The NEXUS of Land, Food, Energy and Water.

Richard Harding

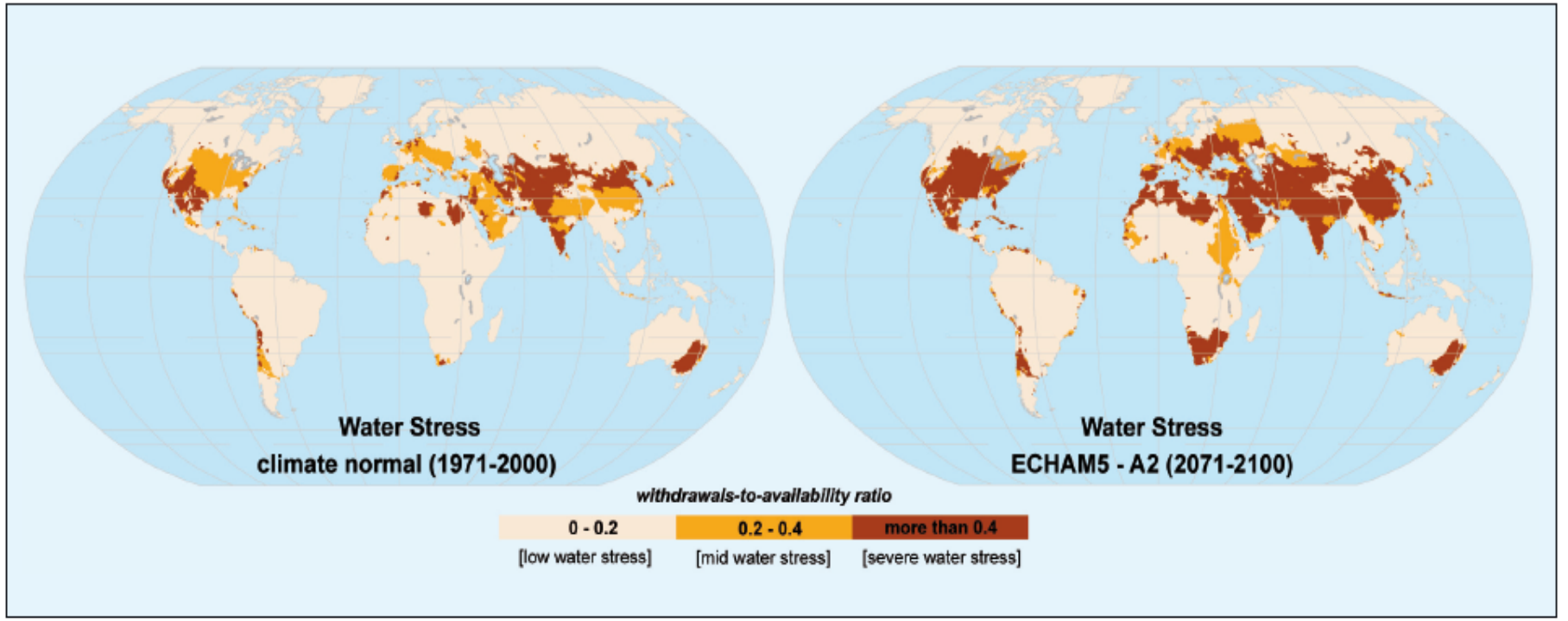


Figure 1: Water stress, calculated as the ratio between water withdrawals and availability, for the late 20th and 21st centuries (see Flörke and Eisner 2011).

