

Addressing Climate Change and Overpopulation's Effect on Water and Agriculture in the Drylands

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Department of Public Policy

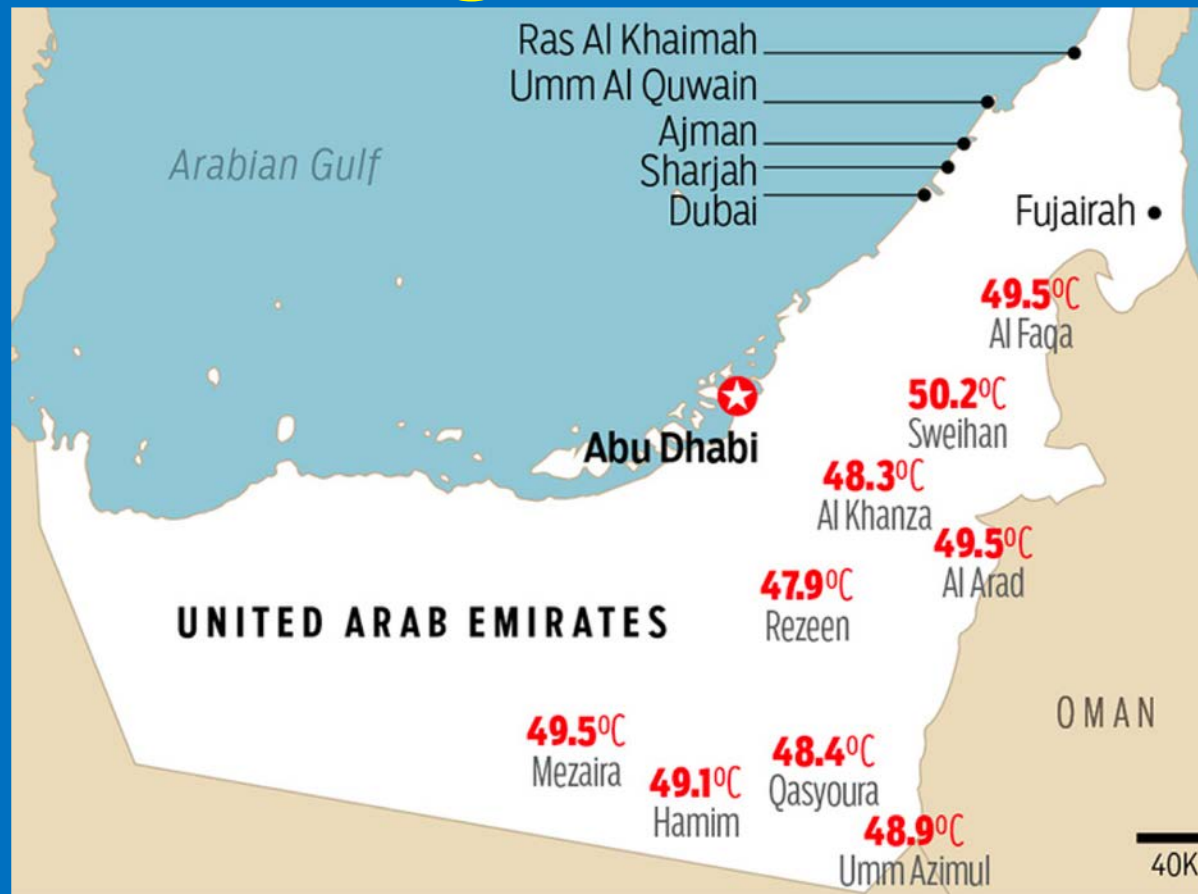
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Point 1: Worldwide: Drylands Are Becoming Warmer & Drier



Point 2:

The Middle East is Literally a Climate Change Hotspot

THE JORDAN TIMES

WEATHER, AMMAN

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Home > Local > Aqaba recorded highest temperature on earth Friday — WMO

Aqaba recorded highest temperature on earth Friday — WMO

By Bahaa Al Deen Al Nawad - Oct 10, 2020 - Last updated at Oct 10, 2020



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Hot as Hell: Temperature in Sodom Broke Israeli Record

The mercury peaked at nearly 50 degrees Celsius at the Dead Sea site during Wednesday's country-wide heat wave.

Zafrir Rinat Jul. 18, 2019 [Follow](#)

The map displays the following countries and their corresponding icons:

- North America:** Canada (yellow), United States (red), Mexico (yellow).
- South America:** Venezuela (yellow), Colombia (yellow), Peru (yellow), Brazil (yellow), Bolivia (green), Chile (green), Argentina (green).
- Europe:** United Kingdom (green), Norway (green), Sweden (yellow), Finland (yellow), Poland (yellow), Germany (yellow), France (red), Spain (red), Ukraine (yellow), Turkey (yellow), Kazakhstan (yellow), Mongolia (yellow), China (yellow), South Korea (red), India (red), Thailand (red), Indonesia (red).
- Africa:** Algeria (yellow), Libya (yellow), Egypt (yellow), Saudi Arabia (yellow), Sudan (yellow), Mali (yellow), Niger (yellow), Chad (yellow), Nigeria (red), DR Congo (red), Angola (yellow), Namibia (yellow), Botswana (yellow), Madagascar (yellow), Africa (red).
- Asia:** Afghanistan (green), Pakistan (green), India (red), Thailand (red), Indonesia (red), South Korea (red), China (yellow), Mongolia (yellow), Kazakhstan (yellow), Turkey (yellow), Iran (yellow), Saudi Arabia (yellow), Egypt (yellow), Sudan (yellow), Mali (yellow), Niger (yellow), Chad (yellow), Nigeria (red), DR Congo (red), Angola (yellow), Namibia (yellow), Botswana (yellow), Madagascar (yellow), Africa (red).
- Oceans:** North Atlantic Ocean, South Atlantic Ocean, Indian Ocean, Southern Ocean.
- Other:** Greenland (white), Iceland (white), Russia (yellow), South Korea (red), Indonesia (red), South Africa (red).

Global average: 1 degree

Sea Level in Israel: up ~10 mm/year

Global average 3 mm

Point 3: Implications for Water Scarcity are Disastrous



War, drought cause Syria's smallest wheat crop in 3 decades

Slump in wheat production puts greater pressure on Assad government as flat bread is a subsidised staple for Syrians.

Tuesday 09/10/2018

🕒 APRIL 19, 2021

The Dead Sea is dying. Drinking water is scarce. Jordan faces a climate crisis

by Nabih Bulos, Los Angeles Times



Zaatari Refugee Camp, Jordan

AP



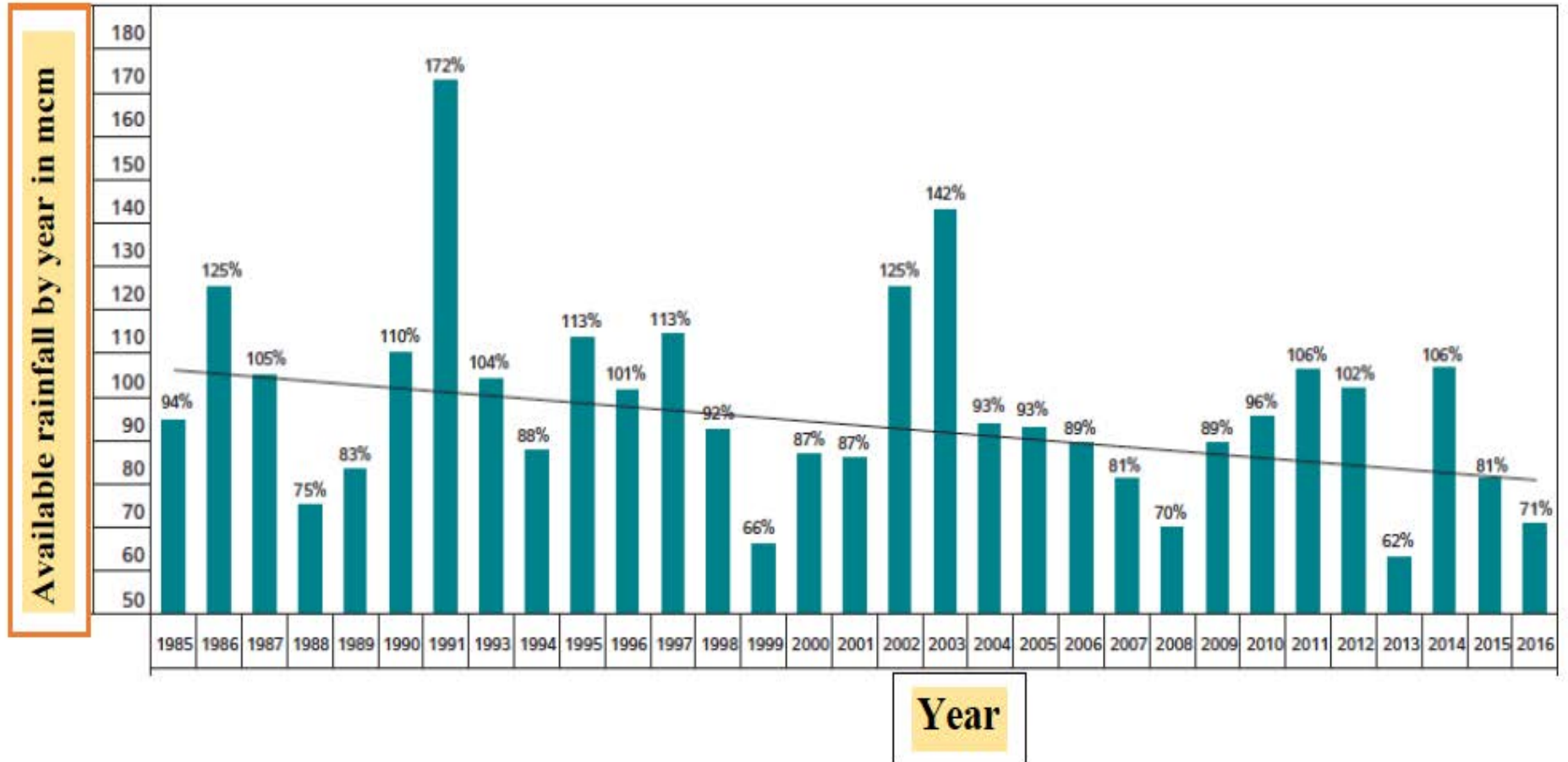


Figure 4: Annual Rainfall Quantities in Israel Relative to the Annual Average: 1985-2016, (Givati and Tal, 2017).

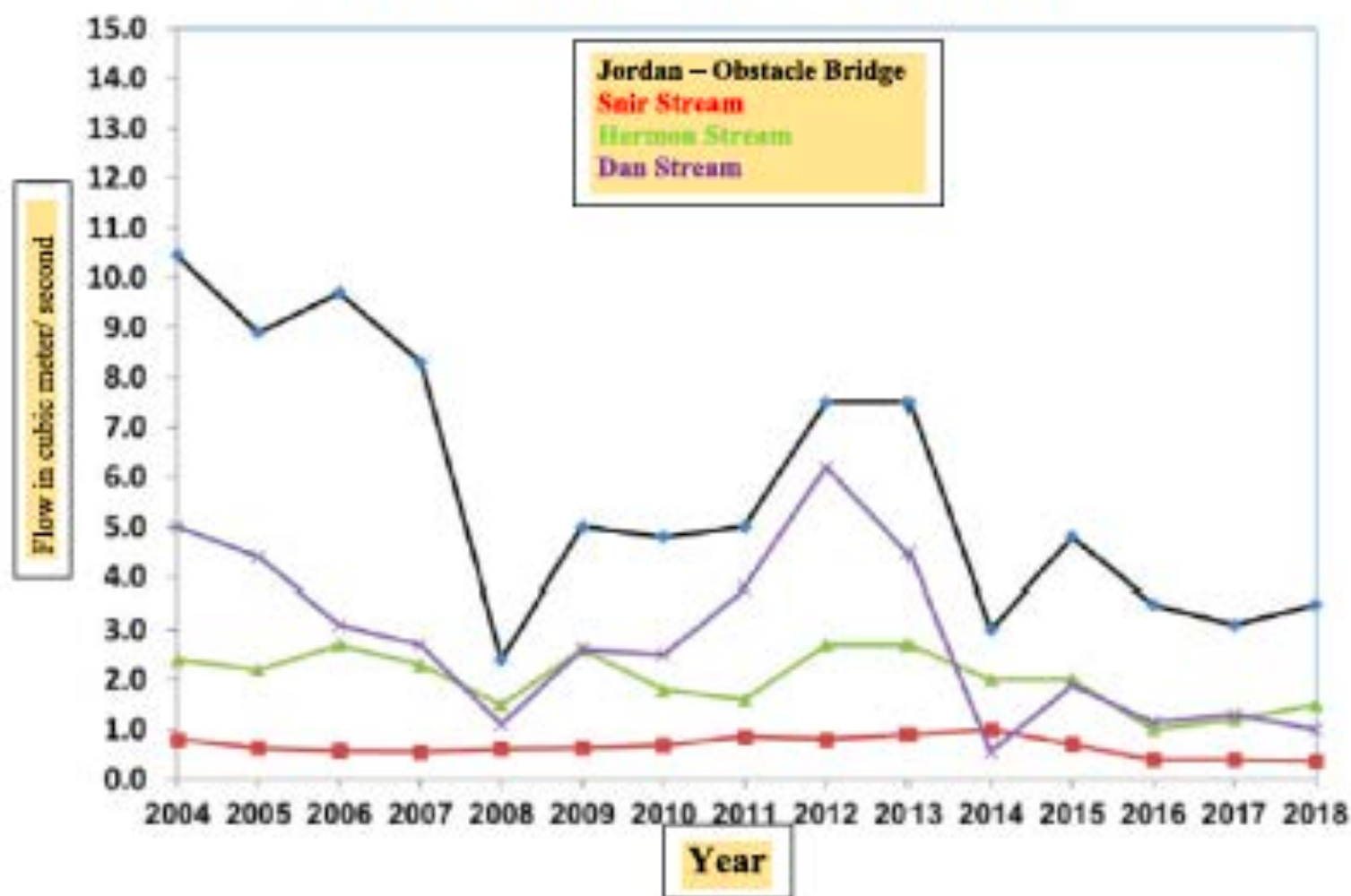


Fig. 5. Flow in 4 Kinneret tributaries: 2004–2018.
(Source: Israel Hydrological Service, 2018)

