Water and Irrigation: Impact on Food security

Felix Reinders

President ICID

INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE

ARC • LNR-AGRICULTURAL ENGINEERING, South Africa

ICID·CIID

Water and Irrigation: Impact on Food security

Felix Reinders

President ICID

INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE

ARC • LNR-AGRICULTURAL ENGINEERING, South Africa

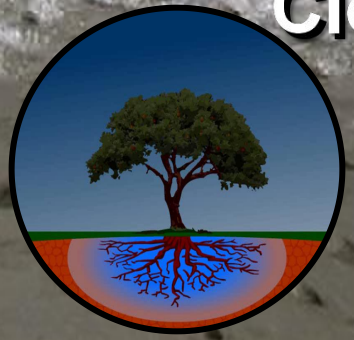
Introduction

International

Irrigation

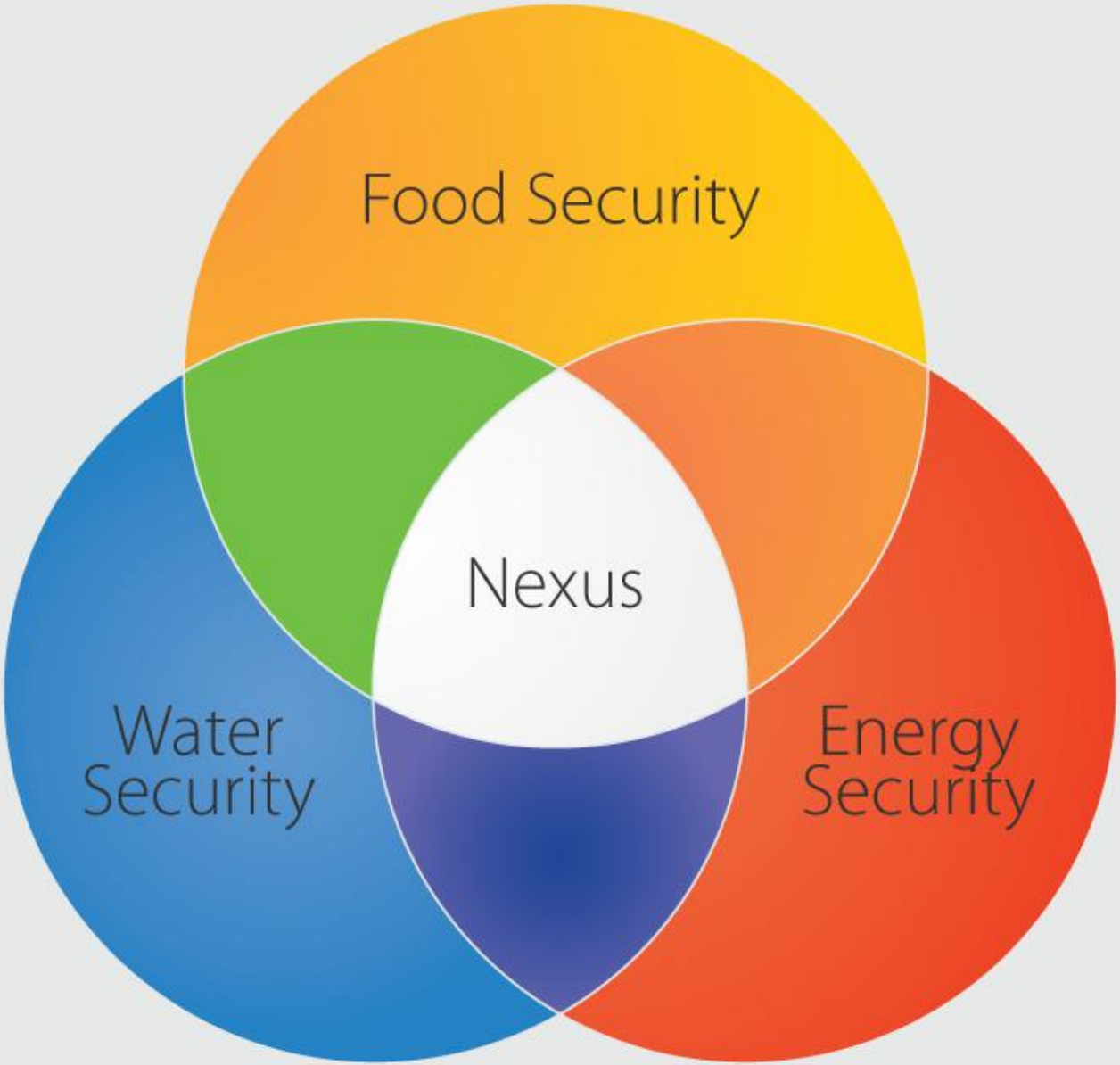
Food security

Closure

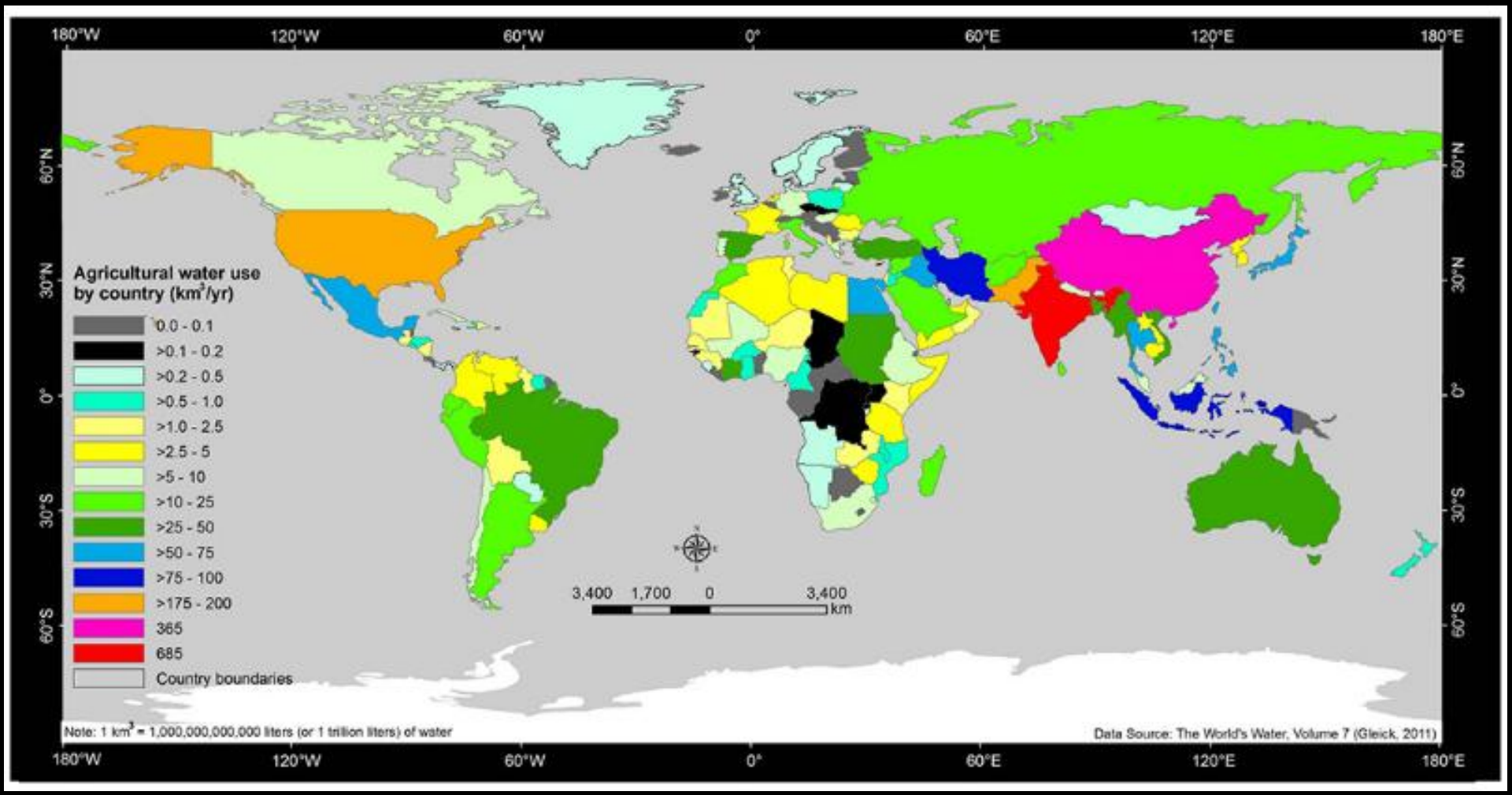


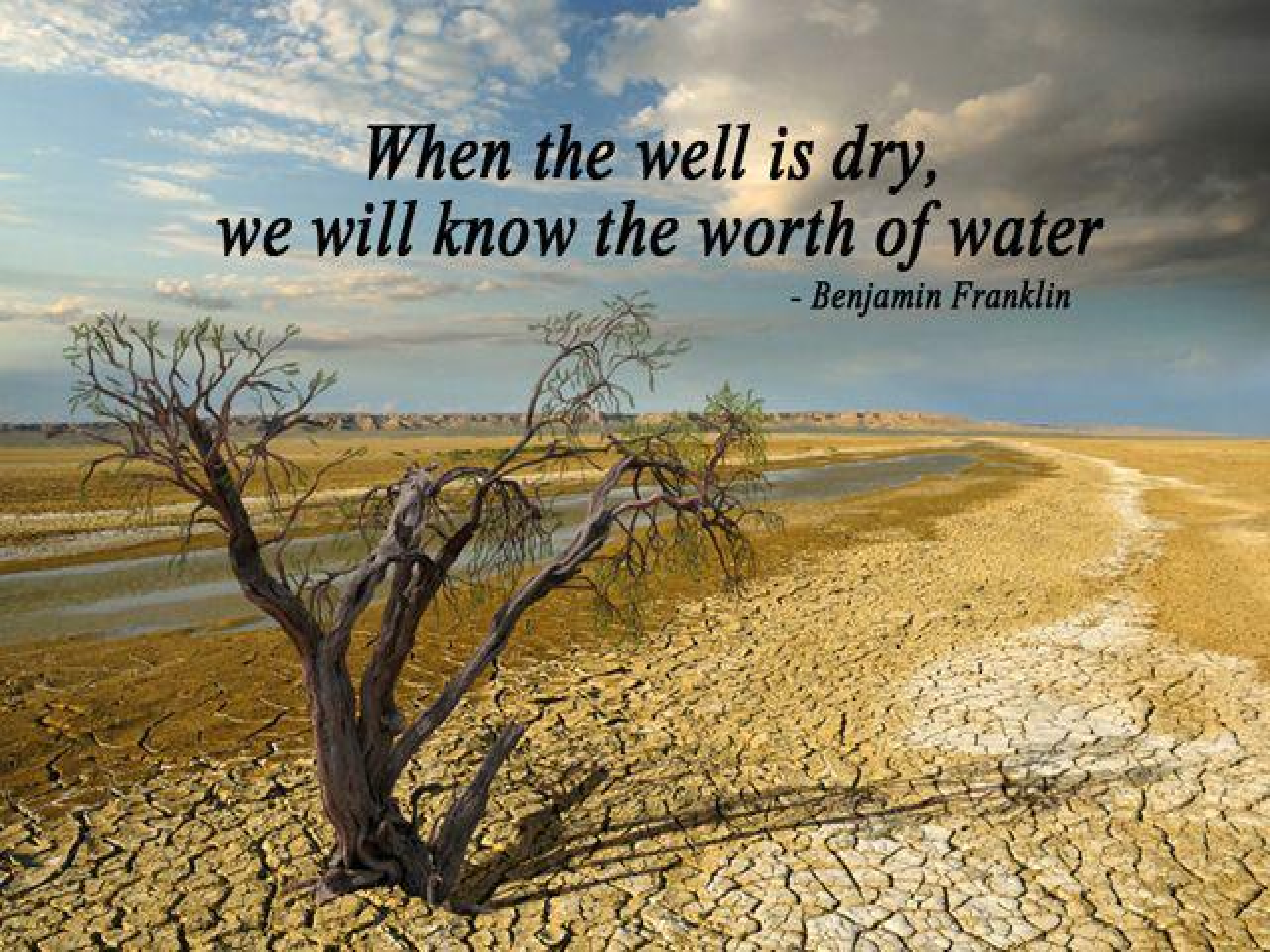
Introduction


Research
Companies
Producers


Food Security
Nexus
Water Security
Energy Security


Water


180°W
120°W
60°W
0°
60°E
120°E
180°E
60°N
30°N
0°
30°S
60°S
Agricultural water use by country (km³/yr)
0.0 - 0.1
>0.1 - 0.2
>0.2 - 0.5
>0.5 - 1.0
>1.0 - 2.5
>2.5 - 5
>5 - 10
>10 - 25
>25 - 50
>50 - 75
>75 - 100
>175 - 200
365
685
Country boundaries
3,400 1,700 0 3,400
km
Note: 1 km³ = 1,000,000,000,000 liters (or 1 trillion liters) of water
Data Source: The World's Water, Volume 7 (Gleick, 2011)


When the well is dry,
we will know the worth of water
- Benjamin Franklin

Two thirds of the world's population

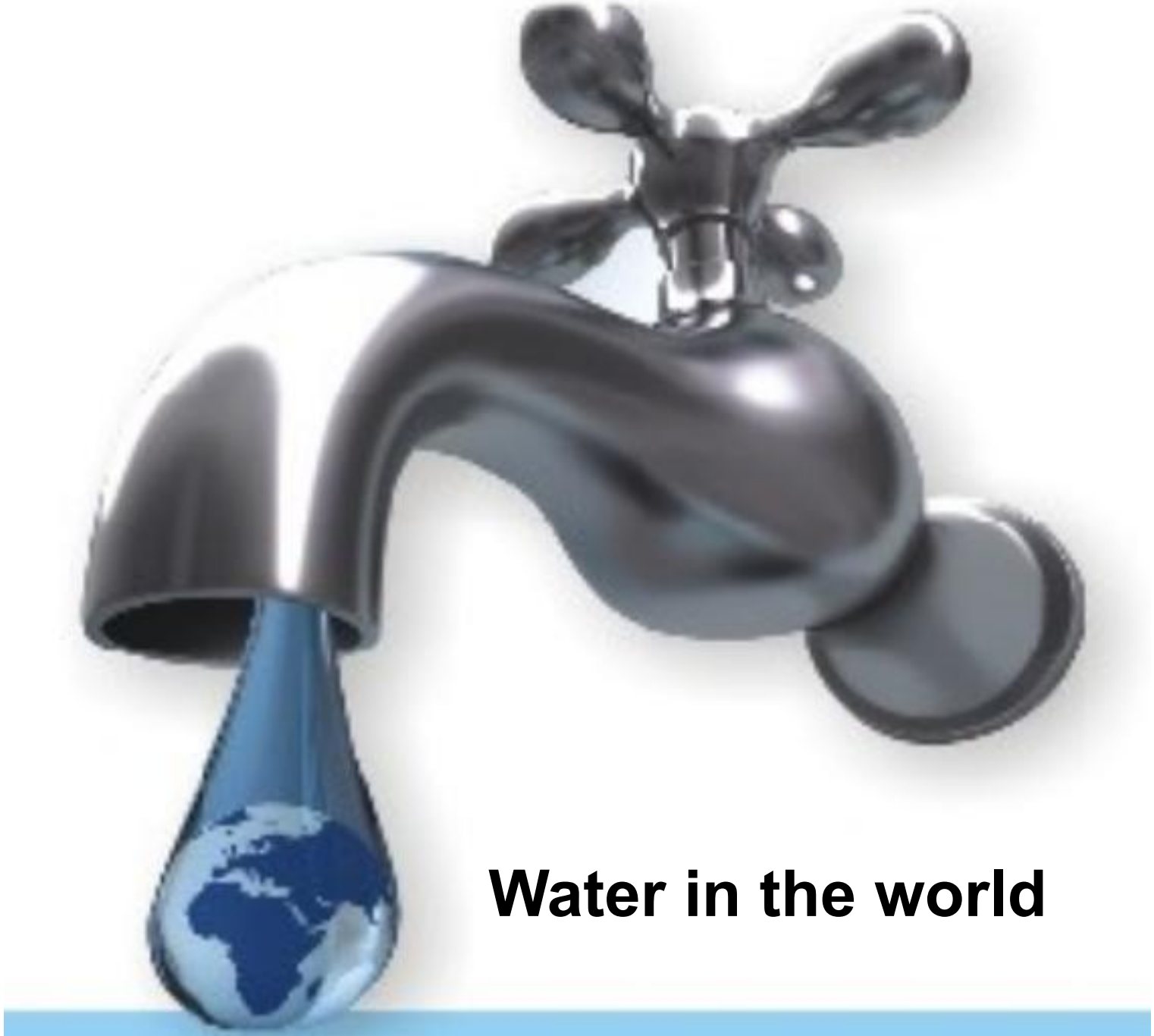
WILL BE AFFECTED BY WATER SHORTAGES BY THE YEAR 2030

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'.