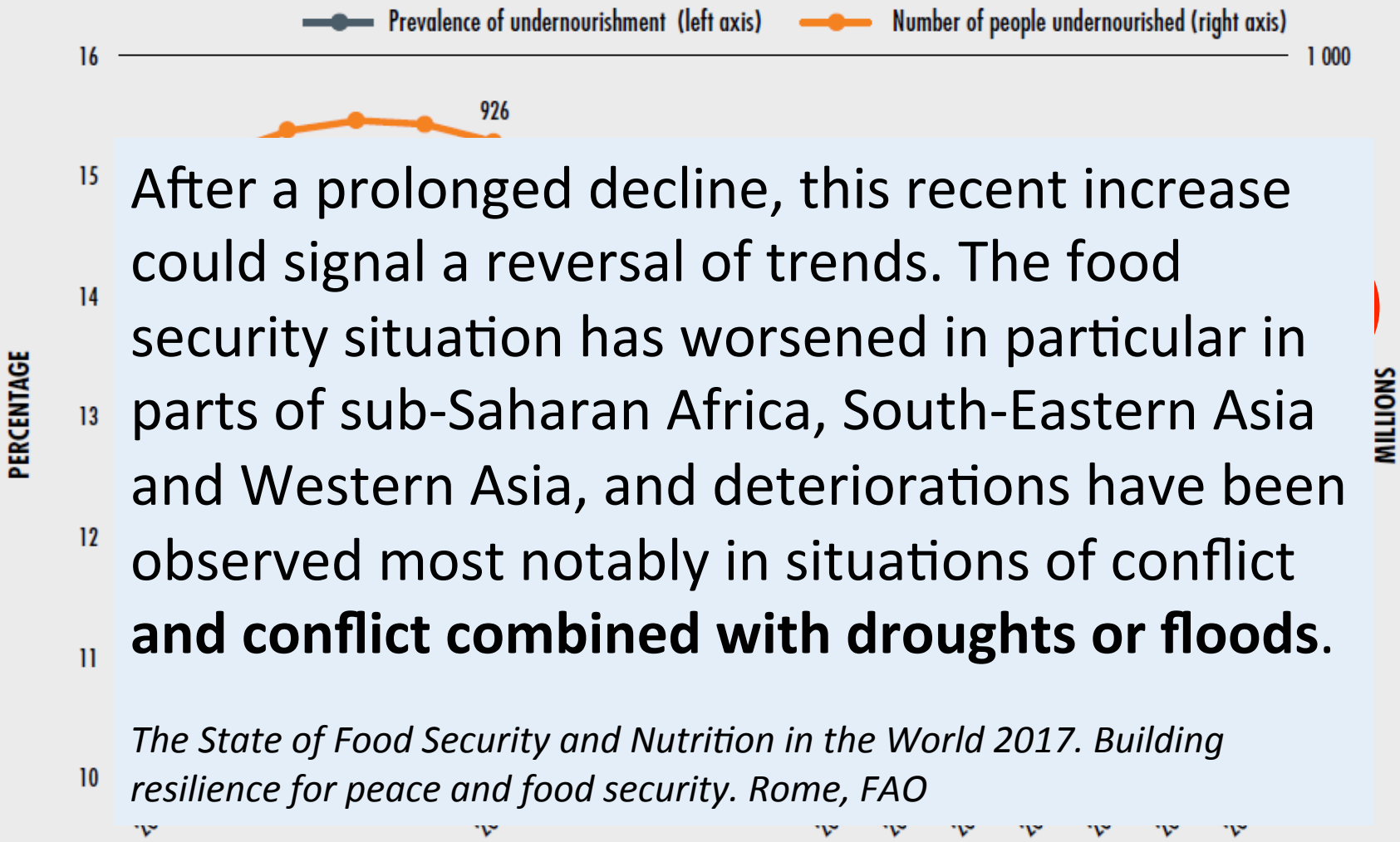
The number of water basins experiencing severe water stress is projected to increase to 40% by 2100

Growth in global urban and rural populations to 2050

Source: UN, 2015.

Image from: FAO. 2017. The future of food and agriculture – Trends and challenges. Rome

