



TIDC India Ltd.

International Conference on
HYDROPOWER AND DAMS DEVELOPMENT FOR WATER AND ENERGY SECURITY –
UNDER CHANGING CLIMATE



Central Board of
Irrigation & Power



Indian National Committee
on Large Dams

**Water, Energy, Food Nexus:
Importance of water**



*Felix Reinders
President Honoraire*

ICID



INTERNATIONAL COMMISSION
ON
IRRIGATION AND DRAINAGE



THDC India Ltd.

International Conference on
HYDROPOWER AND DAMS DEVELOPMENT FOR WATER AND ENERGY SECURITY –
UNDER CHANGING CLIMATE



New Delhi
Central Board of
Irrigation & Power



INCOLD
Indian National Committee
on Large Dams

**Water, Energy, Food Nexus:
Importance of water**



*Felix Reinders
President Honoraire*

ICID



INTERNATIONAL COMMISSION
ON
IRRIGATION AND DRAINAGE

Coming up.....



- Introduction
- Water
- Energy
- Food
- Technology
- Conclusion





Introduction

Water Infrastructures

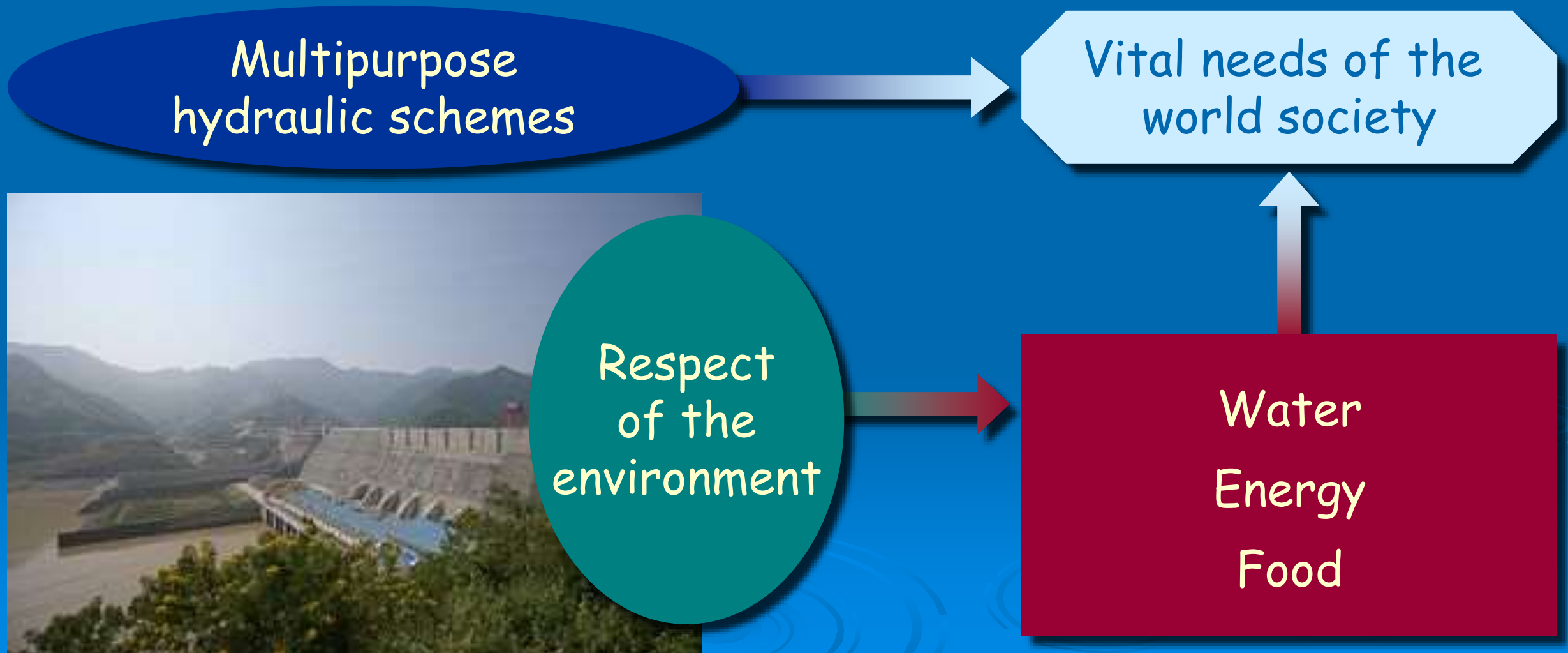
Hydropower, Dams and Reservoirs

Multipurpose
hydraulic schemes

Vital needs of the
world society

Respect
of the
environment

Water
Energy
Food

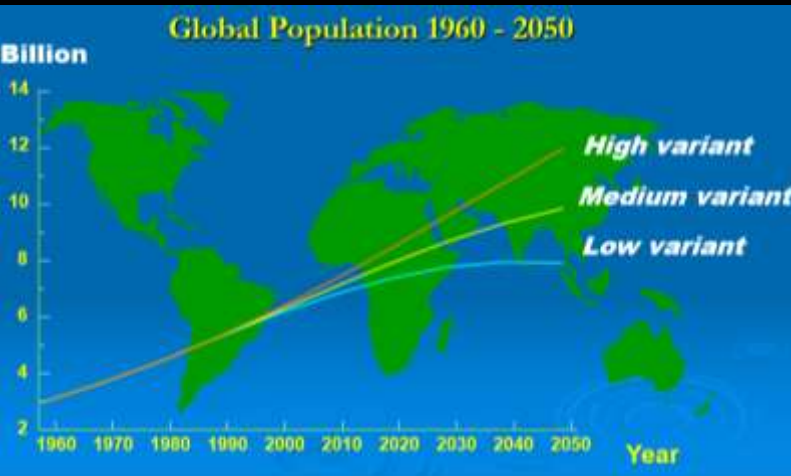


WATER

A glowing blue light effect, resembling a lens flare or a bright light source, is positioned behind the word "WATER". The light is concentrated in a horizontal line, with a bright point of light on the right side that tapers off into a soft, ethereal glow extending to the left. The overall effect is futuristic and high-tech.

The World Government Summit launched a report addresses the four main developments that are placing pressure on agriculture to meet the demands of the future:

- Demographics,
- Scarcity of natural resources,
- Climate change, and
- Food waste.



Demographics

POPULATION
GROWTH =
HIGHER DEMAND
FOR FOOD



10 billion

world population in 2050

=



70%

More food to be produced by farmers

URBANIZATION
DRIVES CHANGE IN
CONSUMPTION
PATTERN



36.4 kg

processed food and meat annual
per capita meat consumption
1997-1999

→

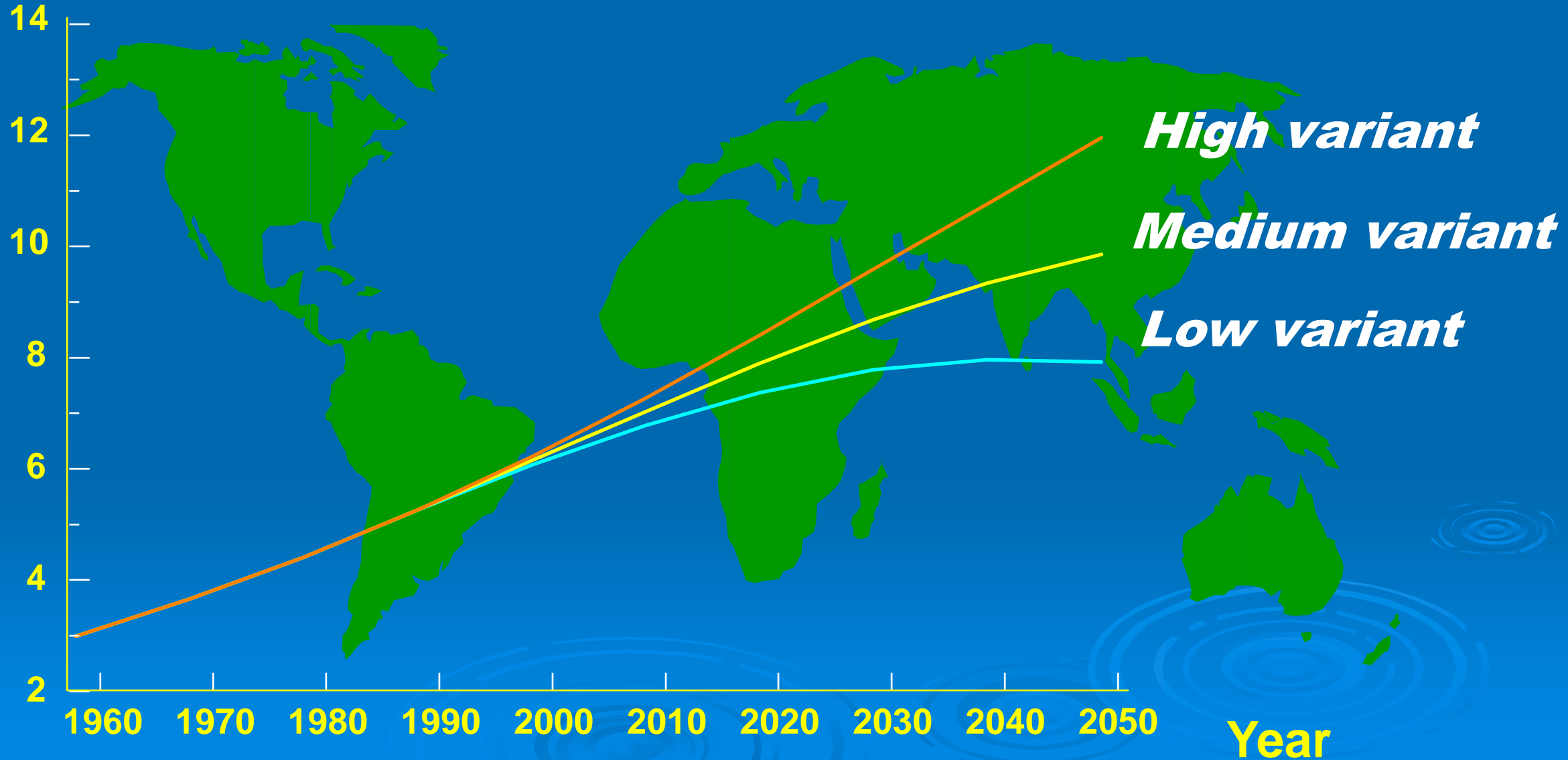


45.3 kg

processed food and meat annual
per capita meat consumption
2030

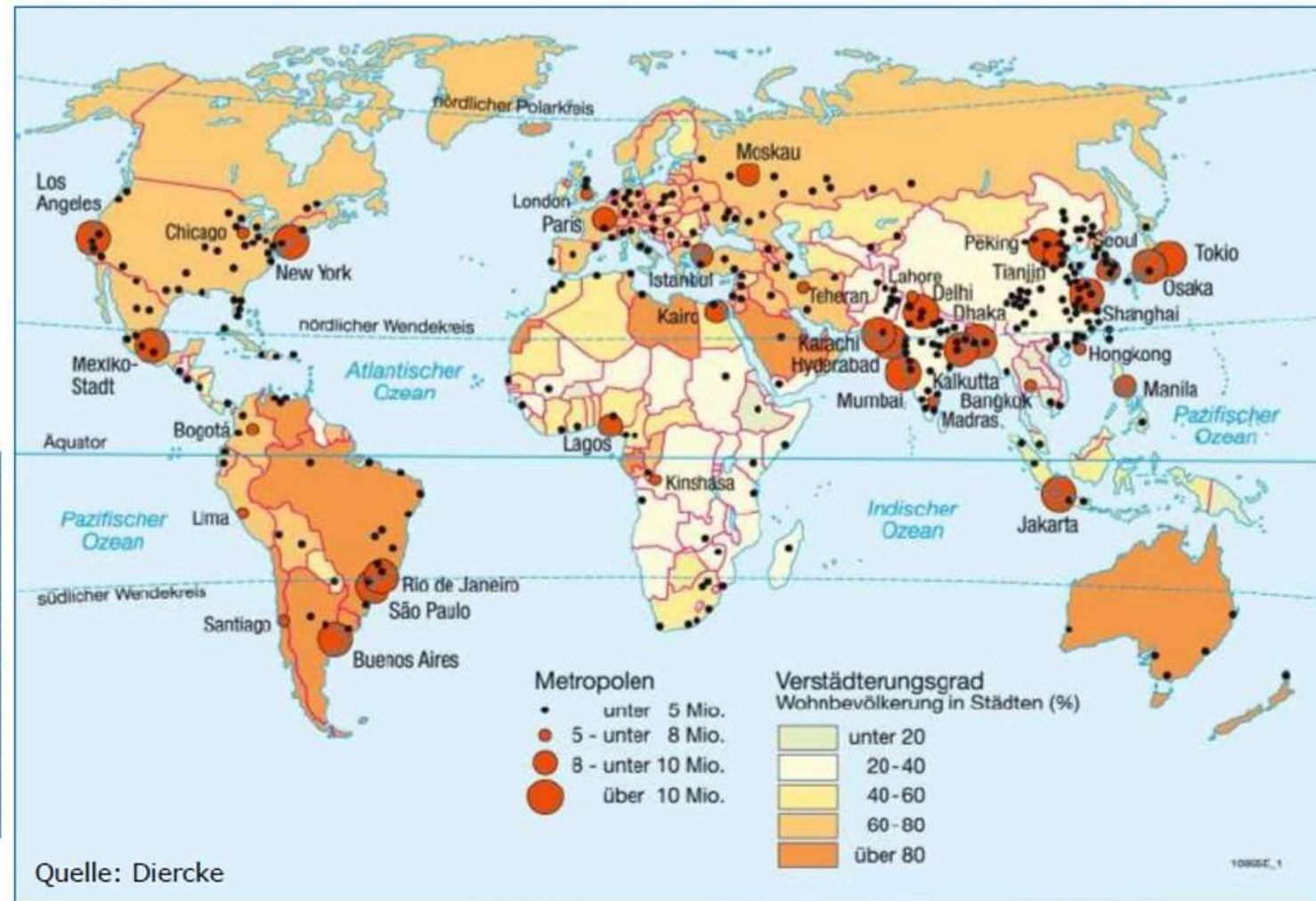
Global Population 1960 - 2050

Billion



Trends in Urbanisation

- Today for the first time more than 50 % of the world's population live in cities; up to 2030 the global population will increase to five billion people.
- Urban growth will be most significant in Africa and Asia.



Natural Resources

25%

of all farmland is already rated as highly degraded

-80%

global deforestation driven by agricultural concerns

\$1 trillion

investment necessary until 2050 for irrigation water management in developing countries alone



EARTH RESOURCES

ANIMAL RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



SOLAR ENERGY

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



WATER RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



WIND ENERGY

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



OIL RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



SOIL RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



COAL RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



FOREST RESOURCES

Lorem ipsum dolor sit amet, mei homero voluptatibus ei.