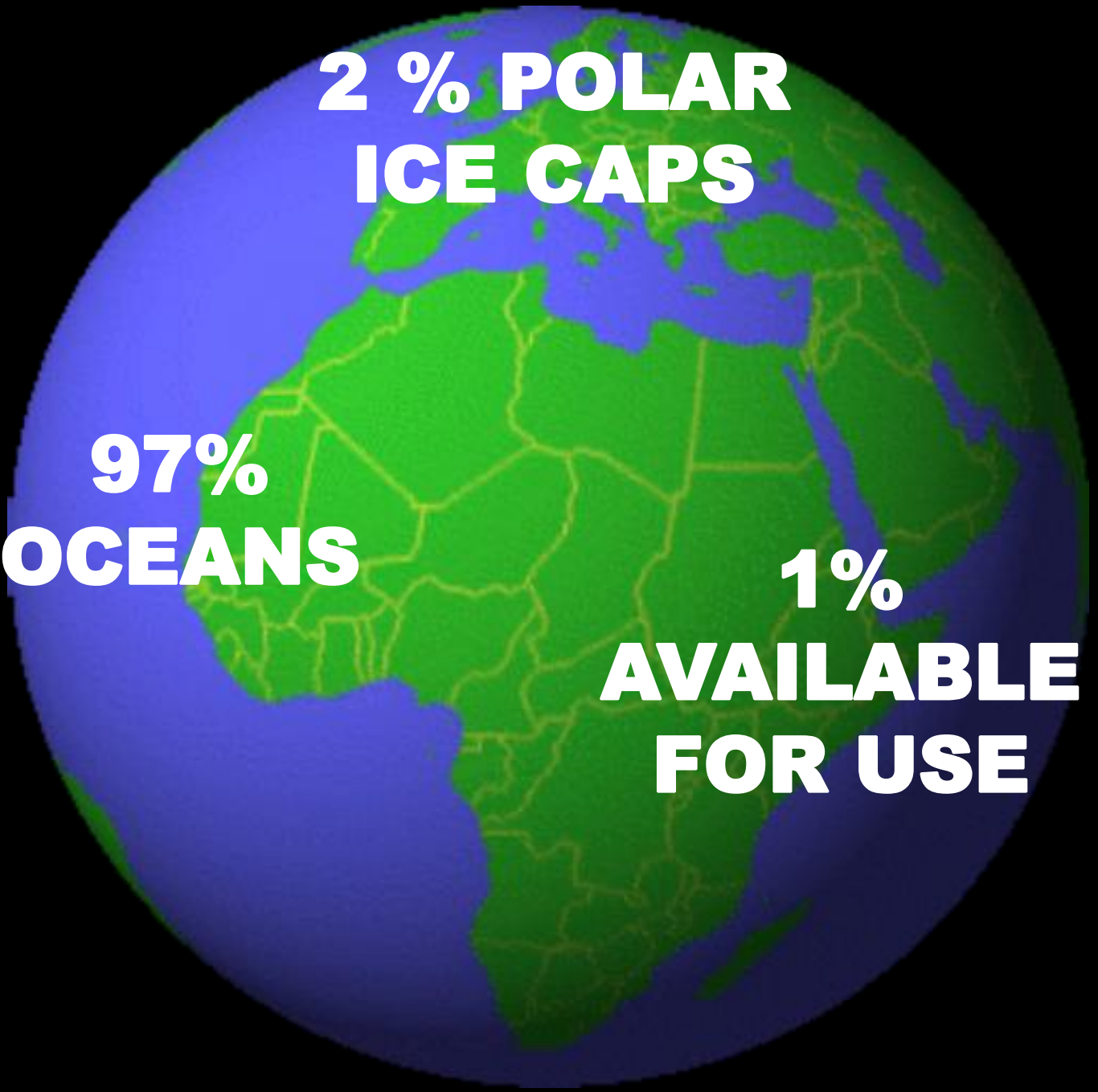
International



Water in the world

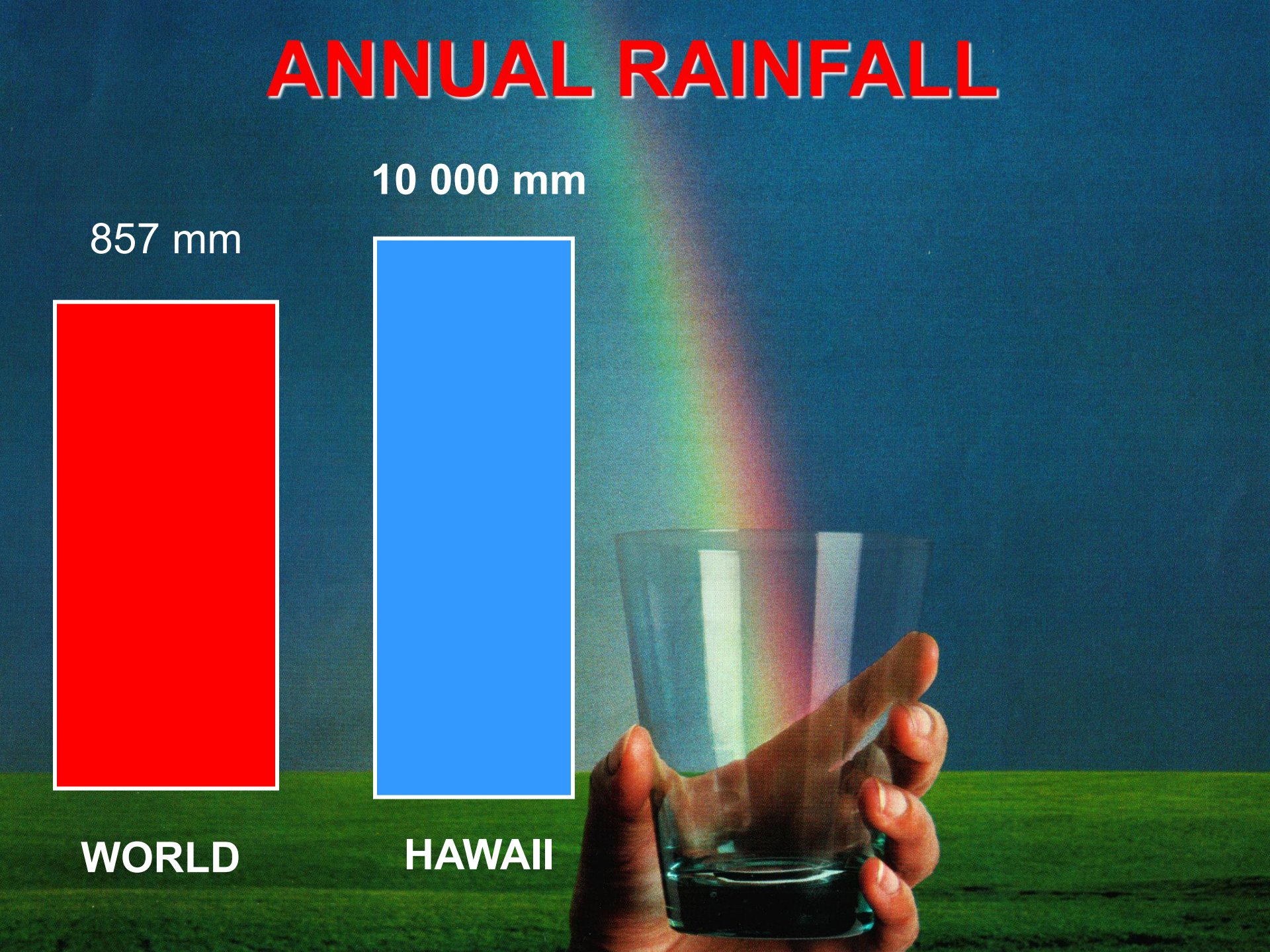

WATER

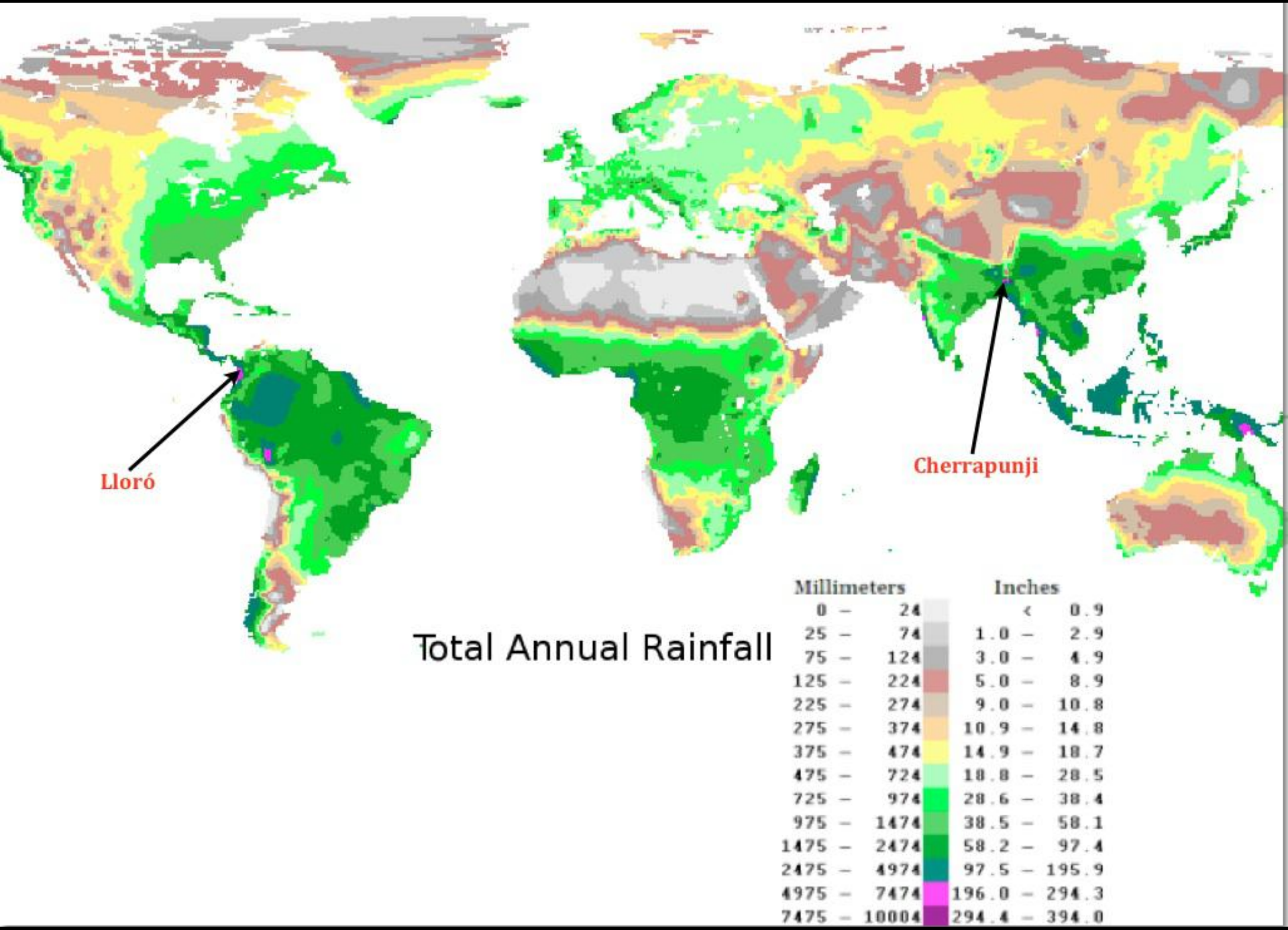
WATER



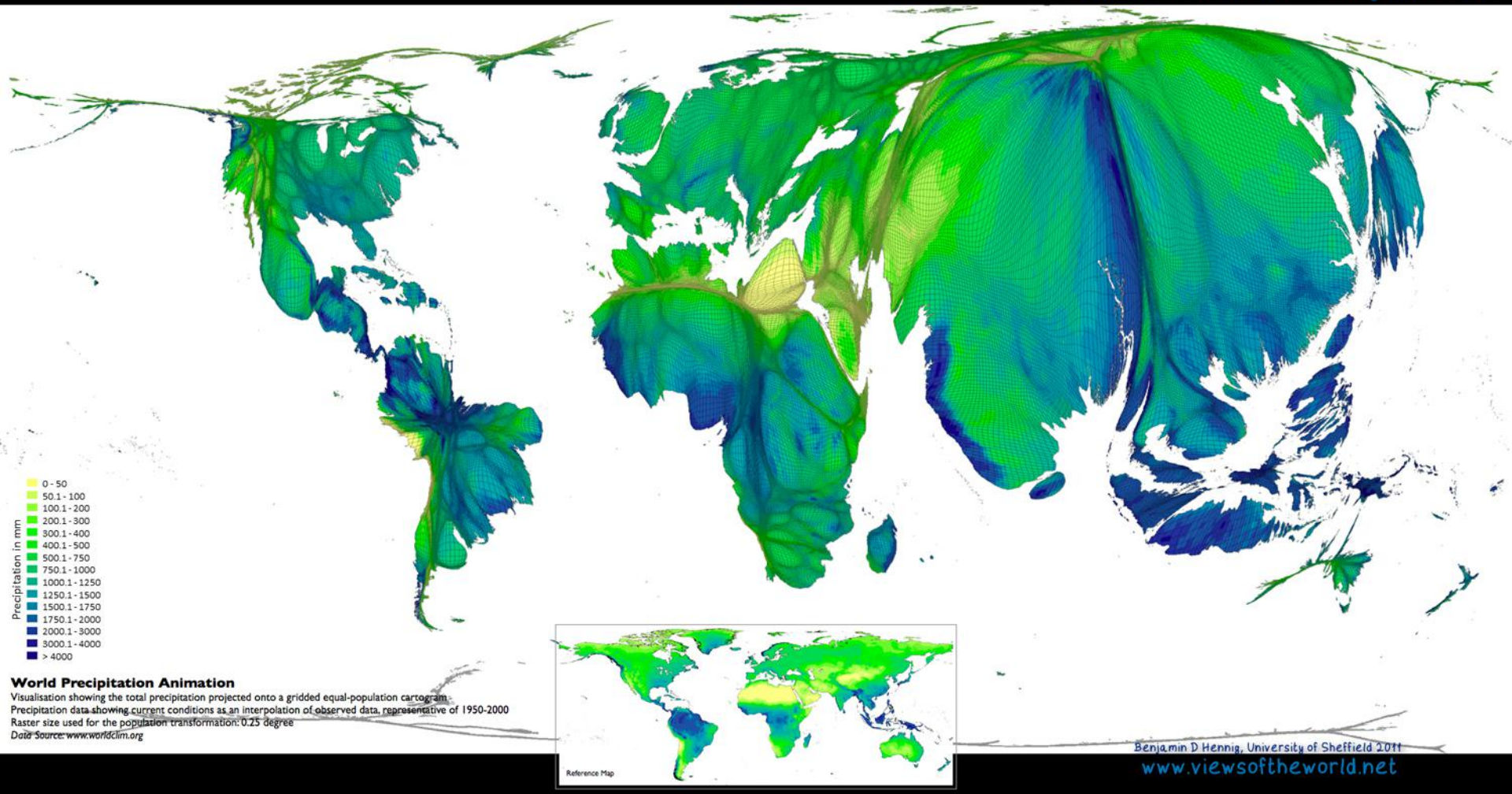

Rain

ANNUAL RAINFALL




Lloró
Cherrapunji
Total Annual Rainfall
Millimeters
Inches
0 – 24
< 0.9
25 – 74
1.0 – 2.9
75 – 124
3.0 – 4.9
125 – 224
5.0 – 8.9
225 – 274
9.0 – 10.8
275 – 374
10.9 – 14.8
375 – 474
14.9 – 18.7
475 – 724
18.8 – 28.5
725 – 974
28.6 – 38.4
975 – 1474
38.5 – 58.1
1475 – 2474
58.2 – 97.4
2475 – 4974
97.5 – 195.9
4975 – 7474
196.0 – 294.3
7475 – 10004
294.4 – 394.0

Global Annual Precipitation



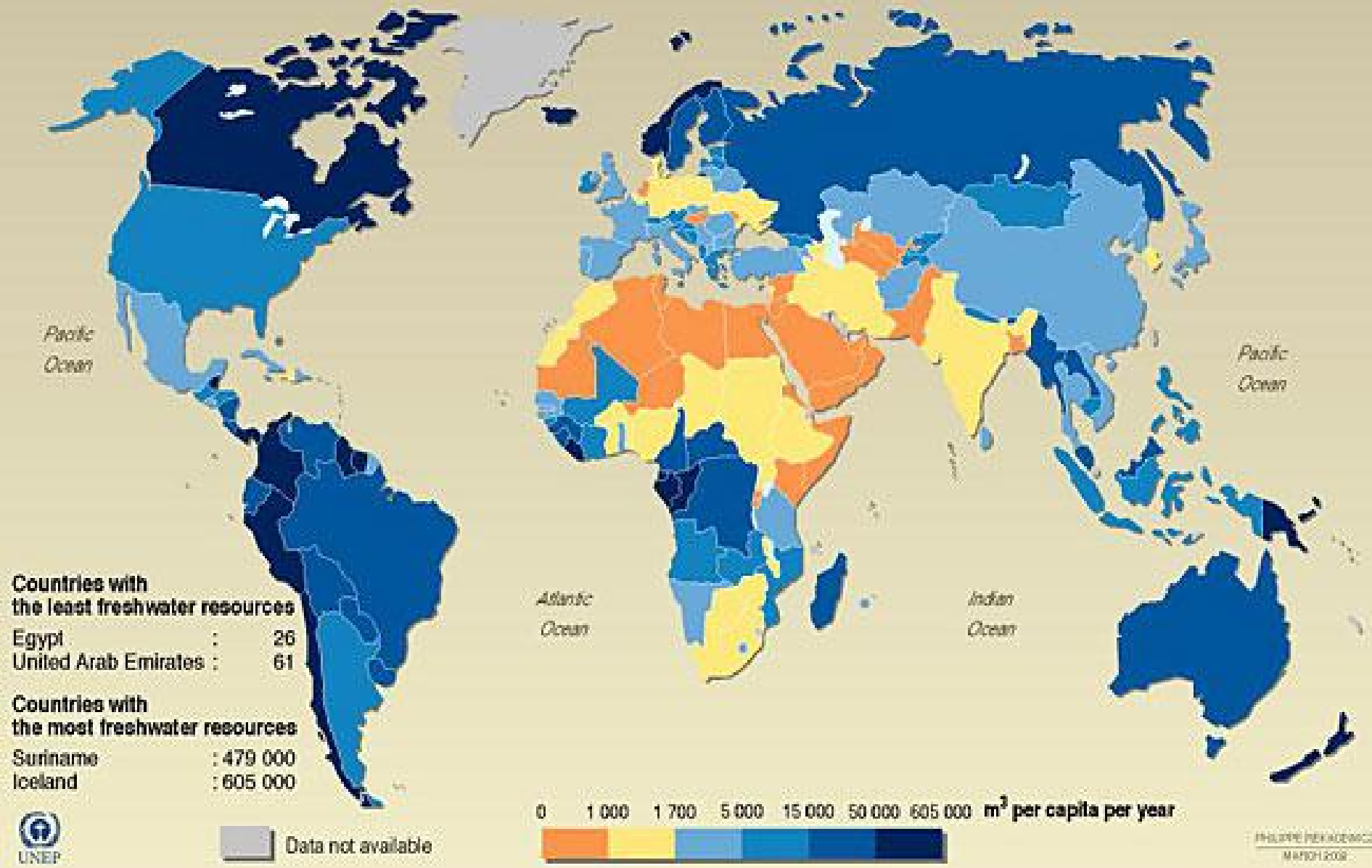
World Precipitation Animation

Visualisation showing the total precipitation projected onto a gridded equal-population cartogram.
Precipitation data showing current conditions as an interpolation of observed data, representative of 1950-2000
Raster size used for the population transformation: 0.25 degree
Data Source: www.worldclim.org