THE NUMBER OF UNDERNOURISHED PEOPLE HAS BEEN ON THE RISE SINCE 2014, REACHING AN ESTIMATED 815 MILLION IN 2016

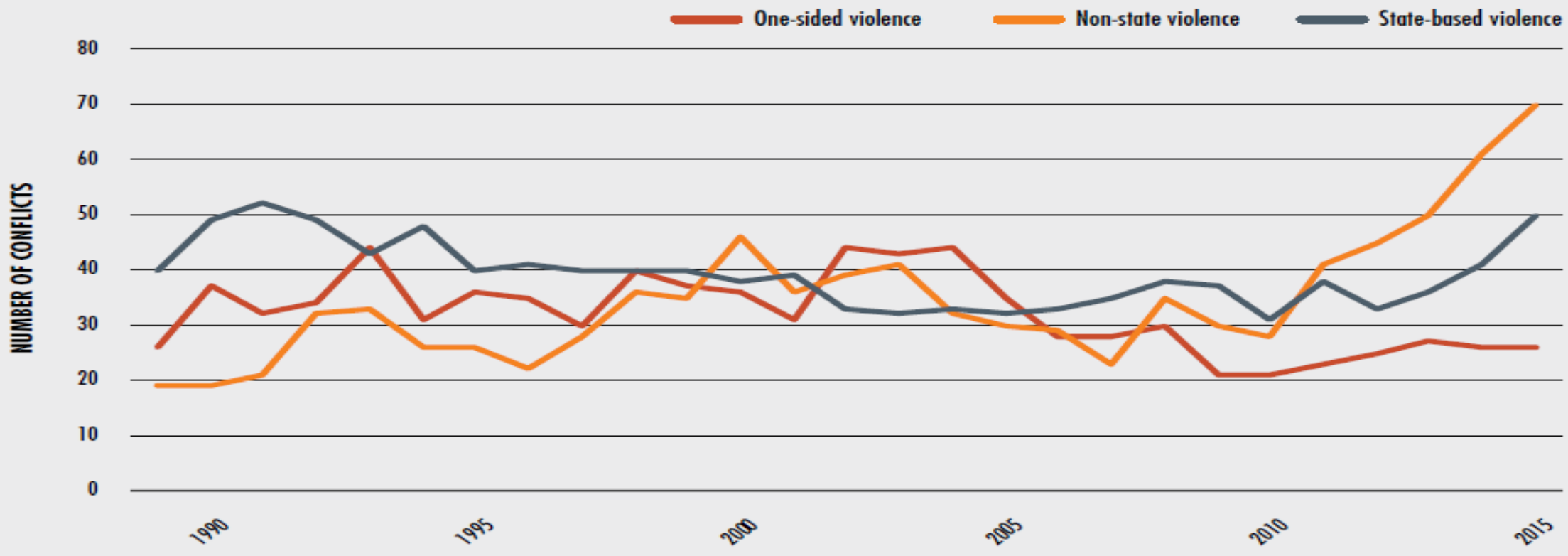


After a prolonged decline, this recent increase could signal a reversal of trends. The food security situation has worsened in particular in parts of sub-Saharan Africa, South-Eastern Asia and Western Asia, and deteriorations have been observed most notably in situations of conflict **and conflict combined with droughts or floods**.

The State of Food Security and Nutrition in the World 2017. Building resilience for peace and food security. Rome, FAO

NOTE: Prevalence and number of undernourished people in the world, 2000–2016.
Figures for 2016 are projected estimates (see Box 1 on p. 4 and Methodological notes in Annex 1, p. 95).
SOURCE: FAO.

MARKED INCREASE IN THE NUMBER OF CONFLICTS SINCE 2010



SOURCE: Uppsala Conflict Data Program (UCDP)

815 million people in the world – or just over one in nine – are undernourished. The majority of these (489 million) live in countries struggling with conflict, violence and fragility, where the prevalence of undernourishment is higher than in countries not affected by conflict.

TABLE 4

CONFLICT AND CLIMATE-RELATED SHOCKS ASSOCIATED WITH FOOD CRISIS SITUATIONS IN 2016

Country	Main climate/weather adverse effect on food security	Number of food-insecure people (IPC/CH phase 3+) in millions
Afghanistan	Floods, landslides in winter; drought in Ghor province	8.5
Burundi	El Niño phenomenon	2.3
Central African Republic	Localized floods	2.0
Democratic Republic of the Congo	El Niño phenomenon	5.9
Iraq*	Drought	1.5
Somalia	El Niño-related drought	2.9
South Sudan	Drought and floods	4.9
Sudan	El Niño phenomenon	4.4
Syrian Arab Republic*	Drought in Aleppo, Idlib and Homs	7.0
Yemen	Flooding, heavy rains and tropical cyclones	14.1
Total		**53.5**

NOTE: Figures for food-insecure populations for countries indicated with an asterisk are reported by the government, Food Security Cluster (HNO or HRP) or WFP-CARI; figures for South Sudan and Somalia refer to IPC analyses conducted in January and February 2017, using data from 2016.