Climate change

GREENHOUSE GAS EMISSIONS



VARIABILITY OF PRECIPITATION REDUCE CROP YIELDS

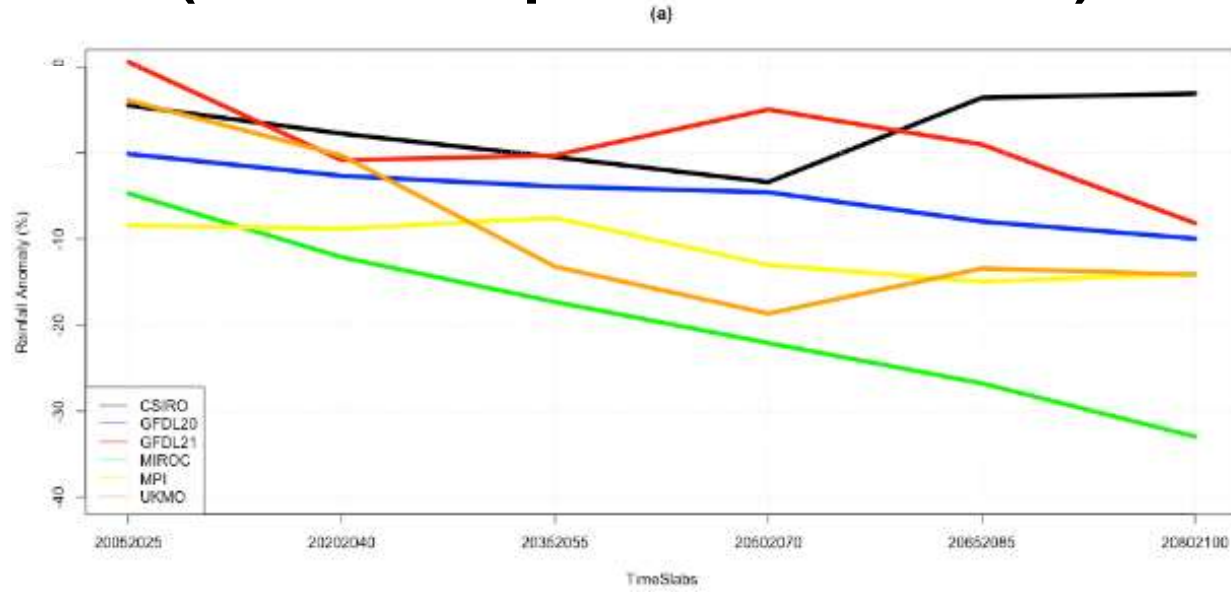


Rise in the frequency of droughts and floods, all of which tend to reduce crop yields

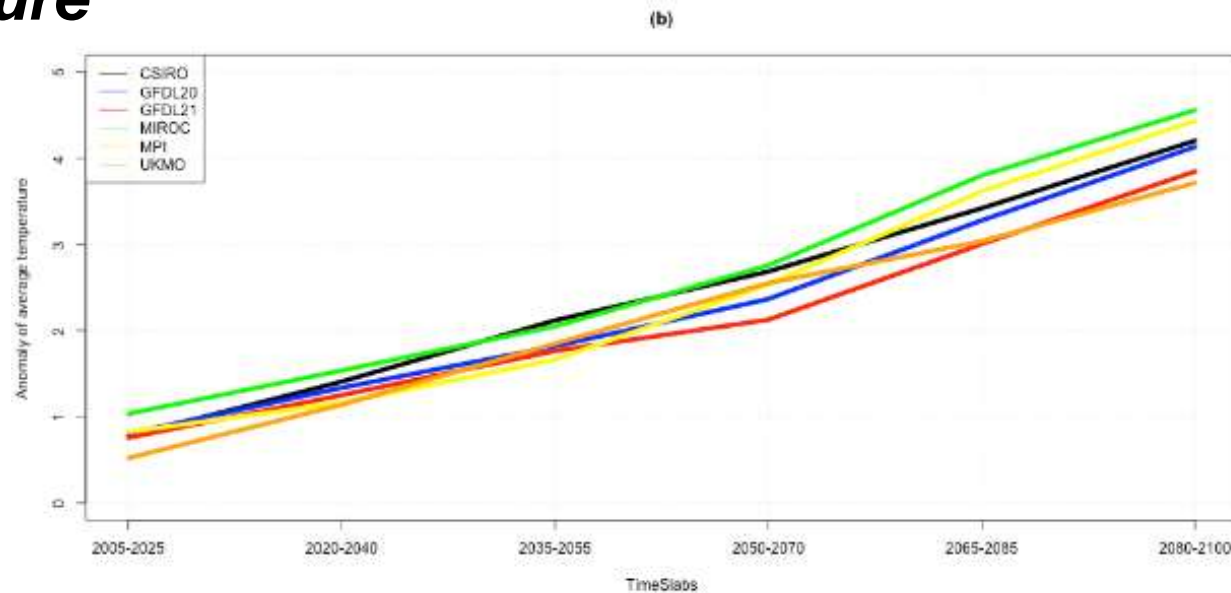


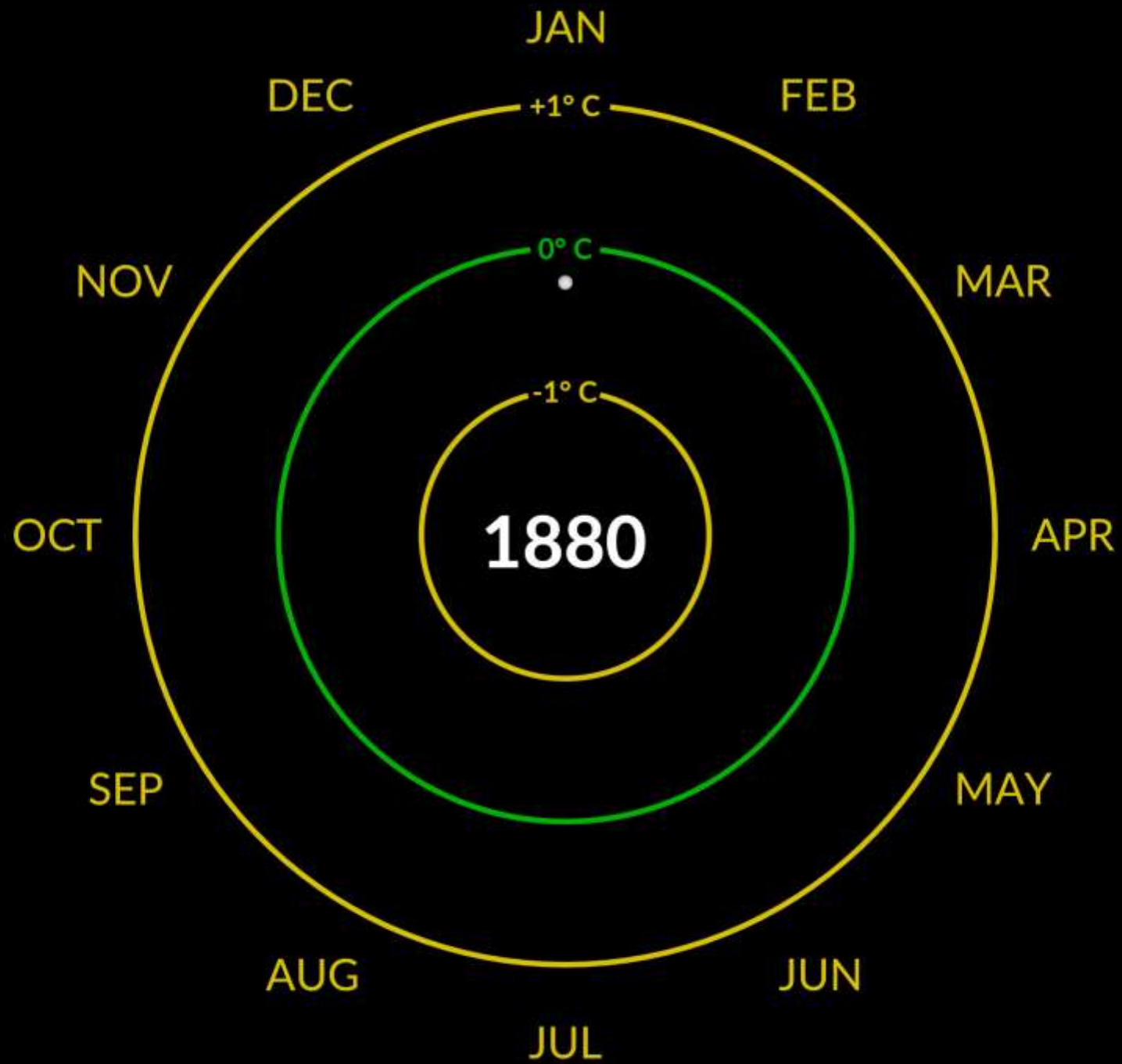
Range of possible outcomes (6 different prediction models)

Rainfall



Temperature





Food Waste



between

33%-50%

of all food produced globally is never eaten

=

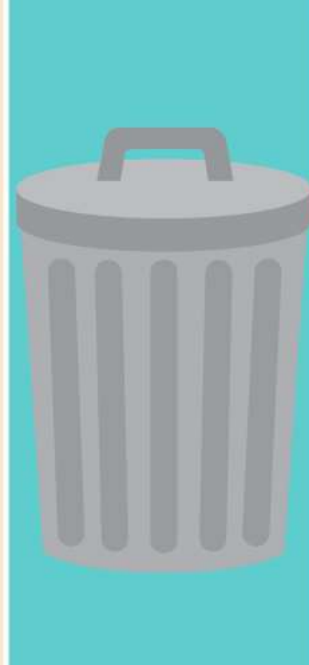
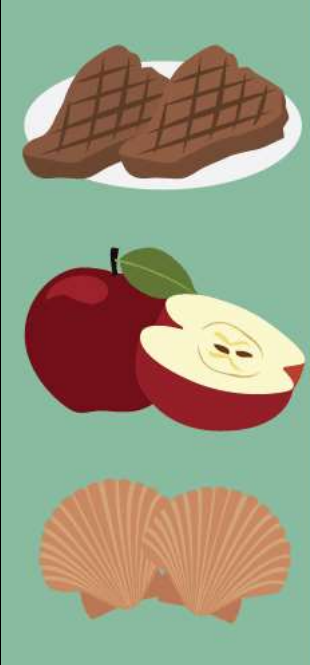


25%

of all fresh water consumption globally

3rd

largest emitter of greenhouse gases after **China** and the **US**, if food waste were a country



WHO'S WASTING THE MOST FOOD?

ANYWHERE FOOD IS GROWN, SOLD, OR EATEN, FOOD IS WASTED. HOWEVER CONSUMERS ARE DEFINITELY THE BIGGEST SOURCE OF FOOD WASTE



Residential
44%



Restaurants
33%



Grocery Stores
11%



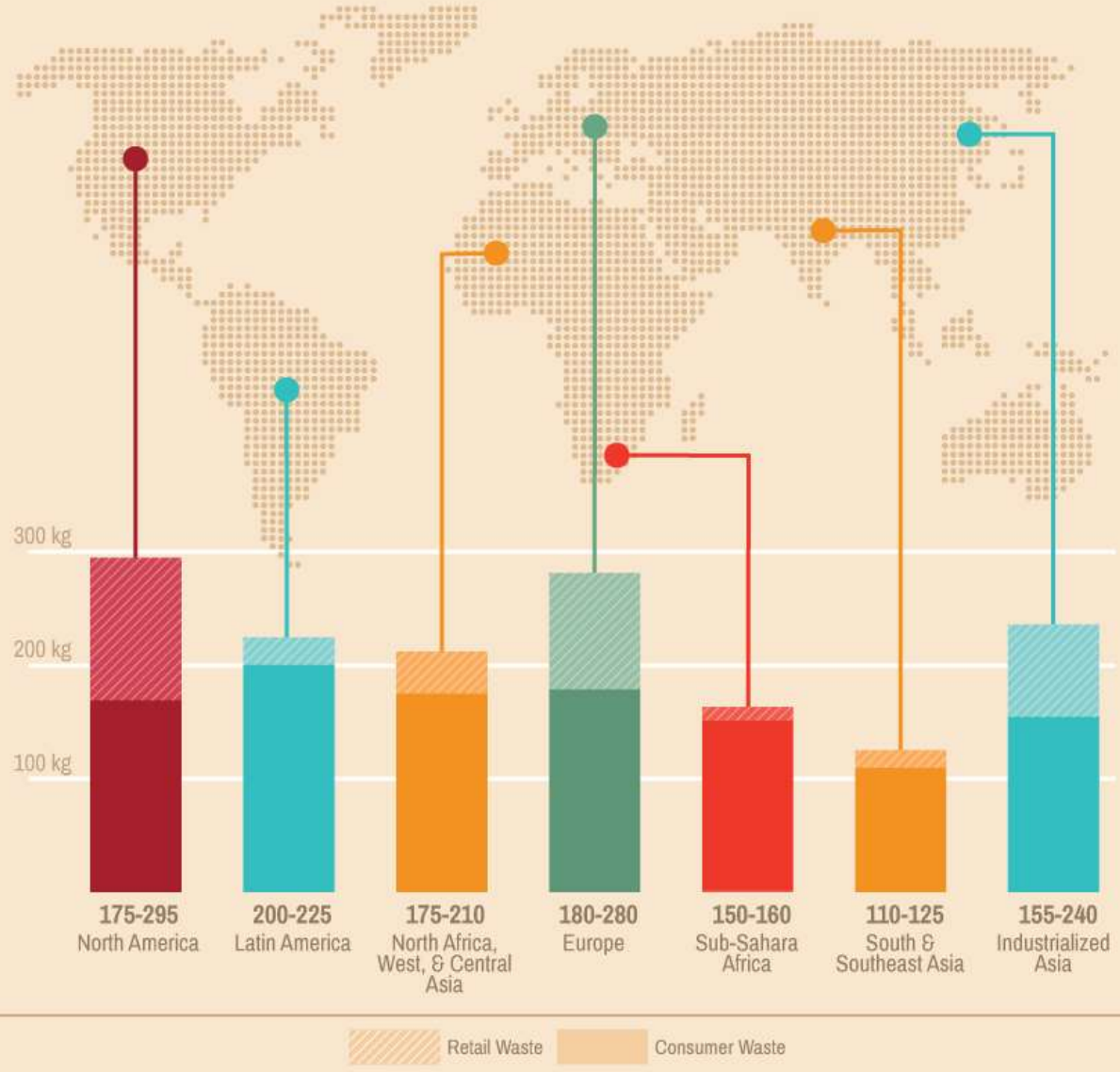
Institutional
10%



Industrial
2%

FOOD WASTE AROUND THE WORLD

TOTAL SHARE OF GLOBAL FOOD WASTE PER CAPITA (KG/YEAR)



All these trends lead to scarcity and hunger

DEMOGRAPHICS

CLIMATE CHANGE

NATURAL RESOURCES

FOOD WASTE



700 million

people remain extremely poor



800 million

face chronic hunger



2 billion

suffer micronutrient deficiencies

Hunger Map 2021



Hunger Map 2021 **CHRONIC HUNGER**

<2,5% 2.5-4,9% 5-14,9% 15-24,9% 25-34,9% >35% DATA NOT AVAILABLE

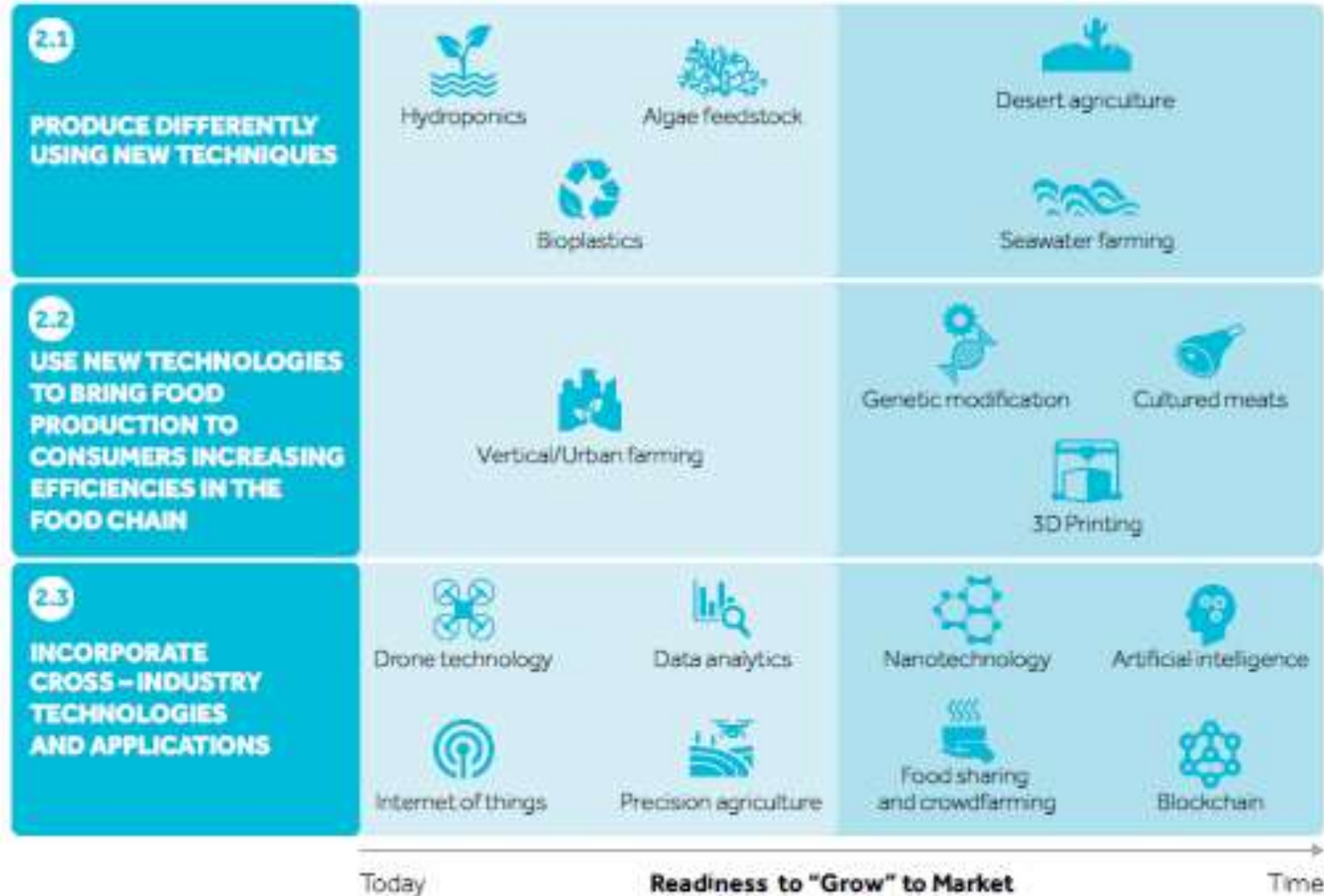


Prevalence of undernourishment in the total population (percent) in 2018-20

Up to 811 million people - 1 in 10 of the global population - do not get enough to eat

World Food Programme (WFP) is a United Nations organization that provides humanitarian aid to hungry people around the world. WFP is the world's largest humanitarian organization, reaching more than 120 million people in over 120 countries. WFP is a leading organization in the fight against hunger, malnutrition and food insecurity. WFP is a member of the United Nations Development Group (UNDG) and is a leading organization in the fight against hunger, malnutrition and food insecurity. WFP is a member of the United Nations Development Group (UNDG) and is a leading organization in the fight against hunger, malnutrition and food insecurity. WFP is a member of the United Nations Development Group (UNDG) and is a leading organization in the fight against hunger, malnutrition and food insecurity.