Benjamin D Hennig, University of Sheffield 2011
www.viewsoftheworld.net

Availability of Freshwater in 2000

Average River Flows and Groundwater Recharge

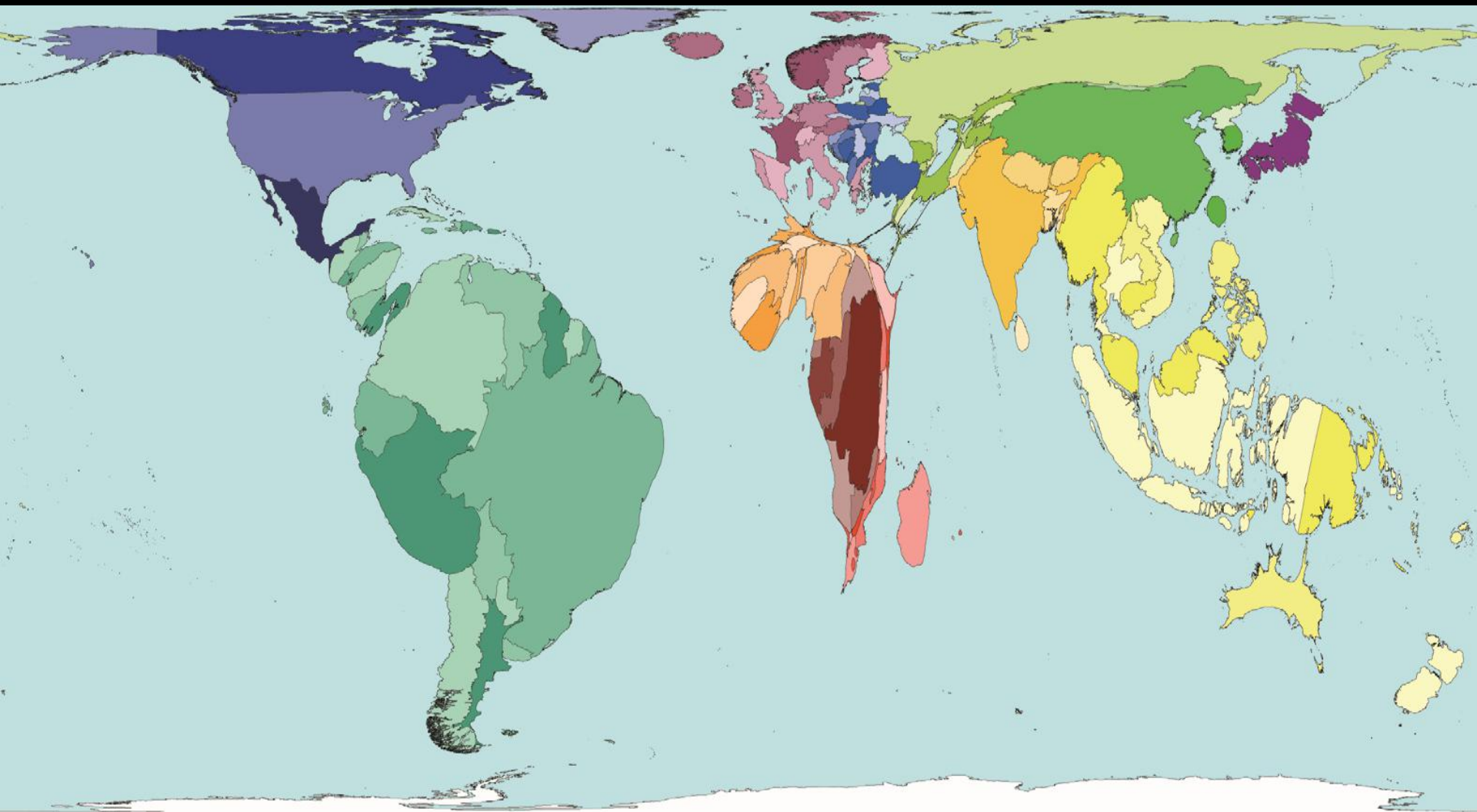


Source: *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000

World's Fresh Water Resources

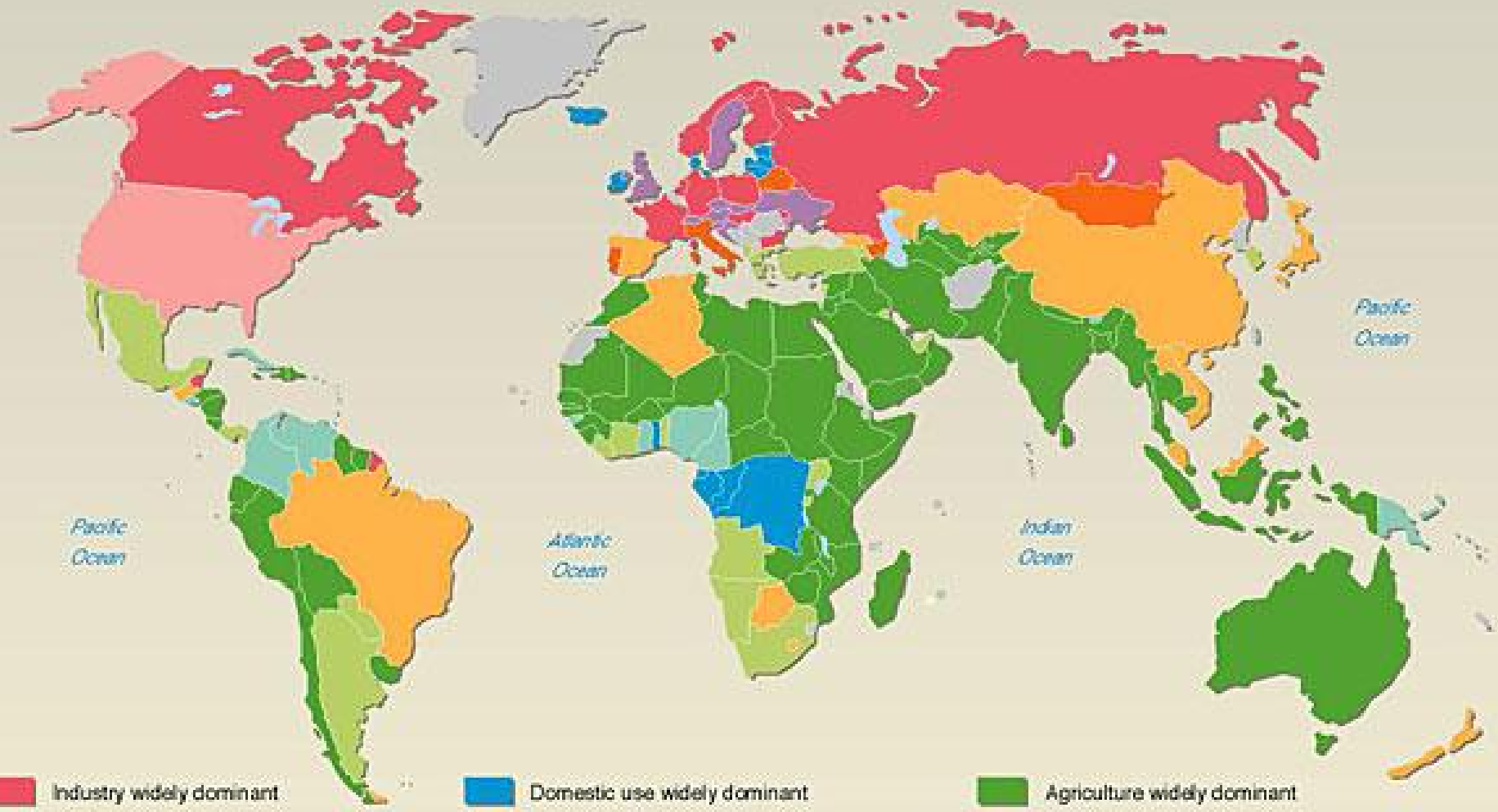
9 countries have 60% the world fresh water resources

Brazil, Canada, China, Colombia, United States, Indonesia, Peru, India and Russia



Global Freshwater Withdrawal

Country Profiles Based on Agricultural, Industrial and Domestic Use



- Industry widely dominant
- Industry and agriculture equally dominant
- Industry dominant with significant use by the domestic sector
- Domestic use widely dominant
- Domestic use and agriculture dominant
- Agriculture dominant with significant use by the domestic sector
- Data not available
- Agriculture widely dominant
- Agriculture dominant with significant use by the industrial sector
- Agriculture widely dominant with significant use by the industrial sector

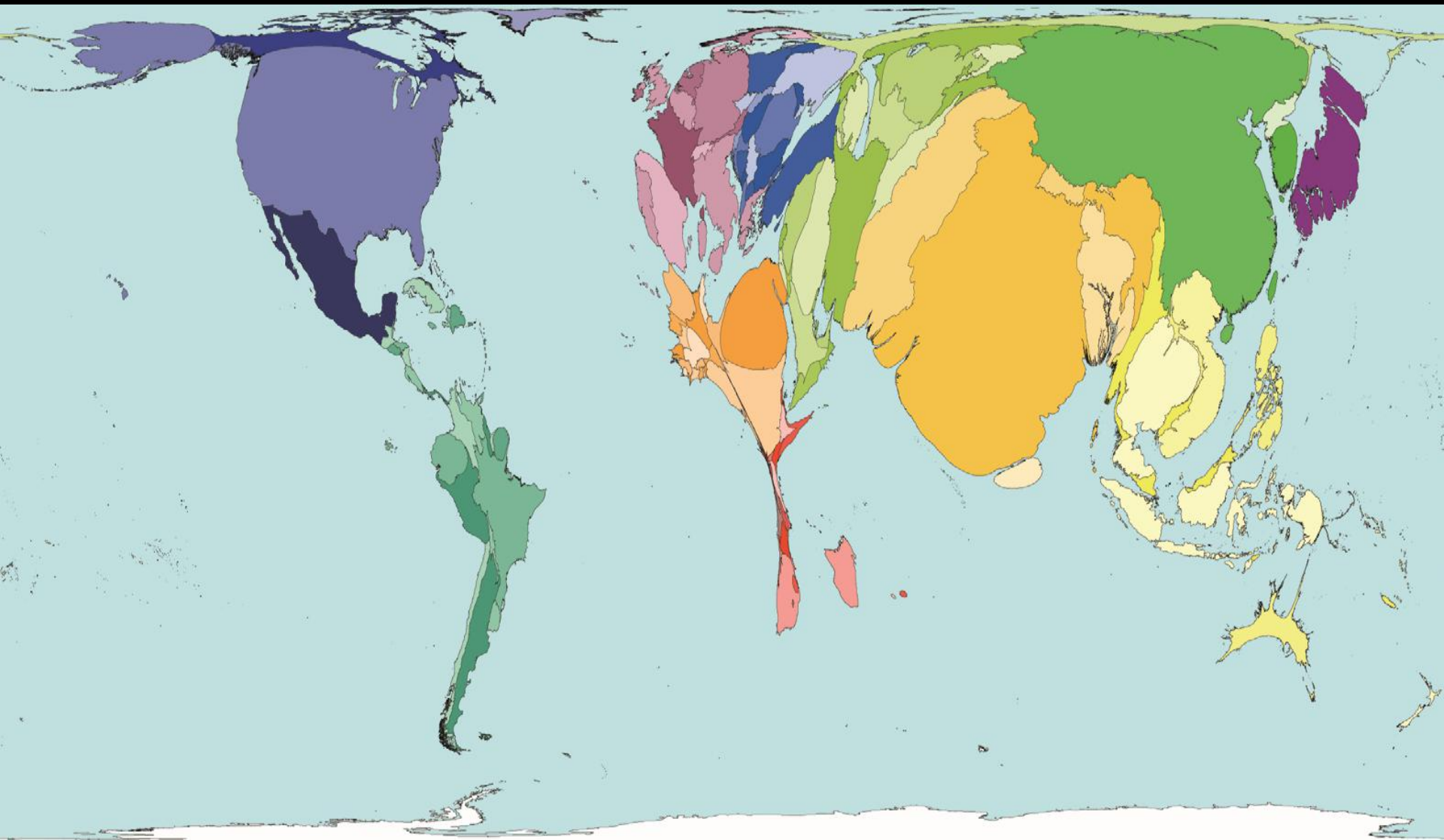
UNEP

PHILIPPE REKACEWICZ
MARCH 2002

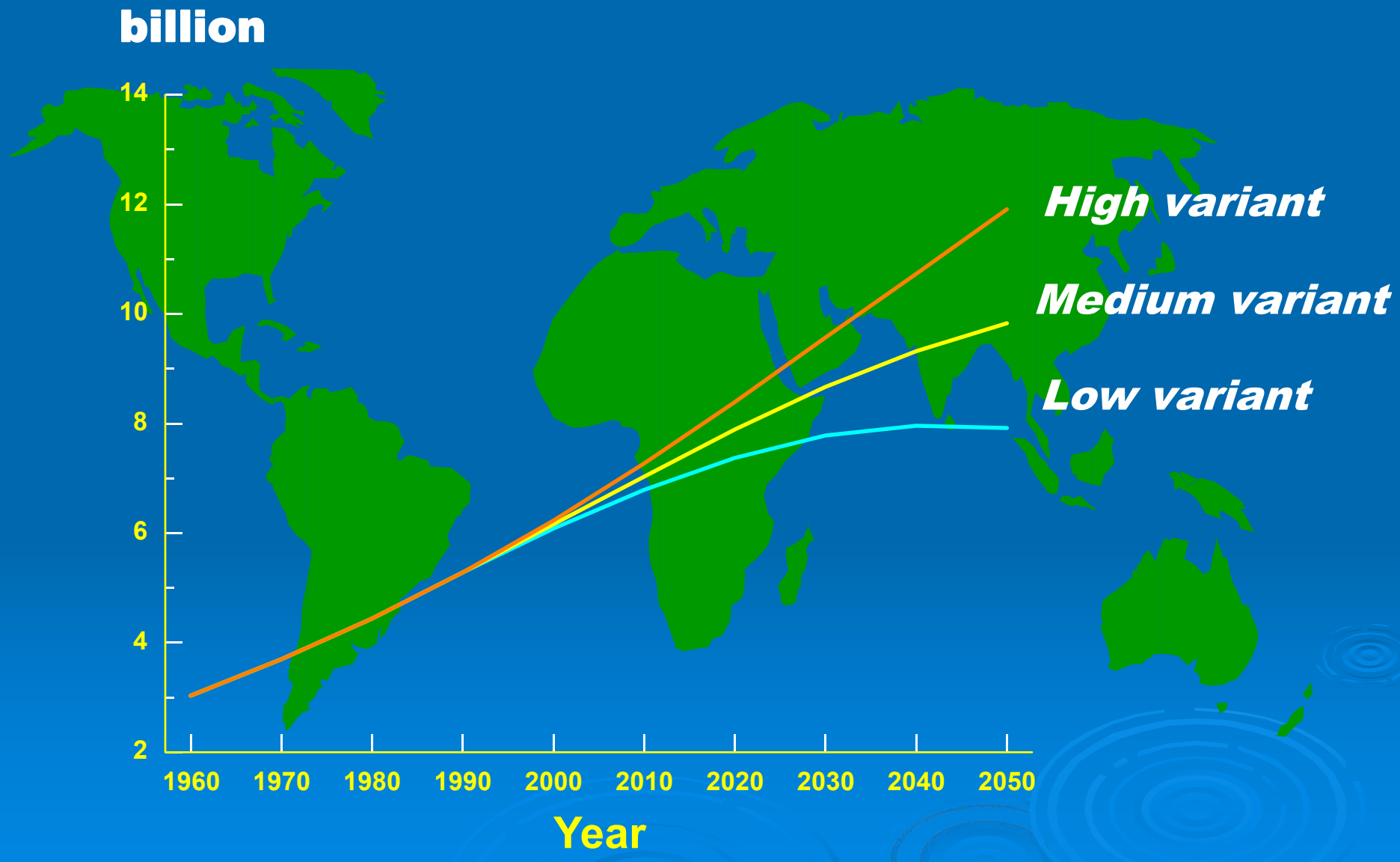
Source: Based on data fromTable FW1 in *World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life*, World Resources Institute (WRI), Washington DC, 2000

