- The Middle East region has some of the largest fossil water reserves in the world, containing up to 75% of the world's total non-renewable groundwater resources.
- Extraction and use of fossil water in the Middle East have increased significantly in recent decades due to population growth, urbanization, and agricultural expansion.
- Concerns have arisen regarding the depletion of these non-renewable resources and the potential environmental impacts of their extraction.
- Exploitation of fossil water resources in the Middle East raises significant concerns about the sustainability of water resources in the region.
- These non-renewable resources are being depleted at an unsustainable rate, potentially leading to environmental impacts, land subsidence, and regional instability.
- Greater efforts are needed to conserve and manage water resources in the region, including the development of alternative sources of water and the implementation of more sustainable management practices.

The level of Seawater Desalination and its Contribution to Meeting the Water Needs



a.
Growth of Desalination Globally, 1960-2020
Desalination Capacity (million m3/day)
Number of desalination plants
Year
120
100
80
60
40
20
0
20000
17500
15000
12500
10000
7500
5000
2500
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Desalination Plants
Operational Desalination Plants
Desalination Capacity
Operational Desalination Capacity

Seawater Desalination in the World

- According to the International Desalination Association (2022):
  - The total installed capacity for seawater desalination worldwide: **105.2** million cubic meters per day.
  - The Middle East and North Africa (MENA) region: **41.4** million cubic meters per day (39% of the world's total capacity).
  - Top five countries in the world: **Saudi Arabia, United Arab Emirates, Israel, Kuwait, Spain.**
  - Around 70% of desalination in the Gulf is currently done through an energy-intensive evaporative process entirely using fossil fuels.

Seawater Desalination in the World

Countries	seawater desalination (MCM/day)	Population (million)	contribution to meeting the water needs (%)
Saudi Arabia	7.8	35.3	50
United Arab Emirates	5.3	10.3	90
Israel	1.9	9.4	25
Kuwait	3.1	4.4	70
Spain	2.5	47.4	7
United states	0.7	332.9	<1
China	1.1	1400	<1
Iran	0.45	84.9	<1

Discharged Brine

- **Saudi Arabia**: approximately **1.5** million cubic meters per day
- **United Arab Emirates**: approximately **1.4** million cubic meters per day
- **Israel**: approximately **0.2** million cubic meters per day
- **Kuwait**: approximately **0.25** million cubic meters per day
- **Spain**: approximately **0.25** million cubic meters per day
- **United States**: approximately **0.1** million cubic meters per day
- **China**: approximately **0.5** million cubic meters per day
- **Iran**: less than **1** million cubic meters per day