Map of technologies and maturity



Water is crucial to development all over the world. It waters the fields; nurtures the crops and stock; provides recreation; it support mines, industry; electricity generation and it provide life for plants and animals that make up ecosystems.

Innovative and sustainable agri-water management with smart irrigation technologies is very important to adapt to a variable and changing climate. The role of technology and new ideas are essential in making agriculture resilient to a fast-changing climate when the demand for water is over-stressed.

STOCKHOLM STATEMENT

A Call for A Sustainable Development Goal on Water

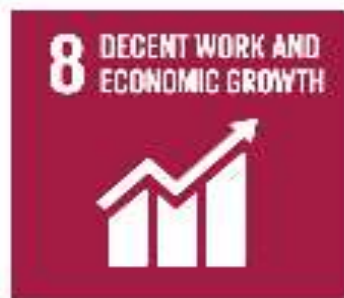
As an outcome of broad consultations prior to and during the 2013 World Water Week in Stockholm, we call upon the United Nations and its Open Working Group to propose a **Sustainable Development Goal on Water**.

Water is at the core of sustainable global development and is a cross cutting resource. Within the post-2015 development agenda water should be considered and integrated into all relevant areas, such as energy and food security. Given the centrality of water for individuals, ecosystems and economic development, water is a powerful tool for cooperation across borders, sectors and communities.

A dedicated goal on water is necessary for a world where all people can live in safety and dignity.

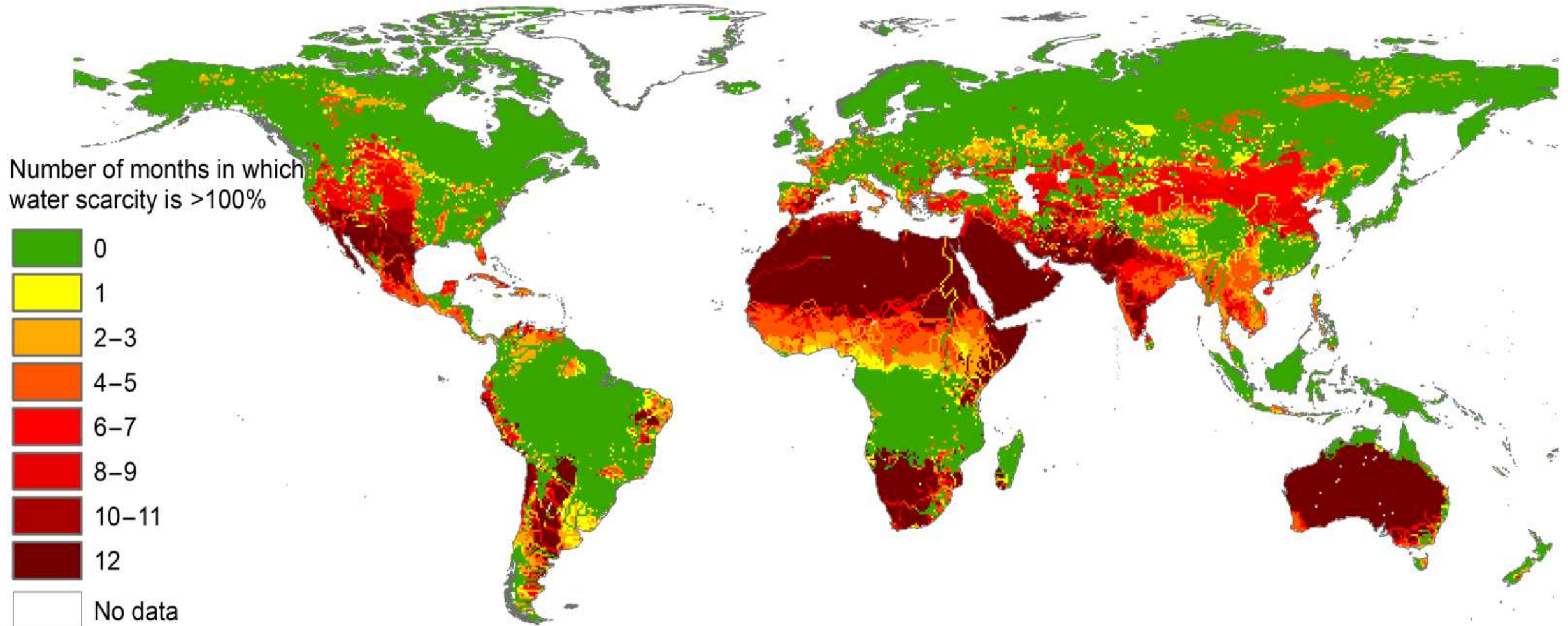


SUSTAINABLE DEVELOPMENT GOALS



Water scarcity: a global issue

4 billion people (66% of all people) lives under severe **water scarcity** for at least 1 month of the year. It affects all regions of the world.

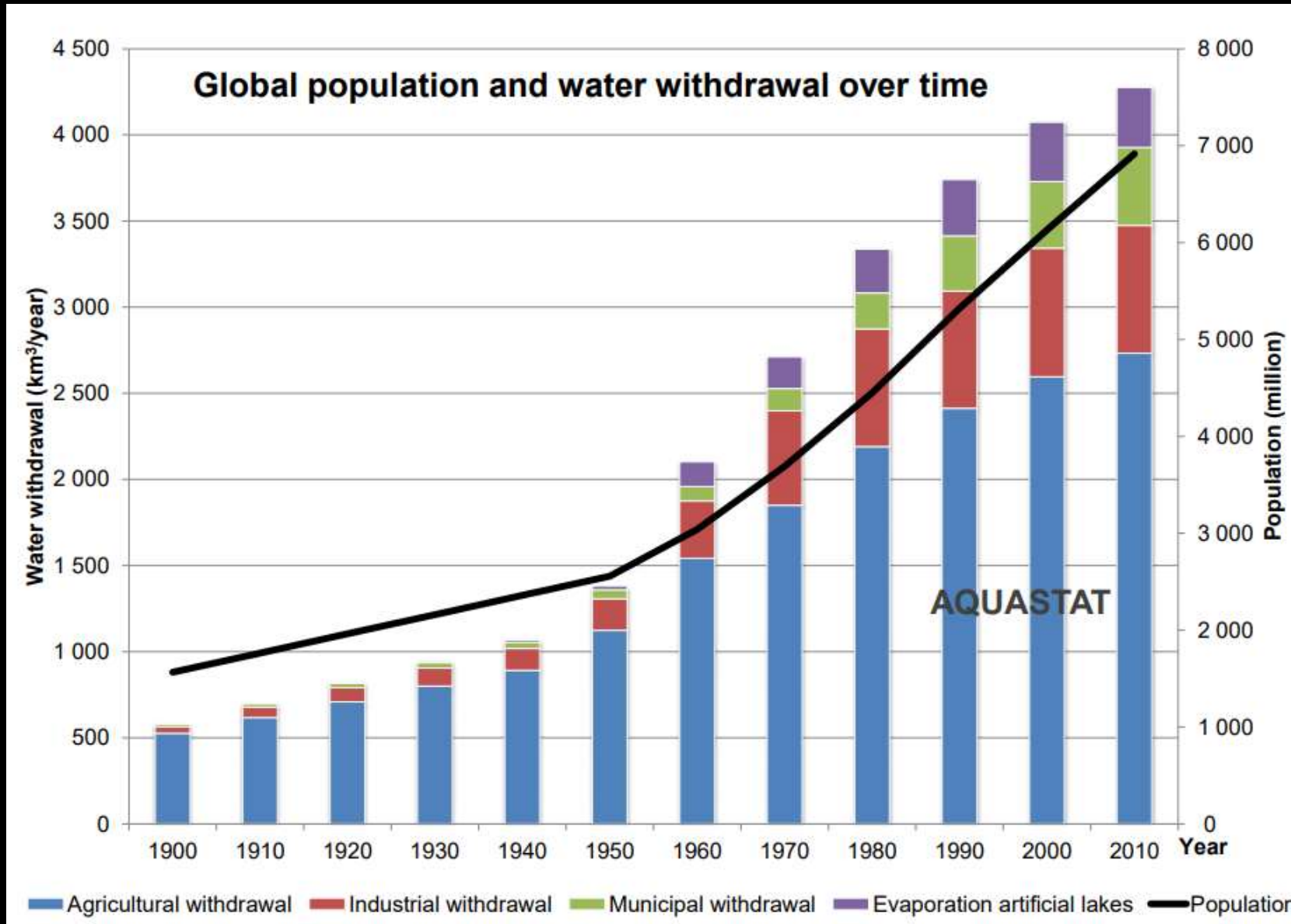


***Two thirds of the
world's population***

***WILL BE AFFECTED BY
WATER SHORTAGES
BY THE YEAR 2030***

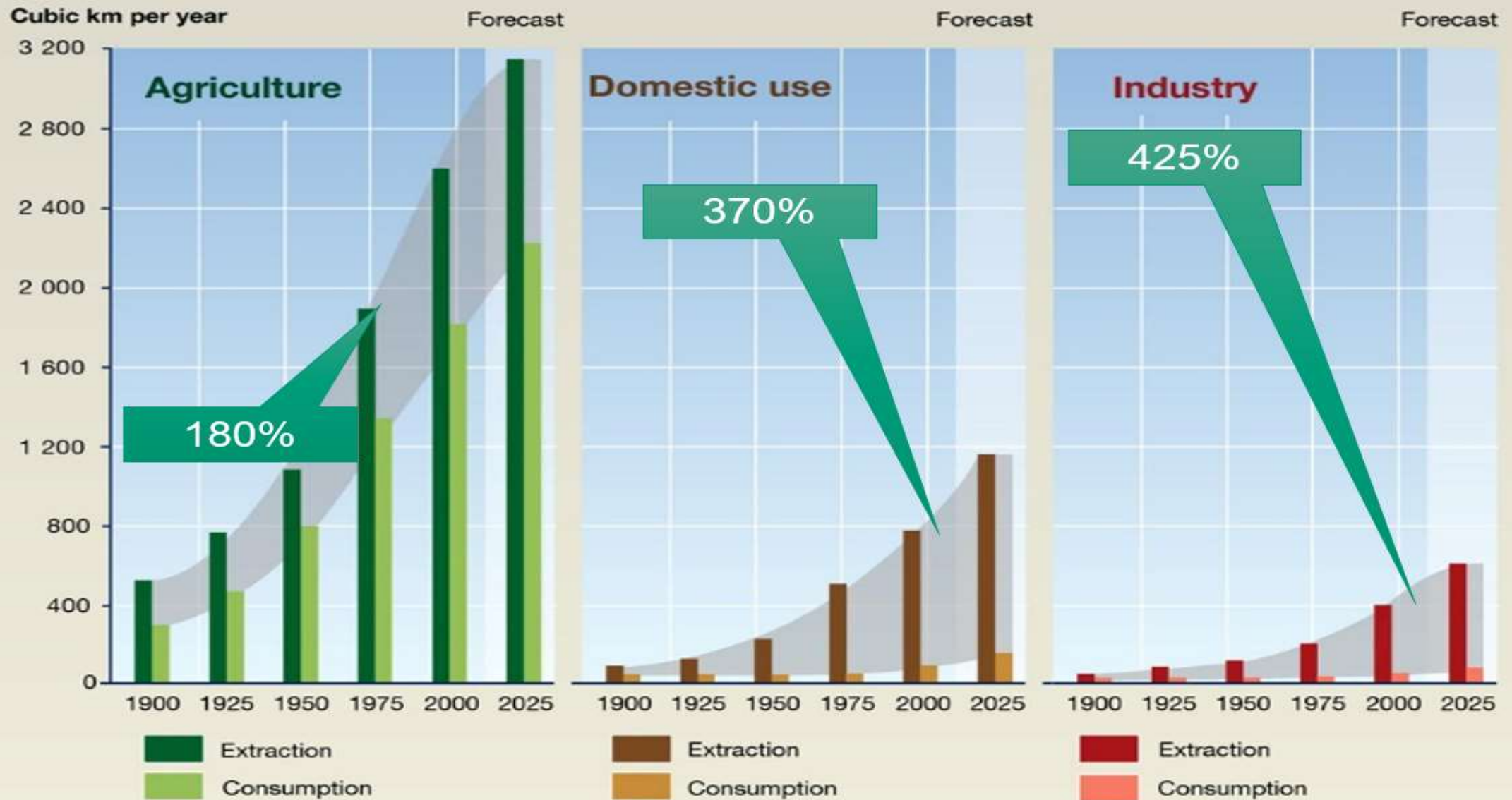


Global Population and Water Demand



Global water withdrawal **increased 1.7 times** faster than world population

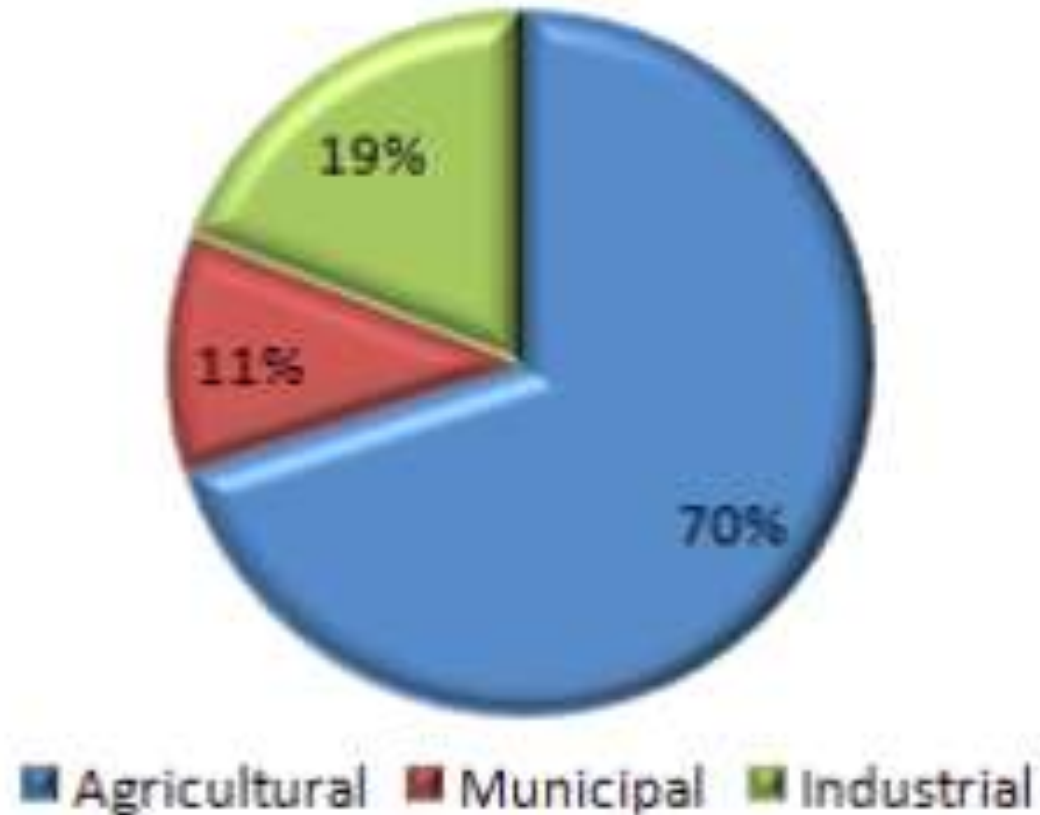
Increase Competition for Water Demand



Adapted from: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg), 2000 and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