World’s fresh water uses

China, India and United States

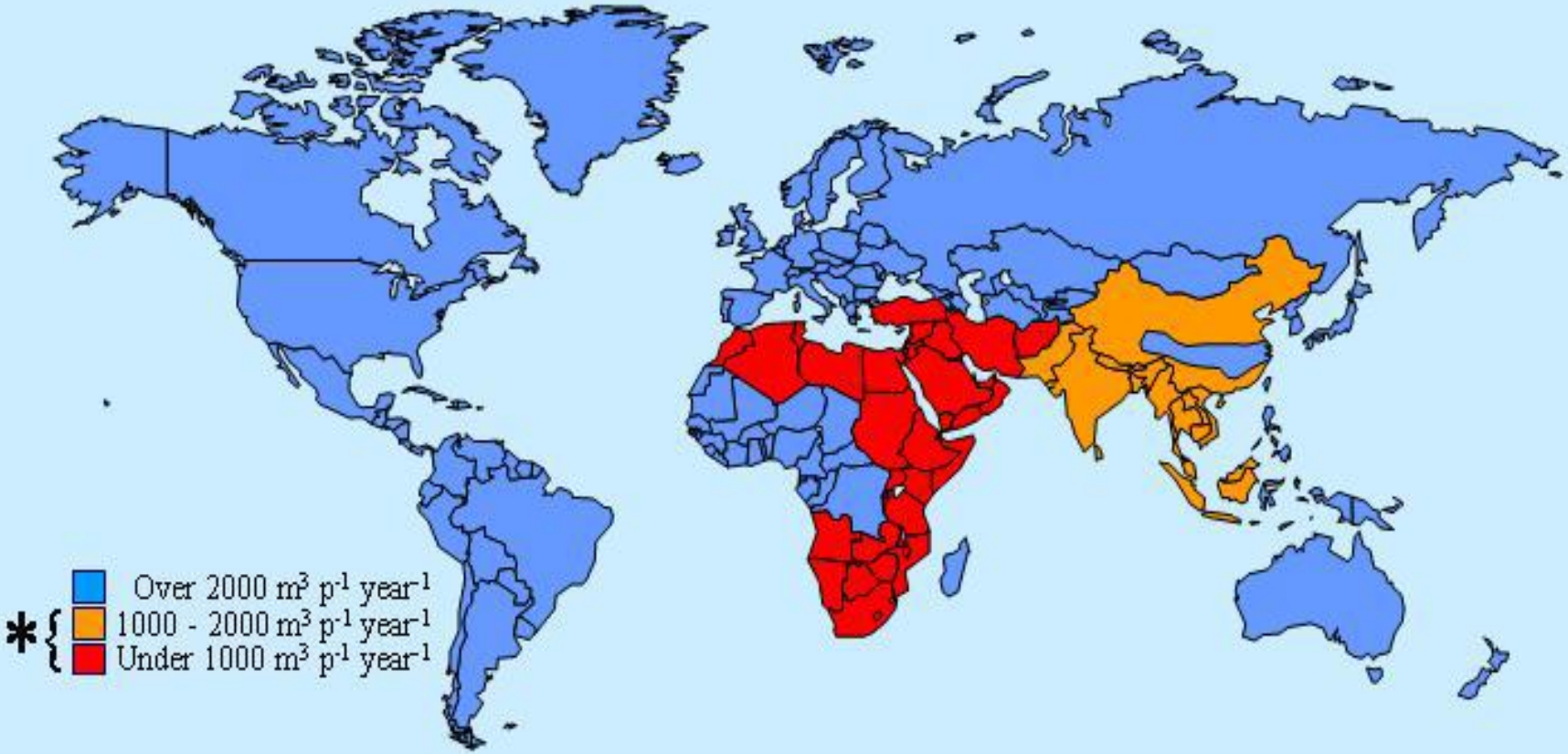


Global Population 1960 - 2050



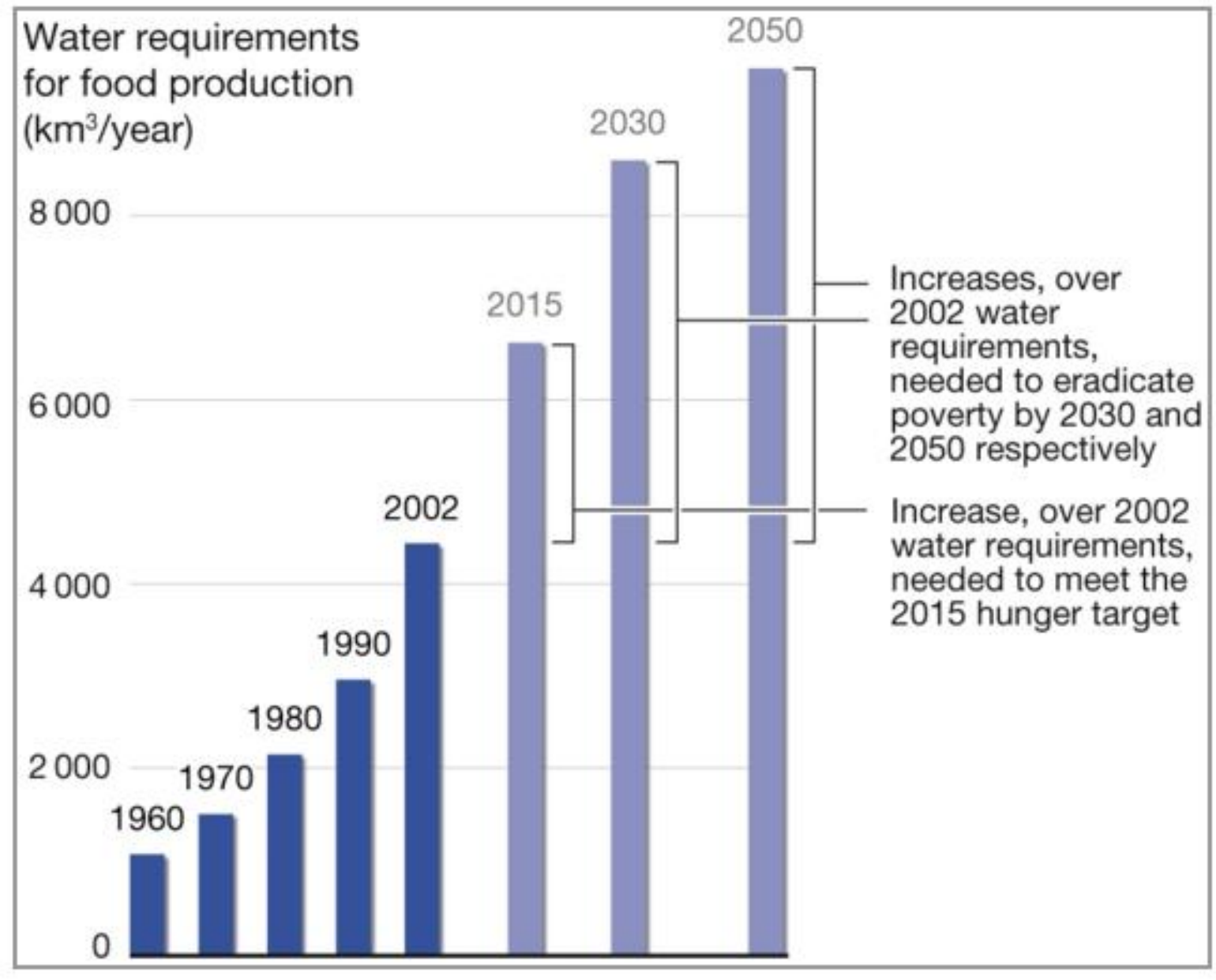
Global water scarcity - 2030

62%* of world population



Data from Fischer and Heilig (1997)

Water requirements for food production 1960-2050

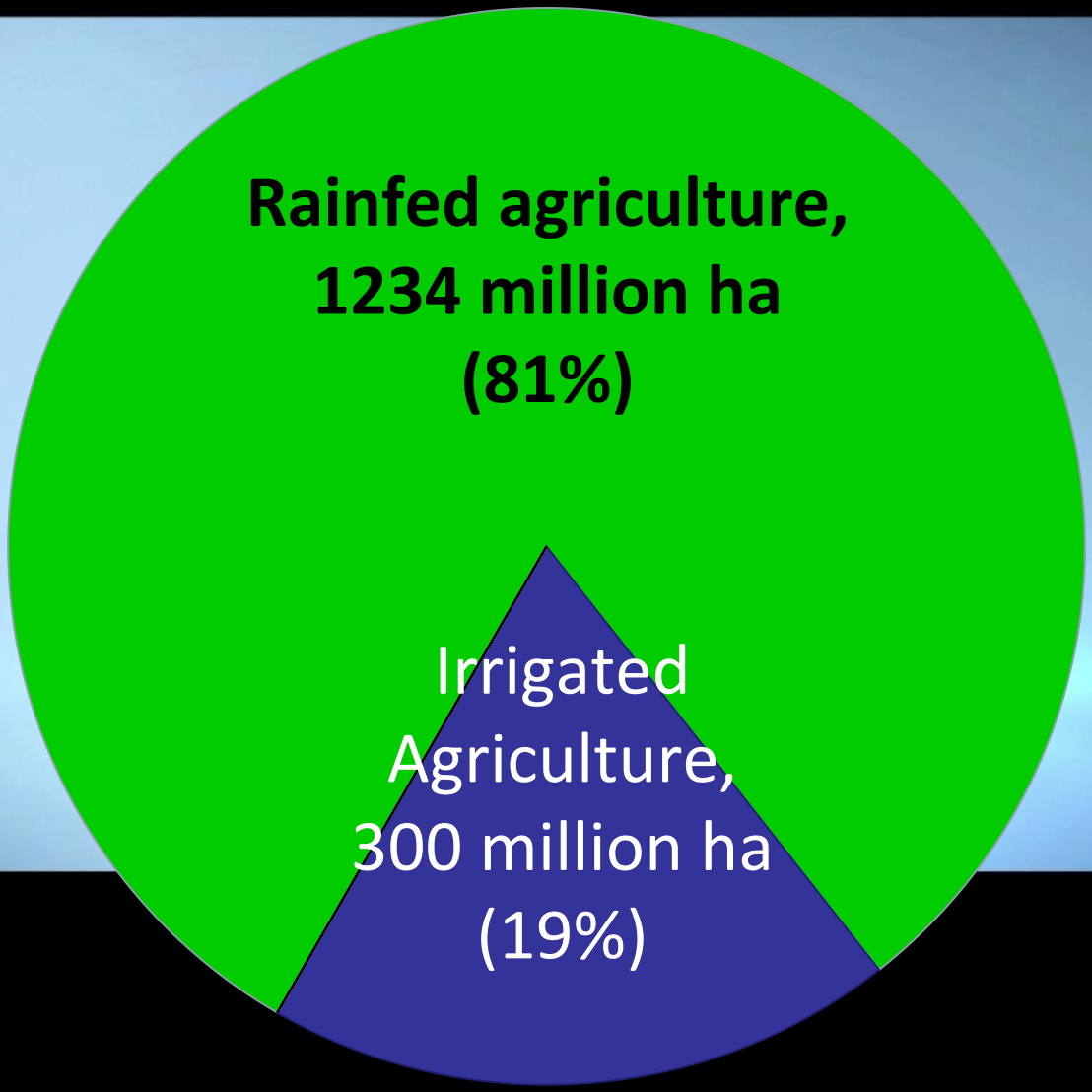



Irrigation

Water dependant

Rainfed agriculture 1234 million ha

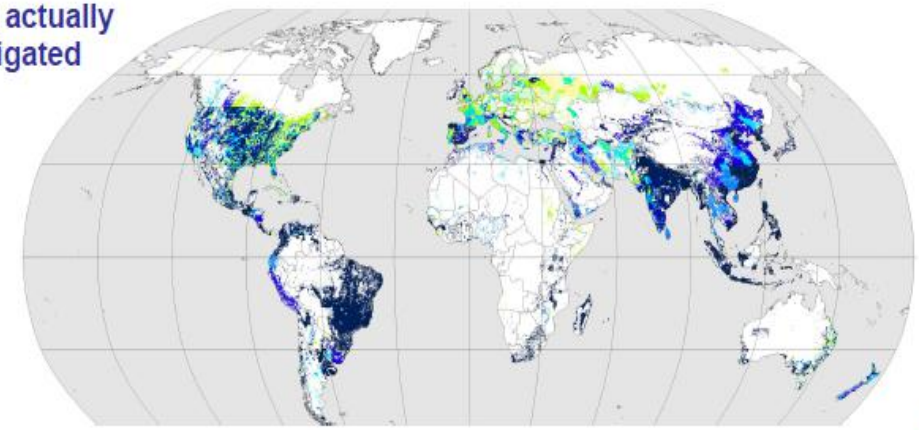
Irrigated Agriculture, 300 million ha


Rainfed agriculture,
1234 million ha
(81%)
Irrigated
Agriculture,
300 million ha
(19%)

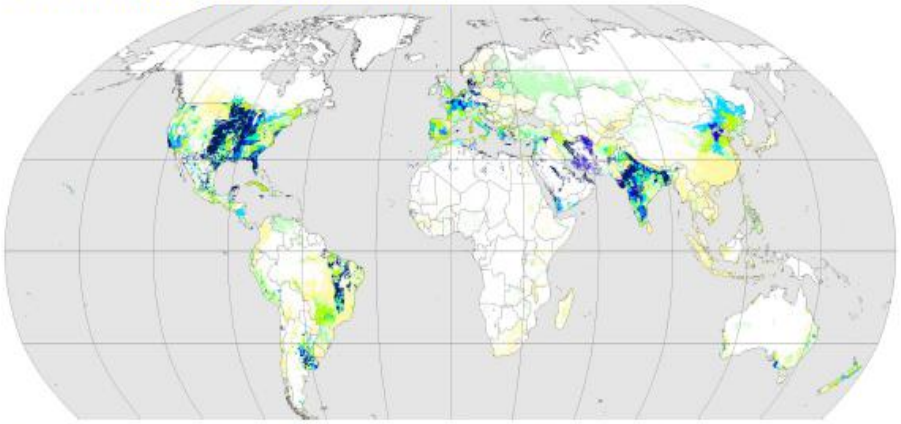
The digital global map of irrigation areas

October 2013

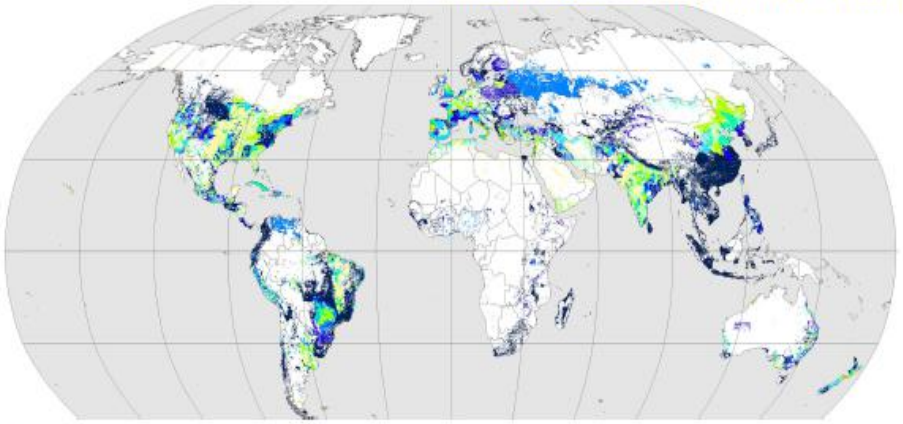
Area actually irrigated



Area irrigated with groundwater



Area irrigated with surface water



Percentage of area equipped for irrigation (AEI)

No AEI	60 - 70
< 10	70 - 80
10 - 30	80 - 90
30 - 50	90 - 100
50 - 60	

The maps show the percentage of area equipped for irrigation that is actually irrigated, irrigated with groundwater or irrigated with surface water. For the majority of countries the base year of statistics is in the period 2000 - 2008.

Projection: Robinson
Resolution: 5 arc-minutes

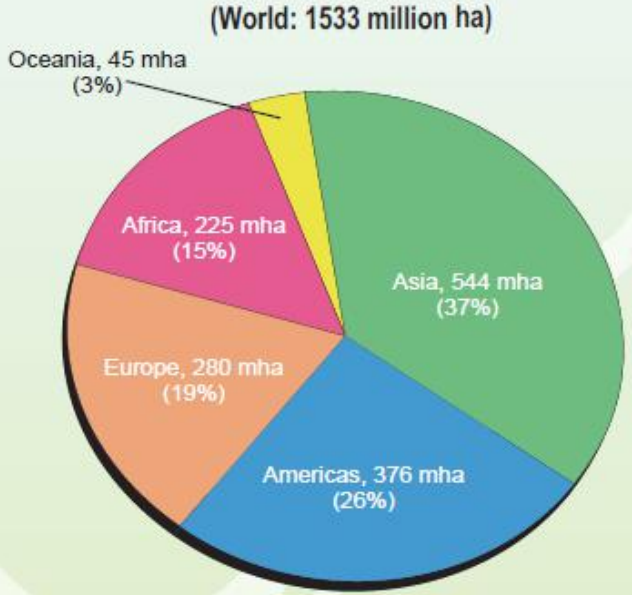
http://www.fao.org/nr/water/aquastat/irrigationmap/index.stm

Stefan Siebert, Verena Henrich (Institute of Crop Science and Resource Conservation, University of Bonn, Germany) and
Karen Frenken, Jacob Burke (Land and Water Division, Food and Agriculture Organization of the United Nations, Rome, Italy)

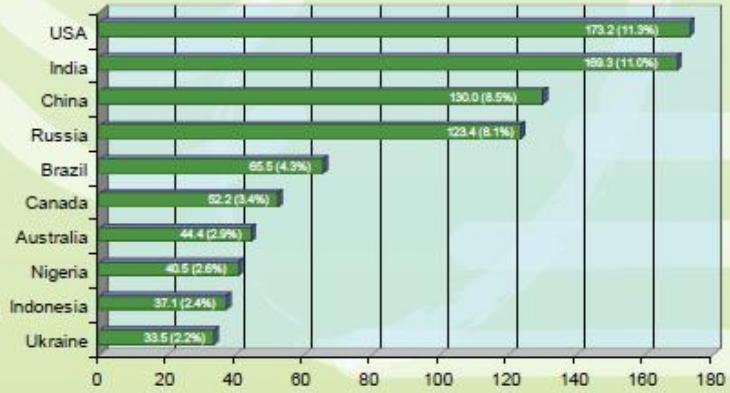
universitätbonn

ICID•CIID

Regionwise Arable and Permanent Cropped Areas of the World



Arable and permanent cropped area (million ha) and its share in the total area (%)
Top 10 Countries



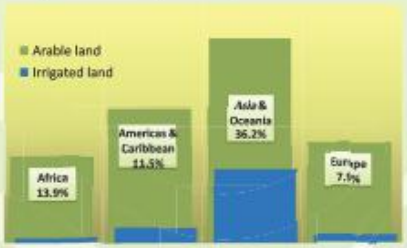
Source : ICID NCs (2010), FAO Stat-FAO Statistics Division (2011

ICID•CIID

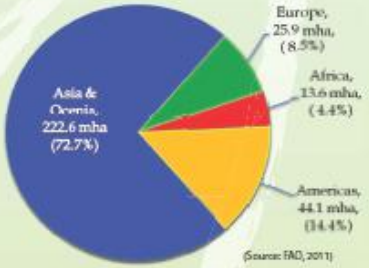
World Irrigation Scenario

World irrigated area (million ha)

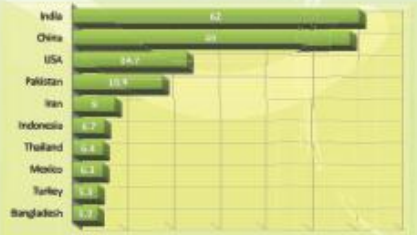
Irrigated area as percentage of arable land