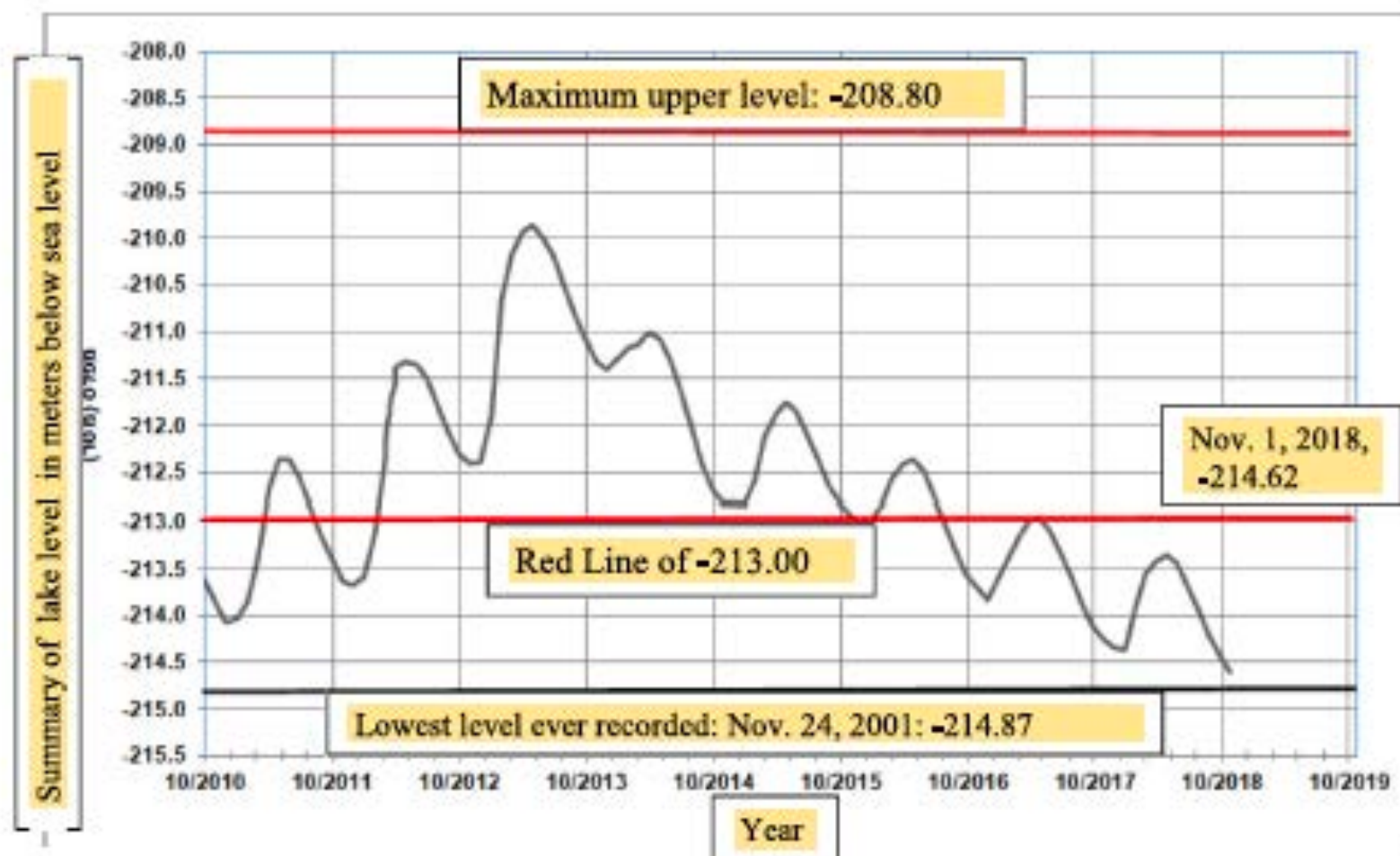


Fig. 1. Drop Kinneret lake water levels by year.
(Source: Israel Hydrological Service, 2018)

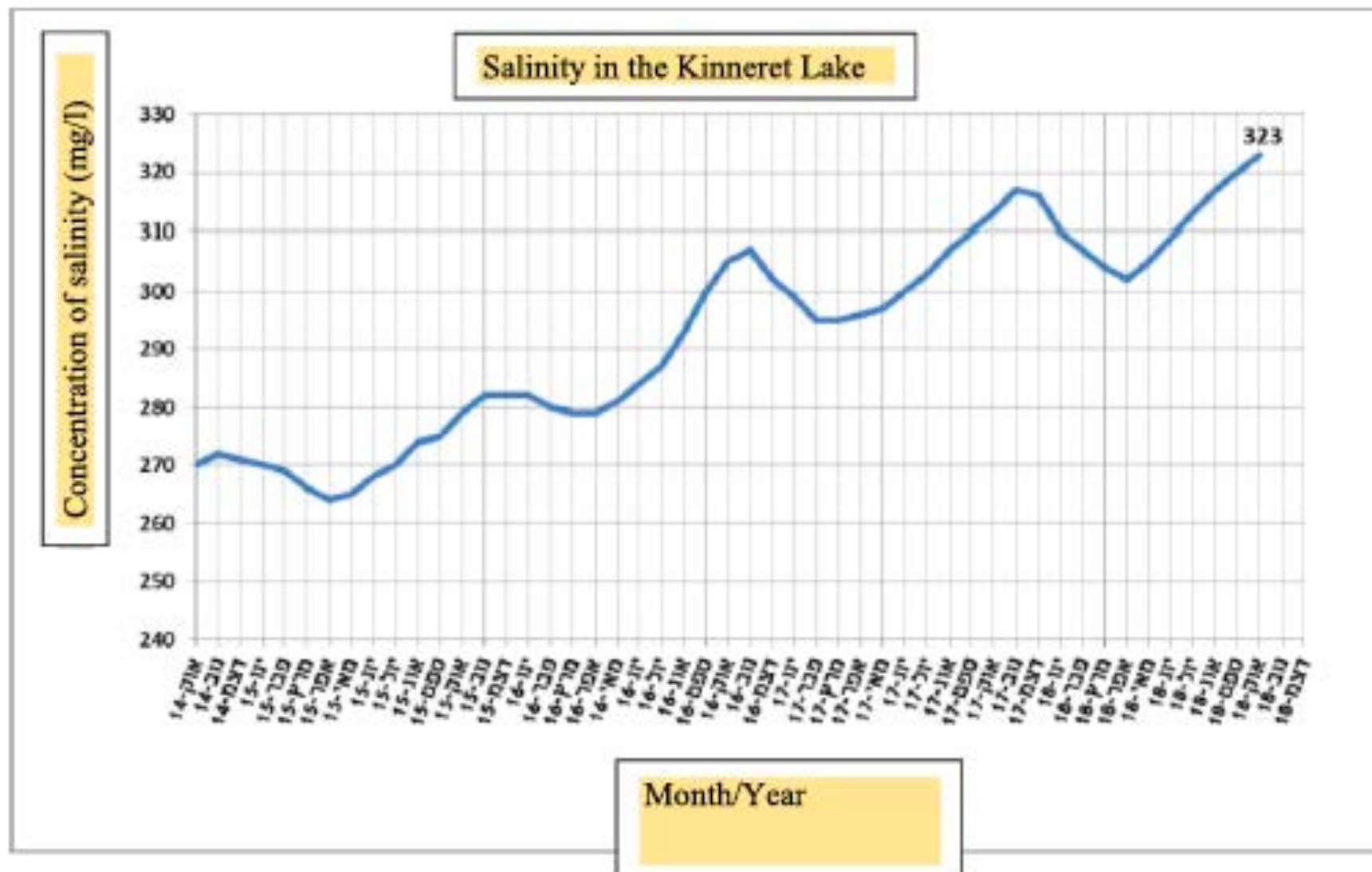


Fig. 3. Kinneret lake salinity: Oct. 2014–Dec. 2018.
(Source: Israel Hydrological Service, 2018)

The Dead Sea Continues to Die

1960



- 390 m
~1020 km²

2006



- 420 m
~ 635 km²

2050



- 550 m
~ 520 km²

Point 4: Implications for Agriculture: Discouraging



Water scarcity and reduction in crop yield due to climate change could drop GDP by 10% in Middle East - Purdue University News

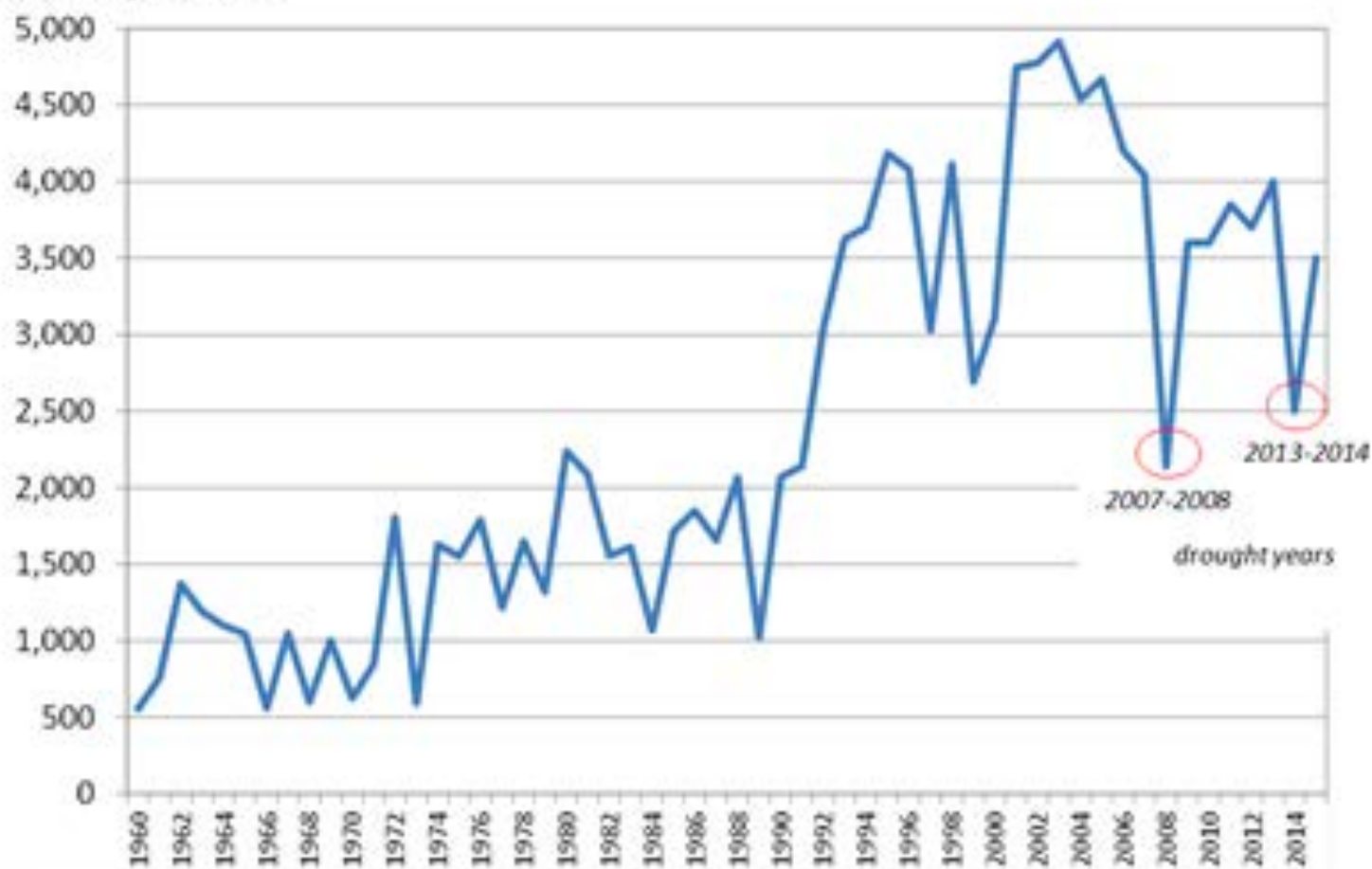
October 30, 2020

Water scarcity and reduction in crop yield due to climate change could drop GDP by 10% in Middle East

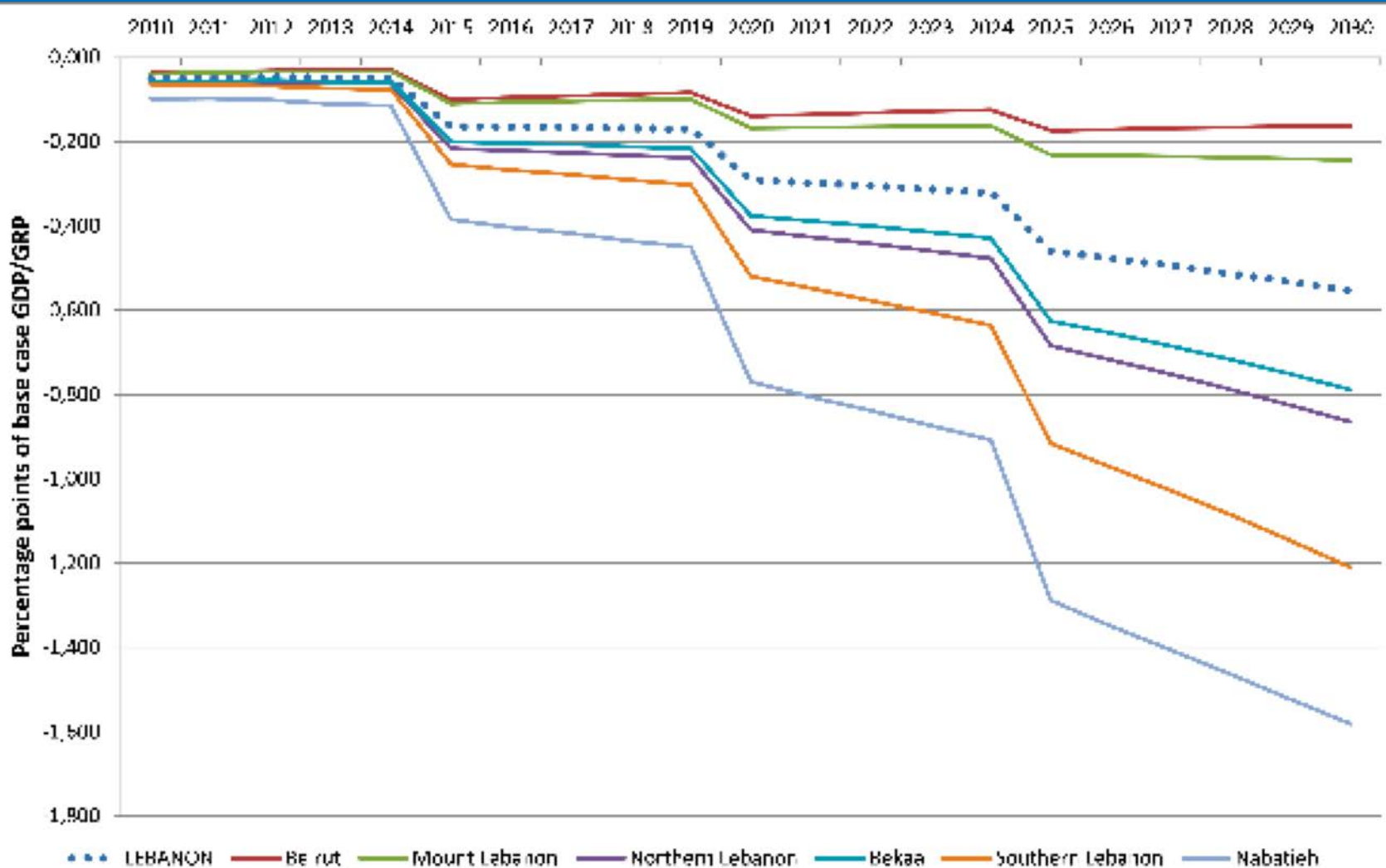


Figure 1. Syria wheat production from 1960 to 2015 (USDA Production, Supply and Demand database).

Wheat
Production, tons x1000



Regional impacts of agricultural productivity changes in Lebanon



Climate change in Lebanon: Higher-order regional impacts from agriculture (Haddad, et al.)