Electricity Power

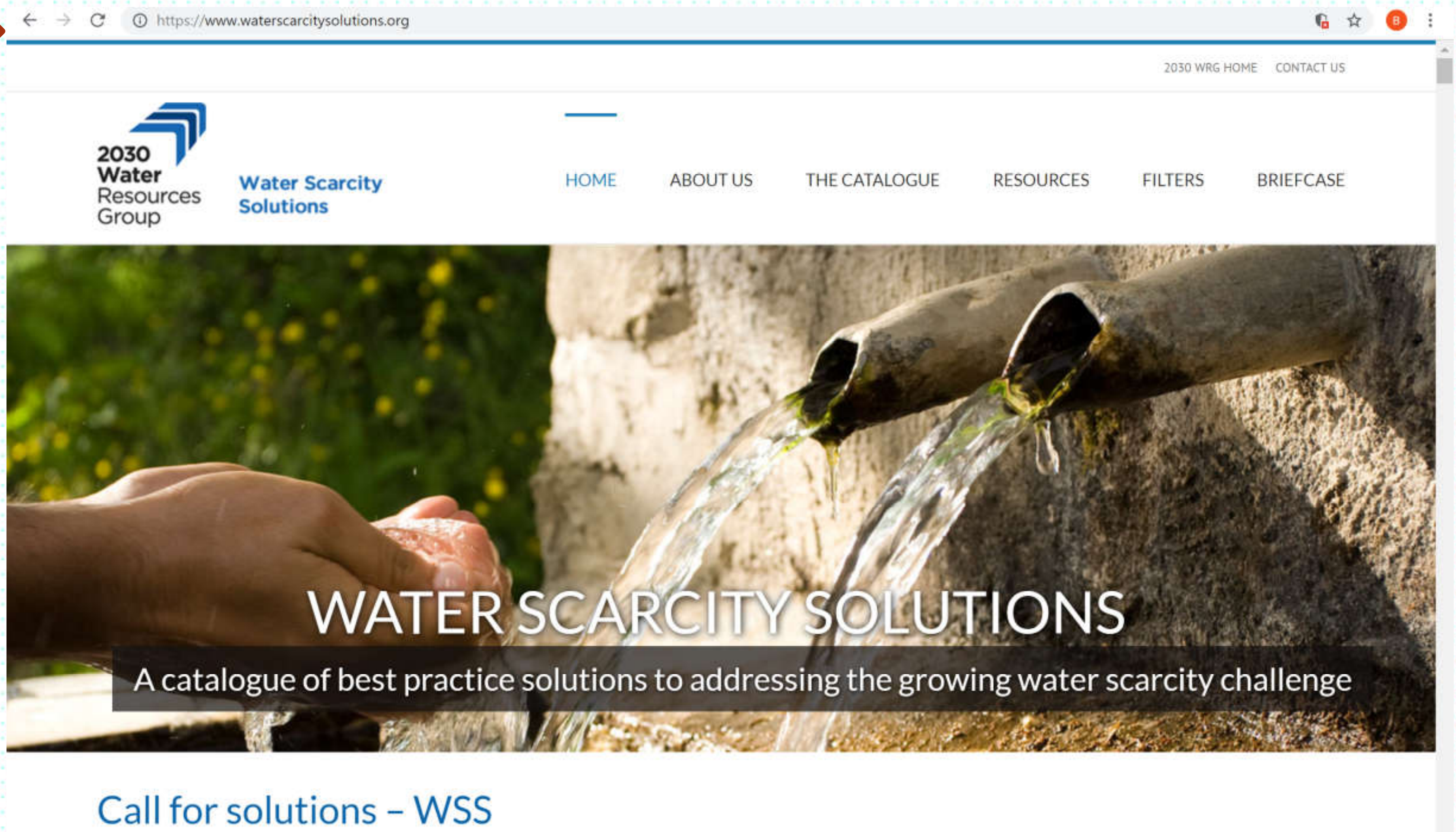
Countries	Electricity consumption (kWh/m³)	Power source	Explanation
Saudi Arabia	3.5-5	fossil fuel-based	-
United Arab Emirates	3.5-6	fossil fuel-based	plans to achieve 50% renewable energy production by 2050
Israel	3	fossil fuel-based	plans to achieve 30% renewable energy production by 2030
Kuwait	4-7	fossil fuel-based	-
Spain	2.5-4	renewable energy-based	wind and solar power
United states	3-4	fossil fuel-based	with some facilities utilizing nuclear or renewable energy sources
China	3-4	fossil fuel-based	-
Iran	3.5	fossil fuel-based	-

Summary

- Renewable water resources (RWR) are the most economic available sources of water.
- Iran has access to much more RWR than most countries in the middle east and north African region.
- Geological formations under Iran have mostly low permeability. Most probably there is no significant deep/fossil aquifer under Iran.
- Total groundwater resources in Iran is very limited and therefore we have to be very careful in keeping the balance between recharge and withdrawals from aquifers.
- All sea water desalination plants if constructed will supply less than 1% of water consumption of the country.