Regional spread of irrigated area



Irrigated area (million ha) - Top ten countries

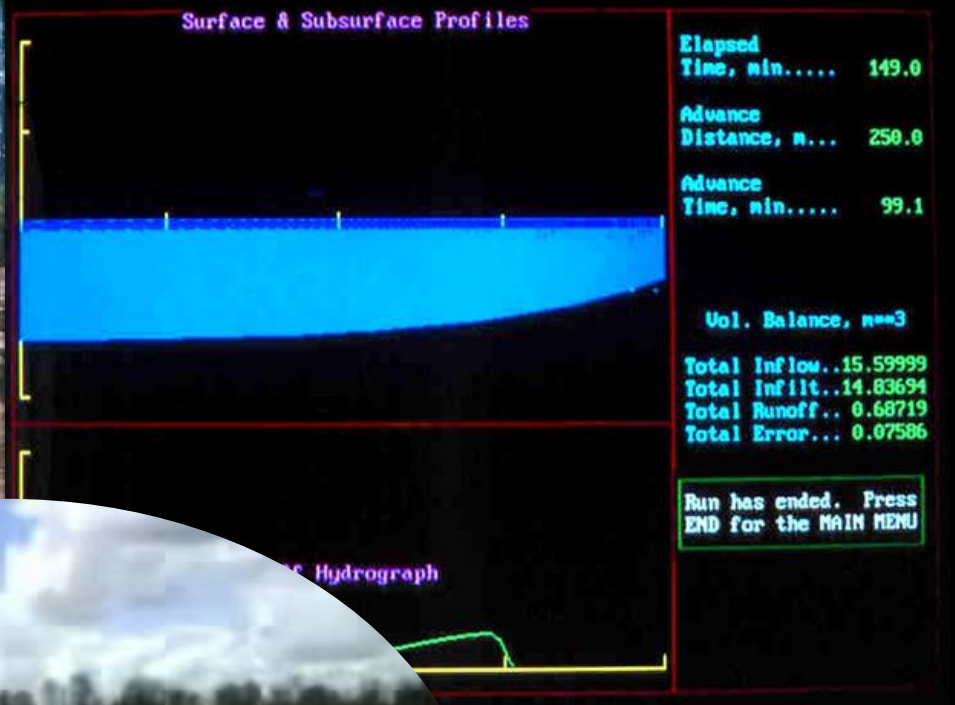


World irrigated area (Hectares/1000 people)


e Regulation Range



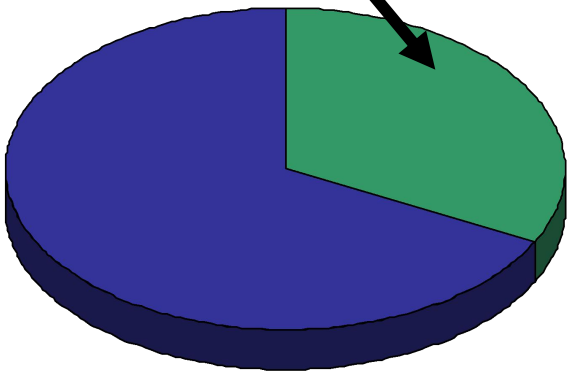



Surface & Subsurface Profiles
Elapsed
Time, min..... 149.0
Advance
Distance, m... 250.0
Advance
Time, min..... 99.1
Vol. Balance, n=3
Total Inflow..15.59999
Total Infilt..14.83694
Total Runoff.. 0.68719
Total Error... 0.07586
Run has ended. Press
END for the MAIN MENU
Hydrograph

World-wide Coverage of Irrigation

Total irrigated area = 300 Mha

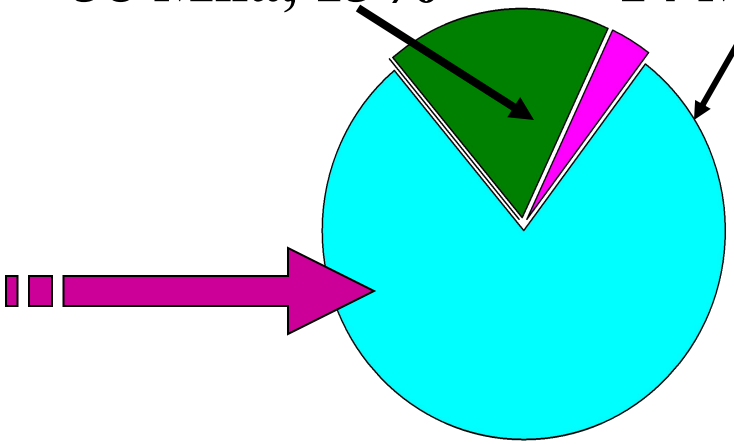
Rice irrigated Area
102 Mha, 34 %



Irrigated area of other crops
198 Mha, 66 %

Sprinkler,
38 Mha, 13%

Micro irrigation,
14 Mha, 5%



Gravity irrigation,
248 Mha,82%

ICID•CIID

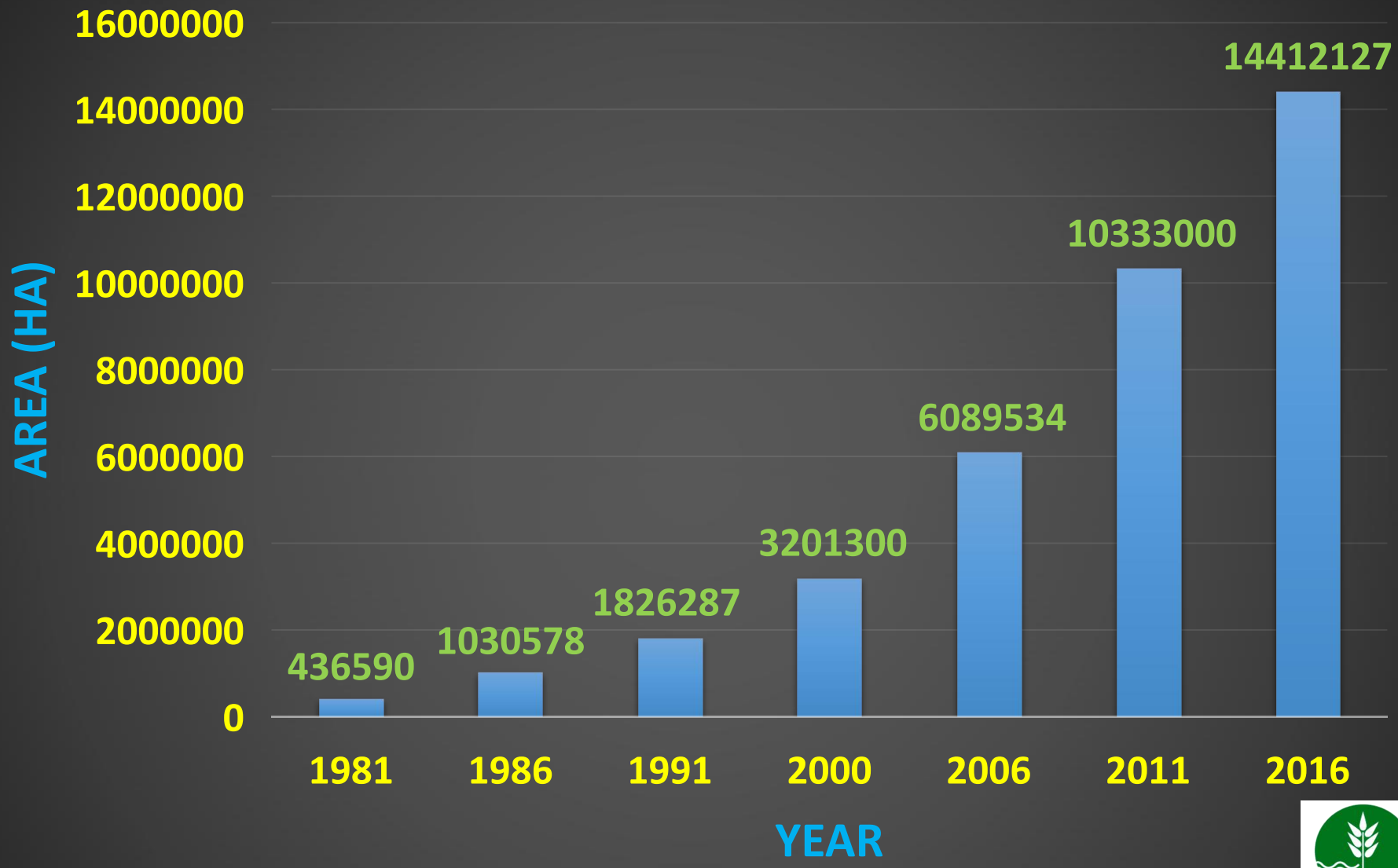
Micro-irrigation survey

Use of micro-irrigation in the world over the last 35 years.

Year	1981	1986	1991	2000	2006	2011	2016
Area (ha)	436 590	1 030 578	1 826 287	3 201 300	6 089 534	10 333 000	14 412 127
% increase		136.1	77.2	75.3	90.2	41.1	39.5

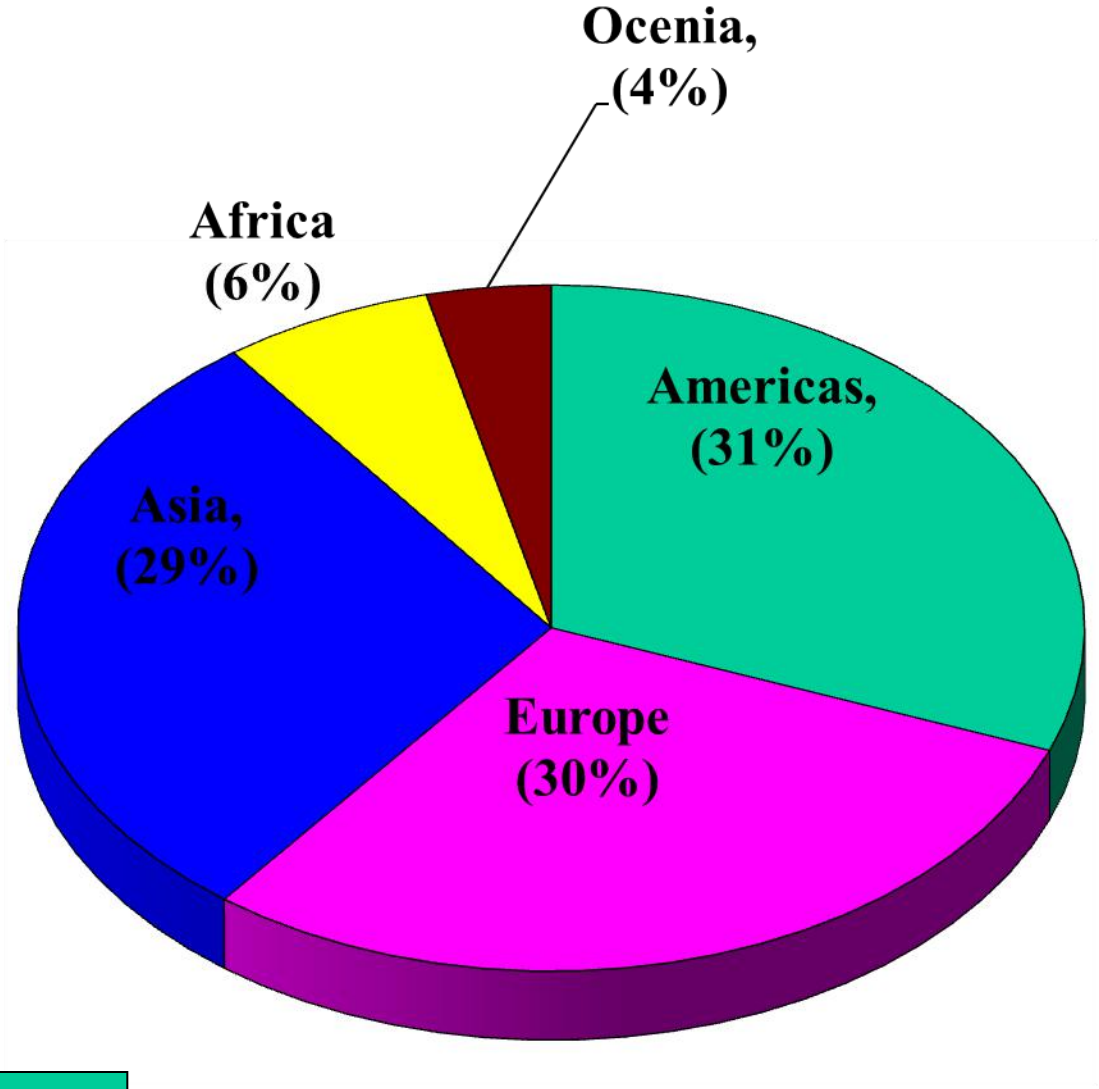
Over the past 35 years (1981-2016) an increase in the usage of micro-irrigation of 3 201% took place.

Micro-irrigation survey



ICID·CIID

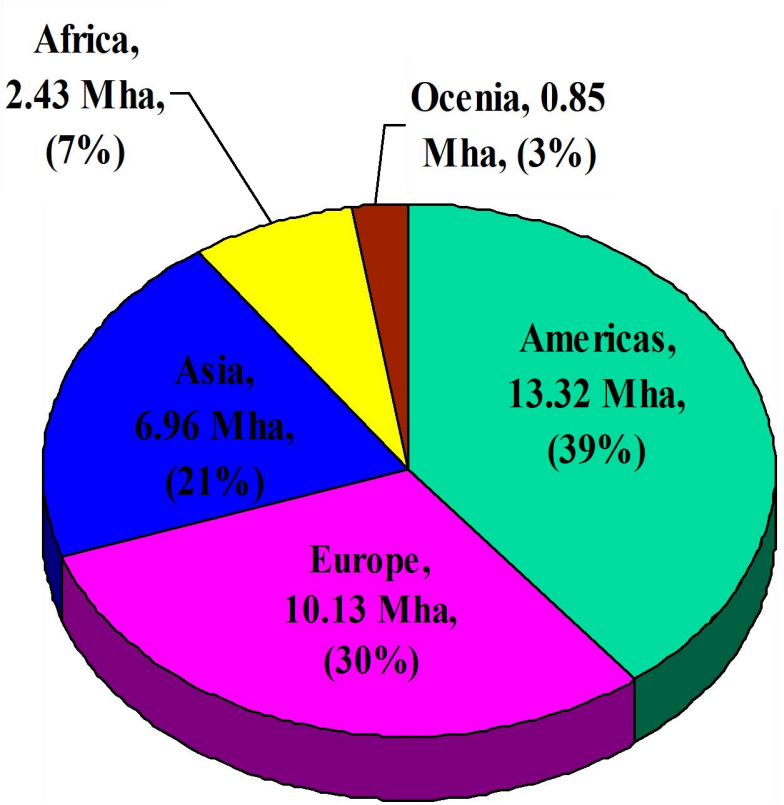
Region's Percentage of Micro irrigation



Micro total=14 Mha

ICID•CIID

Region's Percentage of Sprinkler irrigation



Sprinkler total 38 milj ha

ICID•CIID

Food security

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.

What is food security?

Food security includes the following aspects:

- Availability
- Access
- Affordability
- Quality
- Nutrition
- Safety

The Economist Intelligence Unit

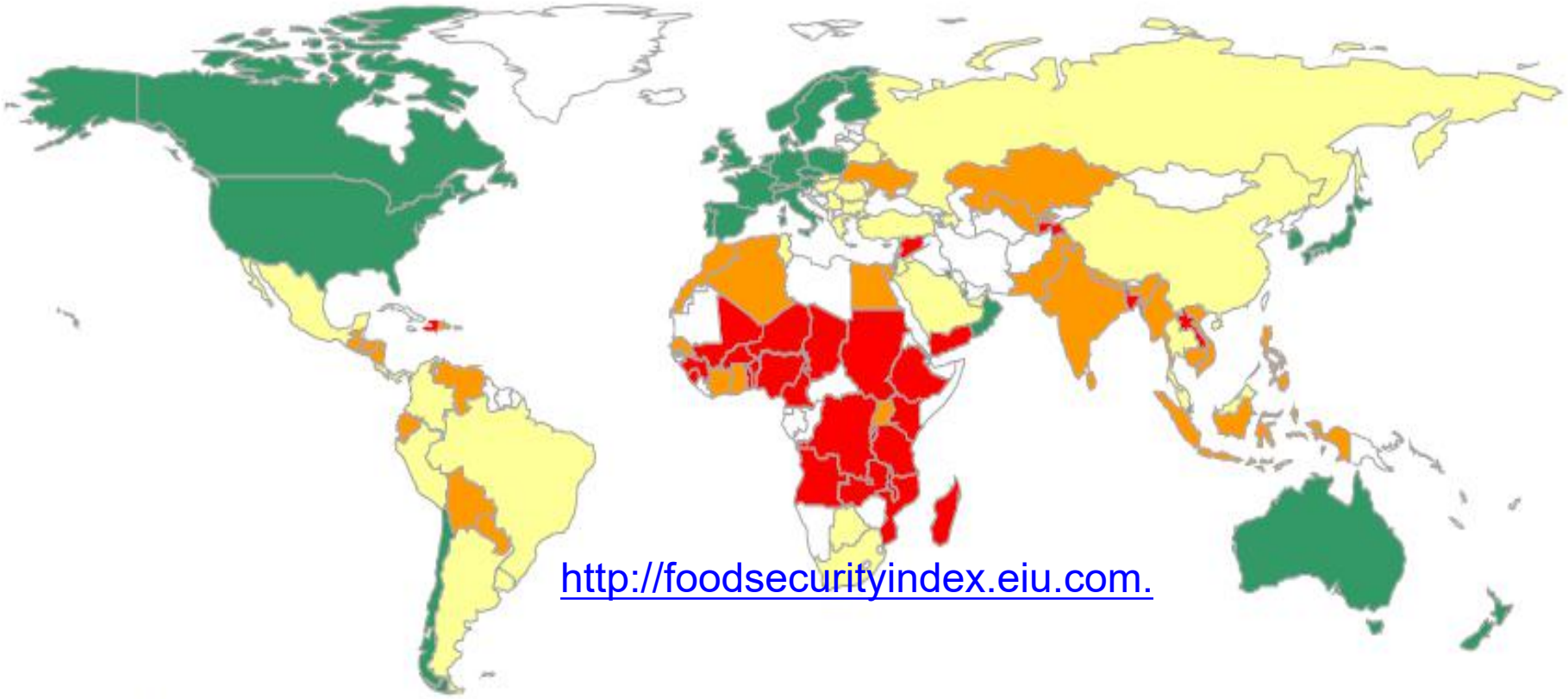
A report from The Economist Intelligence Unit

GLOBAL FOOD SECURITY INDEX 2017

MEASURING FOOD SECURITY AND THE IMPACT OF RESOURCE RISKS

Sponsored by DUPONT

2017 Global Food Security Index



http://foodsecurityindex.eiu.com.