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Impacts of decreasing Nile flow on the Nile Valley aquifer in El-Minia Governorate, Egypt

Mustafa El-Rawy^{a,b,*}, Hossam Eldin Moghazy^c, Mohamed Galal Eltarabily^d



Article

Grains Production Prospects and Long Run Food Security in Egypt

Hamdy Sayed Abdou Abdelaal ¹ and Dawn Thilmany ^{2,*} 

¹ Agricultural Economics Department, Minia University, Minia 61111, Egypt

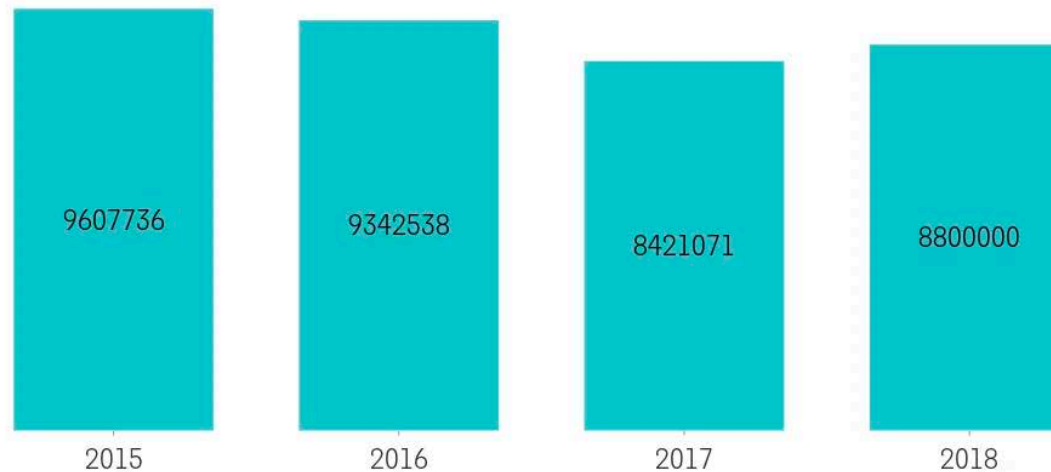
² Department of Agricultural and Resource Economics, Colorado State University, Fort Collins, CO

* Correspondence: dawn.thilmany@colostate.edu

Received: 13 July 2019; Accepted: 15 August 2019; Published: 17 August 2019

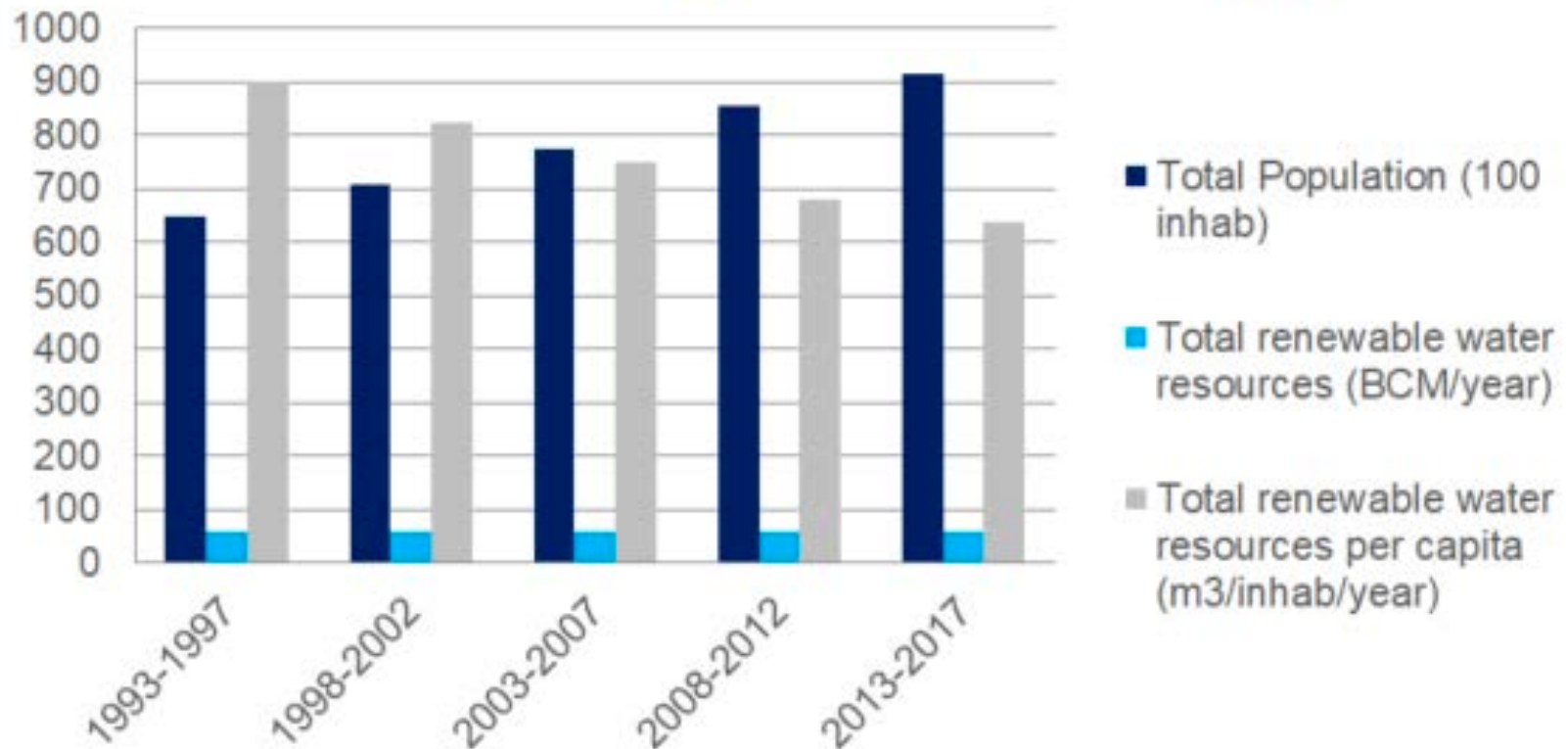
Egypt total agricultural production:

Agriculture Sector : Production Volume in metric ton, Wheat, 2015-2018

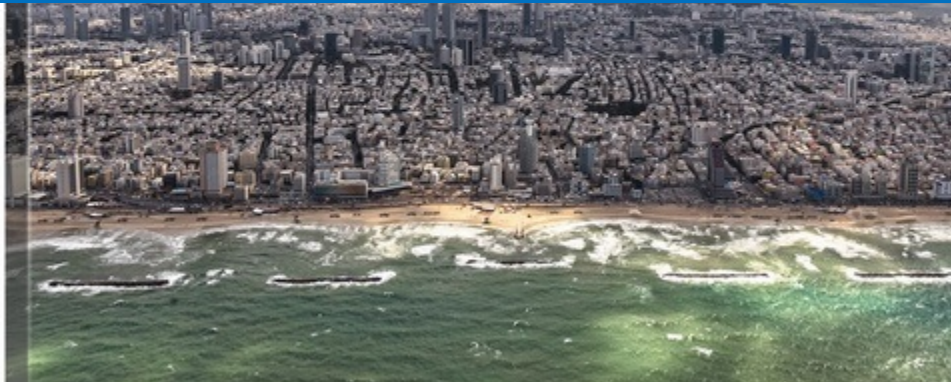


Source : Food and Agriculture Organization, Mordor intelligence 

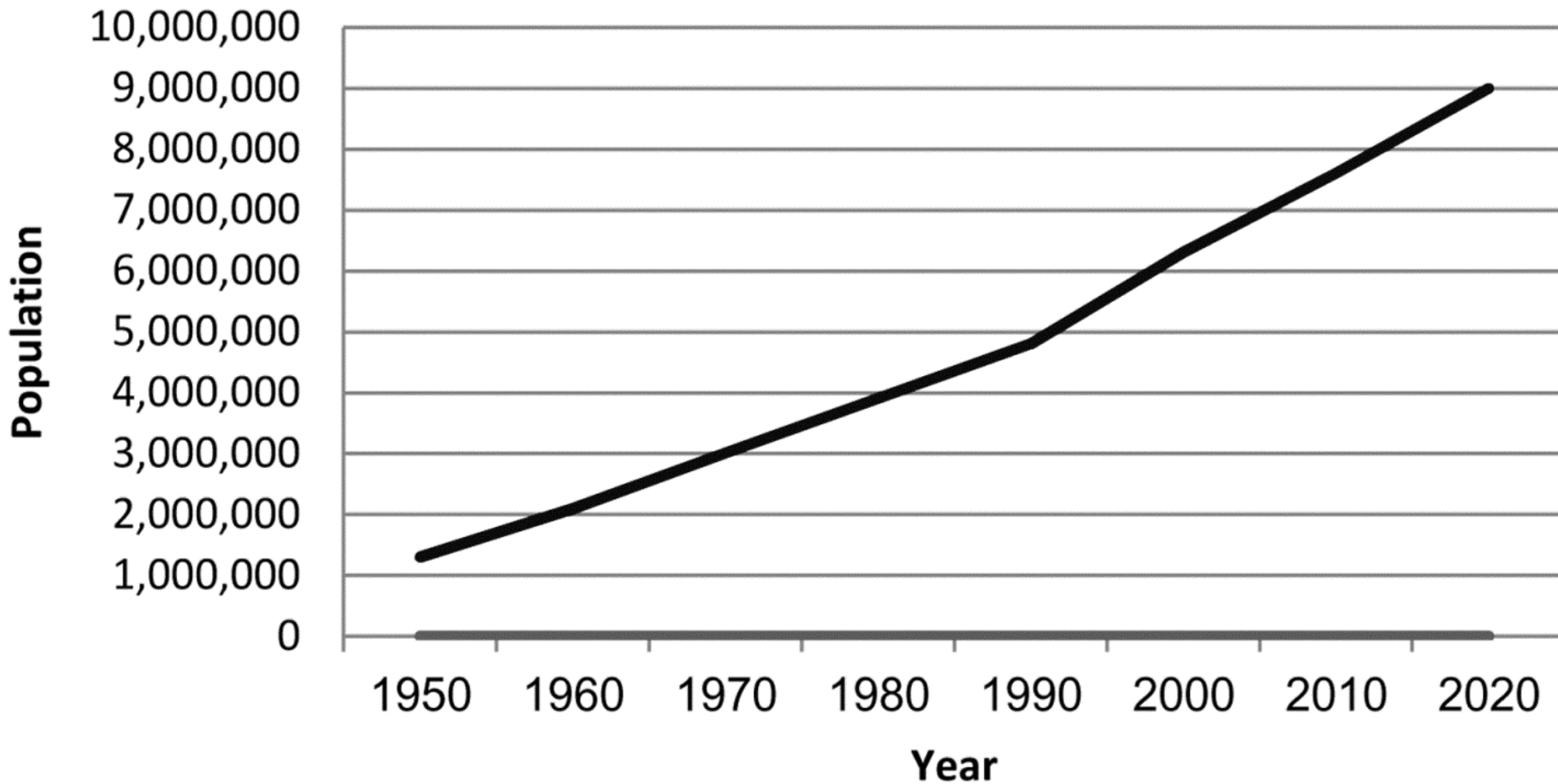
Water challenges overtime - Egypt



Point 5: The Middle East is becoming very crowded

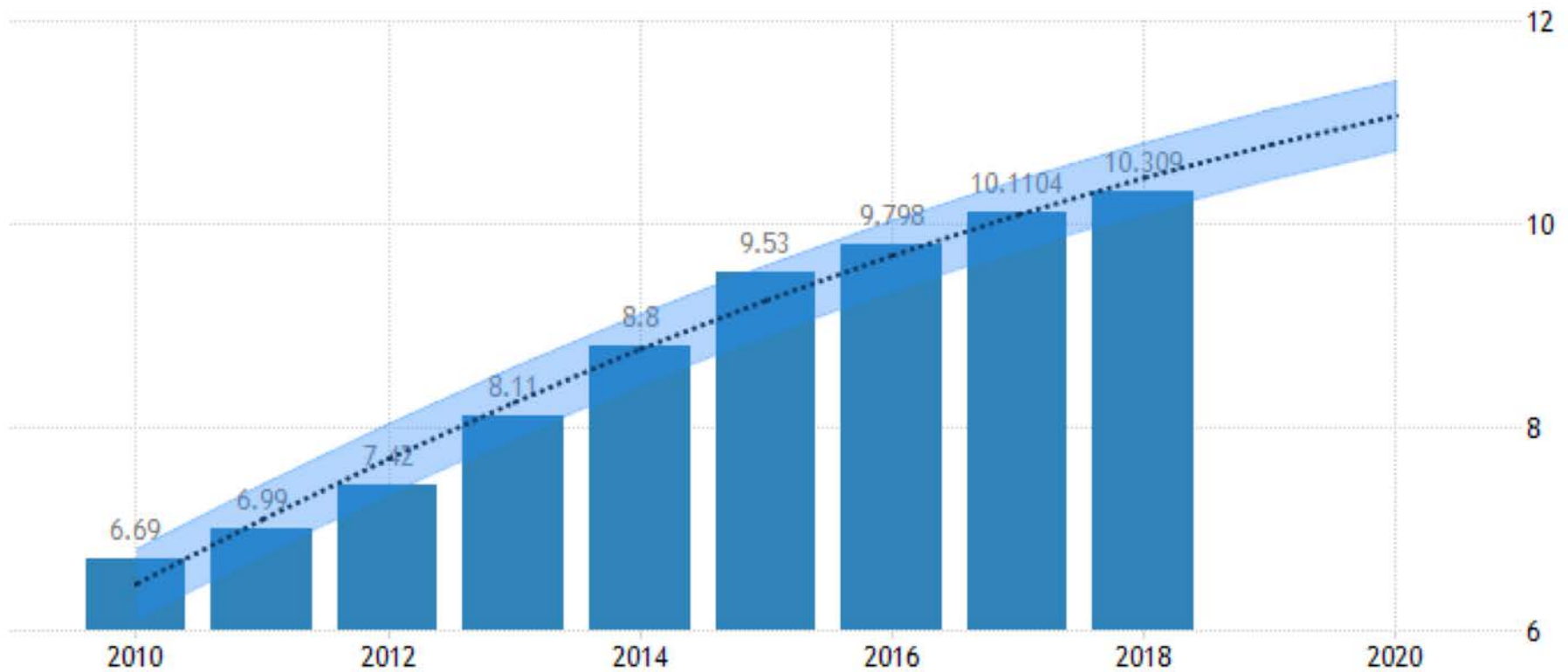


Population in Israel, 1950-2020



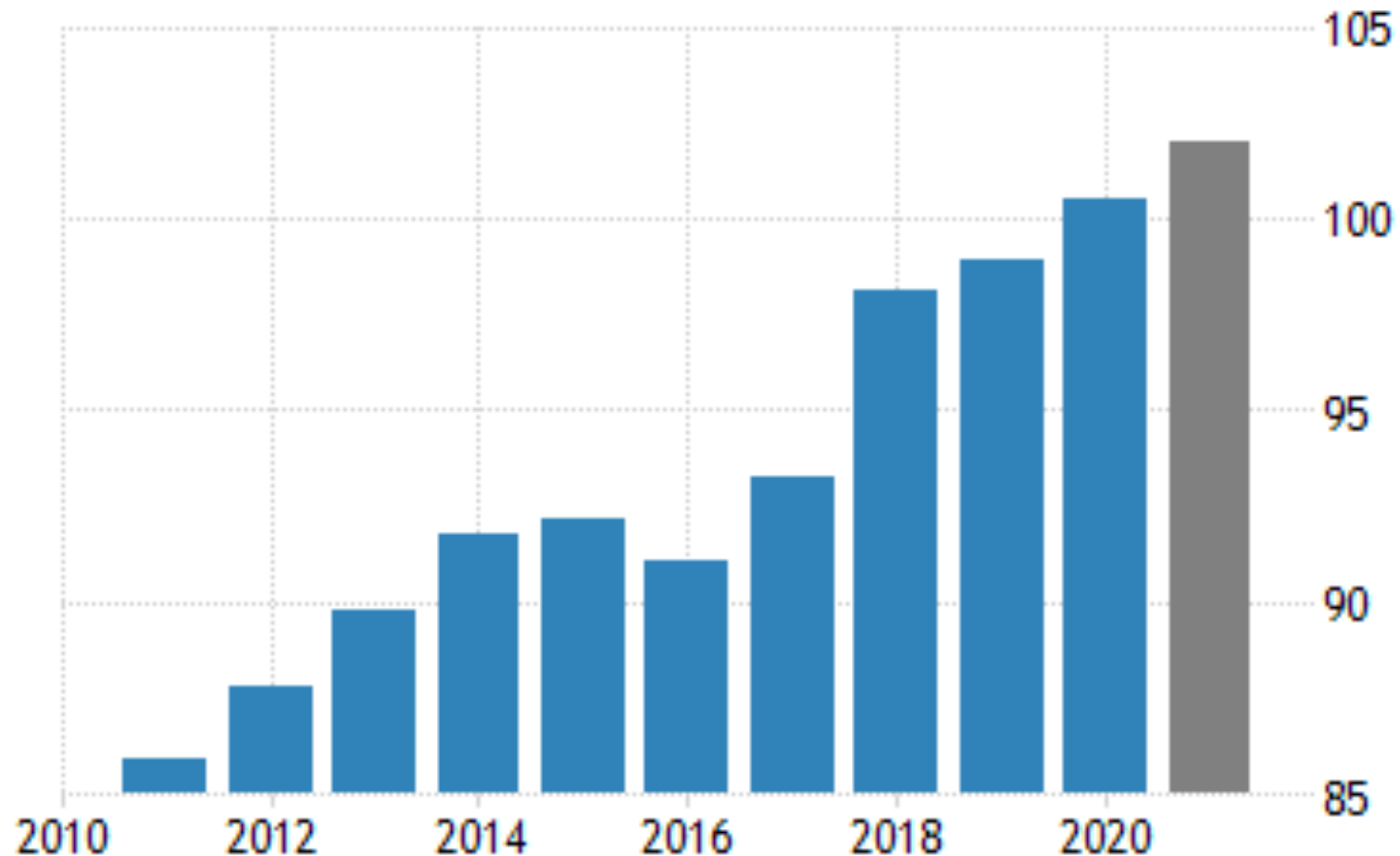
Source: Israel Central Bureau of Statistics