The way forward

- We have lost around 25% of our RWR due to climate change.
- In areas near sea shorelines, sea water desalination is an expensive but doable option for water supply.
- For the rest of the country, water consumption management and recycling is the best available option.
- 20 Billion m^3 reduction in water withdrawals in necessary for achieving the sustainability of water resources in Iran.
- This requires a water allocation reform in Iran.
- Achieving this goal not only requires investment in more efficient water use technologies but also requires reduction of area of agricultural lands and food production self sufficiency targets.


https://www.waterscarcitysolutions.org
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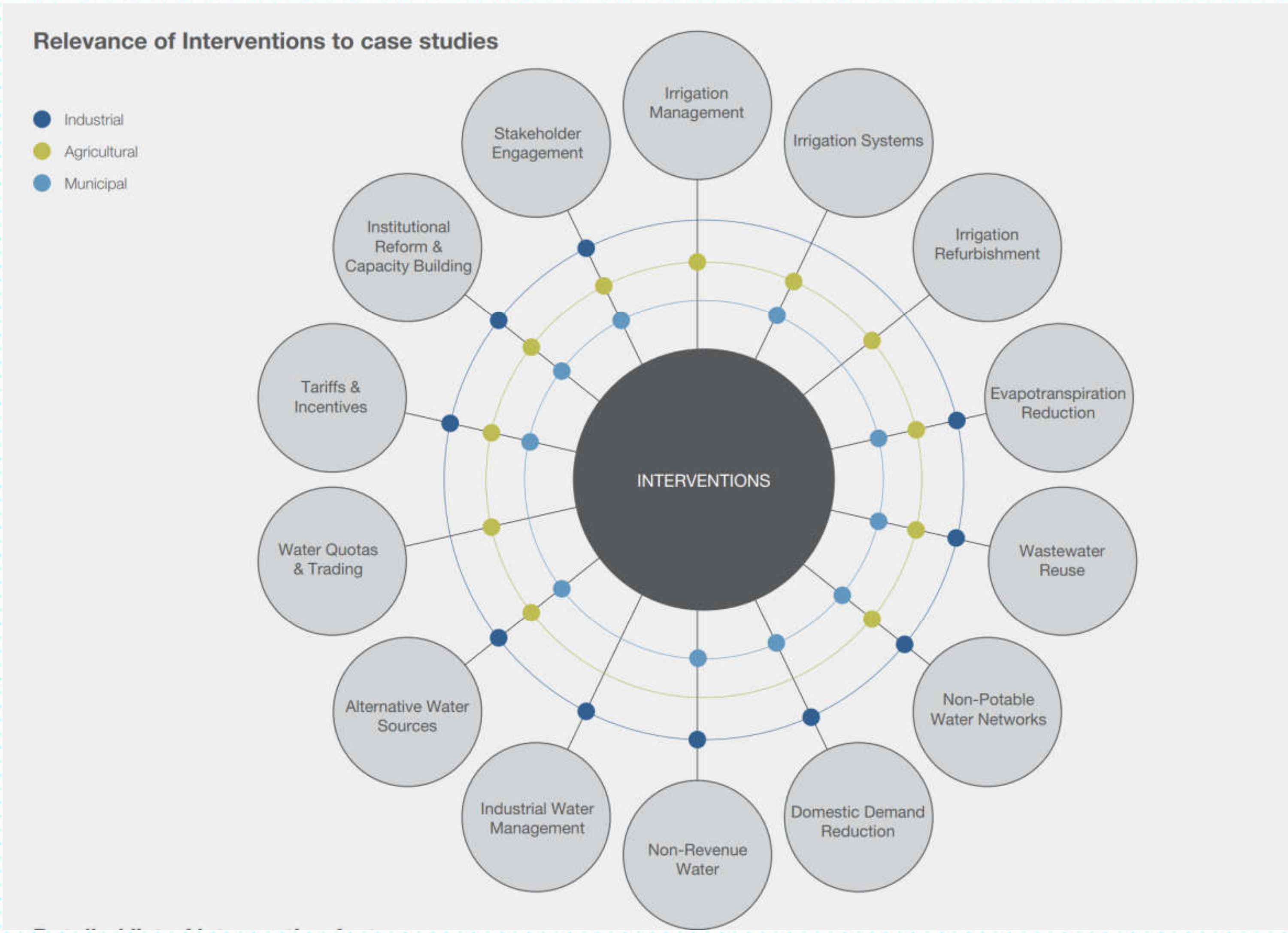
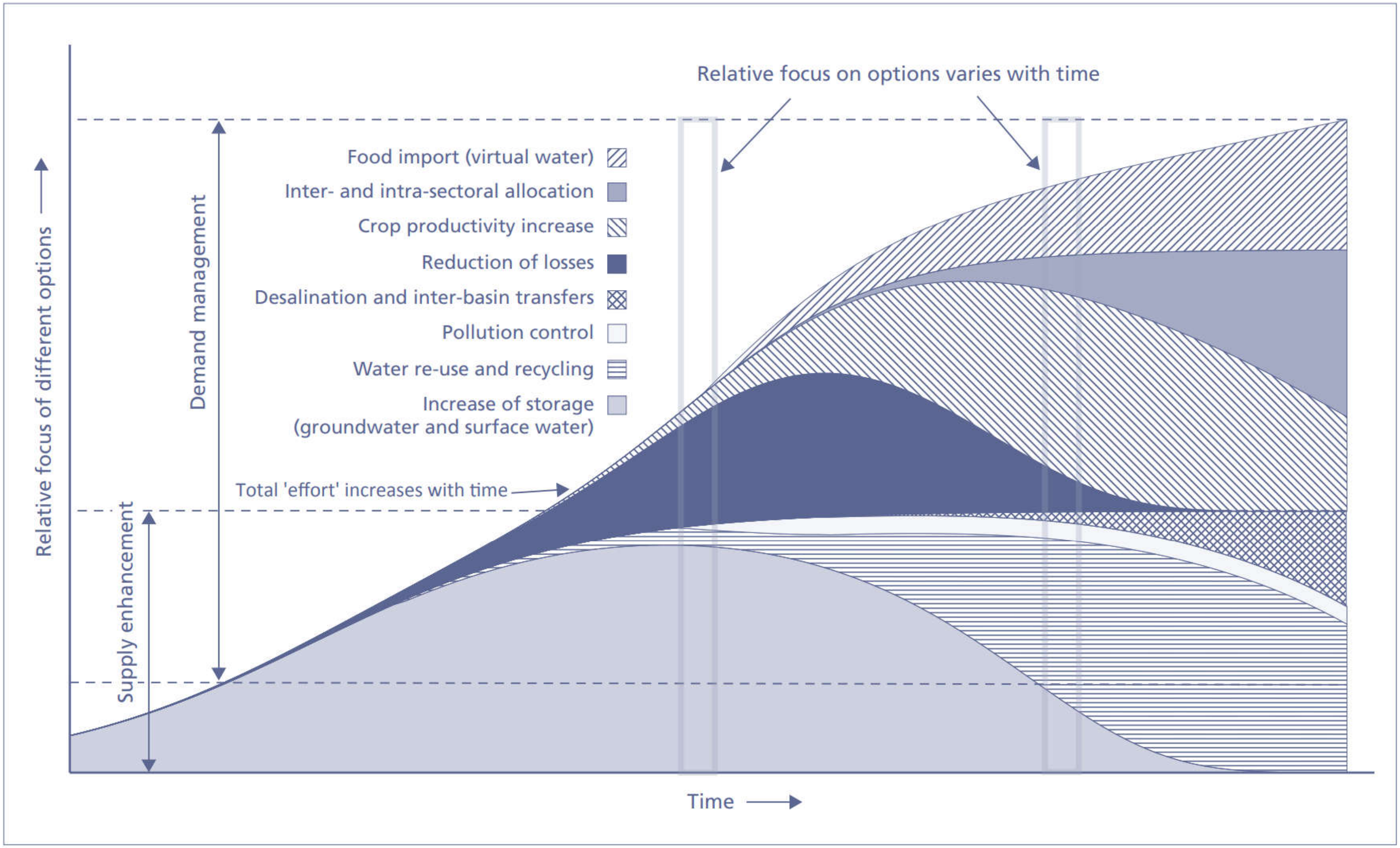
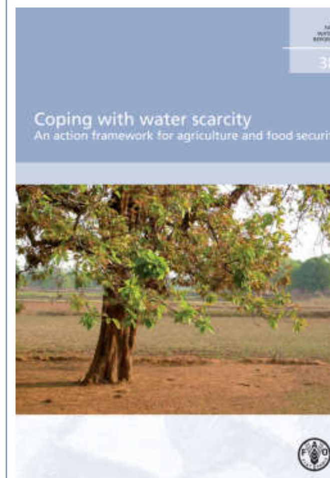
BRIEFCASE
WATER SCARCITY SOLUTIONS
A catalogue of best practice solutions to addressing the growing water scarcity challenge
Call for solutions – WSS