Score = Score in 2017, 0-100 where 100=best

Δ = Change in 2017 score compared with 2016

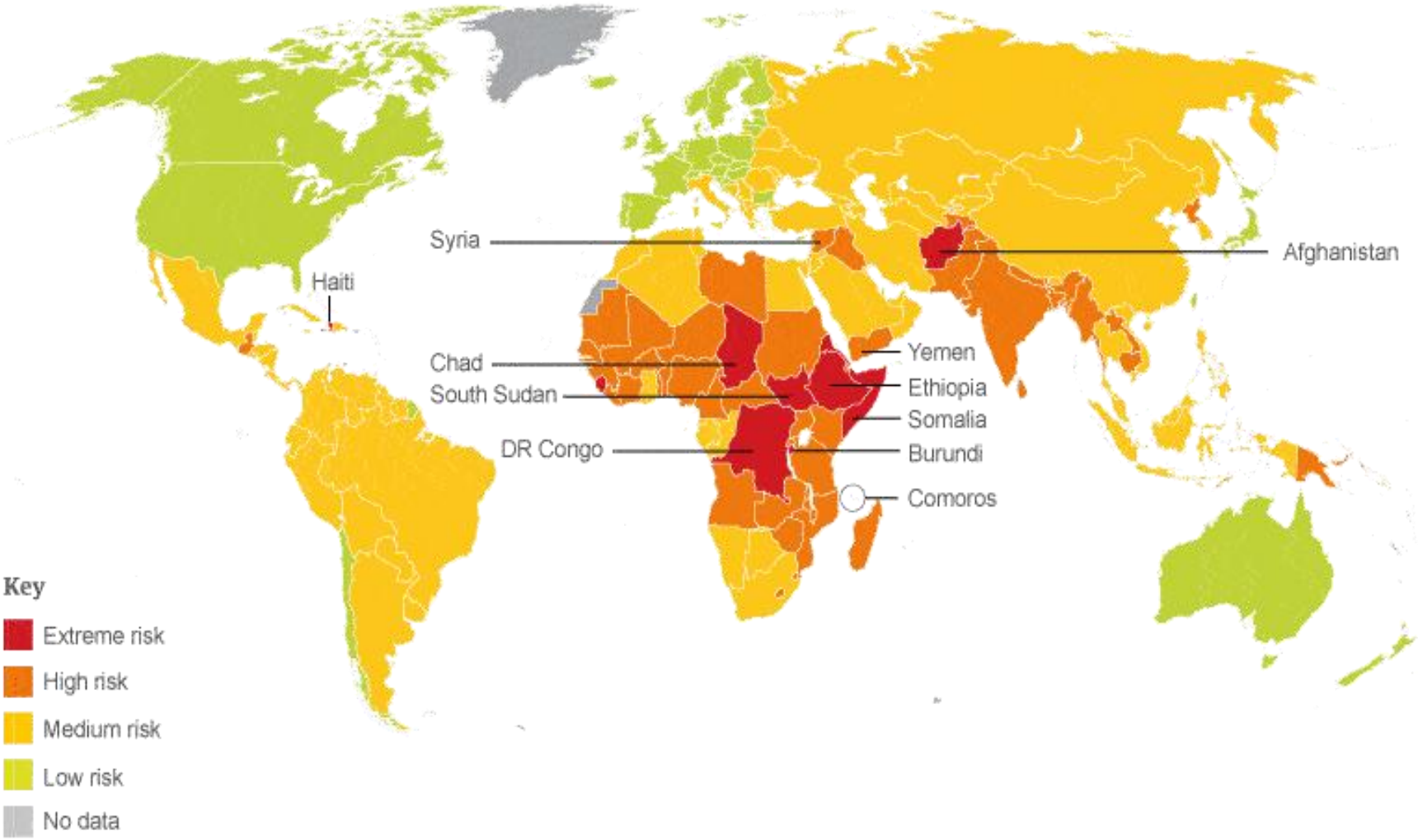
Green= score improved this year

Red = score deteriorated this year

VERY GOOD (TOP QUARTILE)	GOOD (3RD QUARTILE)	MODERATE (2ND QUARTILE)	WEAK (BOTTOM QUARTILE)
Score Δ	Score Δ	Score Δ	Score Δ

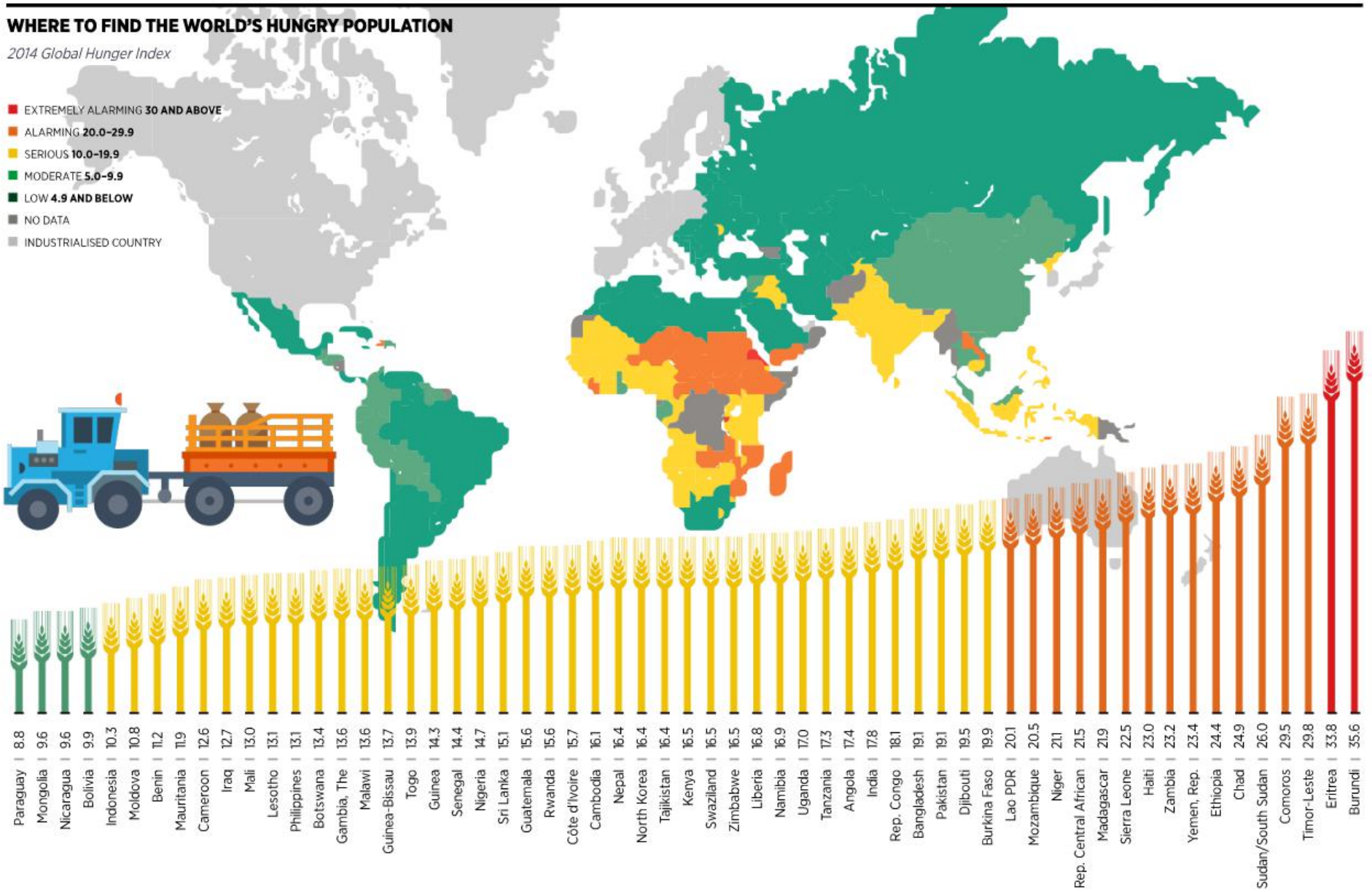
Source: Economist Intelligence Unit/DuPont

Food Security Risk Index 2013



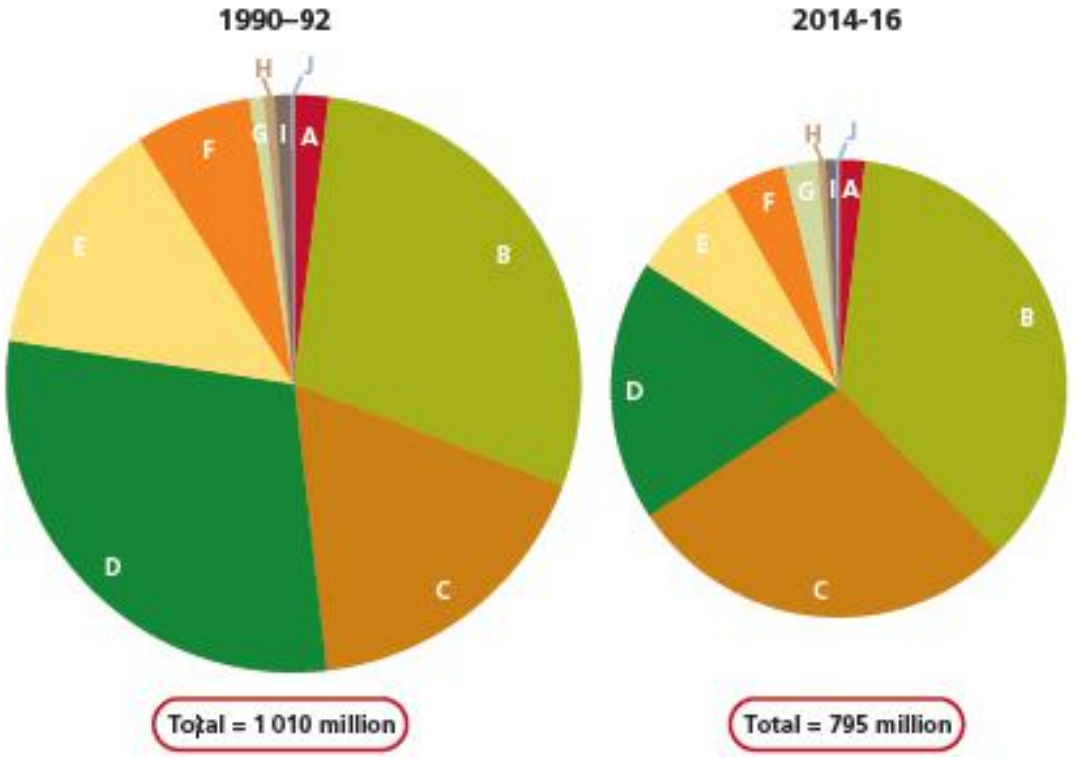
WHERE TO FIND THE WORLD'S HUNGRY POPULATION

2014 Global Hunger Index



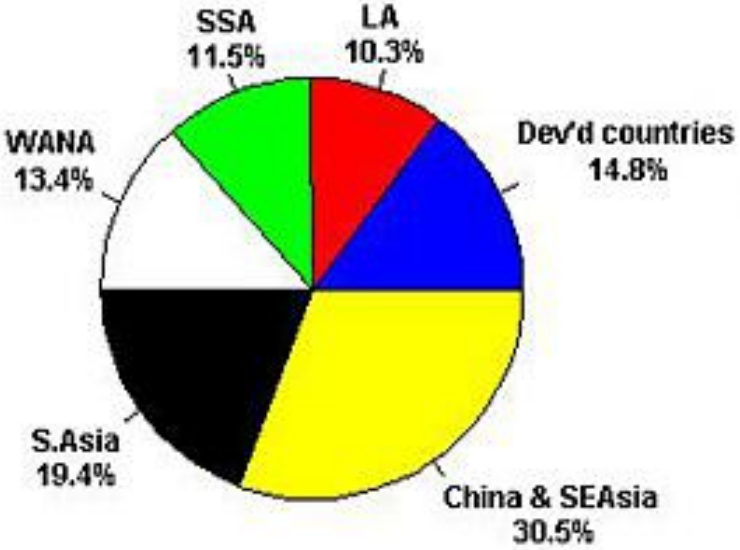
Source: Welthungerhilfe/IFPRI/Concern Worldwide 2014

The changing distribution of hunger in the world

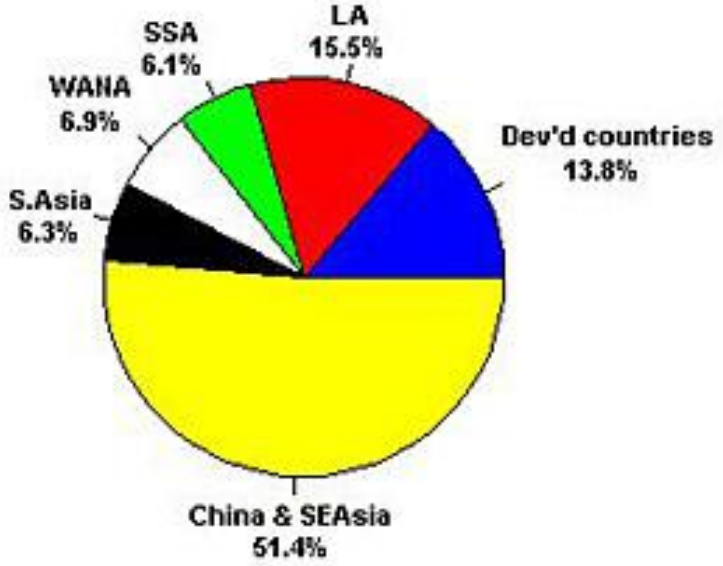


	Number (millions)		Regional share (%)	
	1990–92	2014–16	1990–92	2014–16
A Developed regions	20	15	2.0	1.8
B Southern Asia	291	281	28.8	35.4
C Sub-Saharan Africa	176	220	17.4	27.7
D Eastern Asia	295	145	29.2	18.3
E South-Eastern Asia	138	61	13.6	7.6
F Latin America and the Caribbean	66	34	6.5	4.3
G Western Asia	8	19	0.8	2.4
H Northern Africa	6	4	0.6	0.5
I Caucasus and Central Asia	10	6	0.9	0.7
J Oceania	1	1	0.1	0.2
Total	1 011	795	100	100

Increase in global demand for cereals and meat products, 1993-2020



Cereals

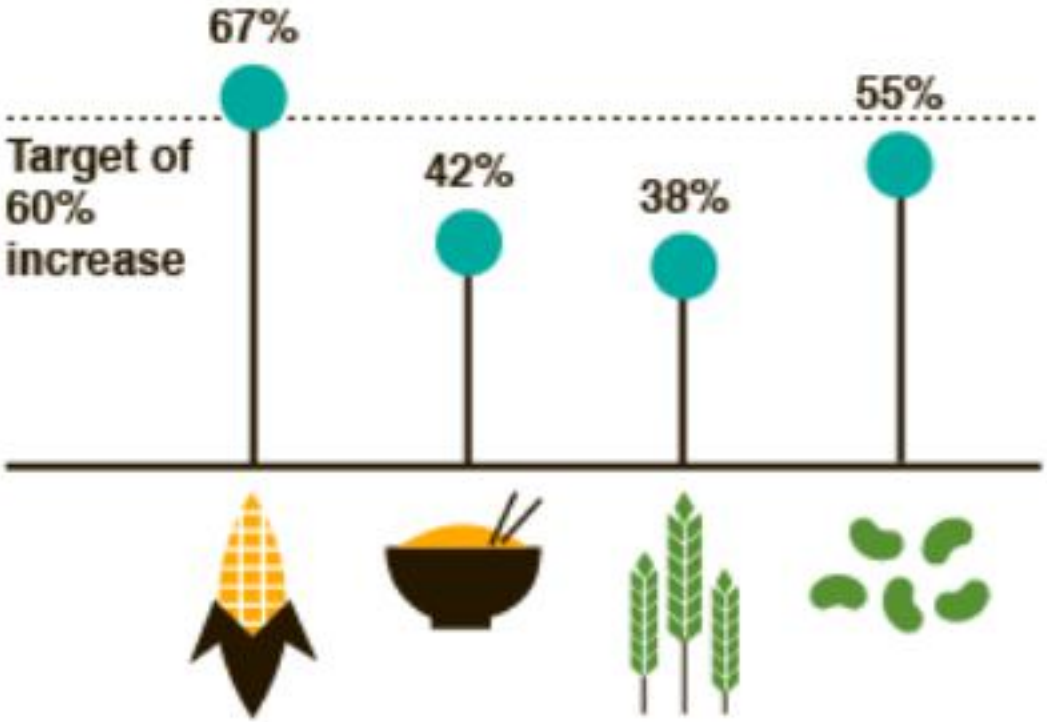


Meat Products

Source: IFPRI IMPACT simulations.

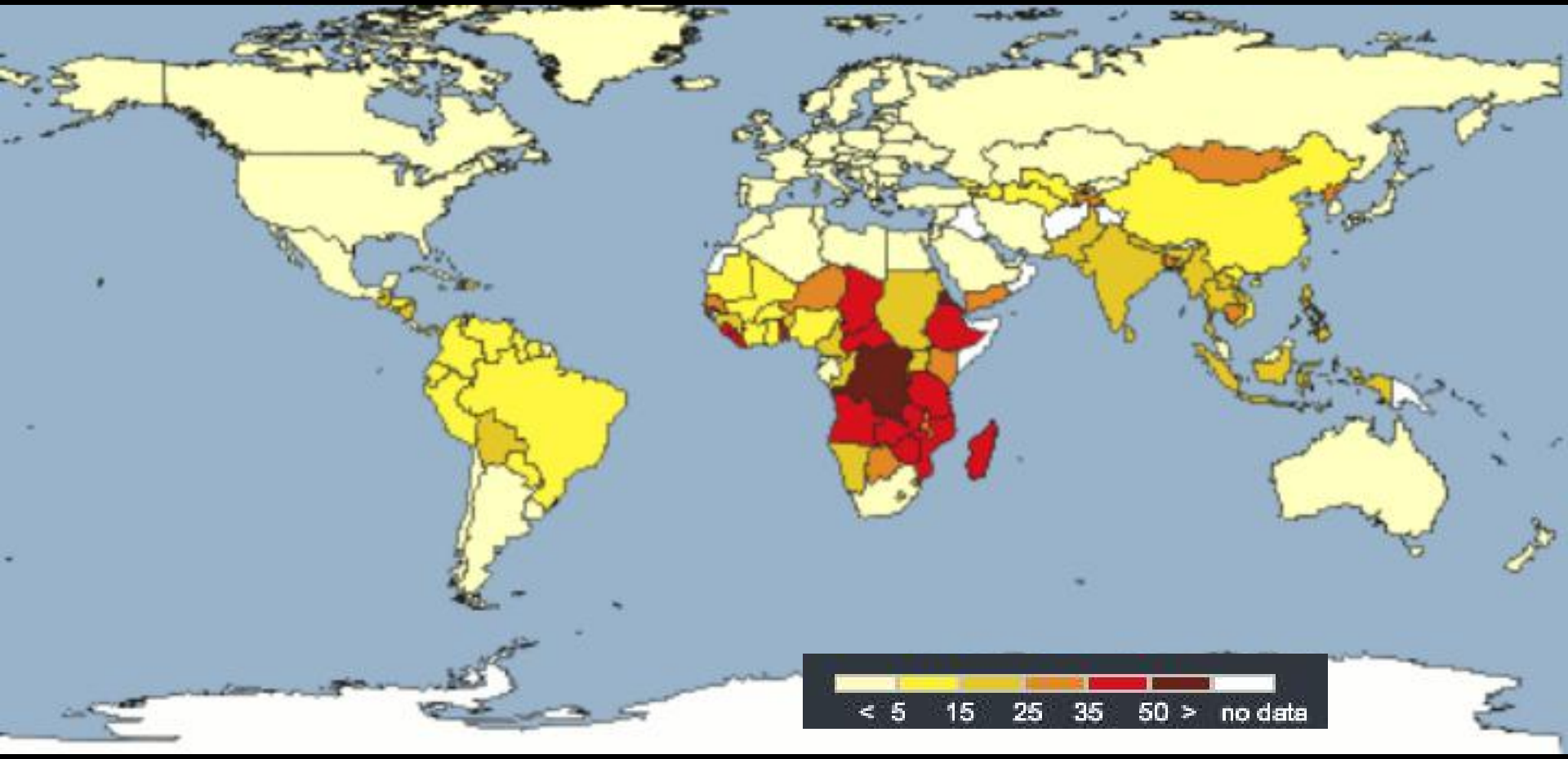
The Food and Agriculture Organization for the United Nations (FAO) and World Water Council (WWC)predict that the world needs to produce an estimated 60 percent more food by 2050 to ensure global food security, and it must do so while conserving and enhancing the natural resource base

Yields of maize, rice, wheat, and soybean all need to **INCREASE BY 60%,** by 2050 to meet demand but current growth in yield are falling short of the target.