Jordan Population :
1949: 400,000
2021: 10.3 million



SOURCE: [TRADINGECONOMICS.COM](https://tradingeconomics.com) | DEPARTMENT OF STATISTICS, JORDAN

Egypt: Population :
1949: 20 million
2021: 104 million

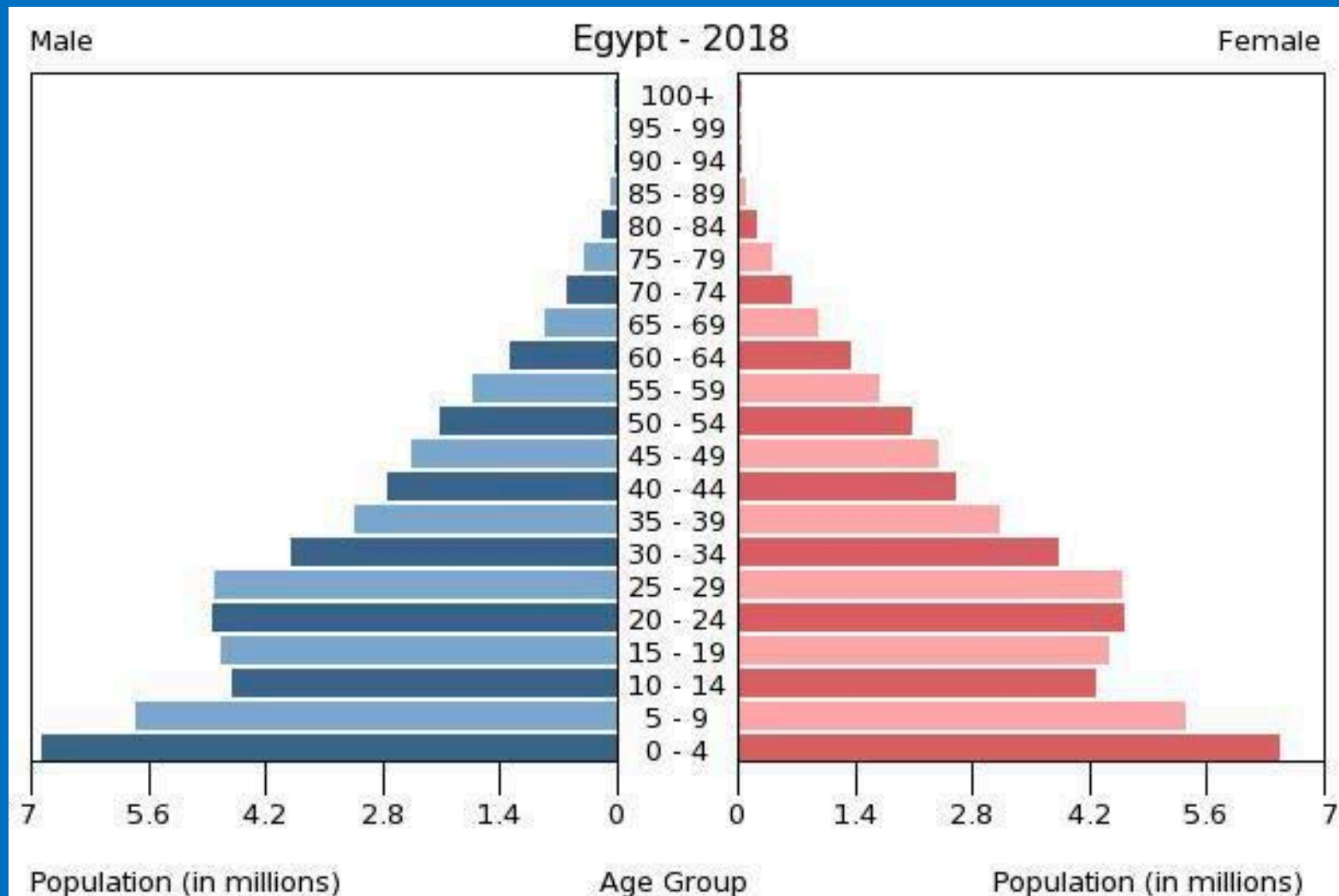


Palestinian Population (West Bank/Gaza)