Increased Competition for Water Demand

Agriculture
is responsible for an
average of
70 %
of water
withdrawals from surface
and groundwater sources
worldwide



That leaves 30 % for
everything else:

- Domestic
- Industries
- Electricity
- Environment

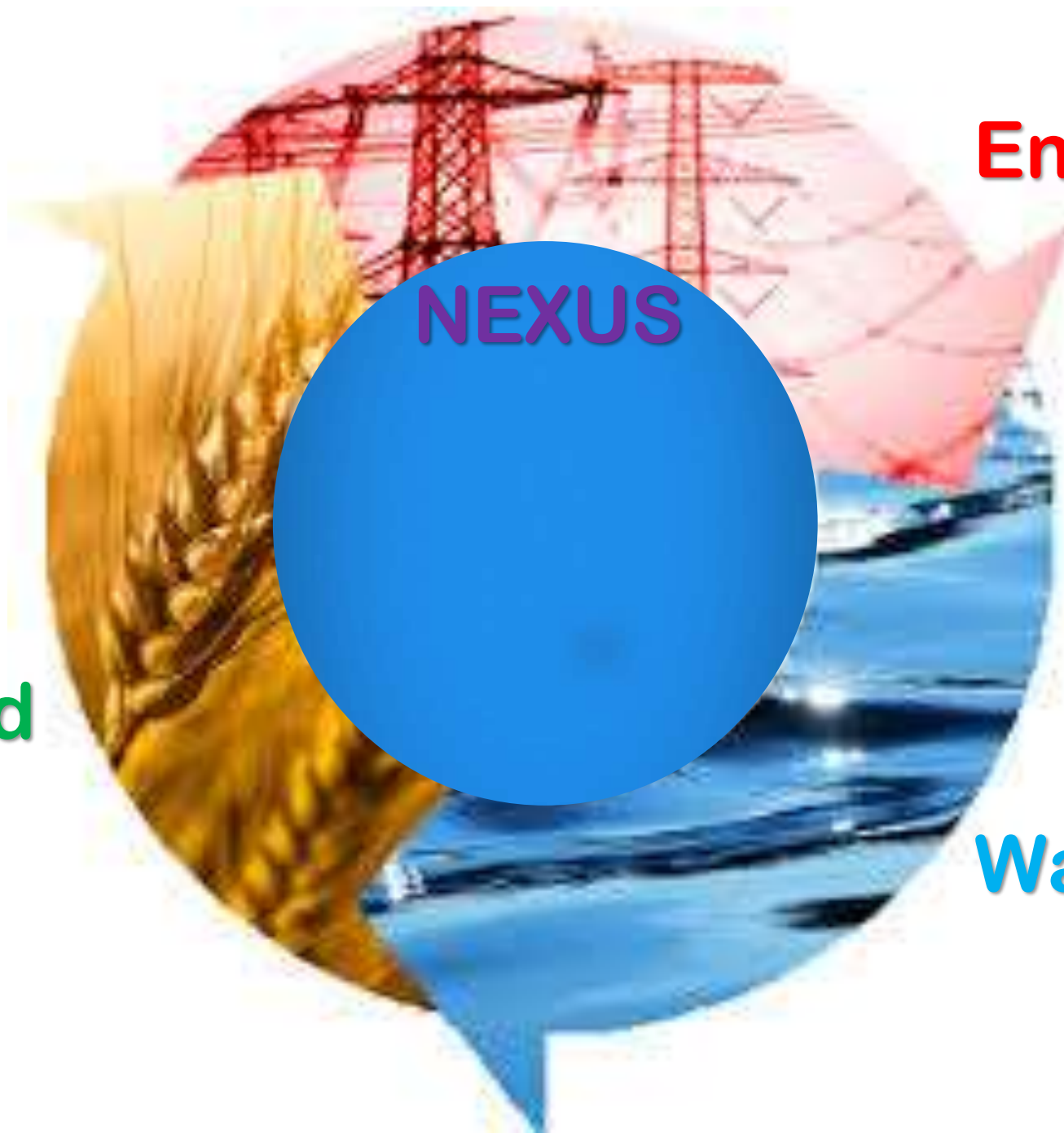
By the year 2030, the following should have been achieved:

- A doubling of global water productivity
- A realisation of the human right to safe drinking water and sanitation
- Increased resilience to water-related disasters
- Increased food production

A closer look at Water-Energy-Food Nexus



Food

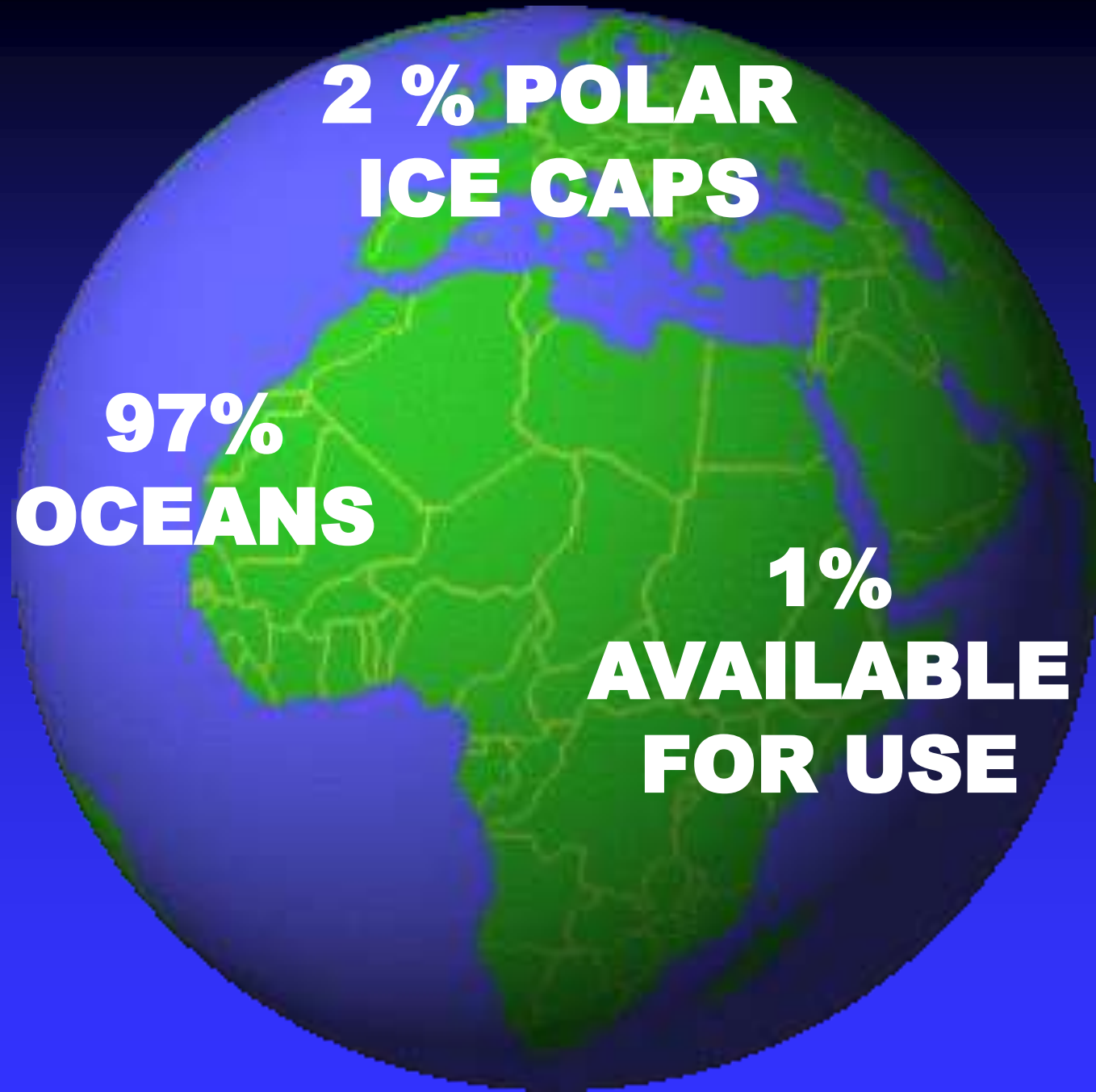


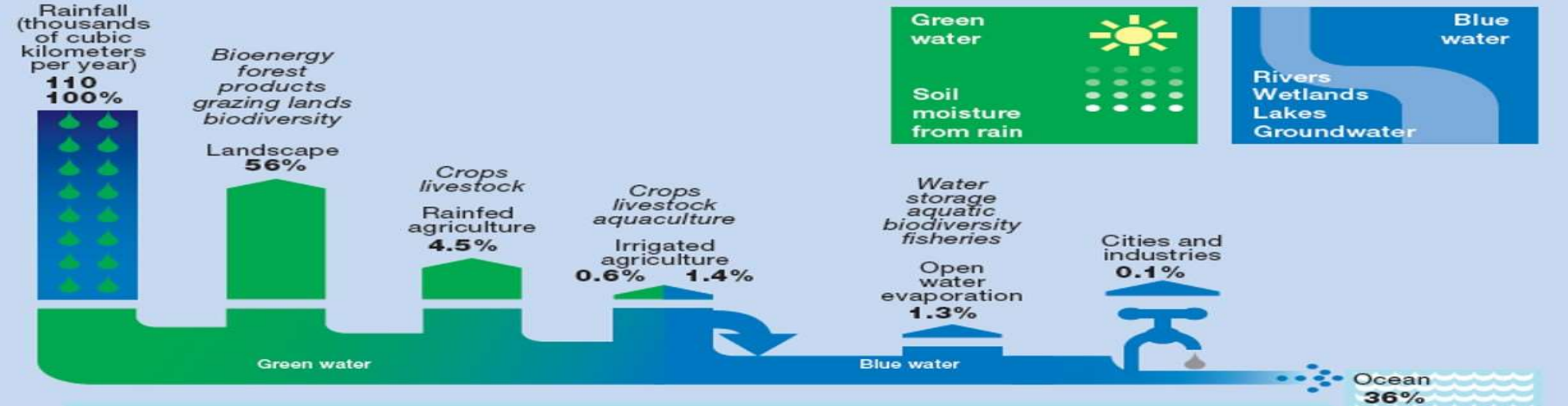
NEXUS

Energy

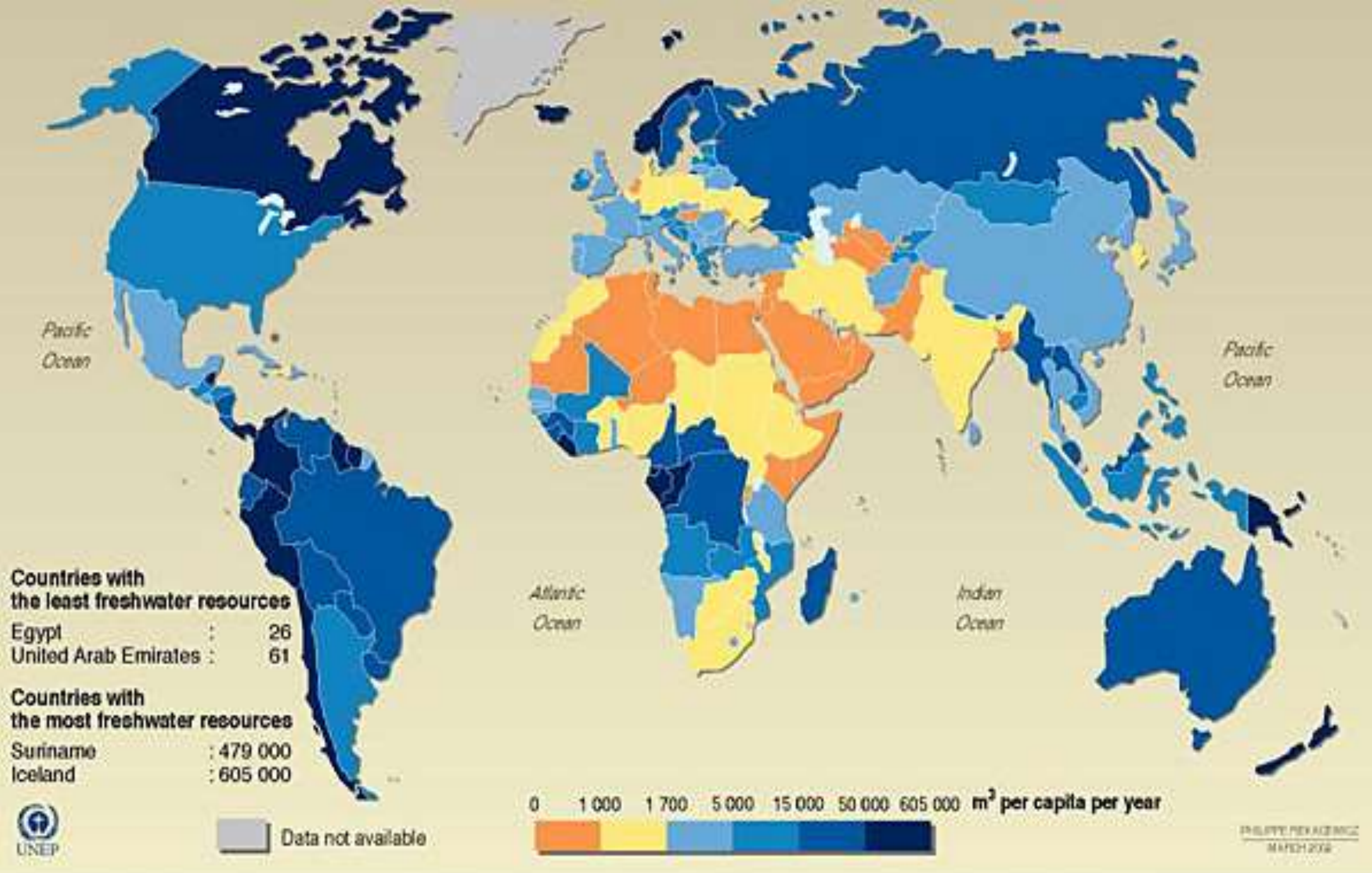
Water

**W
A
T
E
R**





Availability of Fresh water





THDC India Ltd.

International Conference on
**HYDROPOWER AND DAMS DEVELOPMENT FOR WATER AND ENERGY SECURITY –
UNDER CHANGING CLIMATE**



Purposes of dams

Runoff waters are a natural resource for nations and storing water is vital to develop economies.

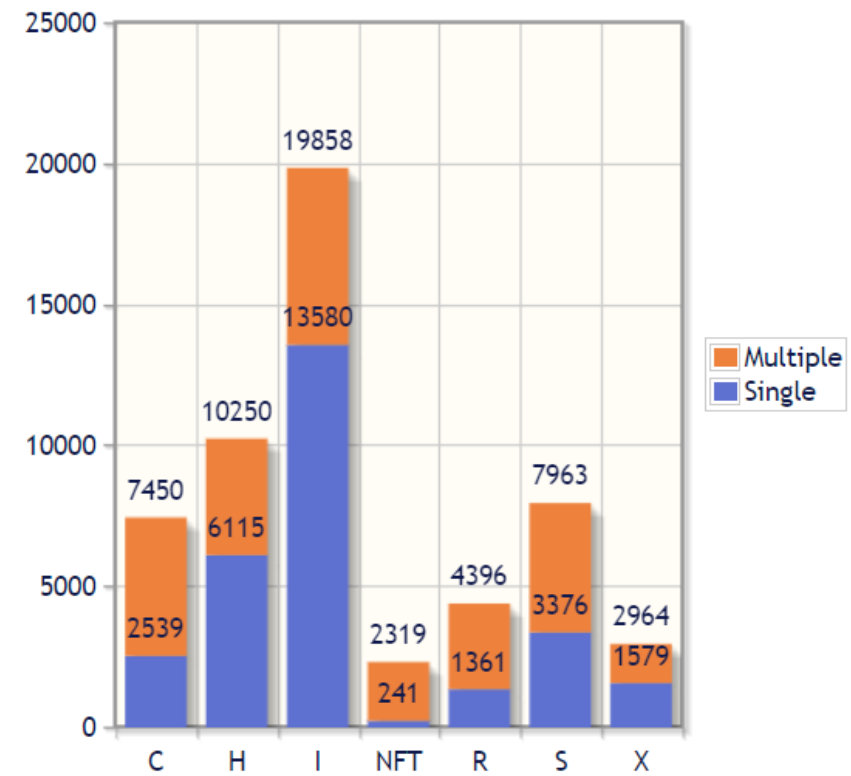
Water reservoirs give largely a guarantee of water supply for irrigation, domestic and industrial use.