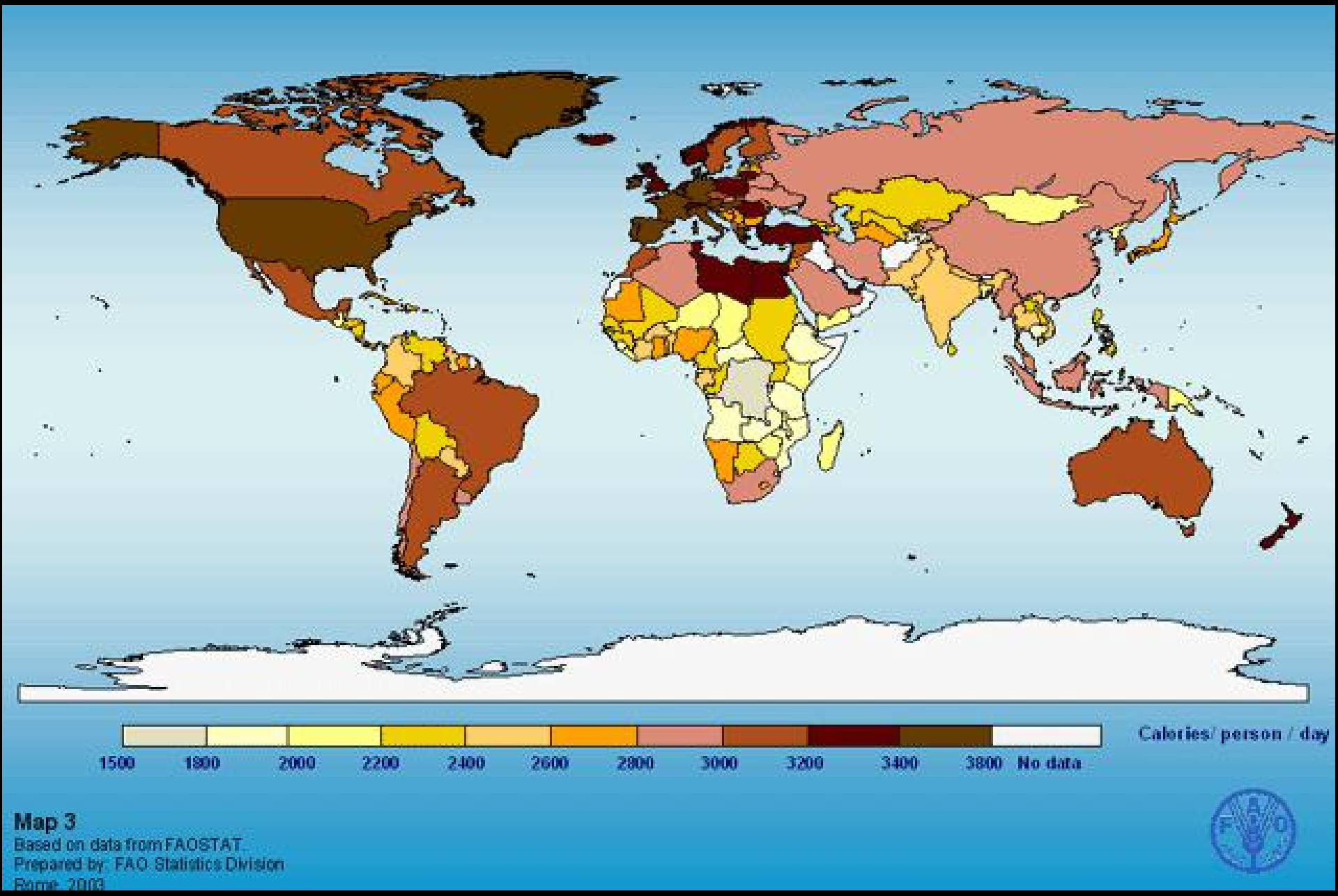


Source: Ray et al., 2013

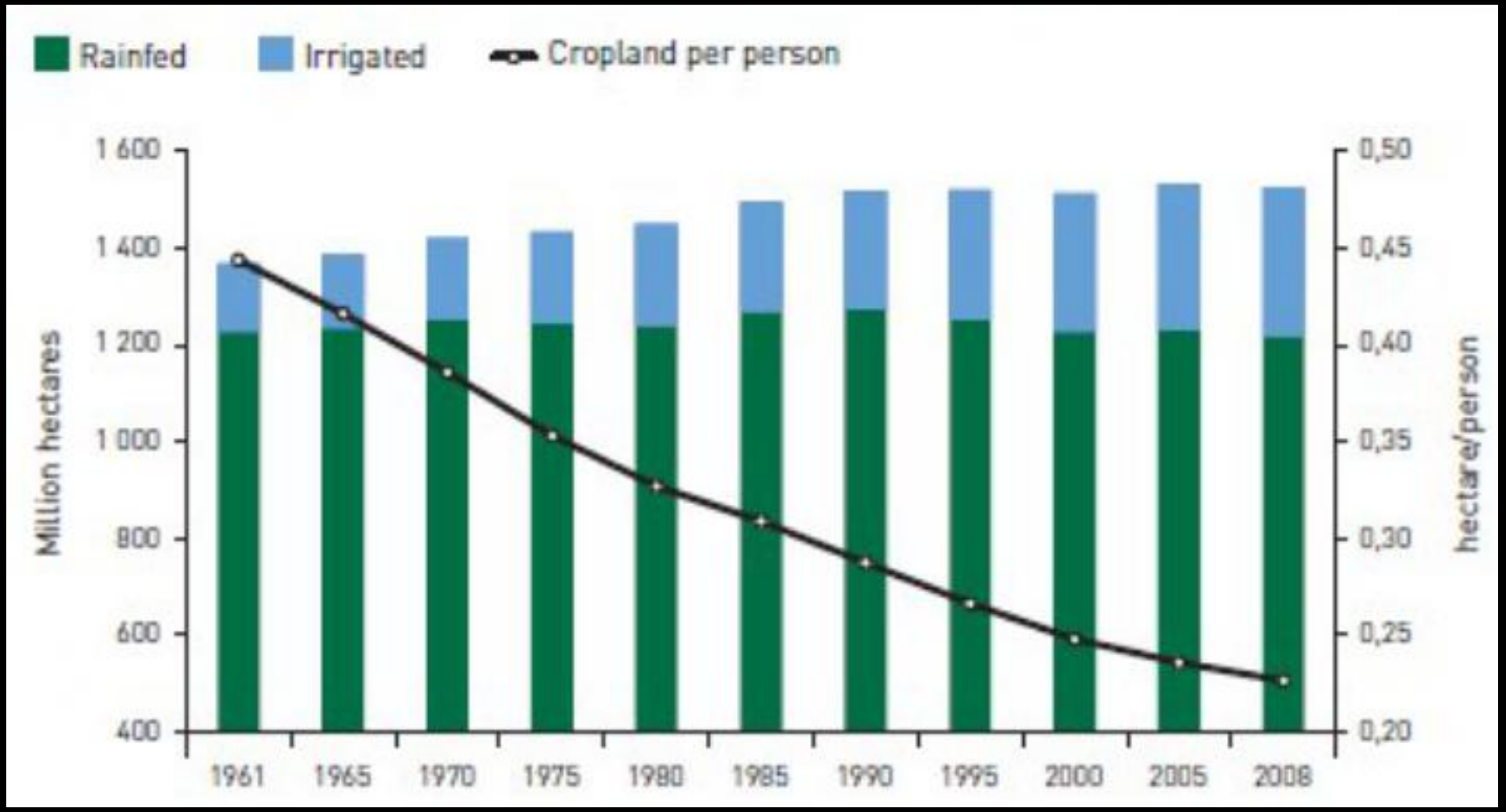
Undernourishment in Total Population (%)



Food consumption

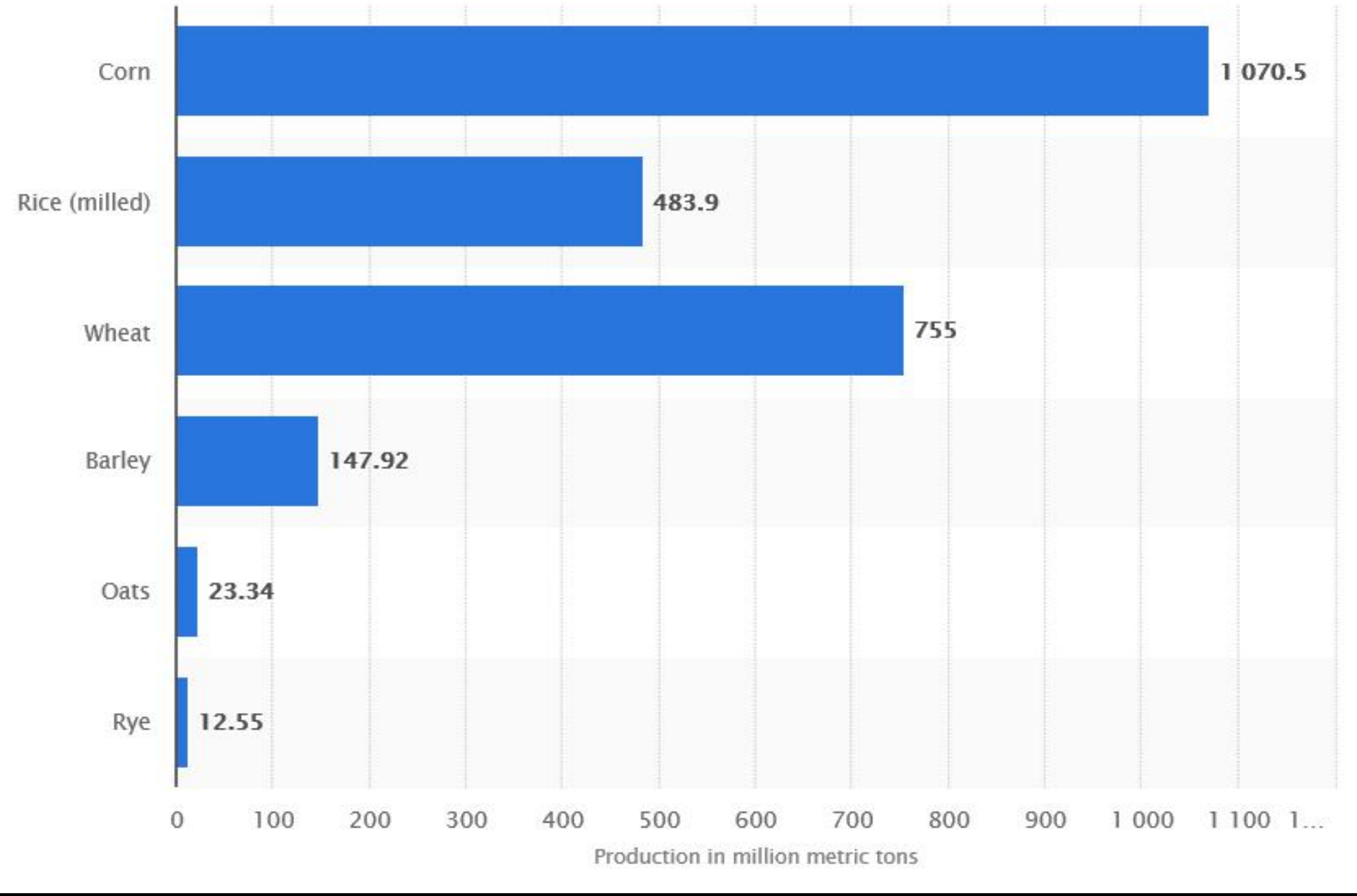


Land under irrigation and rainfed cropping

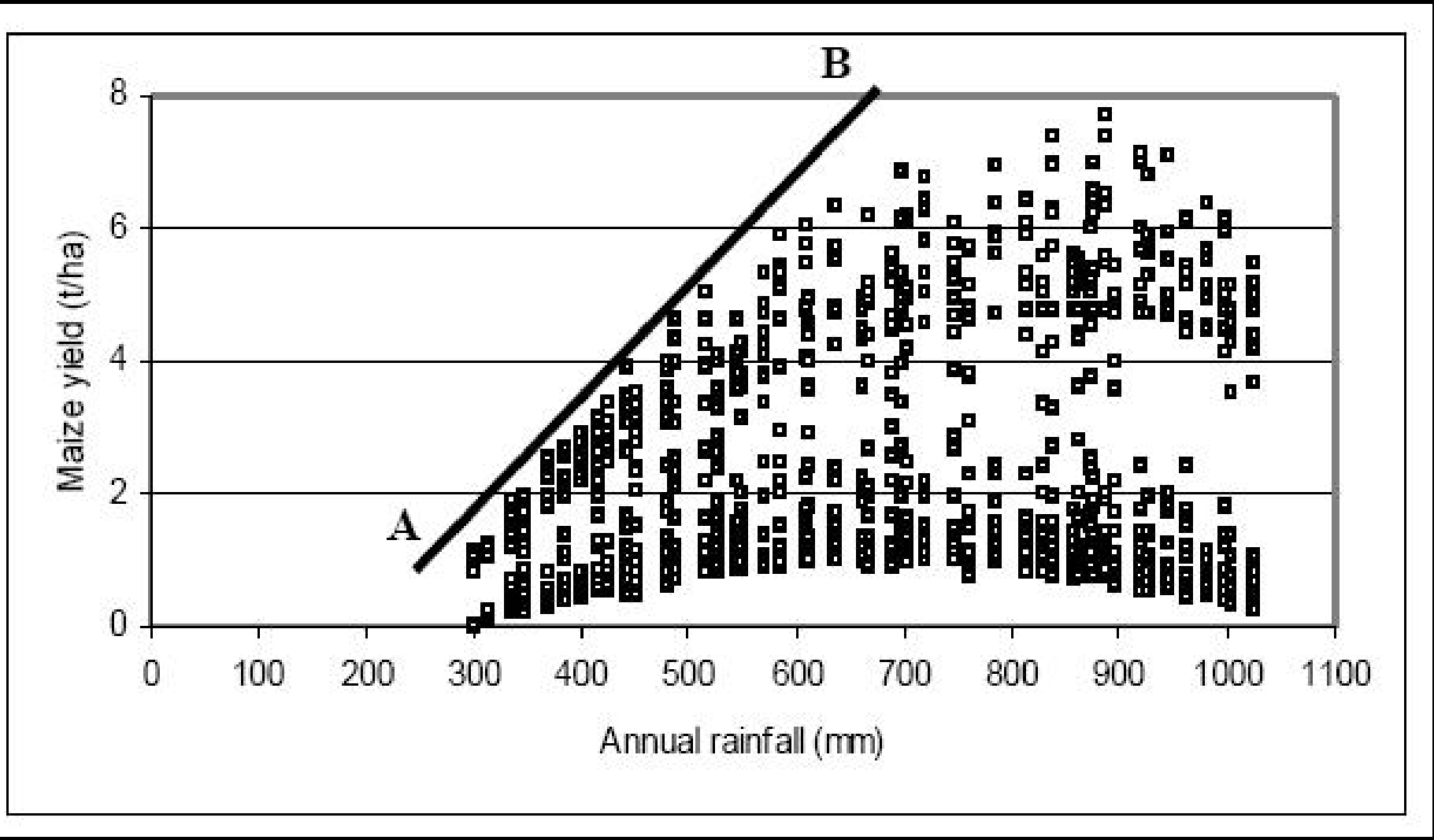


Cereal Production in the world in metric tons

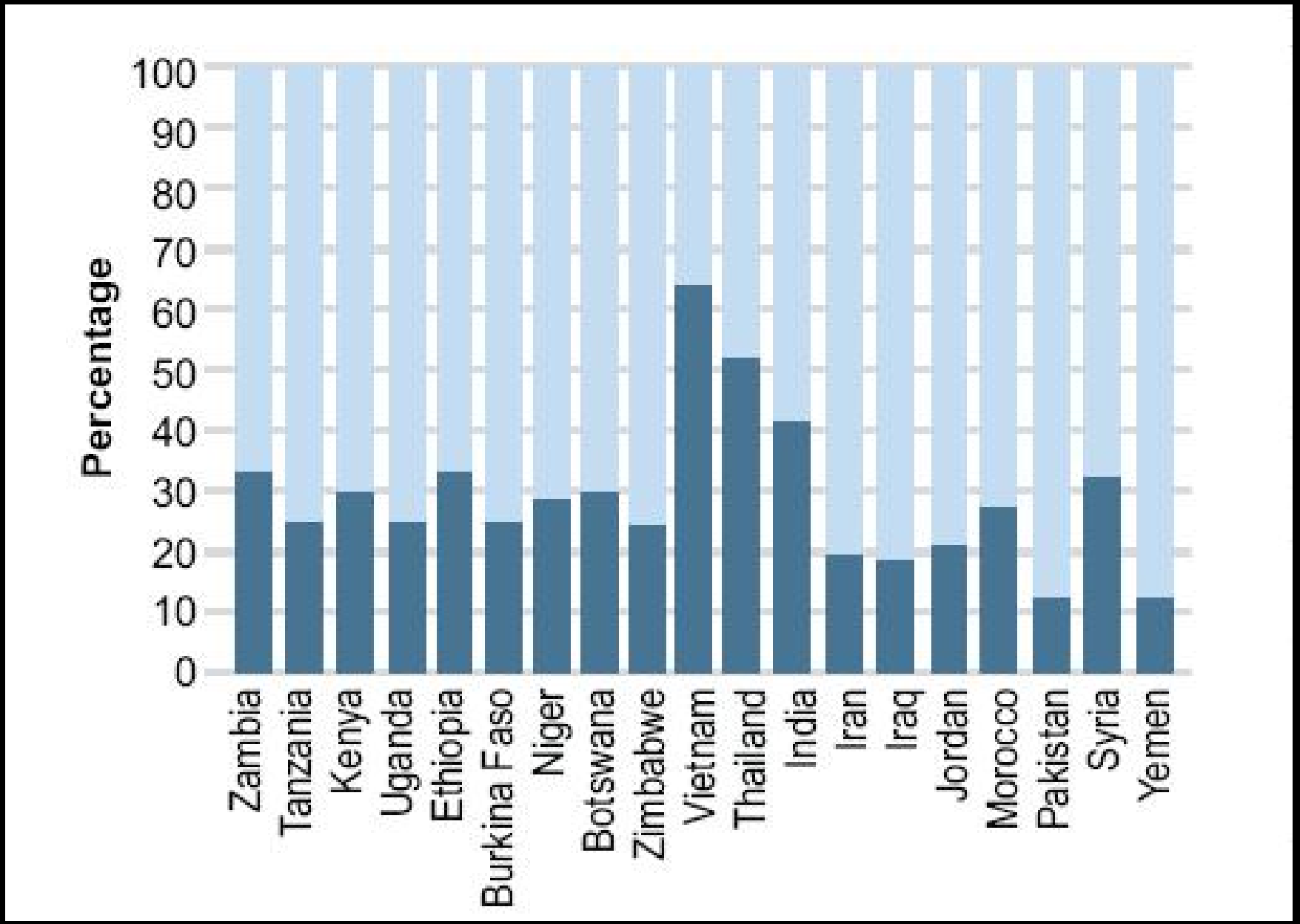
Worldwide production of grain in 2016/17