1949: 800,000
2021: 4.8 million

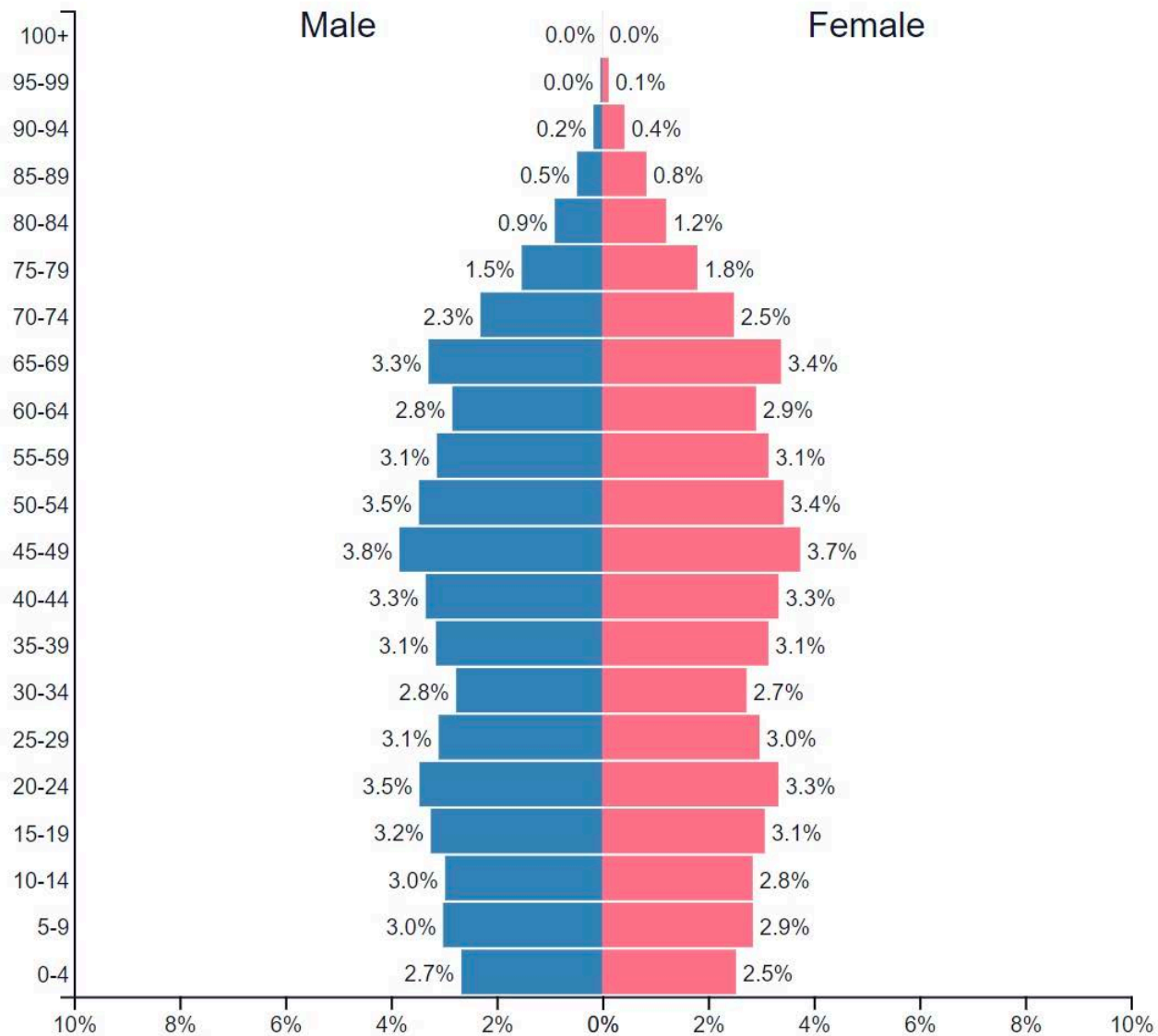


Population Momentum for decades to come



Denmark 2015

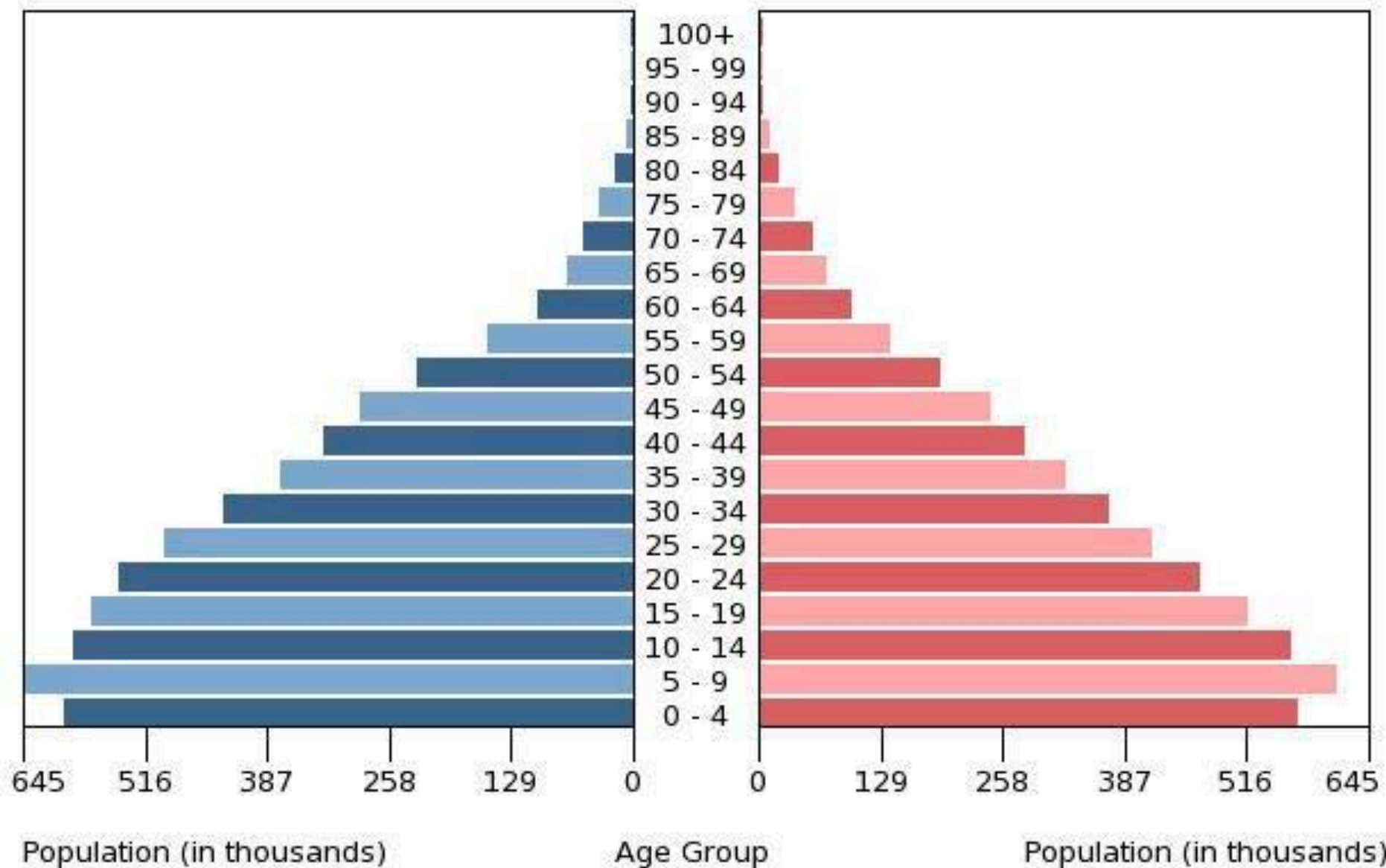
Population: 5,669,080



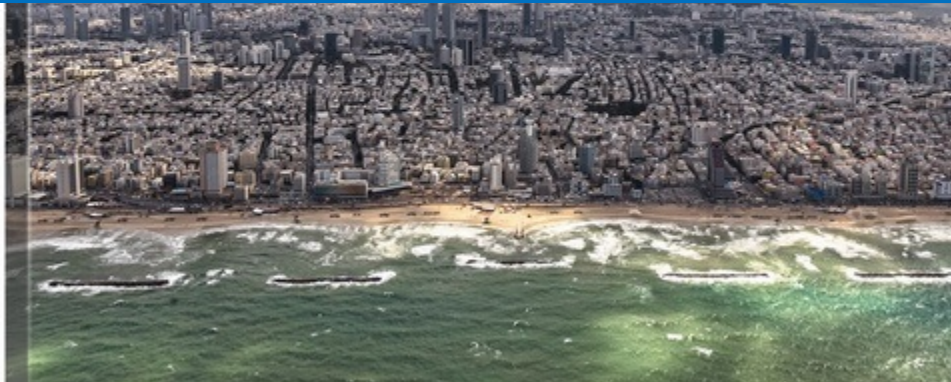
Male

Jordan - 2018

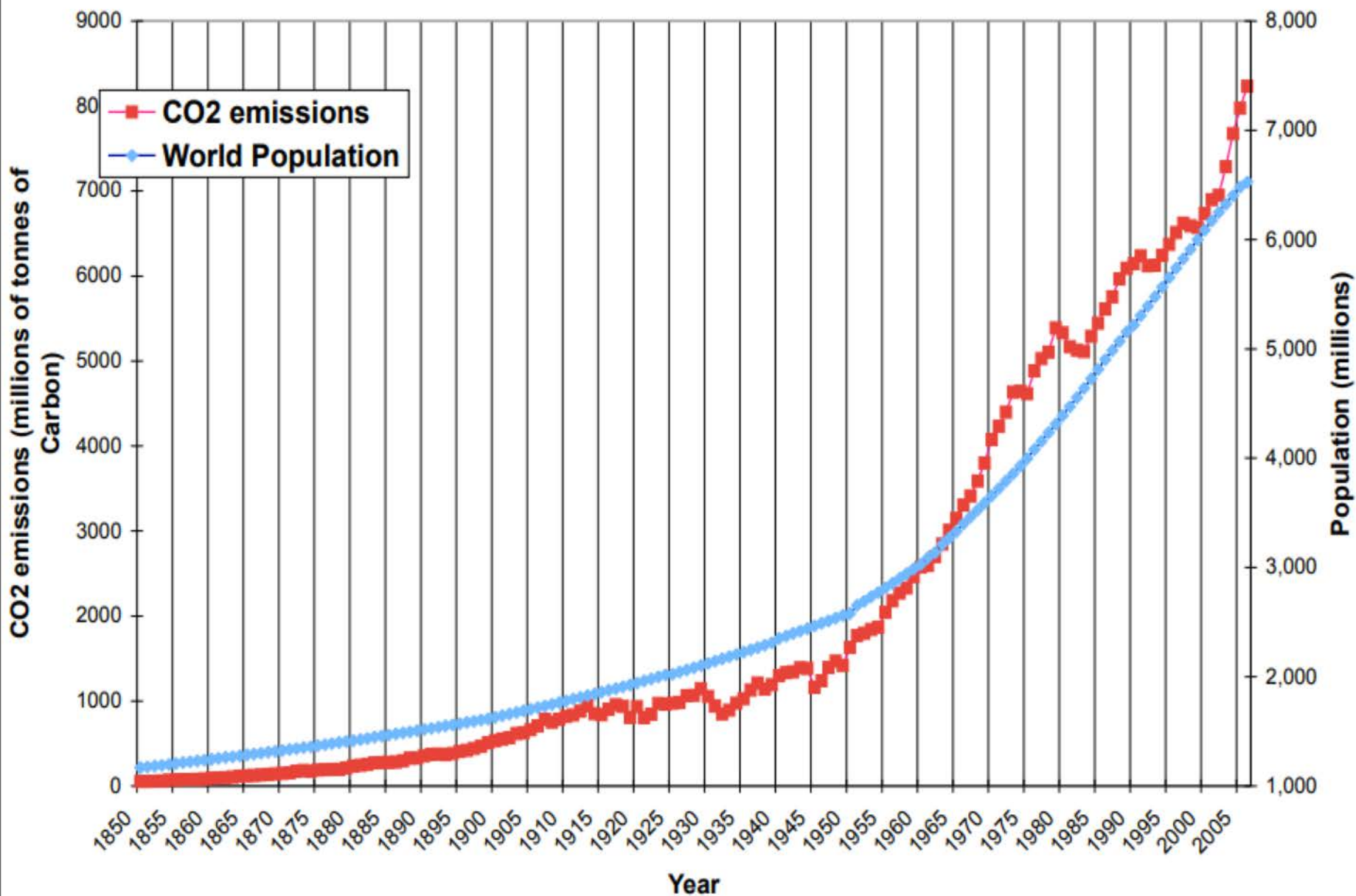
Female



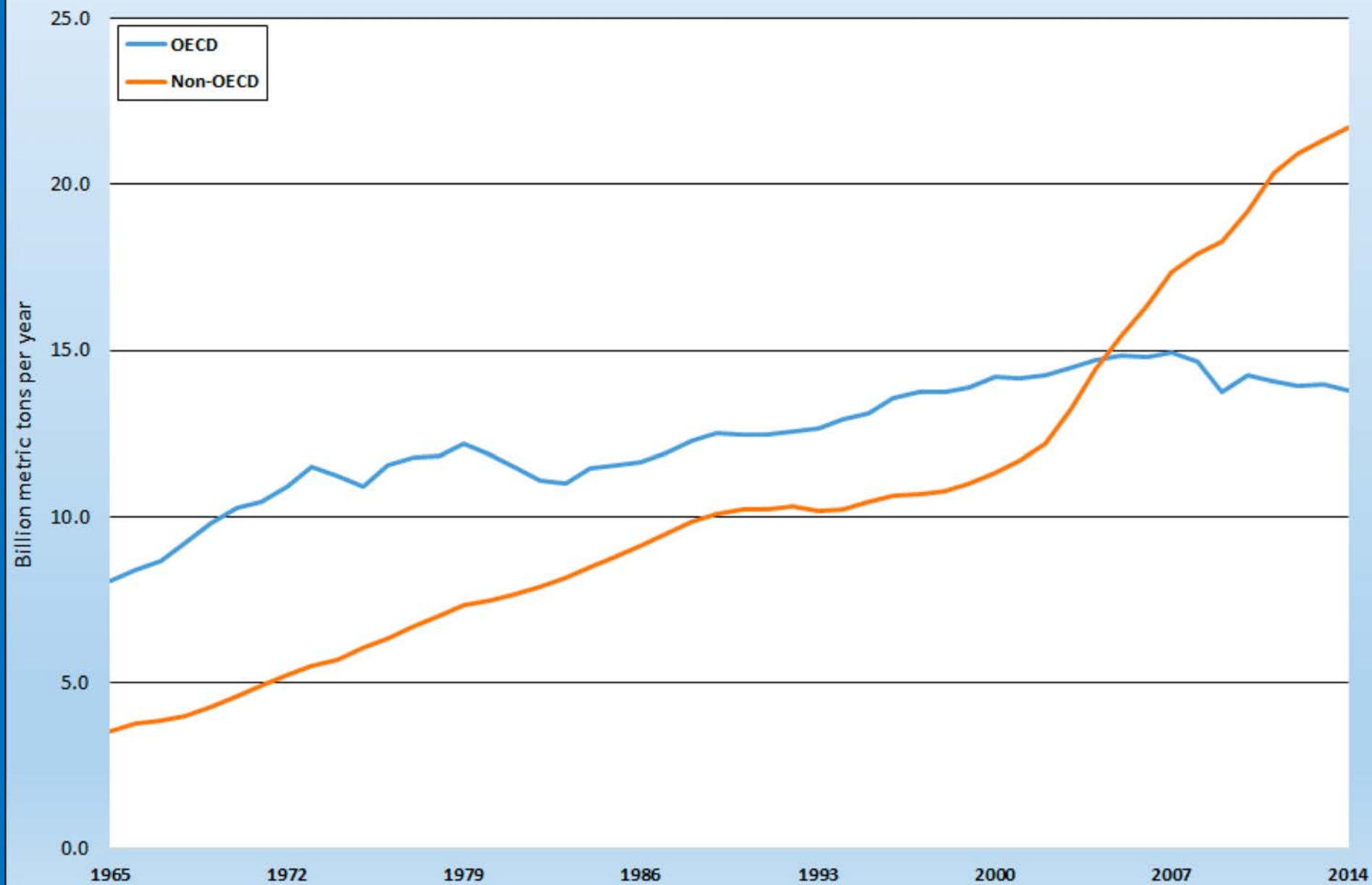
Point 6: Population Growth Dramatically Reduces Latitude Potential Solutions

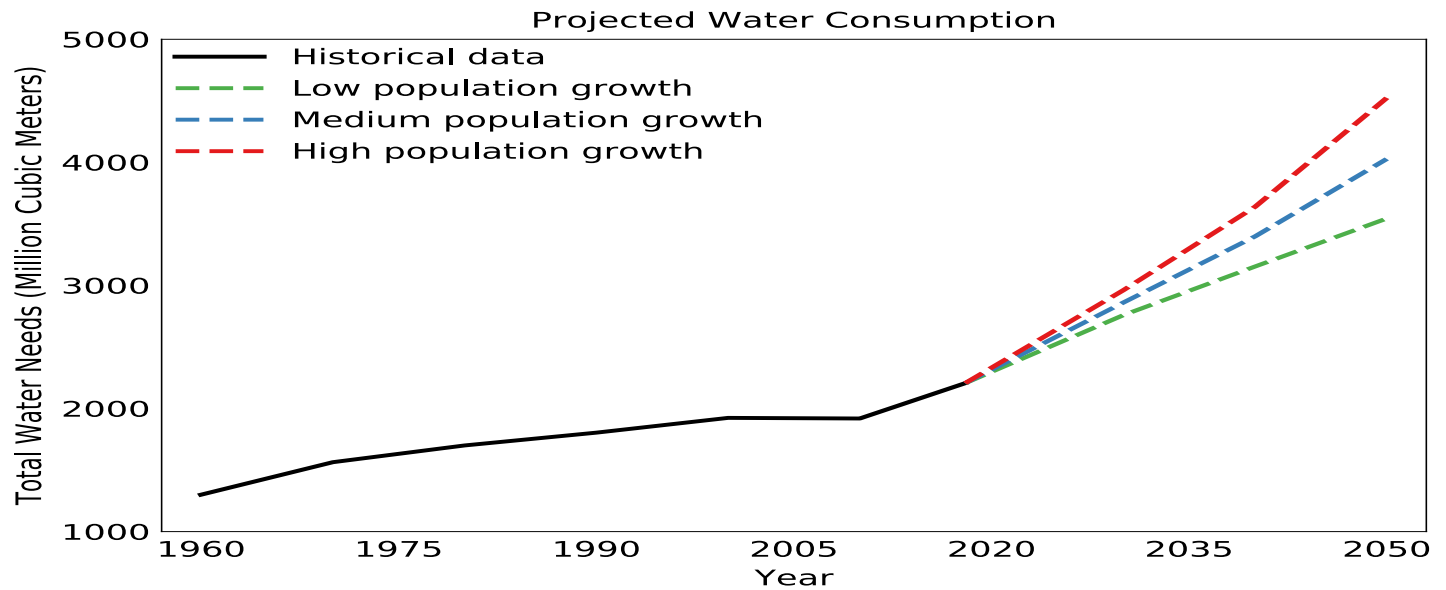
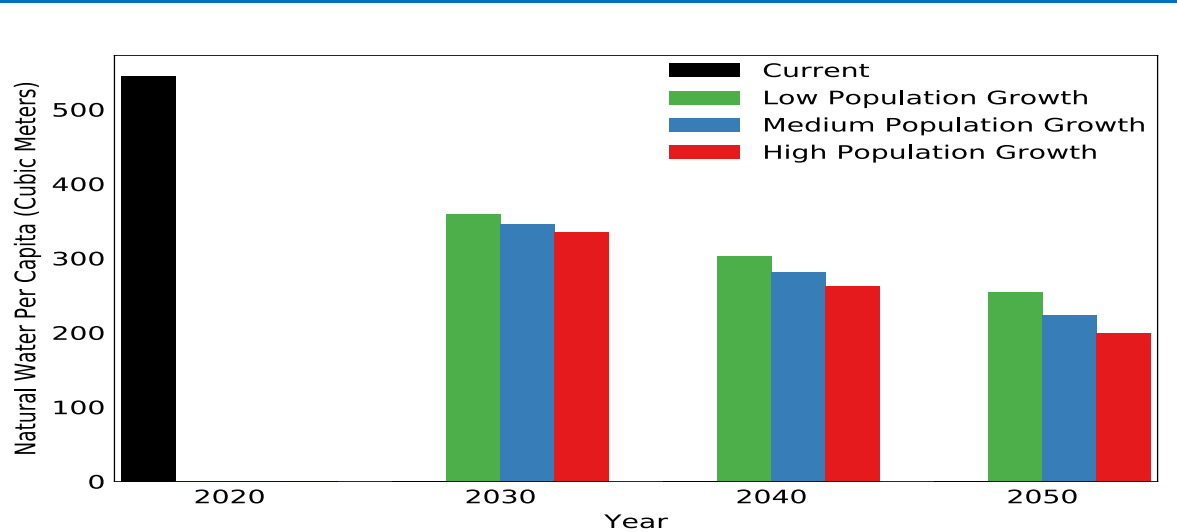


World Population vs. Global Anthropogenic CO2 Emissions



OECD and Non-OECD CO₂ Emissions 1965-2014







Point 7: Technology is the Drylands' Last Best Hope

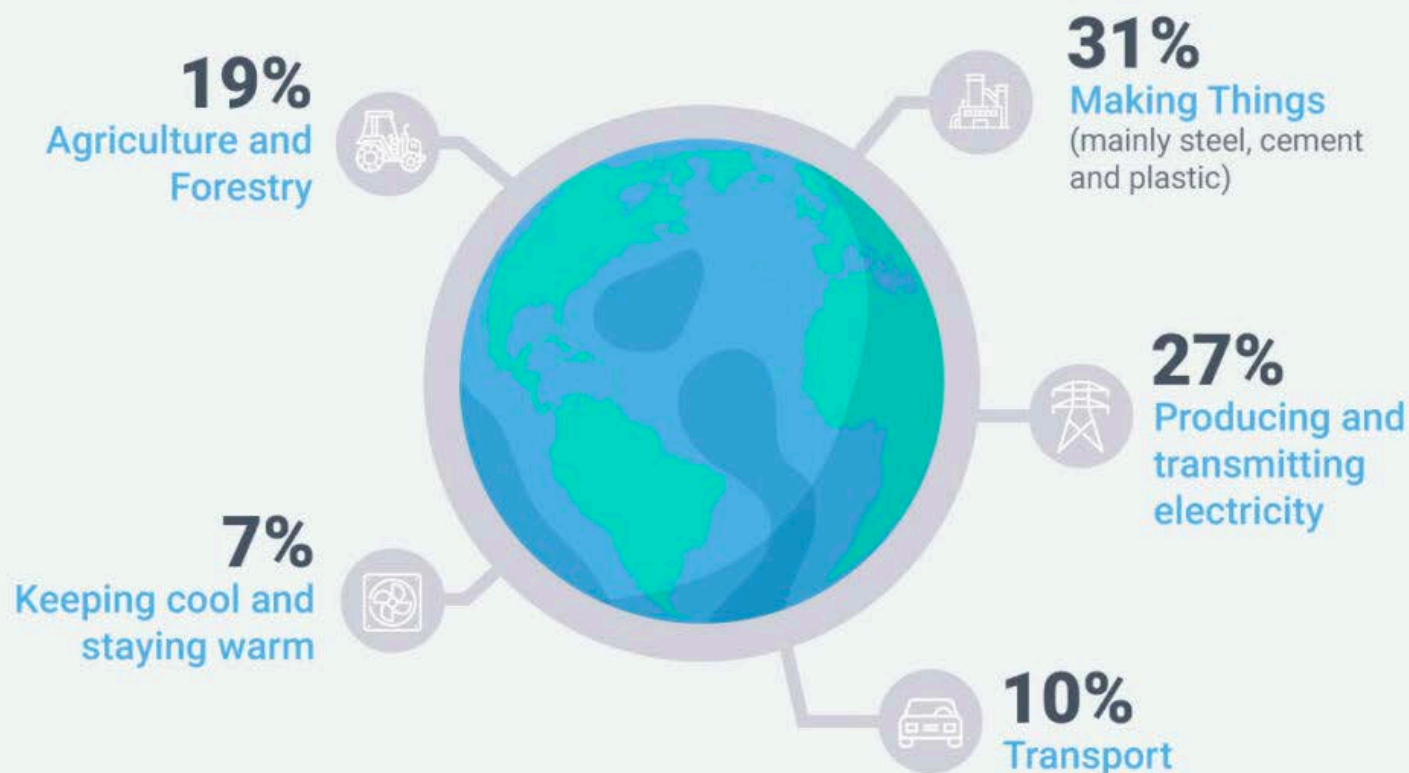




BILL GATES HOW TO AVOID A CLIMATE DISASTER

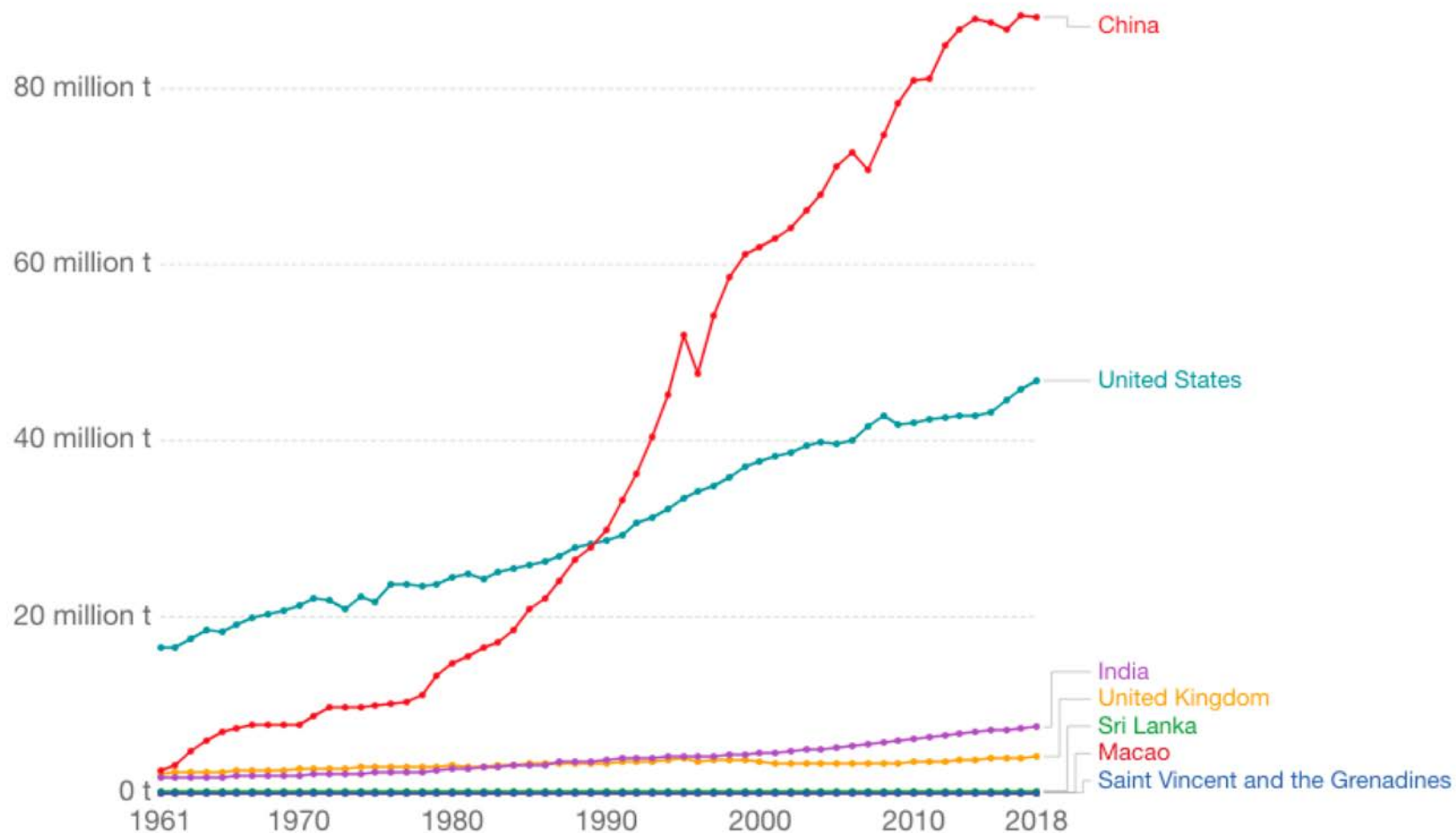
THE SOLUTIONS WE HAVE AND THE
BREAKTHROUGHS WE NEED

Split of the 52bn tonnes of greenhouse
gasses we produce annually



Meat production

Meat includes cattle, poultry, sheep/mutton, goat, pigmeat, and wild game.