With 58 713 dams registered in the world, 13 580 dams are for the sole purpose of irrigation and 6 278 dams with a multiple-purpose that include irrigation.

58 713 registered dams

13 580 dams for irrigation

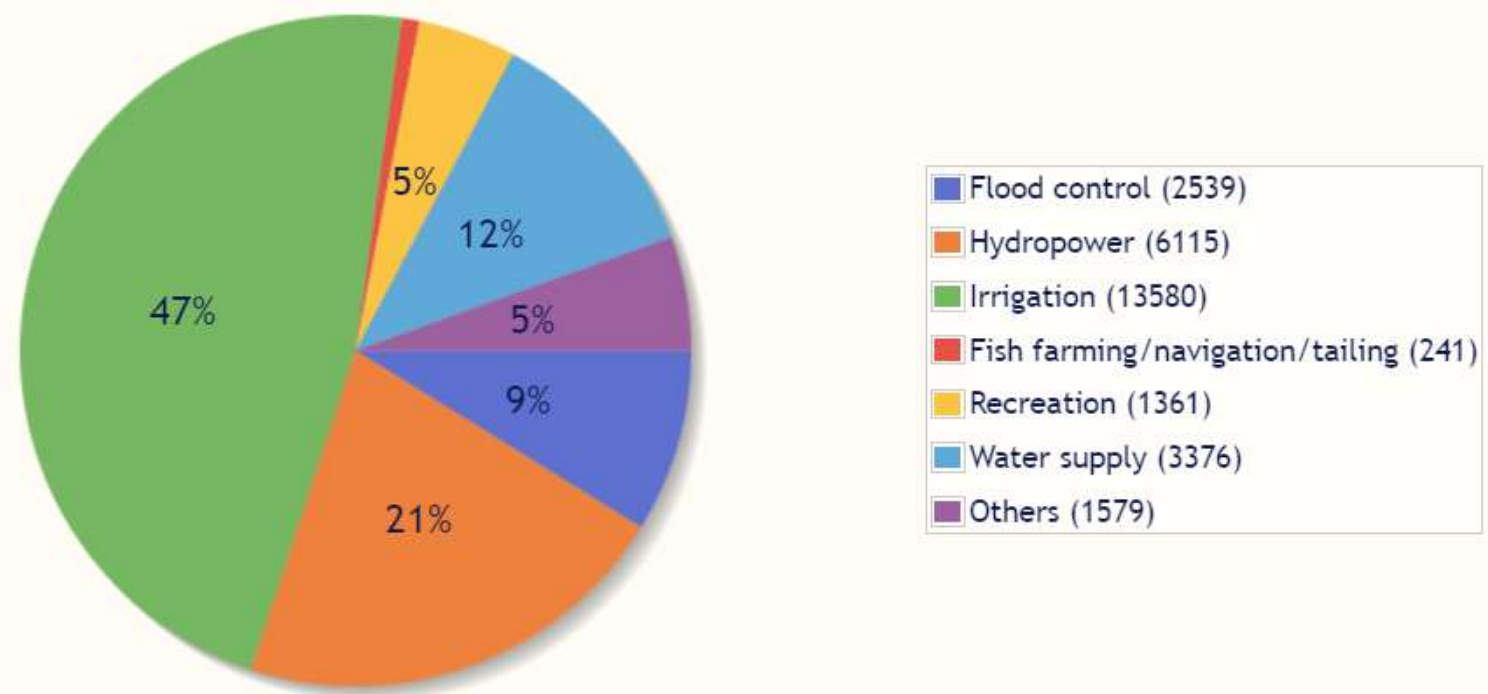
6 278 dams with a multiple-purpose that include irrigation.



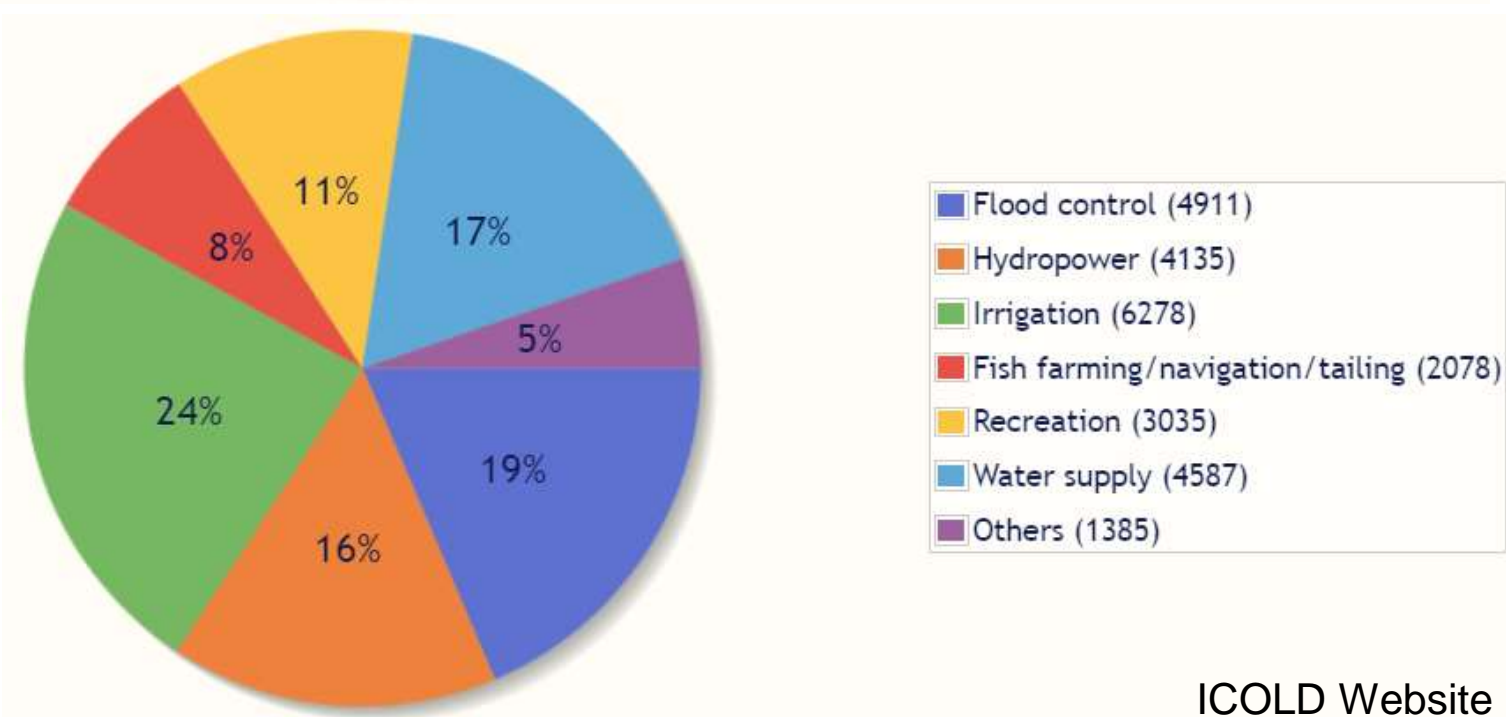
Legend

Code	Description	Dams with this sole purpose	Multiple-purpose dams with this purpose
C	Flood control	2539	4911
F	Fish farming	42	1487
H	Hydropower	6115	4135
I	Irrigation	13580	6278
N	Navigation	96	579
R	Recreation	1361	3035
S	Water supply	3376	4587
T	Tailing	103	12
X	Others	1579	1385

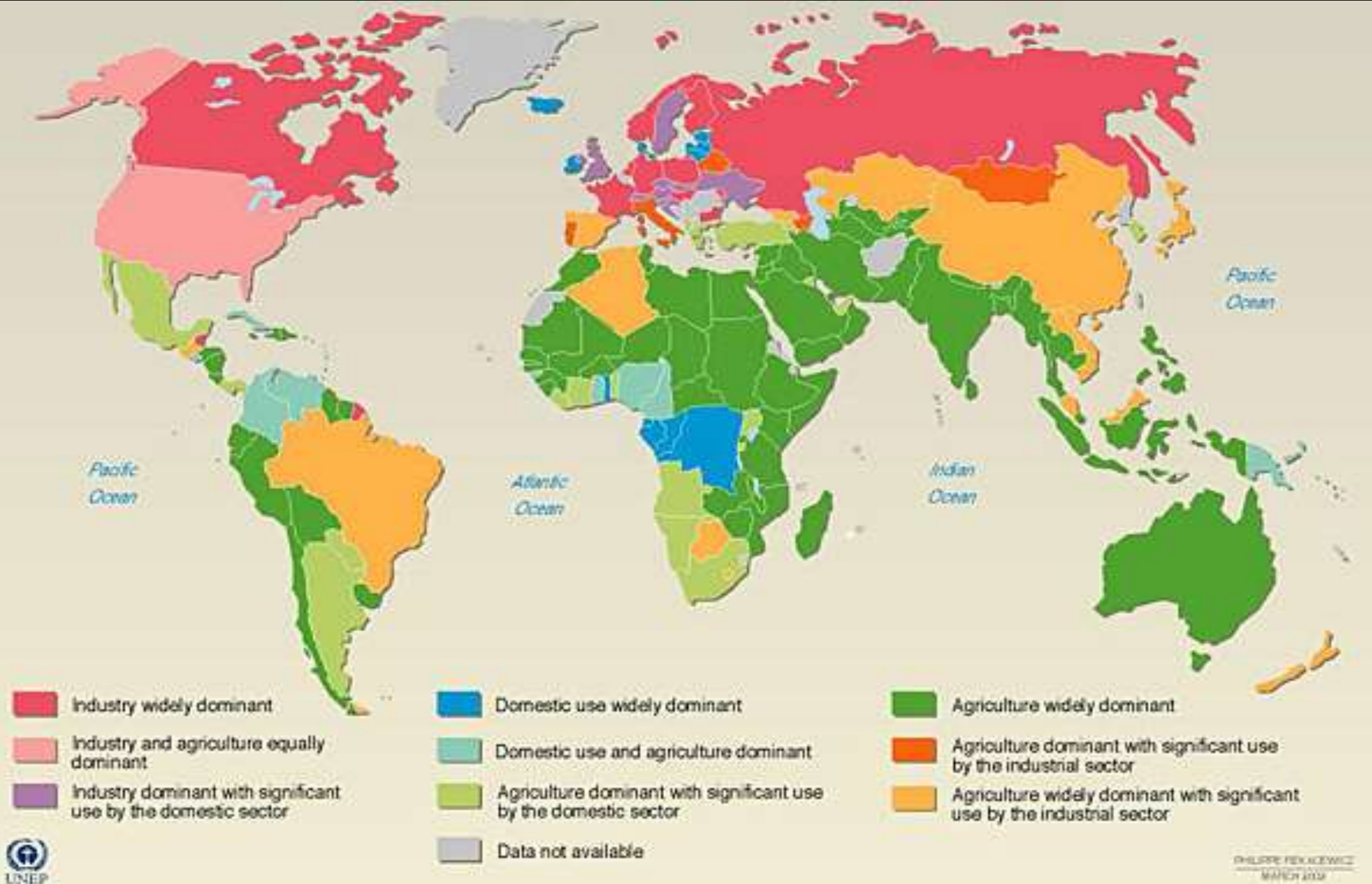
Single - purpose dams:



Multipurposes dams:

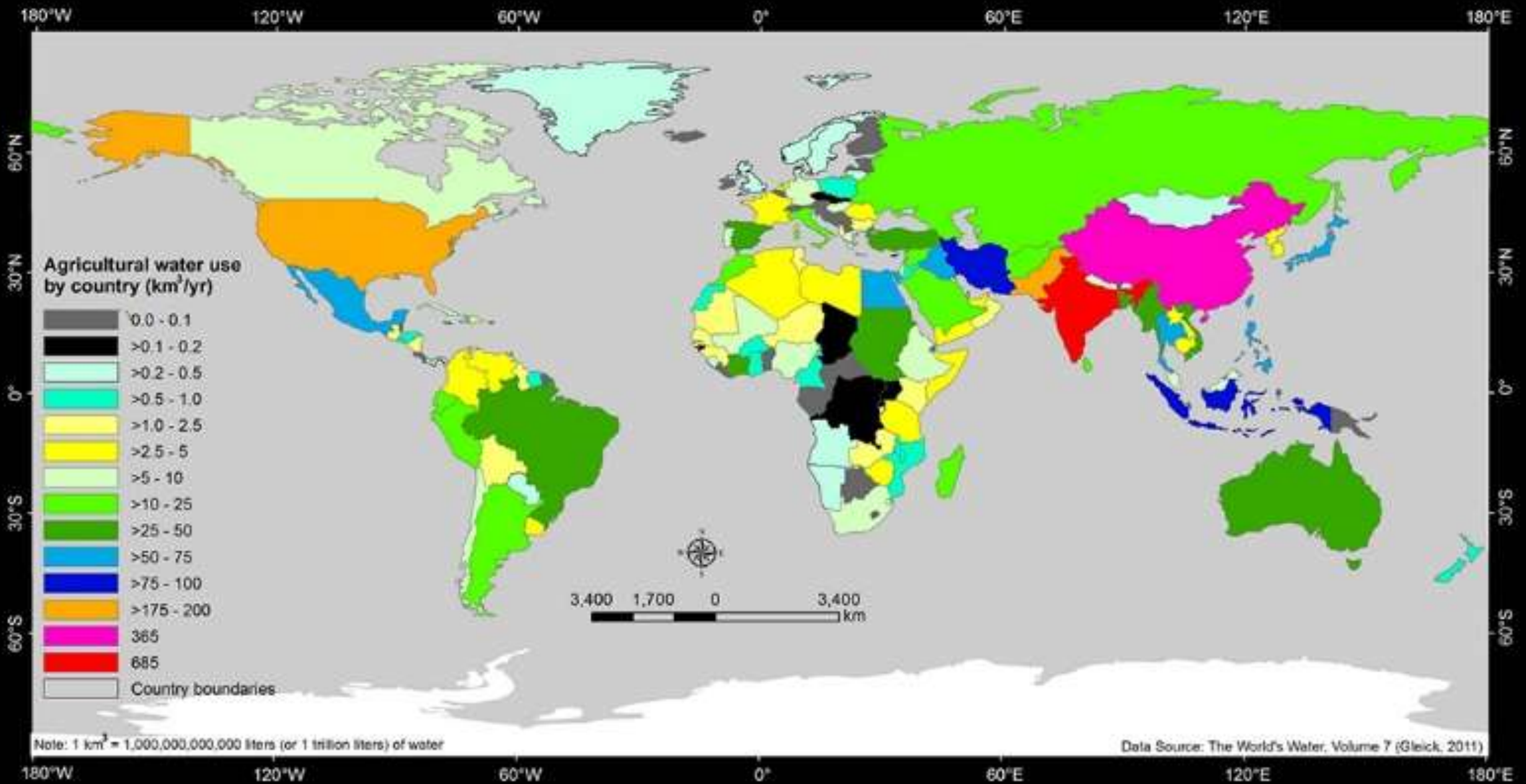


Global Freshwater withdrawal



Source: Based on data from Table FW1 in *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000