Maize yield as a funtion of annual rainfield



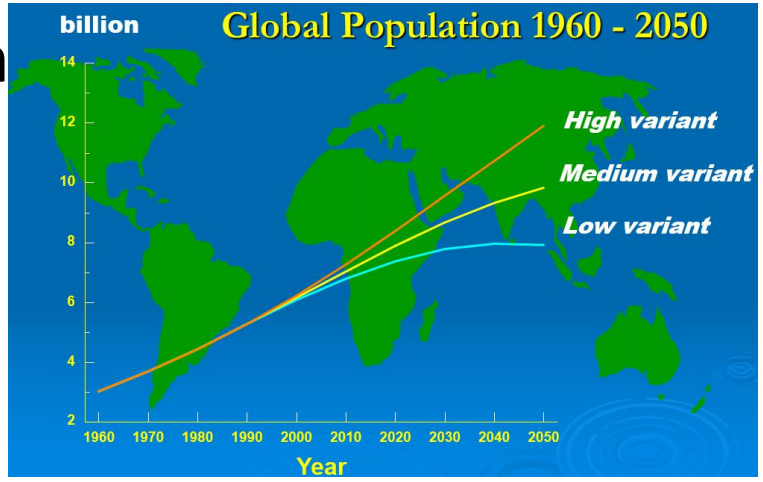
Gap between farmer's yields and achievable yields



What are some of the issues affecting world food security?

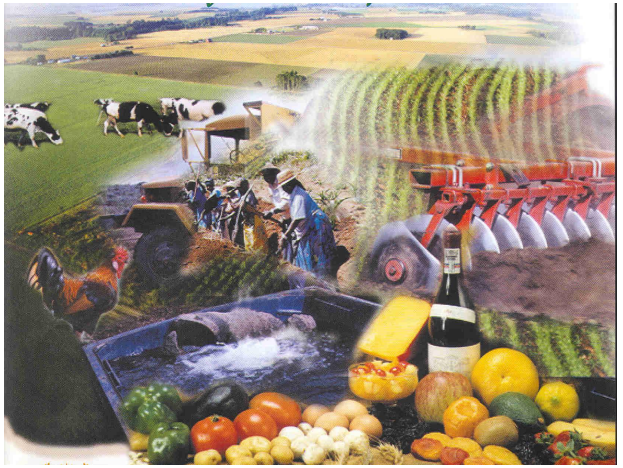
Food security is one of the biggest challenges facing humankind. There are many factors which have combined to make food security such a large issue. This includes:

- **Increasing population -** In 2012, the world population was 7 billion By 2050, it is predicted to reach 9 billion. Our current output of food is not enough to feed a population of 9 billion.



What are some of the issues affecting world food security?

- **Changing diets -** As countries develop and people become richer they tend to eat a more varied diet, including more meat, which requires more energy to produce. This also means there is more competition for the same types of food.



- **Reduced arable land -** The drive to produce more biofuels for transport uses edible crops and has reduced arable land.

Transport costs - The relatively high price of oil in recent years has increased the price of food storage and distribution.

Climate change - Climate change is leading to a warmer world which will affect what crops can be grown where. Climate change can also lead to more frequent extreme weather events (e.g. floods) which can damage crops.

Pests and diseases - Pests and diseases are becoming more resistant to pesticides and sprays. The changing climate is also bringing pest and diseases into new areas where they could not previously survive.

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 and Mission

Vision

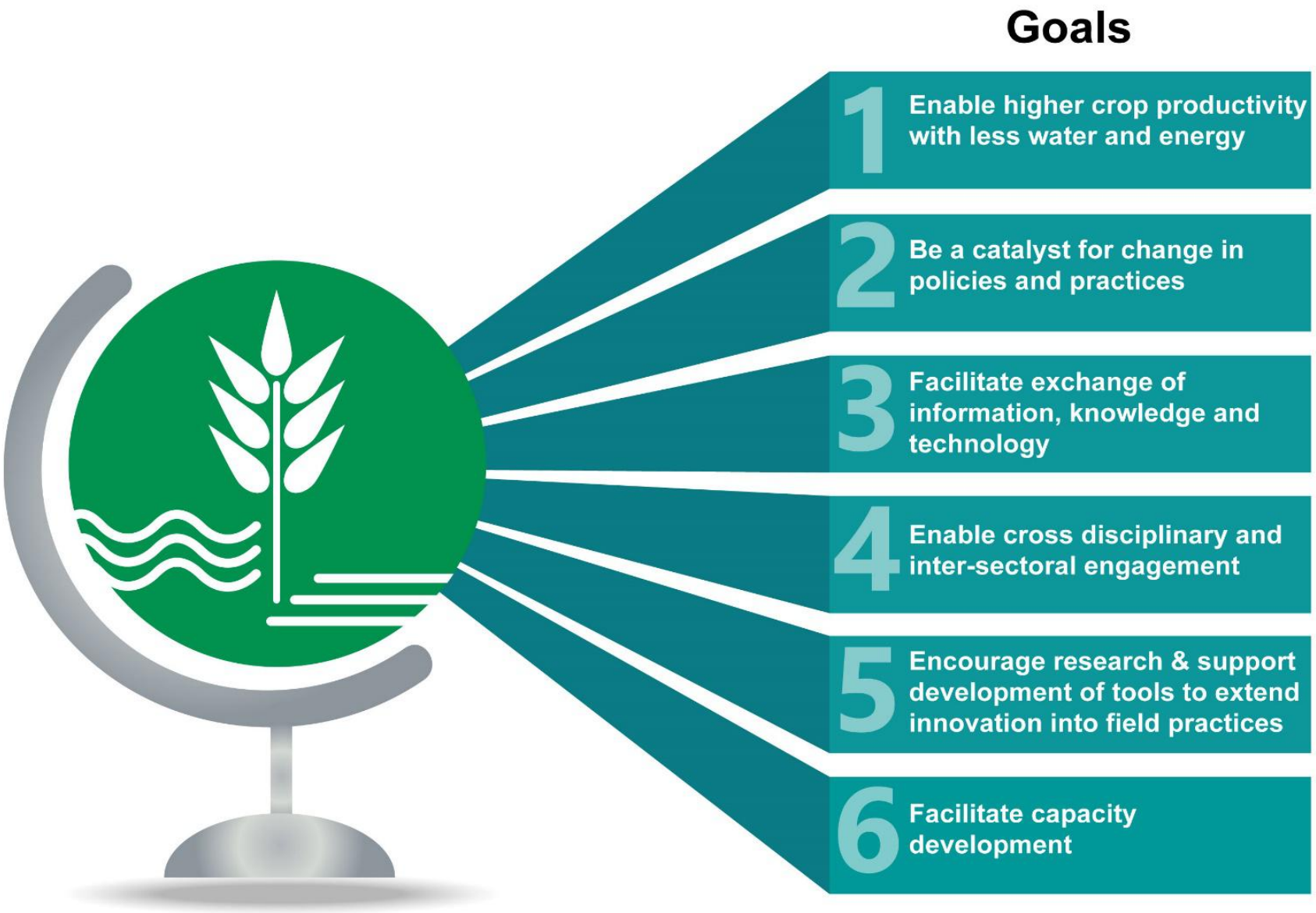
Water secure world free of poverty and hunger through sustainable rural development

Mission

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

ICID•CIID

Roadmap to ICID Vision 2030 Organisation Goals



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

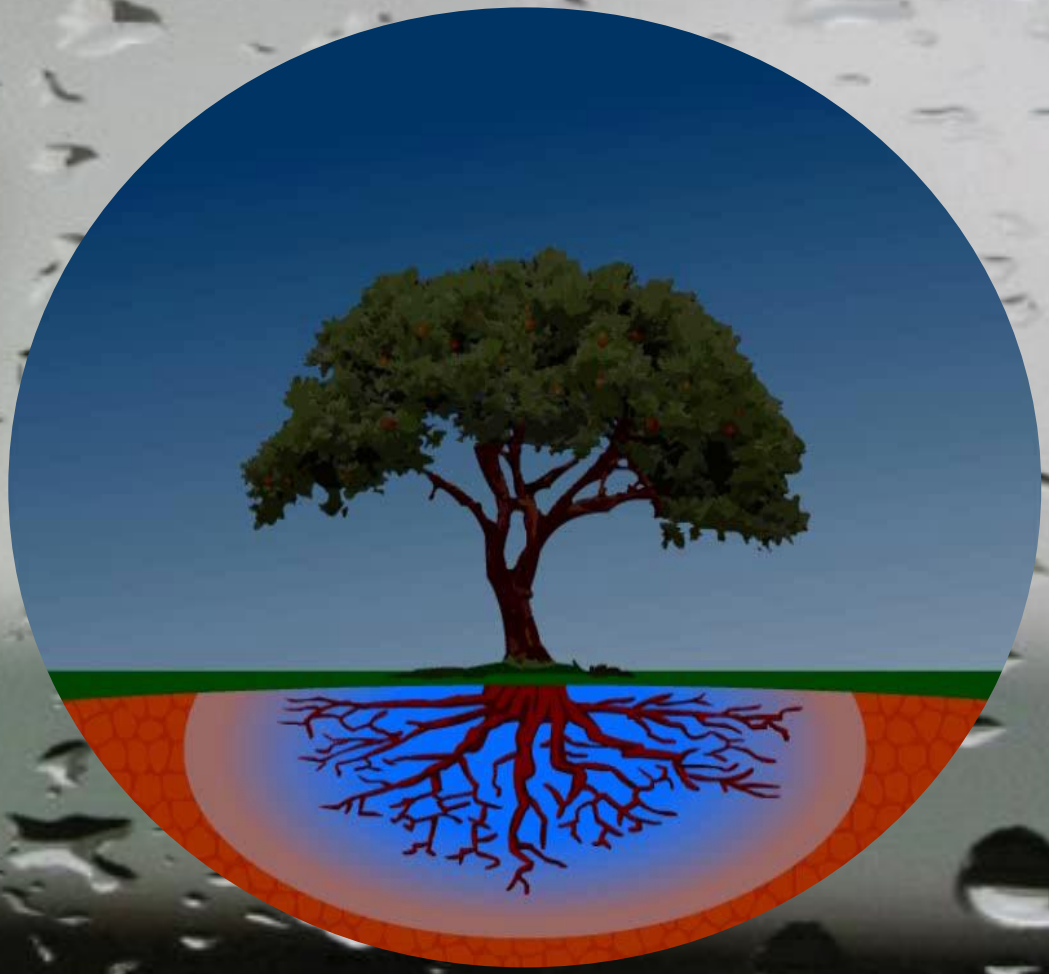
A5 : Supporting water productivity enhancement

A6 : Improving performance of irrigation systems

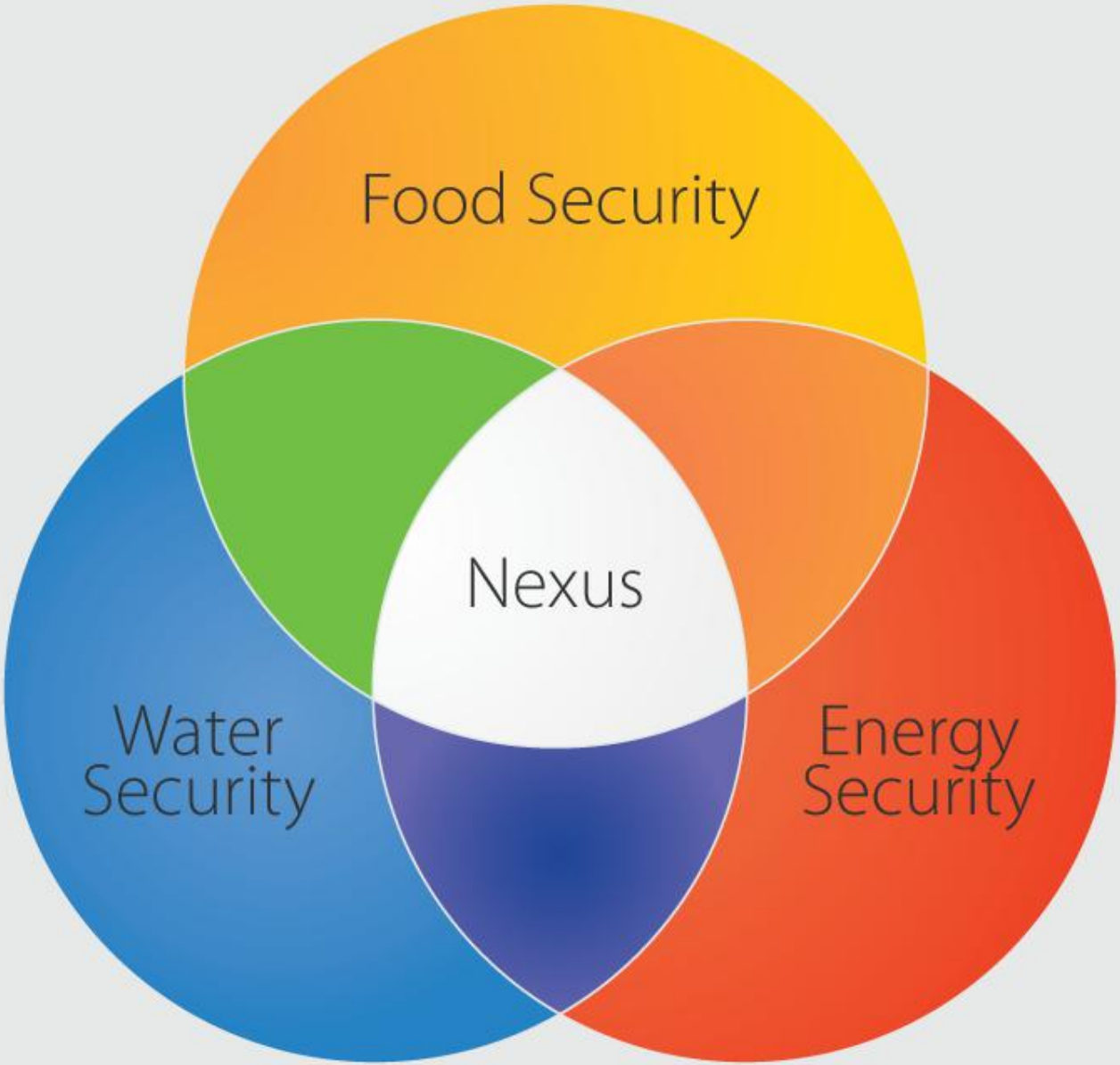
A7 : Using wastewater or poor quality water for irrigation

A8 : Encouraging participatory management of irrigation systems

ICID•CIID



In Closure

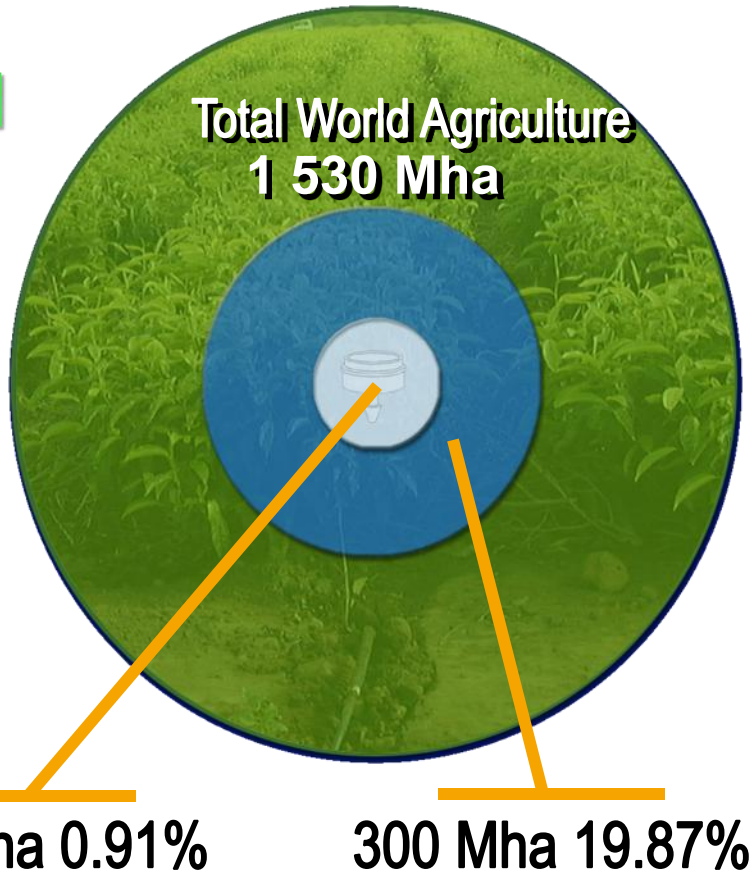

Food Security
Nexus
Water Security
Energy Security

Cultivated Land Worldwide

- 1 530 Mha – Total world Agriculture Area
- 300 Mha – Currently under Irrigation

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

- 14 Mha - Drip irrigated



Source: ICID - CIID

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'.

COUNT EVERY DROP
BECAUSE EVERY
DROP COUNTS