Source: UN Food and Agricultural Organization (FAO)

Note: Figures are given in terms of dressed carcass weight, excluding offal and slaughter fats.

OurWorldInData.org/meat-production • CC BY



Vs



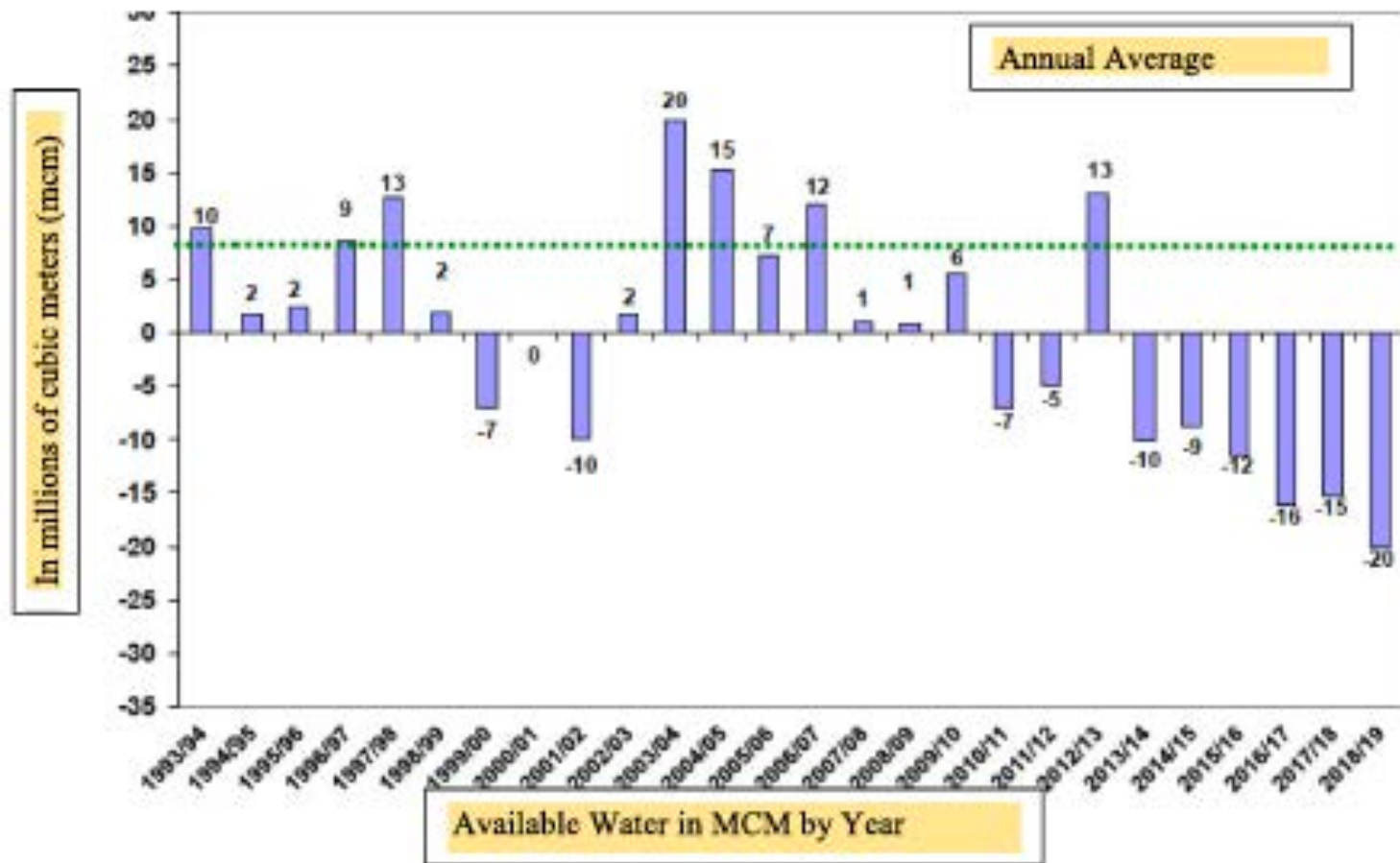
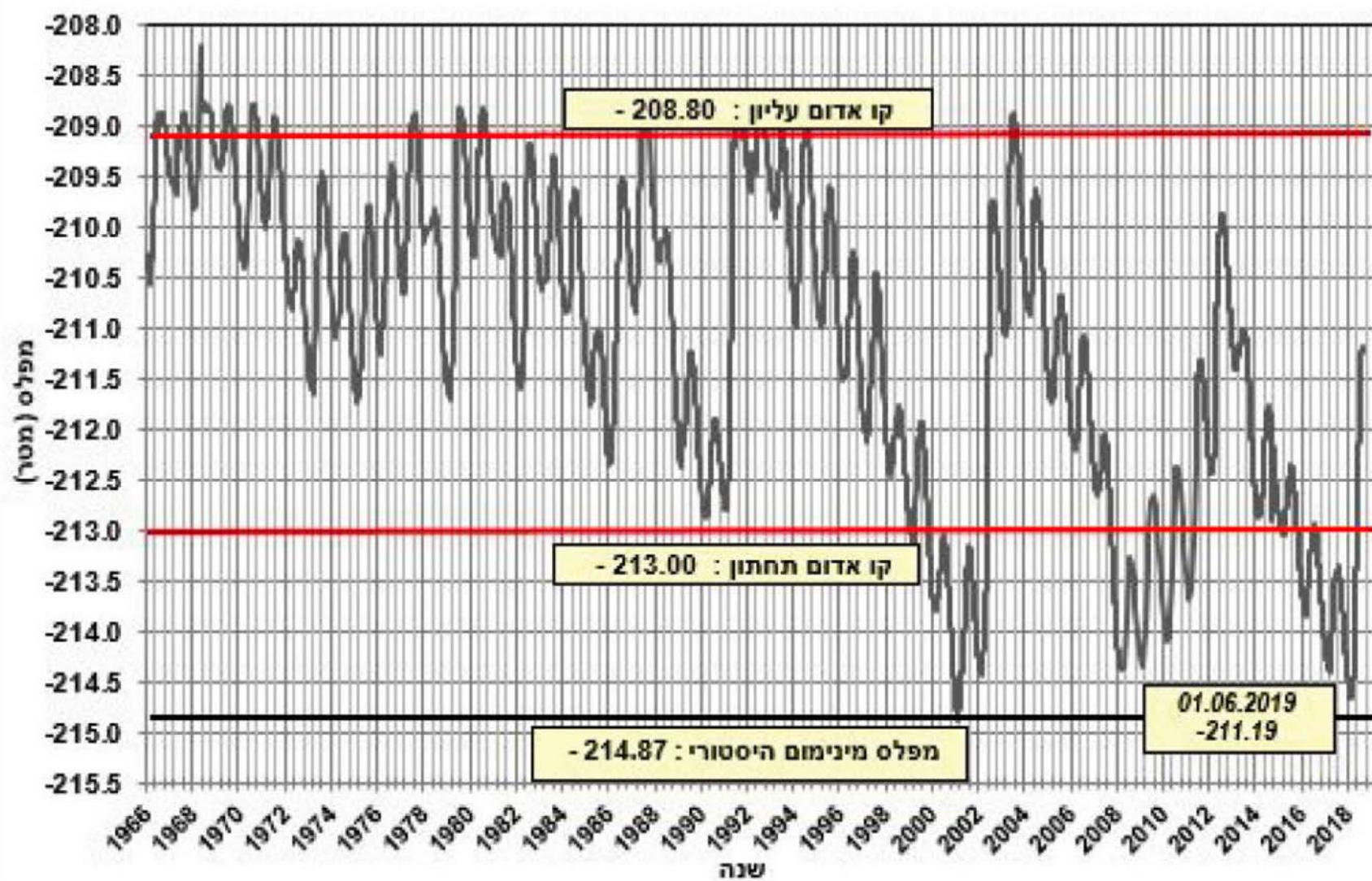


Fig. 2. Kinneret lake water volume availability.
(Source: Israel Hydrological Service, 2018)

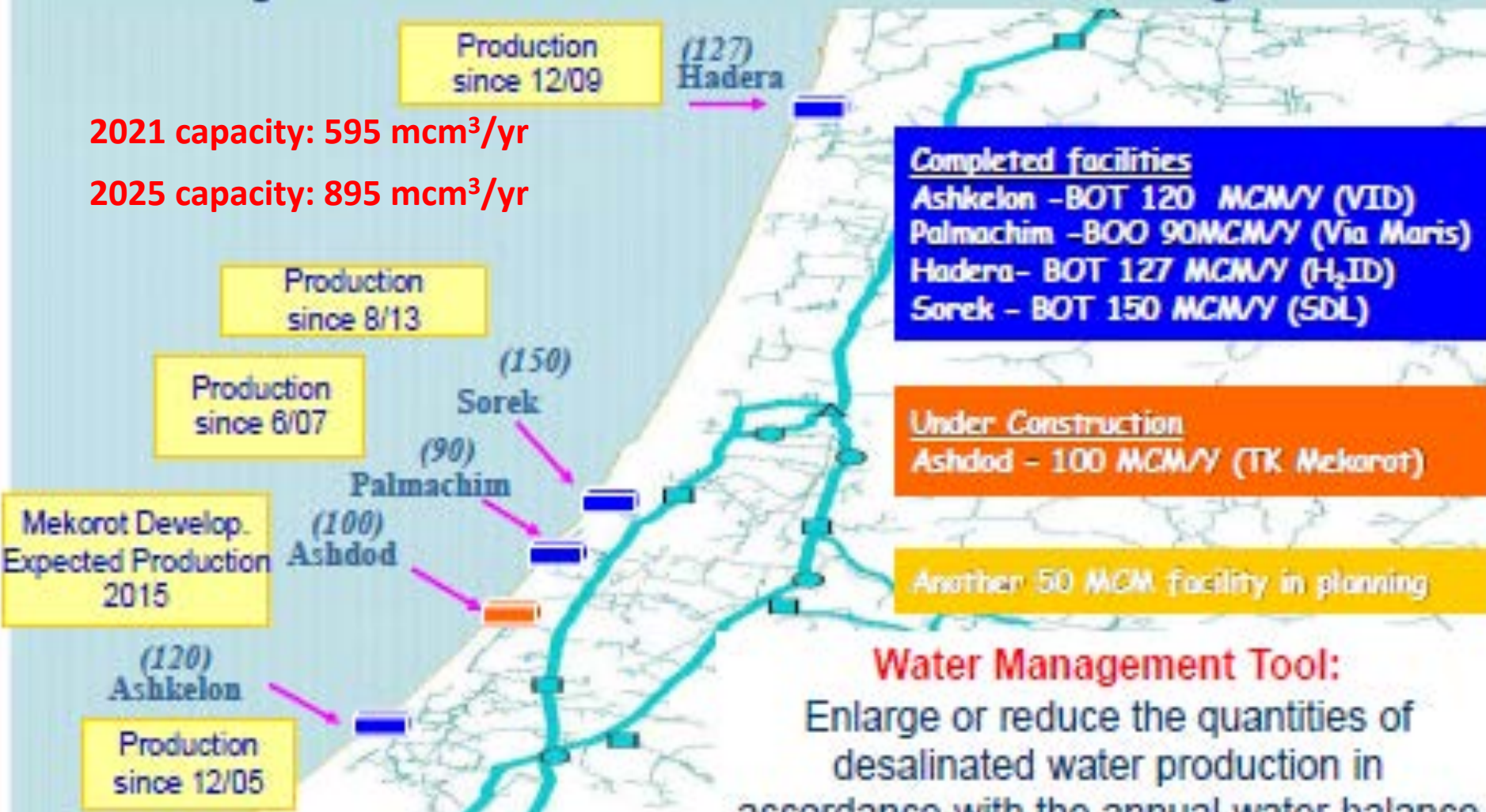


Sea Water Desalination

In accordance with the Government decisions since 2001 large scale seawater desalination facilities are being built:

2021 capacity: 595 mcm³/yr

2025 capacity: 895 mcm³/yr







KROHNE

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מפעל טיהור מים
מפעל טיהור מים

מפת ישראל

מפעל טיהור מים
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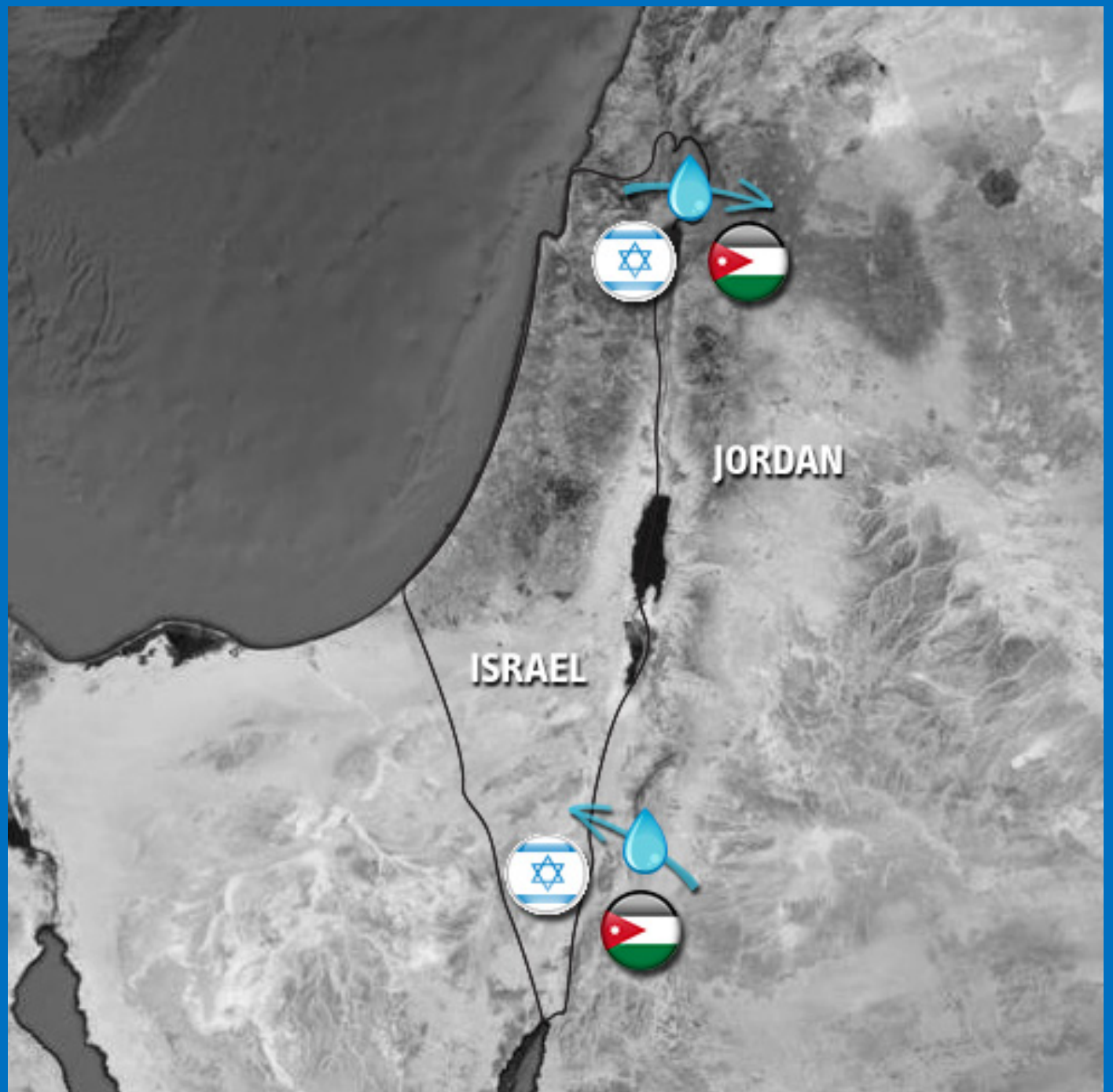
מפעל טיהור מים
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Adaptation