Agricultural water use by country



*When the well is dry,
we will know the worth of water*

- Benjamin Franklin



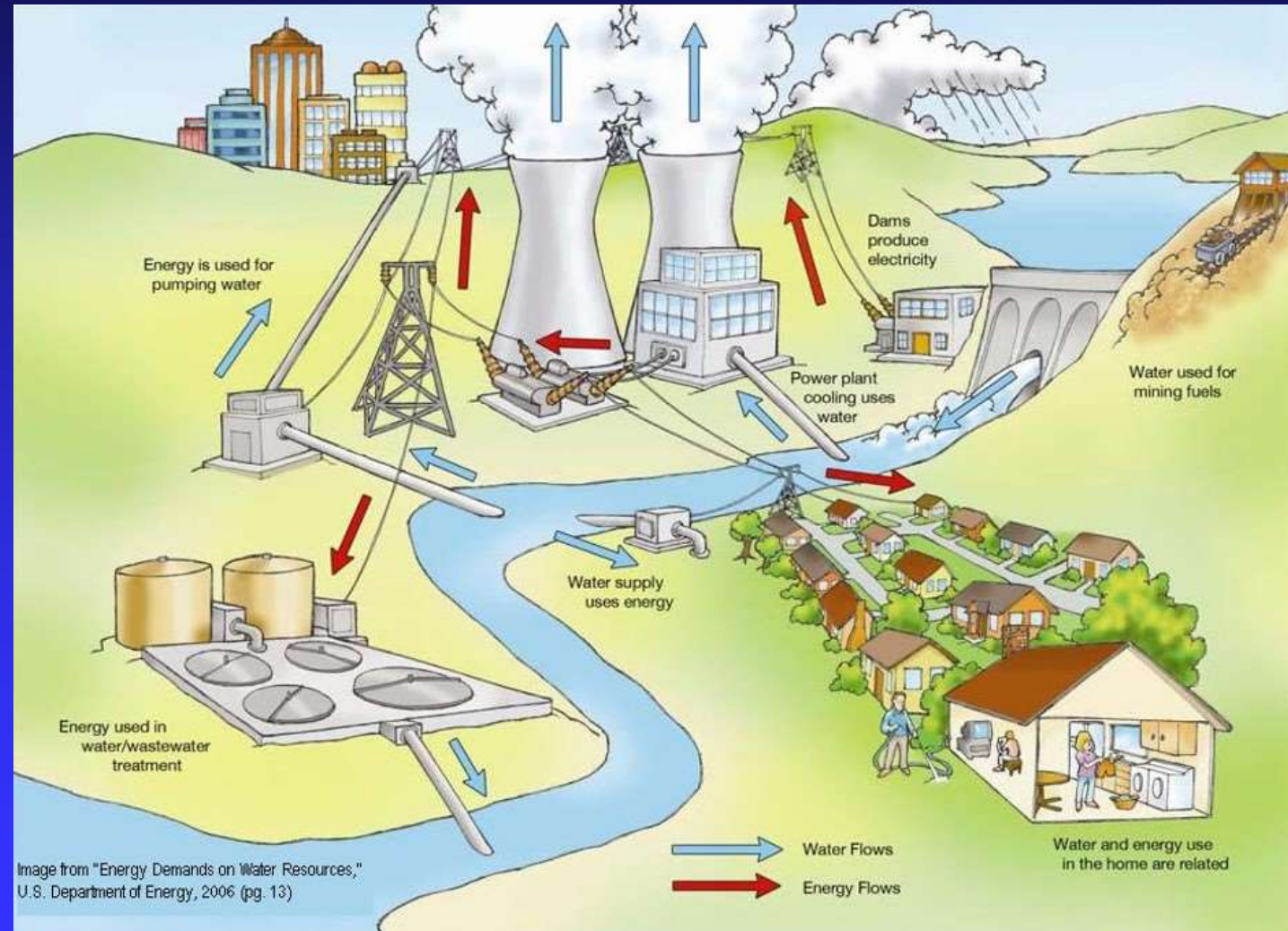
The importance of water:

- **Water is the key to food security**
 - without water, crops simply cannot grow.
- **Water is not just for primary production**
 - it plays a vital role at all stages along the agricultural value chain
- **Water for agriculture connects us all together**
 - In times of scarcity we all have a responsibility to use water wisely, efficiently and productively.

We need to be more ‘water smart’.

Water needs energy

Energy is vital to providing water → needed to power systems that collect, transport and distribute water.

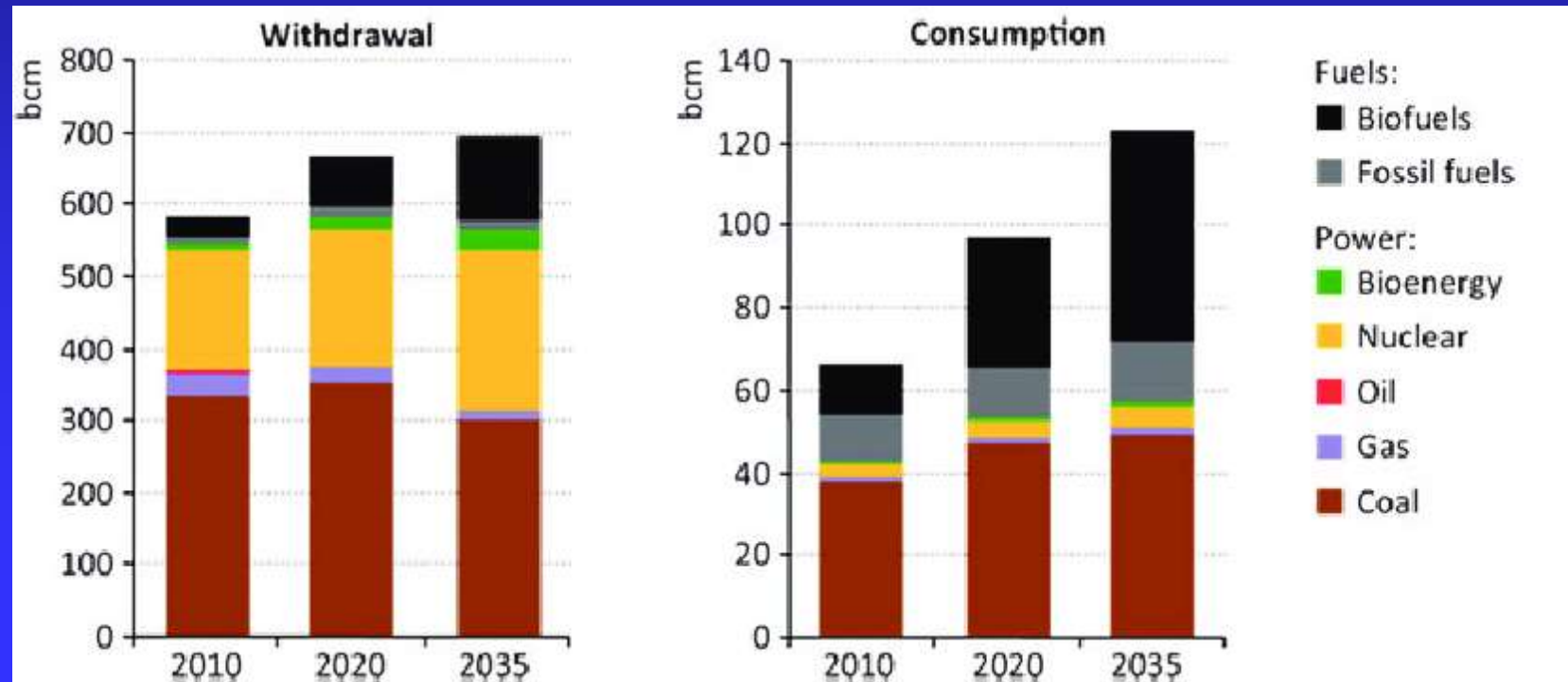


ENERGY



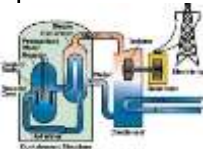





Energy needs water

- Energy production depends on water → some 670 billion cubic metres of freshwater are withdrawn for energy production every year (IEA, 2020)
- Water is used for primary energy production as well as power generation especially for cooling at thermal power plants
- Extraction, transport and processing of fuels and irrigation to grow biomass feed-stock are also water intensive

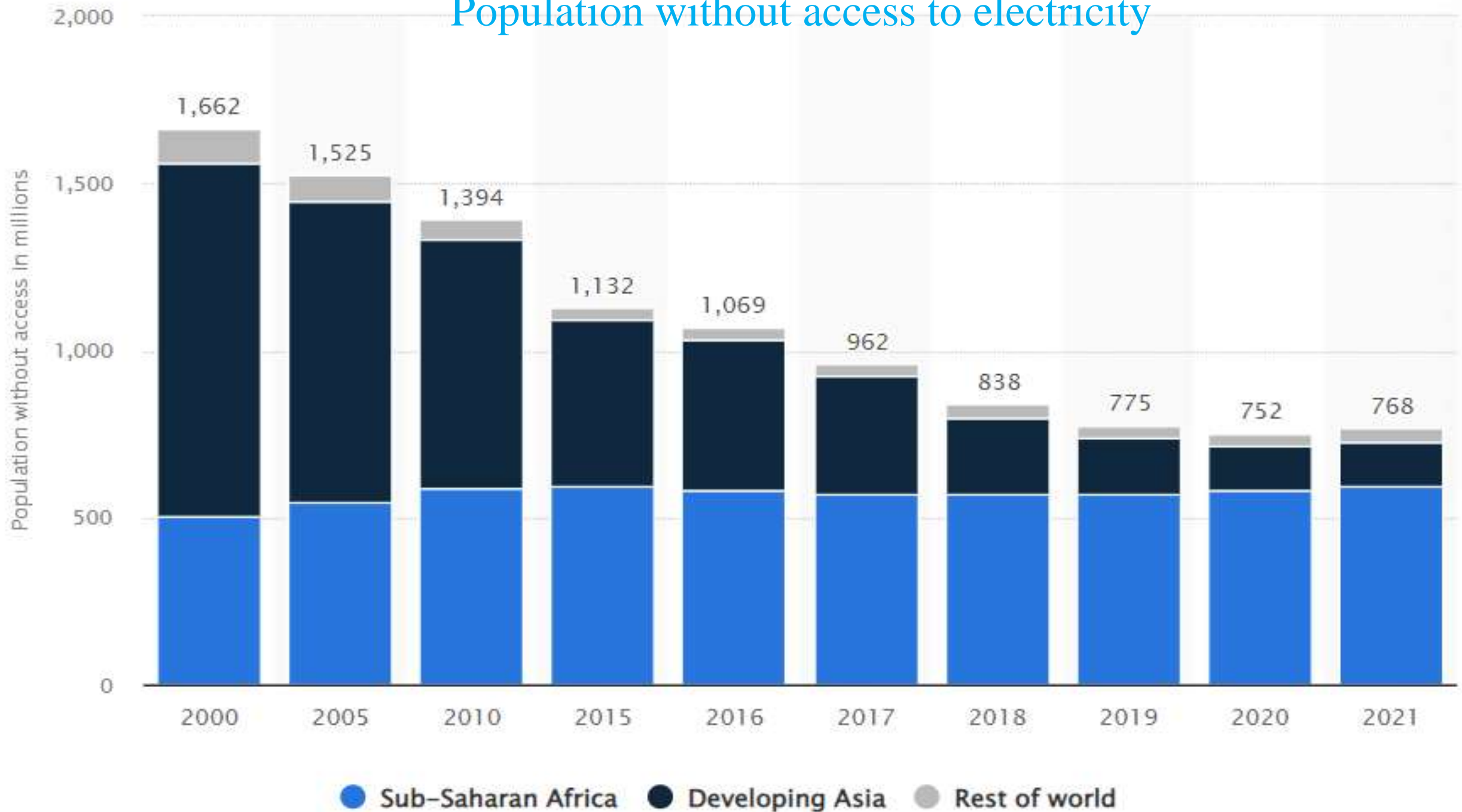


Power Generation

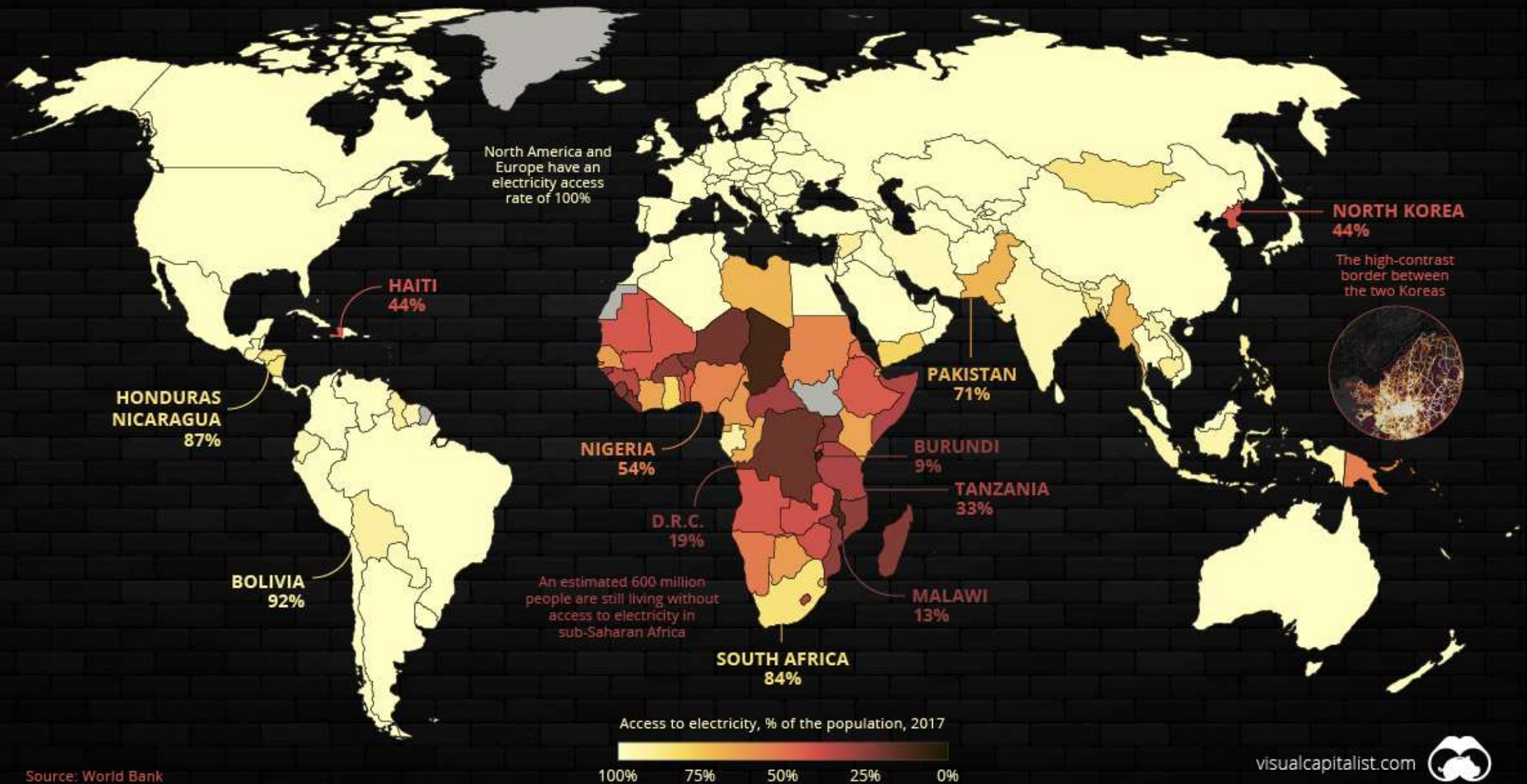
Type	BioMass	Coal	Nuclear	Natural Gas	Solar	Wind
						
Water Impact	Moderate	High	High	High	Low	Low

Fuels	Description
Oil and gas	Drilling, well completion and hydraulic fracturing; injection into the reservoir in secondary and enhanced oil recovery; oil sands mining and in-situ recovery; upgrading and refining into products.
Coal	Cutting and dust suppression in mining and hauling; washing to improve coal quality; re-vegetation of surface mines; long-distance transport via coal slurry.
Biofuels	Irrigation for feedstock crop growth; wet milling, washing and cooling in the fuel conversion process.

Population without access to electricity



GLOBAL ACCESS TO ELECTRICITY



Examples of energy savings

- LEPA: Low energy precision application systems
- Utilising of low pressure drip irrigation technologies
- Improved Irrigation scheduling

F
O
O
D



Do we have sufficient biomass for
food production?

Challenges

Demand for food

- 1 billion people are threatened by hunger
- 2 billion people can not afford healthy diet

Additional drivers

- +population increase
- +additional demand for food
due to increased income

Food production need to increase

- +42% until 2030
- + 70% until 2050

What is food security?

There are many different definitions of food security.

The definition frequently used as defined at the
World Food Summit of 1996:

Food security is existing when all people at all times have
access to sufficient, safe, nutritious food to maintain
a healthy and active life.