Relevance of Interventions to case studies
Industrial
Agricultural
Municipal
INTERVENTIONS
Irrigation Management
Irrigation Systems
Irrigation Refurbishment
Evapotranspiration Reduction
Wastewater Reuse
Non-Potable Water Networks
Domestic Demand Reduction
Non-Revenue Water
Industrial Water Management
Alternative Water Sources
Water Quotas & Trading
Tariffs & Incentives
Institutional Reform & Capacity Building
Stakeholder Engagement

A schematic representation of the relative focus on different options for the agricultural sector to cope with increasing levels of water scarcity over time

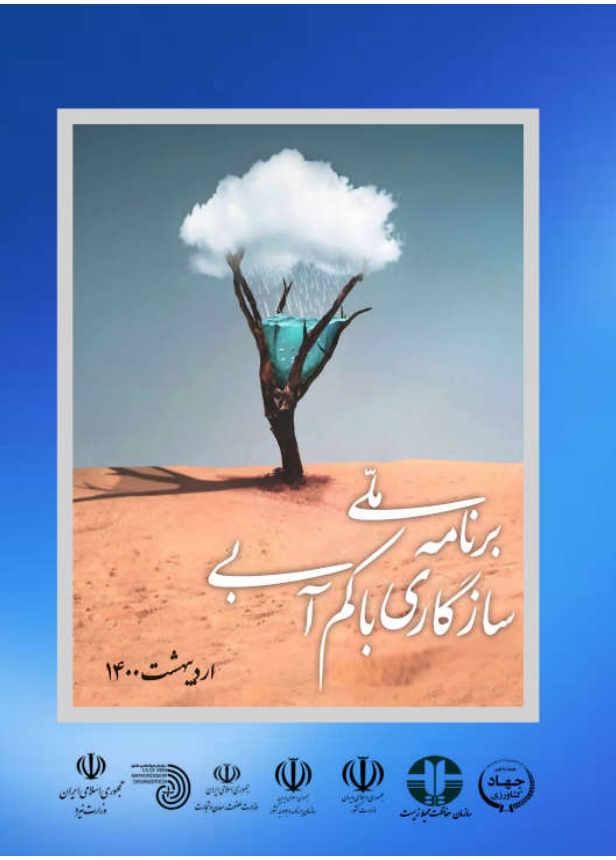




NATIONAL WATER SCARCITY WORKGROUP

- Established in March 2018
- NWWSA consists of a hierarchy of three levels of decision making committees:
  - National Committee
    - Ministers of Energy, Agriculture, Industry/Mine/Trade, and Interior,
    - Heads of Planning and Budget Organization, Meteorological Organization and Department of Environment
  - Technical Committee
    - Vice ministers and deputies of organizations
  - Provincial Committees
    - Heads of the same provincial organizations, Judicial system representatives, Local Universities, Police Departments, Farmer Organizations, …

National Water Scarcity Adaptation Plan (2021-2026)



3 years of efforts of the national work group and provincial workgroups between 2018 and 2021 led to the preparation of the first national water consumption management program.

76000 MAN HOURS

Thank you for your attention

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