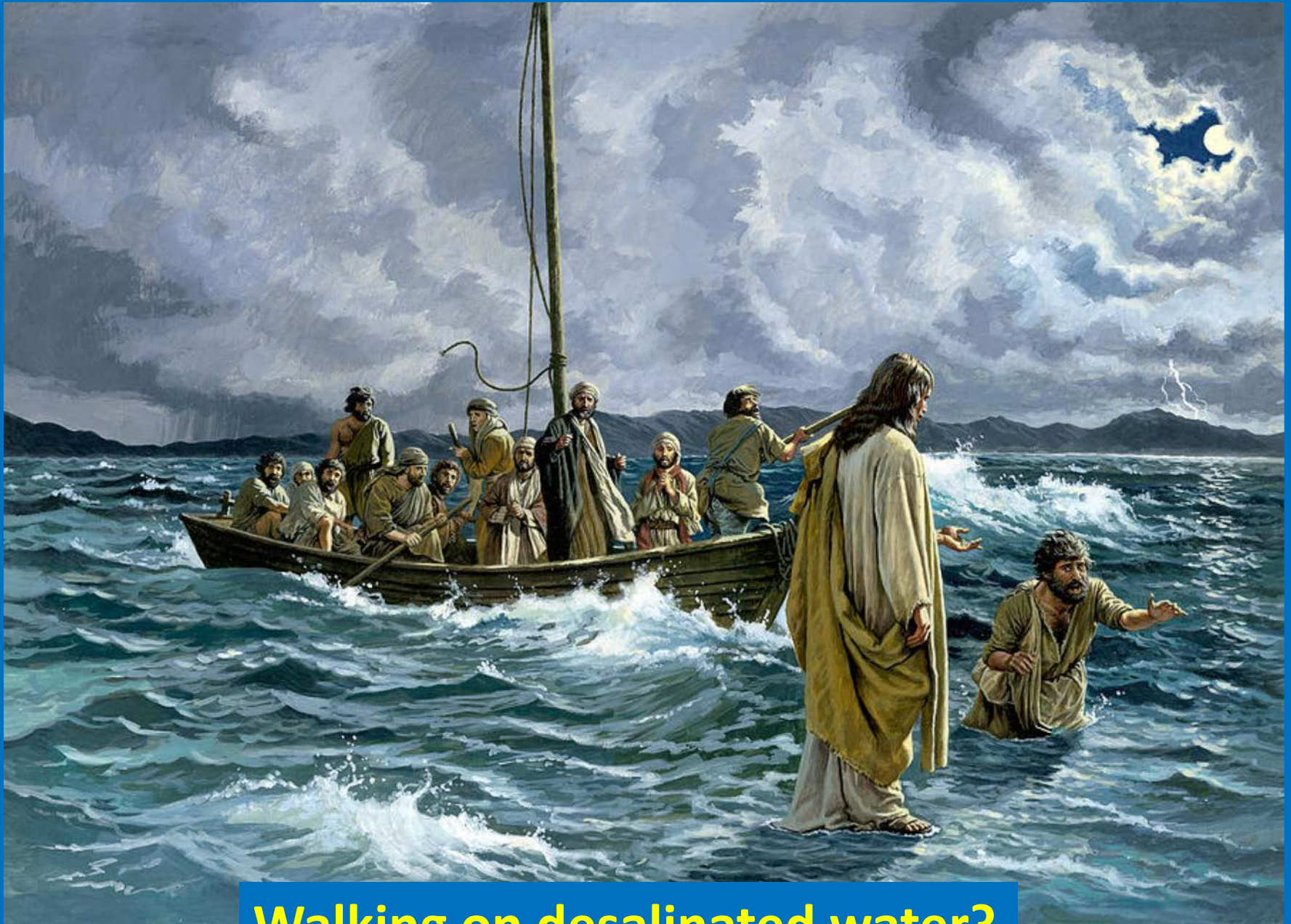
- By 2022- 120 MCM more
- 1.2 billion cubic meters for the region

The goal – returning the Kinneret as a national reservoir









Walking on desalinated water?

Potential Increase in Desalination

Population in 2050 (million)	Desalination in 2050 (MCM)	Increase 2050 vs. 2018 (MCM)	Increase 2050 vs 2018 (%)
Low: 14	1,700	1,055	64%
Medium: 16	2,000	1,355	110%
High: 18	2,300	1,655	157%

Desalination demand could more than double by 2050!

How much solar would be needed to power desal?

- At the end of 2018 Israel had about 1 gigawatt of installed solar capacity.
- With 100% efficient electric storage, 3.1 – 4.3 GW of solar needed to generate electricity for desal in 2050.
- 1 GW of solar pV could require 10 km² – 20 km² (Tel Aviv is ~50 km²)



Photo: Jerusalem Post & EGE

40 Megawatt Solar PV Facility (0.040 GW)
Near Kibbutz Ketura, Israel
133 Acres = 0.54 km²

Ashok Gulati · Yuan Zhou · Jikun Huang ·
Alon Tal · Ritika Juneja

From Food Scarcity to Surplus

Innovations in Indian, Chinese and
Israeli Agriculture

 Springer



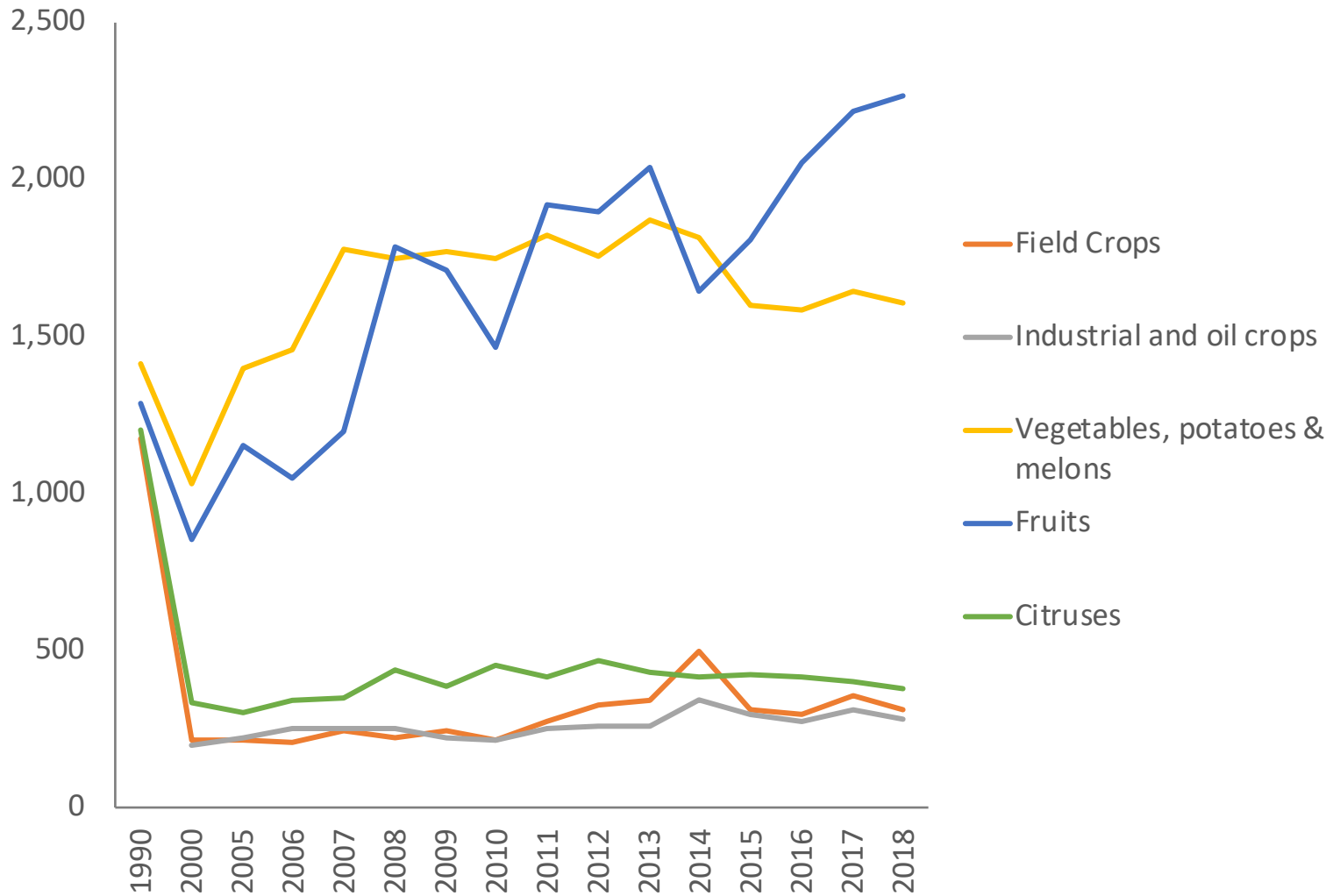


Number of Agro-tech Patents Attained

Years	Israeli	International
1970/74	4	0
1975/79	6	3
1980/84	17	6
1985/89	27	33
1990/94	13	21
1995/99	32	12
2000/04	35	56
2005/09	25	38
2010/14	30	71
2015/17	29	61



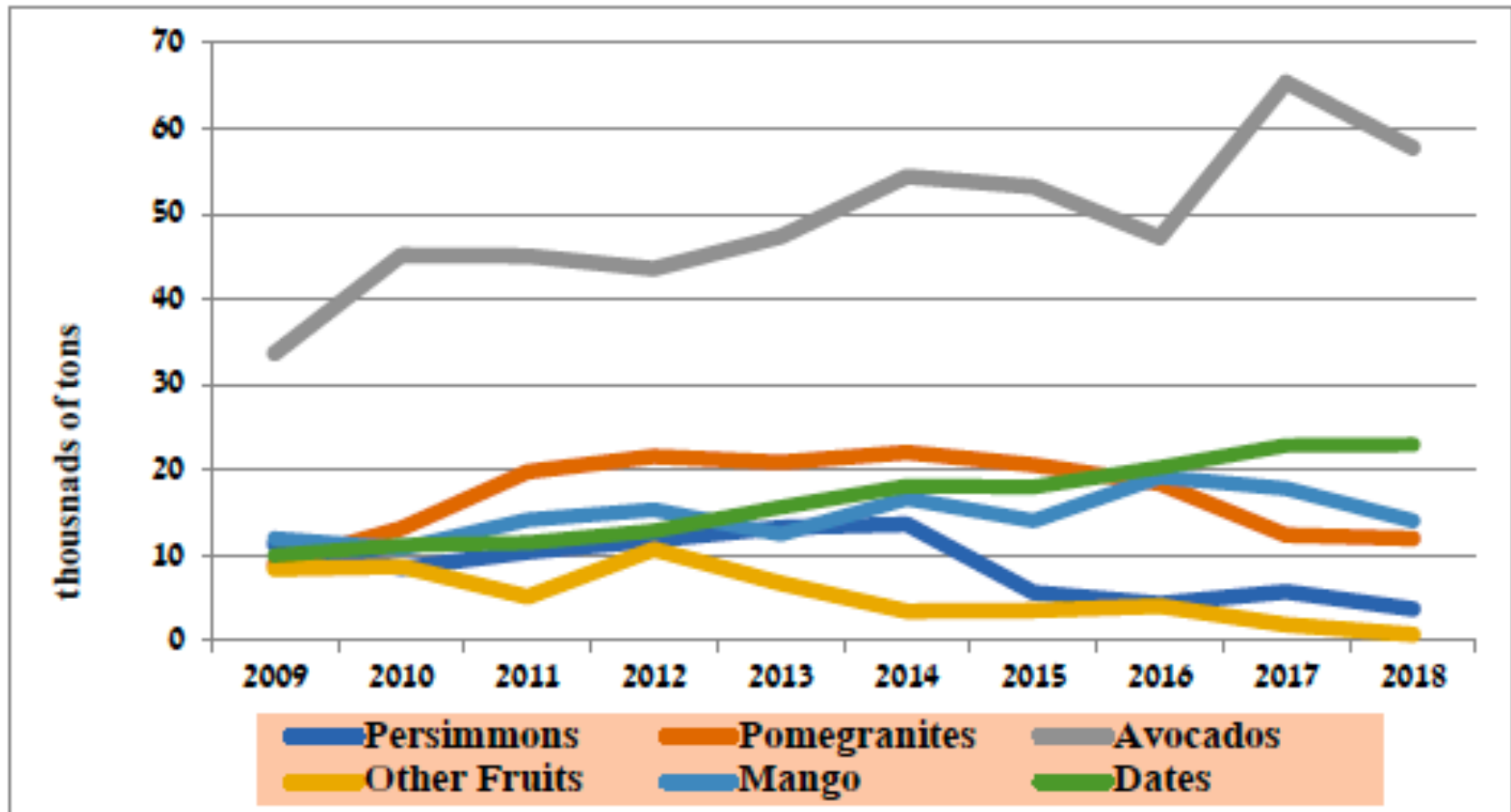
Value of Israeli Production (in millions of USD) deflated by output prices



Source: Annual Census, CBS of Israel, 2020



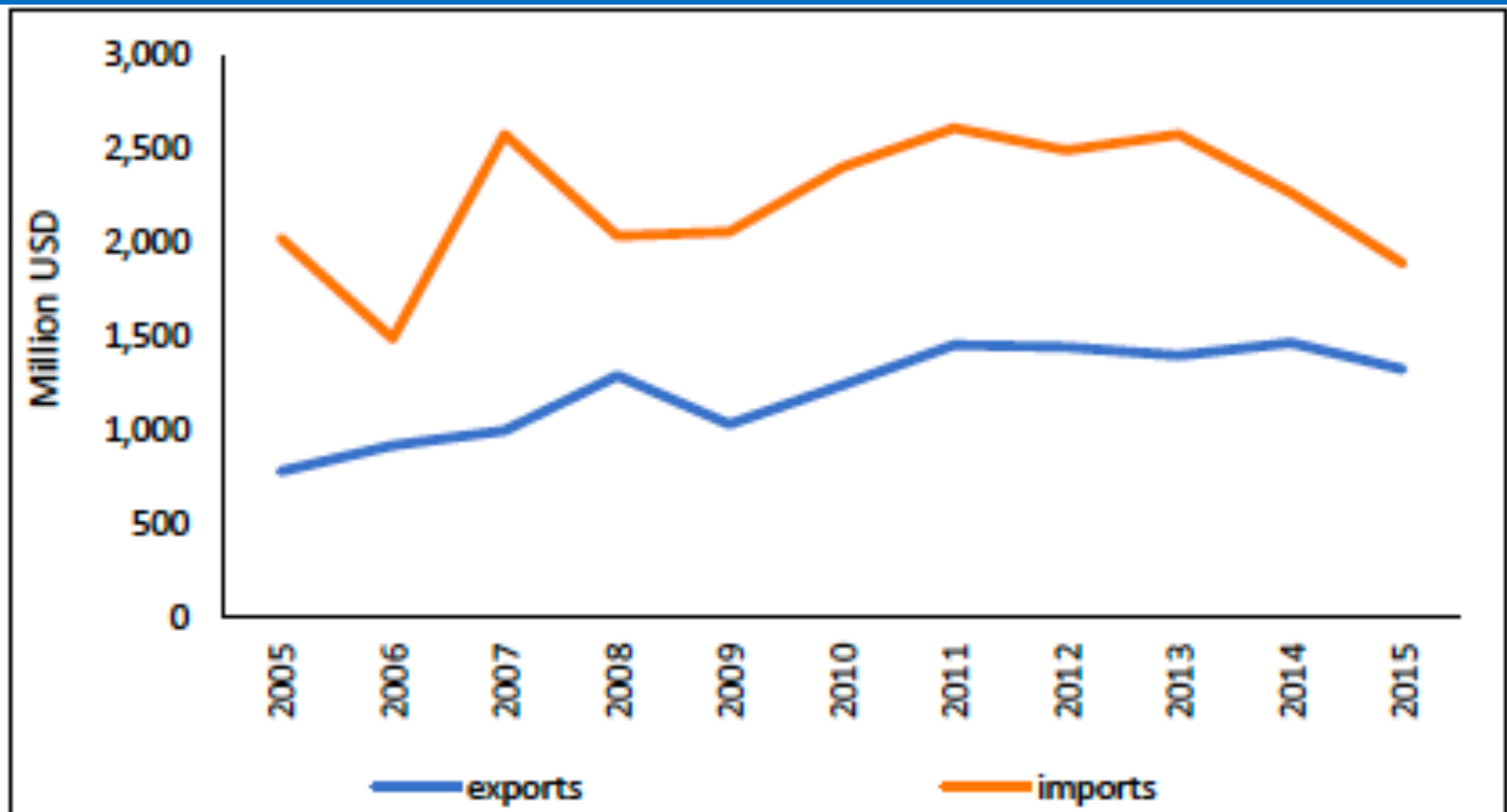
Israeli Fruit exports, 2009-2018 (in thousands of tons)



Source: Israeli Ministry of Agriculture and Rural Development, Research, Economics and Strategy Division (2019).