Cultivated Land Worldwide

- 1 533 Mha – Total world Agriculture Area
- 300 Mha – Currently under Irrigation

20% of total agricultural land area supplies about **40%** of the world's food

- 18 Mha - Drip irrigated

Crop productivity values:
- Rain fed 30% of Irrigation



18 Mha 1.3%

300 Mha 19.6%



ICID-CIID

Source: ICID - CIID

Per capita food production

Calculated as: $\text{total production} / \text{population}$

Growing, but not as rapidly as total production

Annual growth rates:

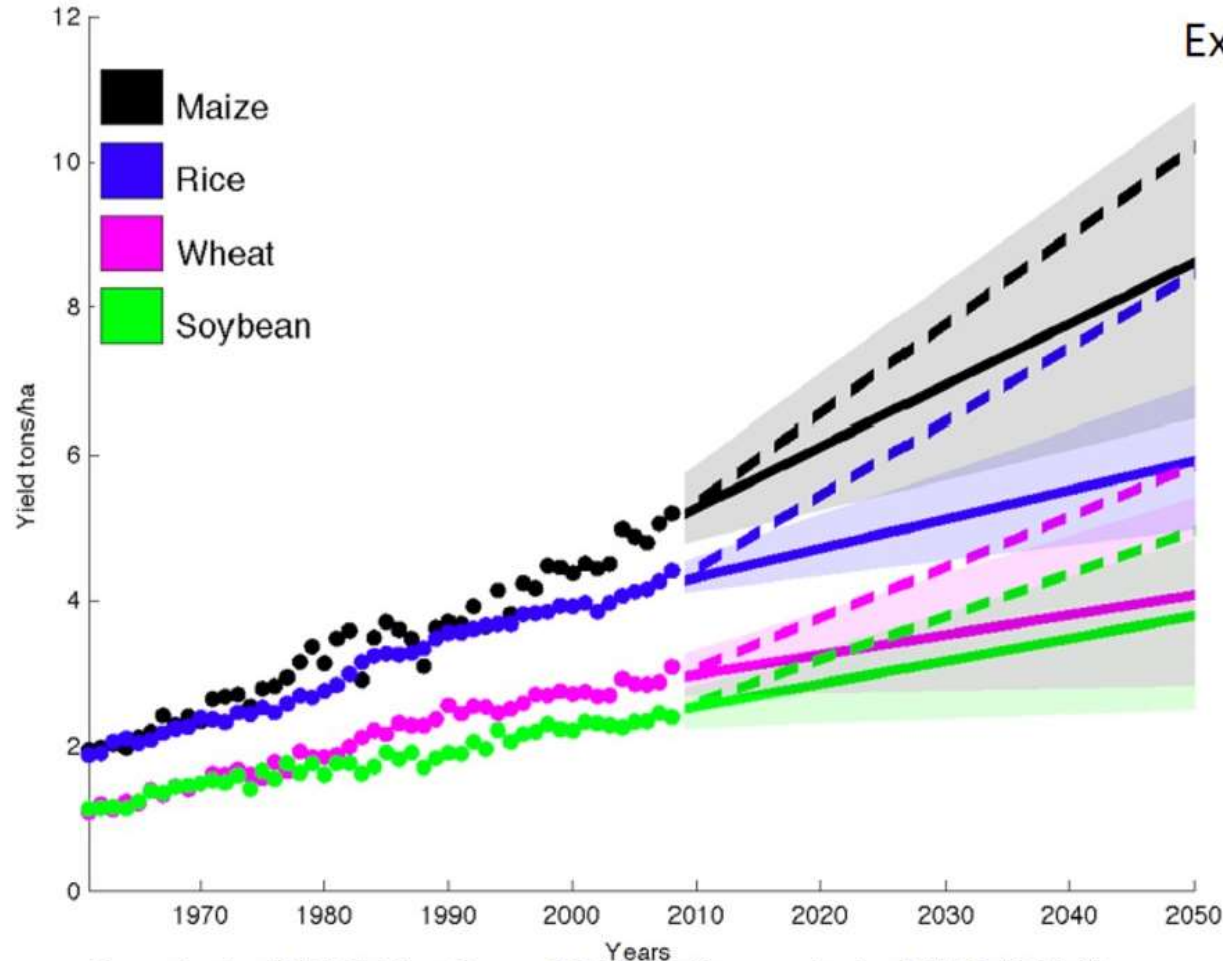
1950s: 1.4%

1960s: 0.8%

1970s: 0.4%

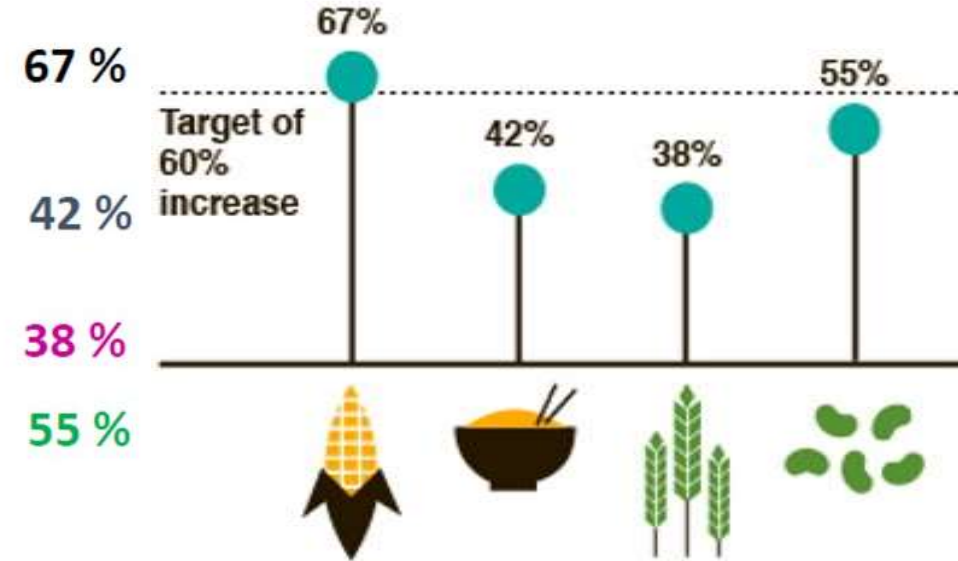
1980s: 0.4% ... and holding steady

What is needed to sustain food production?



Ray et al., (2013) PlosOne e66428; Tilman et al., PNAS (2011)

Expected increase
(2050)



Annual increase rates need to double

Game-changing solutions are needed to produce „more with less“

Health and Safety



Water dependant

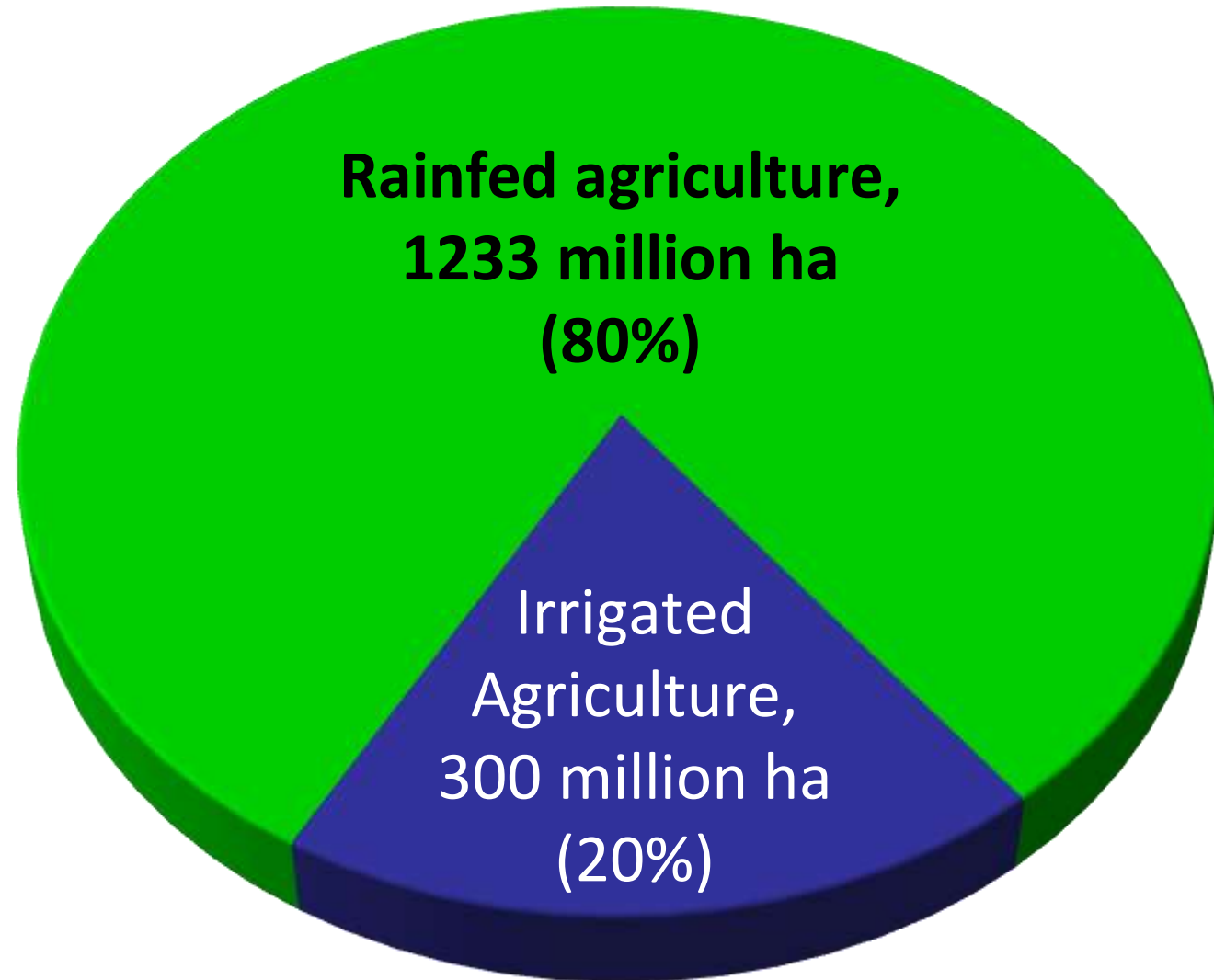
**Rainfed
agriculture
1233 million ha**



**Irrigated
Agriculture
300 million ha**



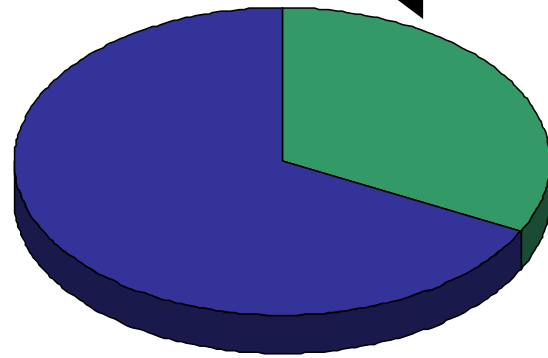
Global irrigated area



World-wide Coverage of Irrigation

Total irrigated area = 300 Mha

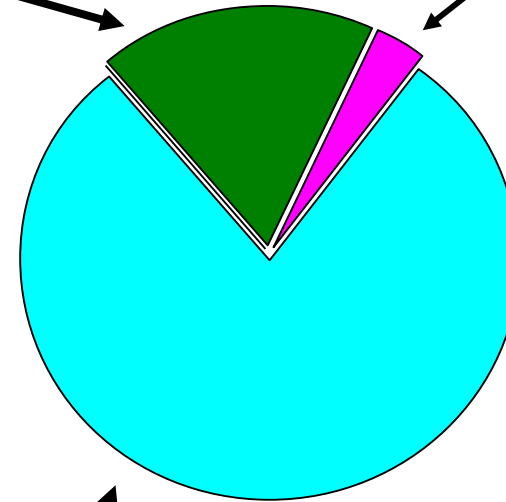
Rice irrigated Area
102 Mha, 34 %



Irrigated area of other crops
198 Mha, 66 %

Sprinkler,
38 Mha, 12,7%

Micro irrigation,
20 Mha, 6,7%



Gravity irrigation,
242 Mha, 80,7%





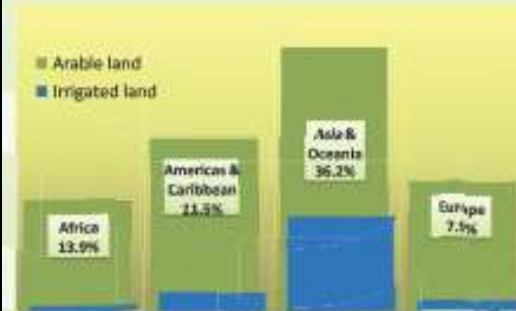
ICID-CIID

World Irrigation Scenario

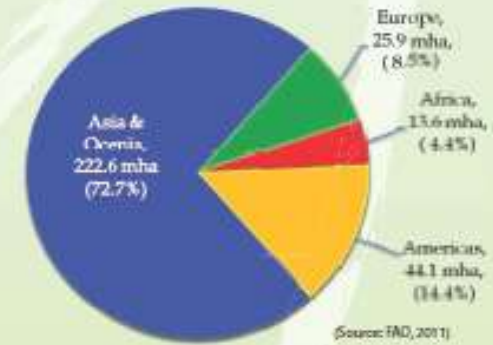
World irrigated area (million ha)



Irrigated area as percentage of arable land



Regional spread of irrigated area



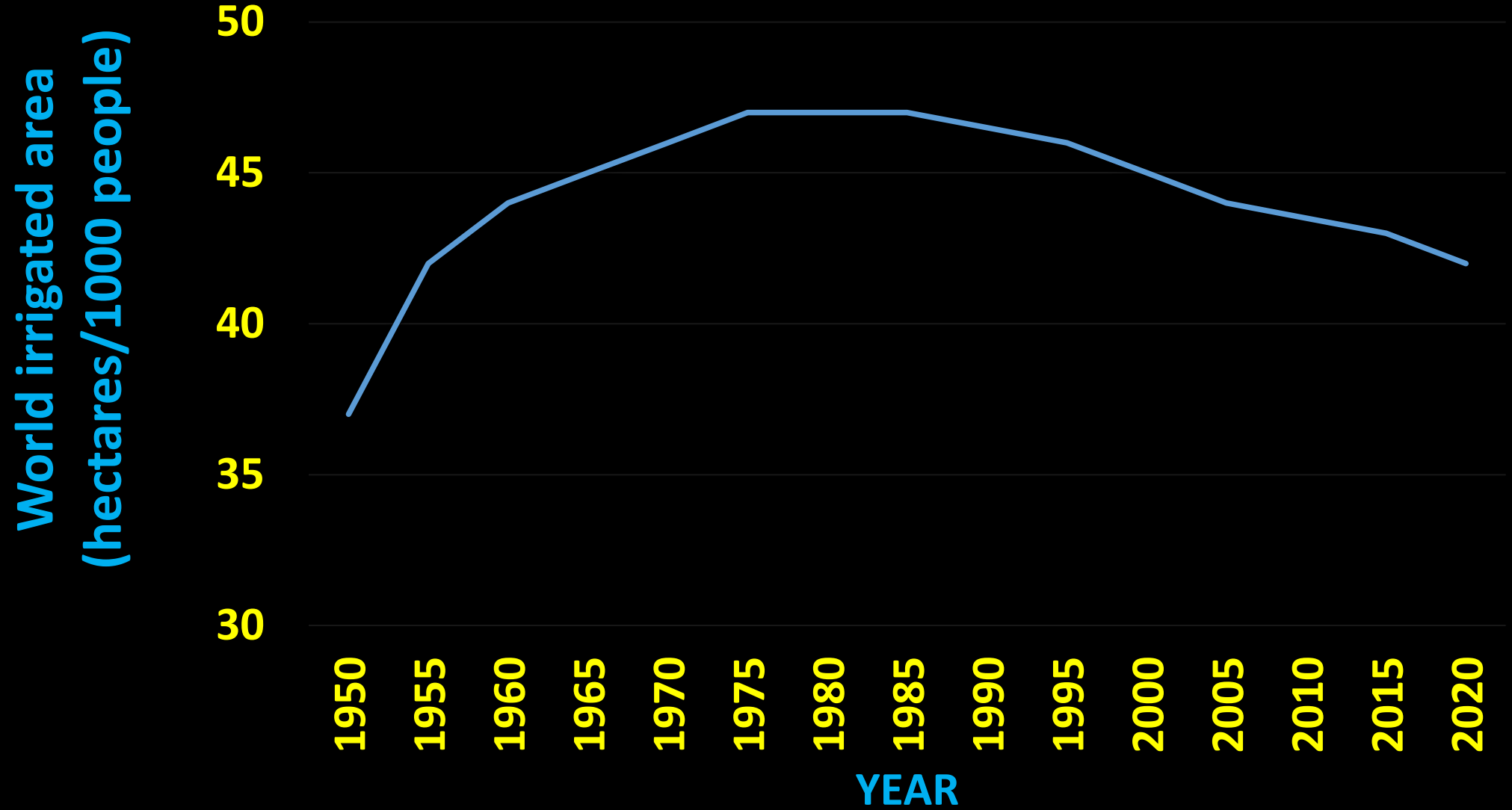
Irrigated area (million ha) - Top ten countries