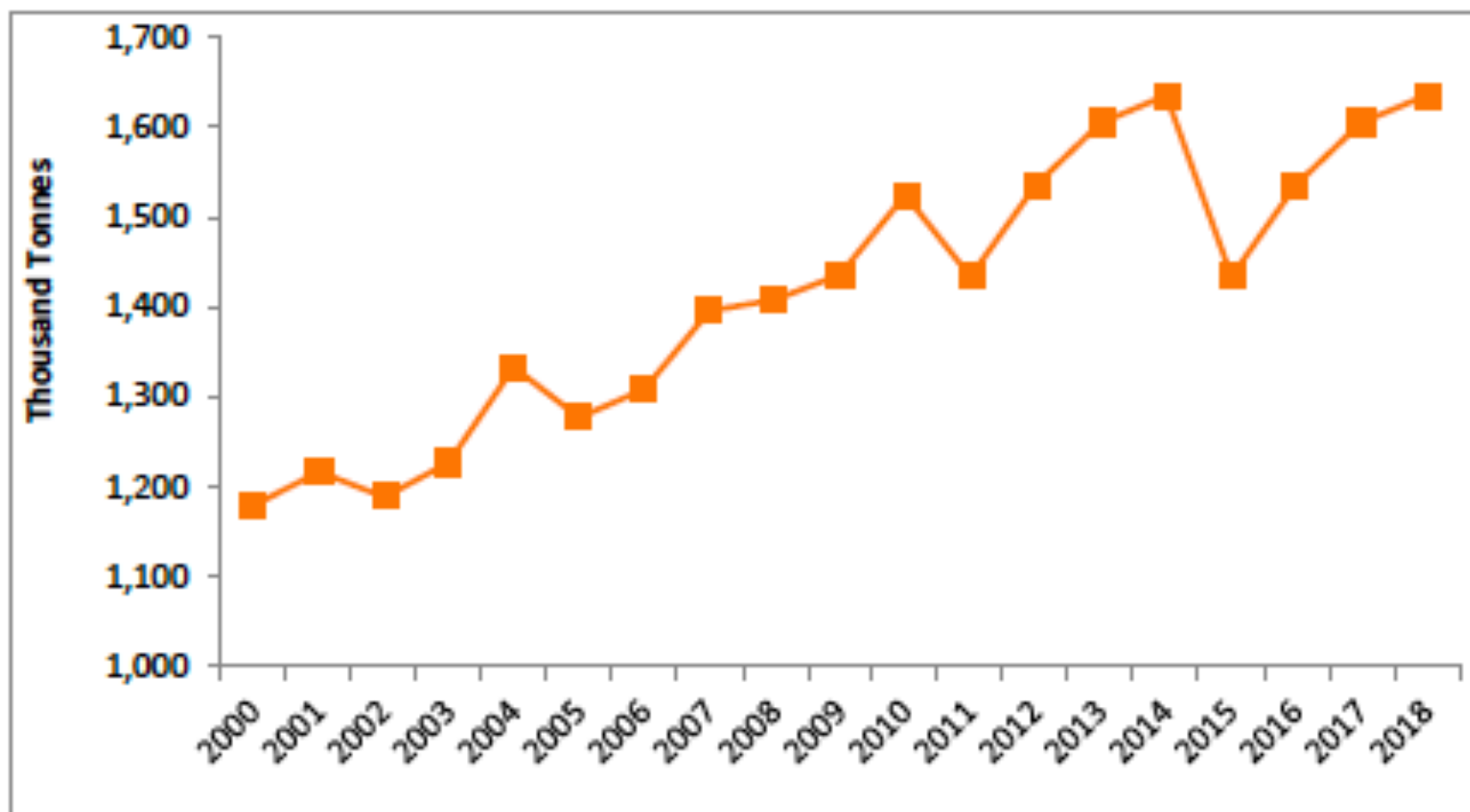
Value of International Trade in Agri produce (in Million USD) at current prices



Source: Israel, Central Bureau of Statistics, 2020



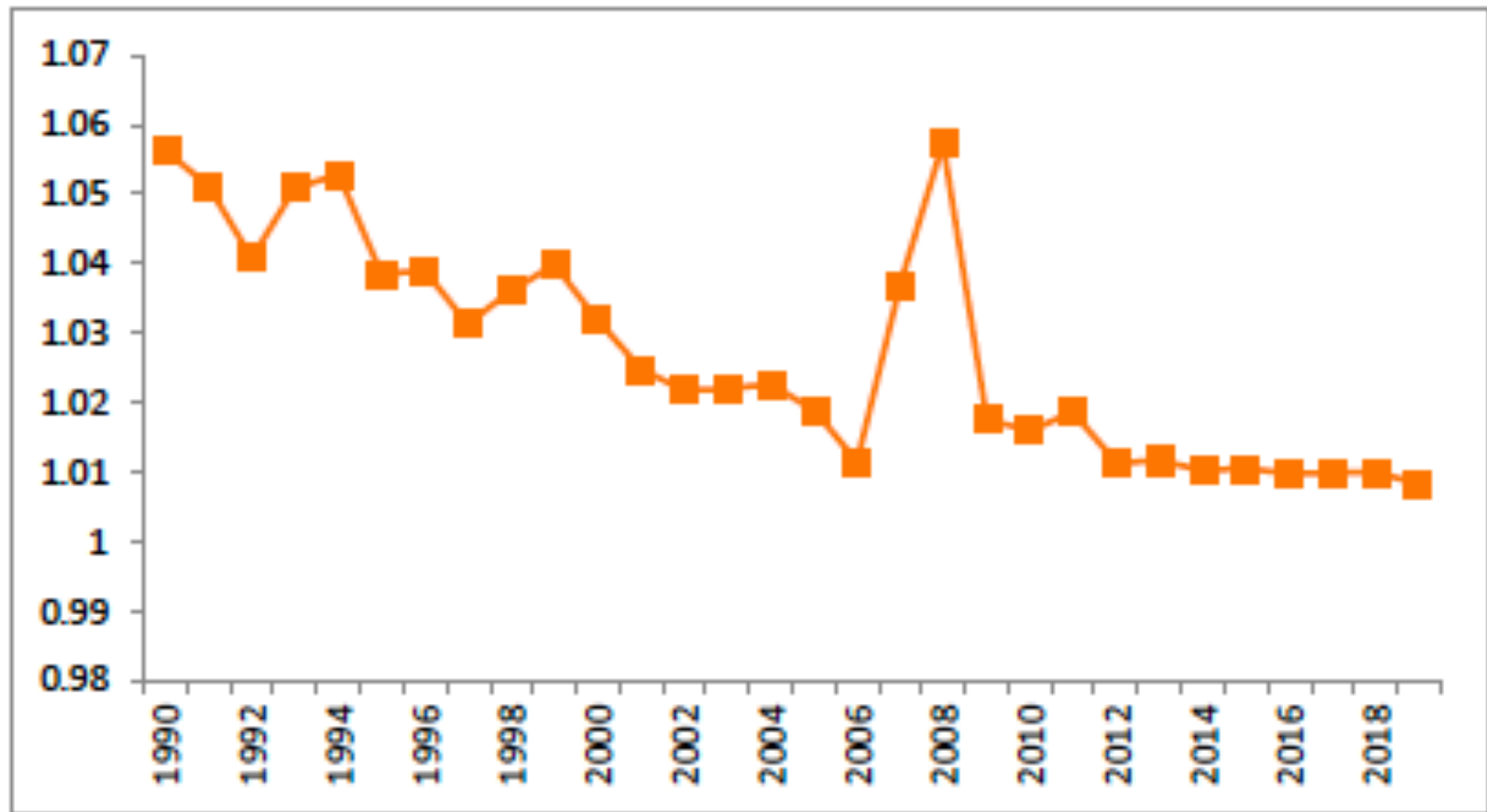
Milk Production (in thousand tonnes)



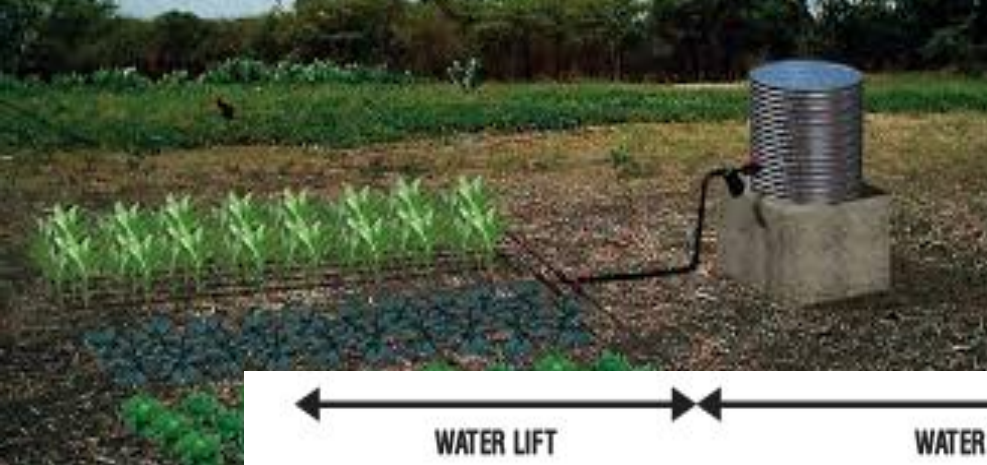
Source: Annual Census, CBS of Israel, 2019



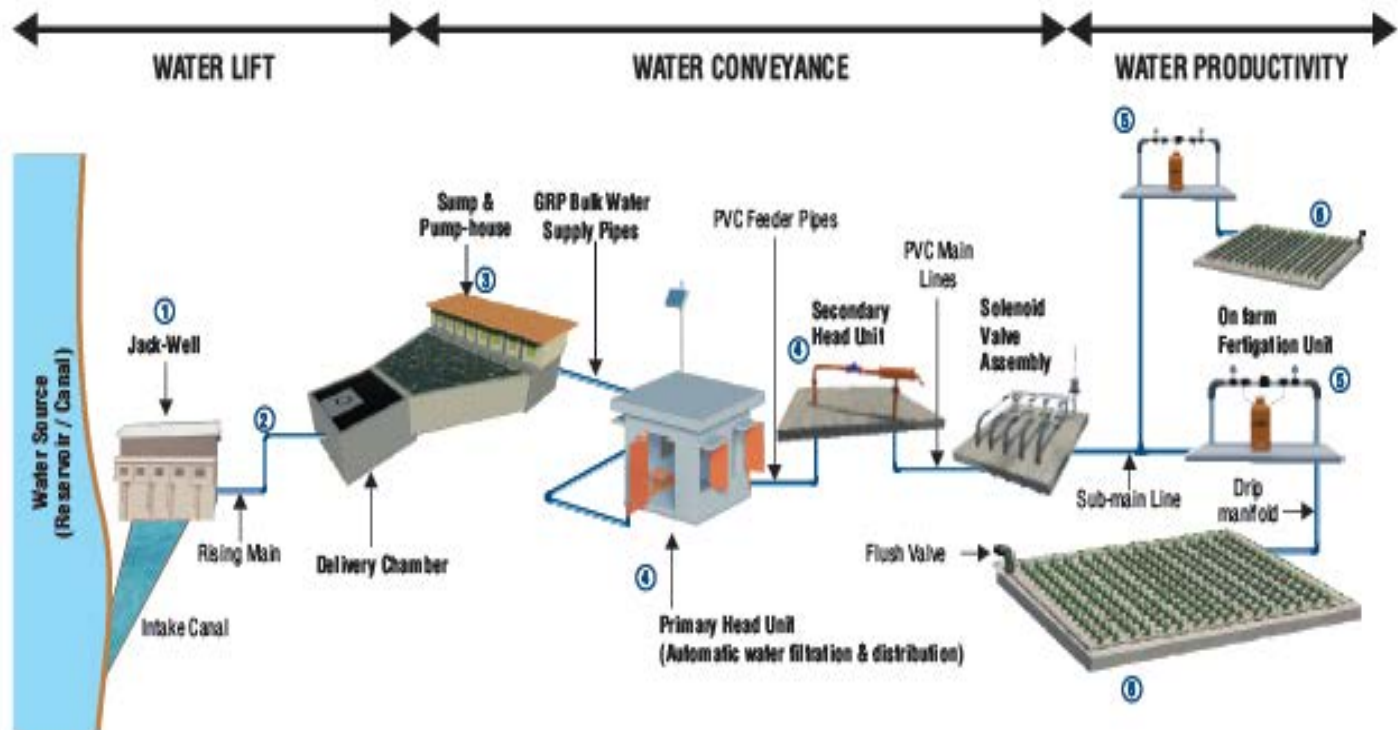
Feed to poultry meat Conversion Ratio



Source: OECD, 2019



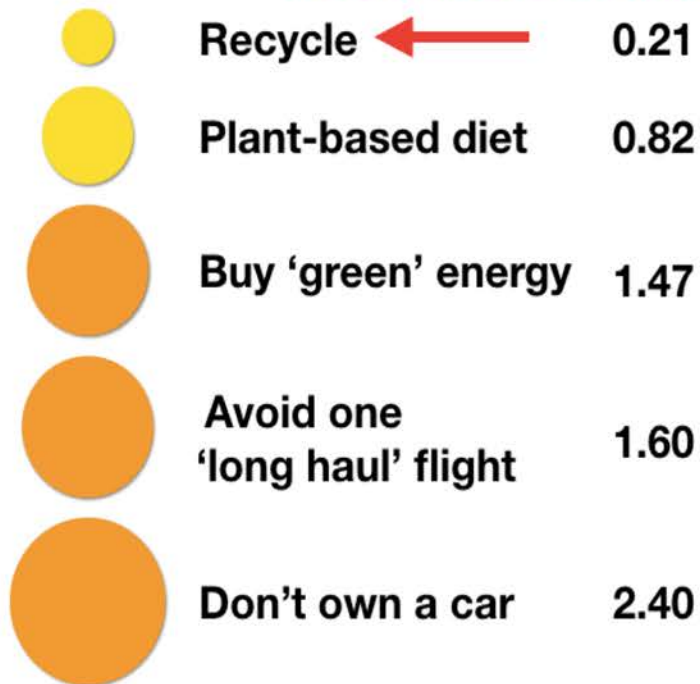
Family Drip Systems: Not just for Large Farms



- ① Water is lifted from the water source
- ② Water is conveyed through closed conduit & pressurized pipe network
- ③ Water is collected at a central location in a sump
- ④ Water collected at the sump is filtered through the Primary & Secondary Head Units (Automated)
- ⑤ Fertigation system and control valves are provided to each field to manage fertigation & irrigation schedule
- ⑥ Water is delivered to the root zone of each plant through the network of dripper-lines, ensuring equitable distribution of water across the field

Tons of CO₂-equivalent avoided per year for one person undertaking each action

Most cited in text books



Never cited
in text books!

Choose 1 less child
in developed world

58.6 tons

Source: Wynes & Nicholas, Environmental Research Letters

We Can Do It!



Thanks