World irrigated area (Hectares/ 1000 people)



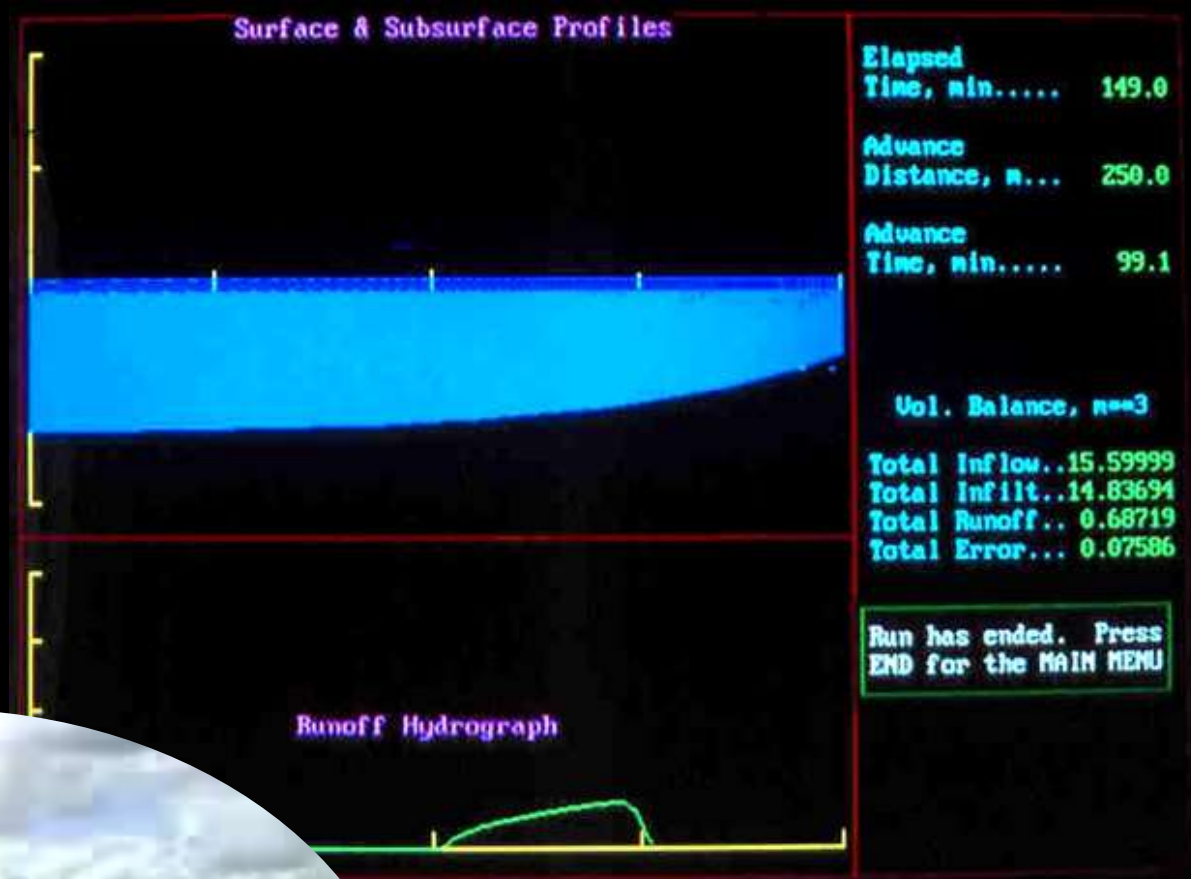
World irrigation scenario







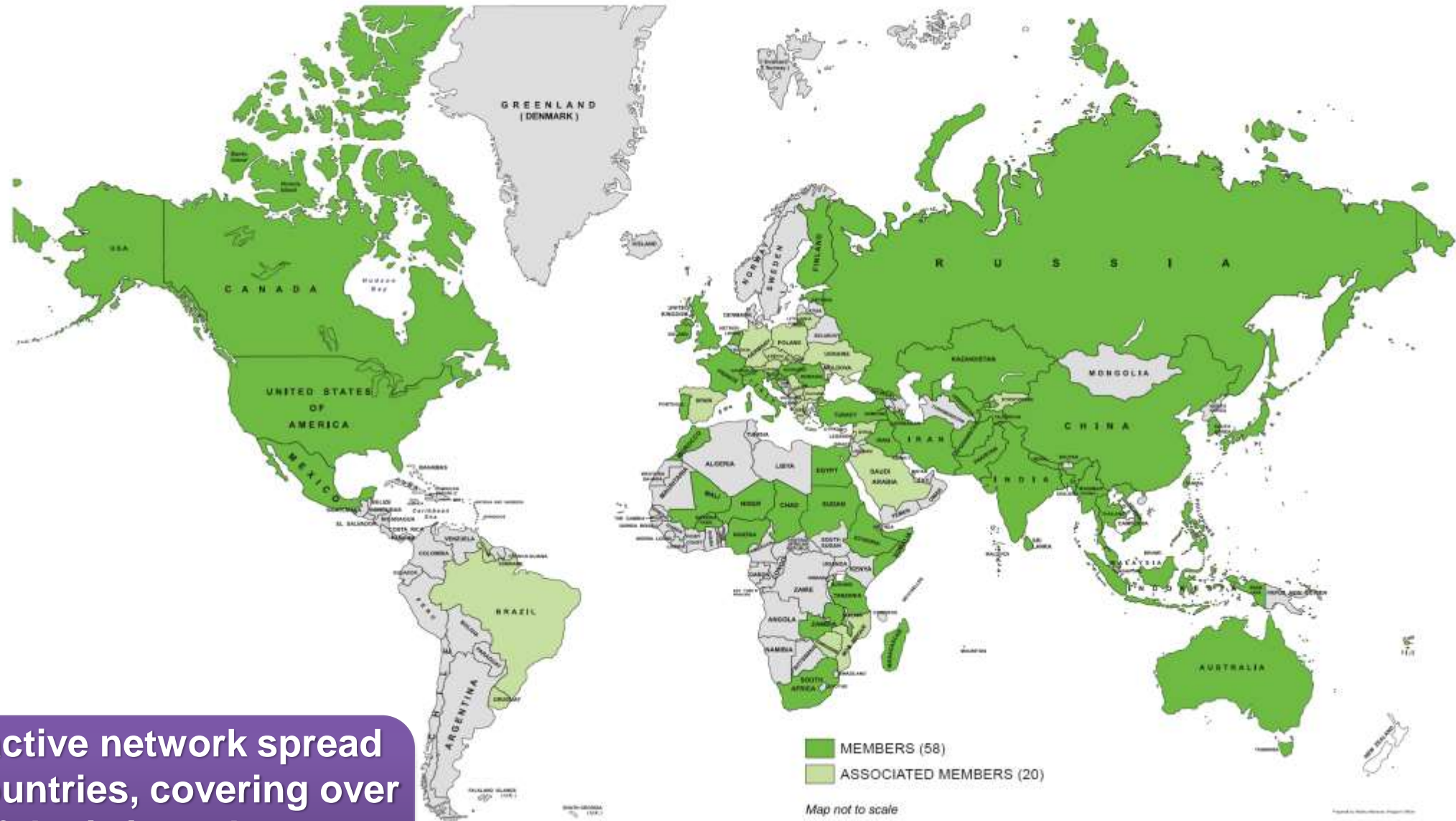




International Commission on Irrigation and Drainage



ICID Membership Network 2022



Present active network spread over 80 countries, covering over 95% of the irrigated area of the world



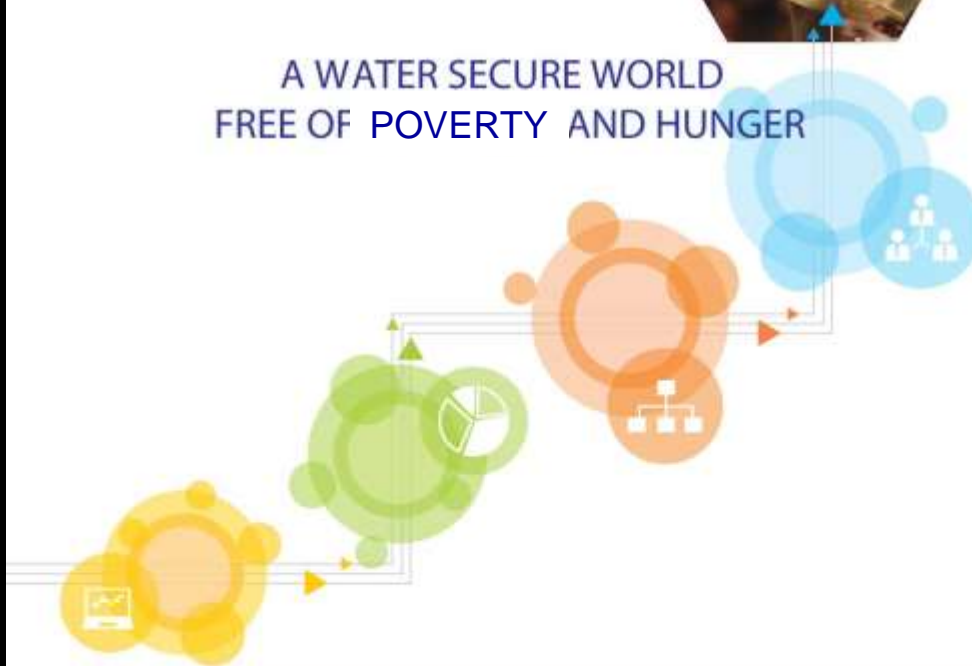
ICID•CIID

<http://www.icid.org/nc1.php>

A ROAD MAP TO **ICID VISION 2030**



A WATER SECURE WORLD
FREE OF POVERTY AND HUNGER



ICID • CIID

INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE

Roadmap to ICID Vision 2030



Vision

Water secure world free of poverty and hunger through sustainable rural development

Mission

Working together towards sustainable agriculture water management through interdisciplinary approaches to economically viable, socially acceptable and environmentally sound irrigation, drainage and flood management



Roadmap to ICID Vision 2030

Organisation Goals



Goals

- 1** Enable higher crop productivity with less water and energy
- 2** Be a catalyst for change in policies and practices
- 3** Facilitate exchange of information, knowledge and technology
- 4** Enable cross disciplinary and inter-sectoral engagement
- 5** Encourage research & support development of tools to extend innovation into field practices
- 6** Facilitate capacity development

Action Plan

Strategies to achieve goals

Goal A: Enable higher crop productivity with less water and energy

Strategies

- A1 : Modernization of irrigation systems
- A2 : Improving O&M of Irrigation Systems
- A3 : Implementing water saving techniques and technologies
- A4 : Promoting Institutional Reforms
- A5 : Supporting water productivity enhancement
- A6 : Improving performance of irrigation systems
- A7 : Using wastewater or poor quality water for irrigation
- A8 : Encouraging participatory management of irrigation systems



Challenges in Energy



In times of scarcity we all have a responsibility to use water wisely, efficiently and productively.



**By the year 2030,
the following should have been achieved:**

- **A doubling of global water productivity**
- **Increased efficiency and water saving from 60% - 95%**
- **Increased food production**
- **Increased and intensified production;**
- **Reducing of risk;**
- **Diversified production;**
- **Renewed/sustained natural resources..**

We must continue to:

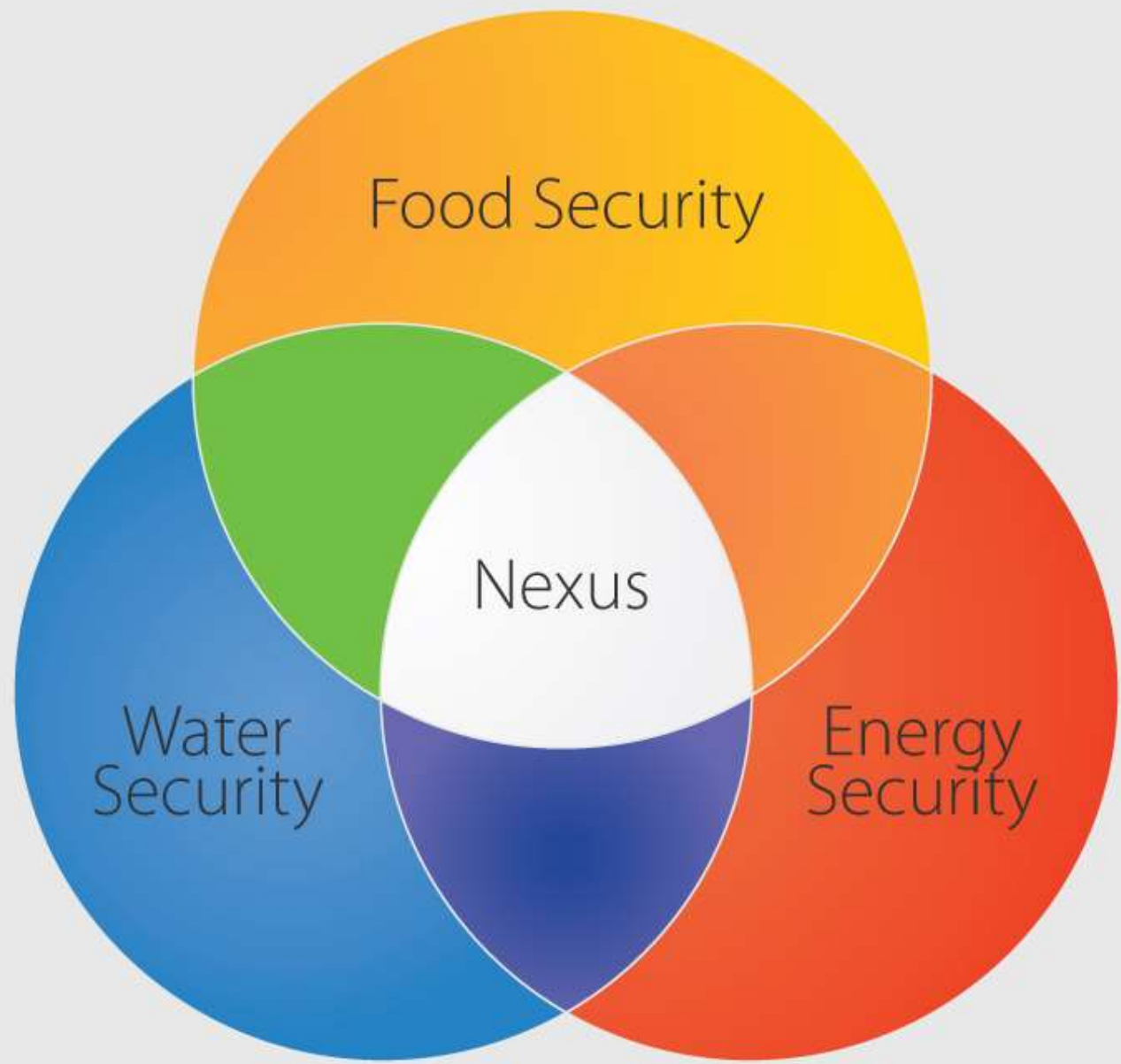
1. Modernize irrigation systems
2. Improve O&M of Irrigation Systems
3. Implement water saving techniques and technologies
4. Promote Institutional Reforms
5. Support water productivity enhancement
6. Improve performance of irrigation systems
7. Use wastewater or poor quality water for irrigation
8. Encourage participatory management of irrigation systems



The importance of water:

- **Water is the key to food security**
- **Water is not just for primary production**
- **Water for agriculture connects us all together**
 - **In times of scarcity we all have a responsibility to use water wisely, efficiently and productively.**

We need to be more ‘water smart’.



Water-Energy-Food Nexus

- Moving towards a Green and Bio-economy for sustainability
- Water efficiency: from 60% - 95%
- Energy efficiency: from high to low use, bio energy, **limit wasteful transport of foods**
- Food efficiency: stop wastage of 30 – 40%; it saves water and energy
- Apply technology to improve food production

Importance of water



Thank you