SOURCE: Food Security Information Network (FSIN). 2017. *Global Report on Food Crises 2017*. Rome.

The Cycle of Climate, Food and Conflict

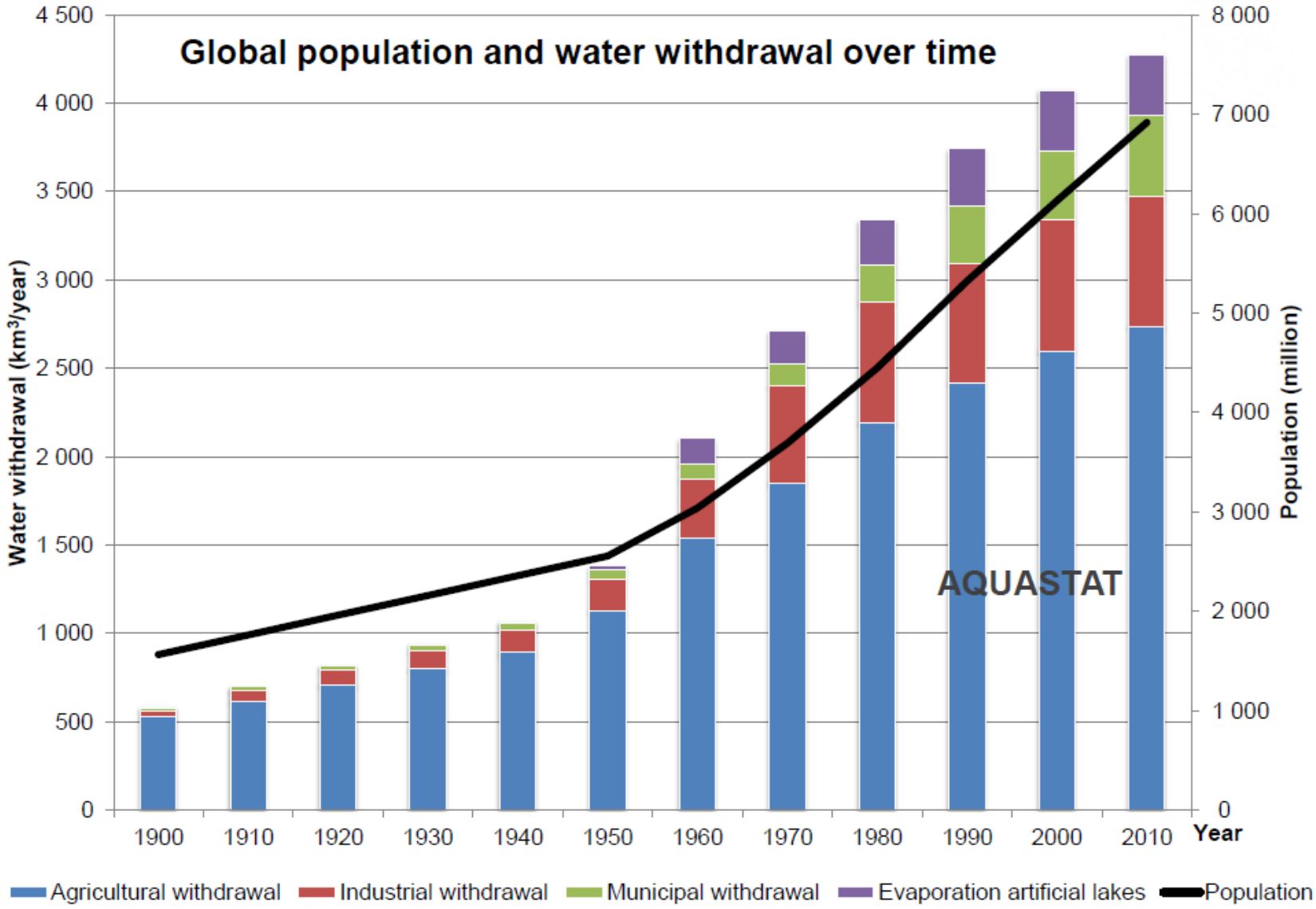
Food shortages

‘Natural’ disasters:
Floods
Droughts
Storms

resilience

Conflict

Global Water Use



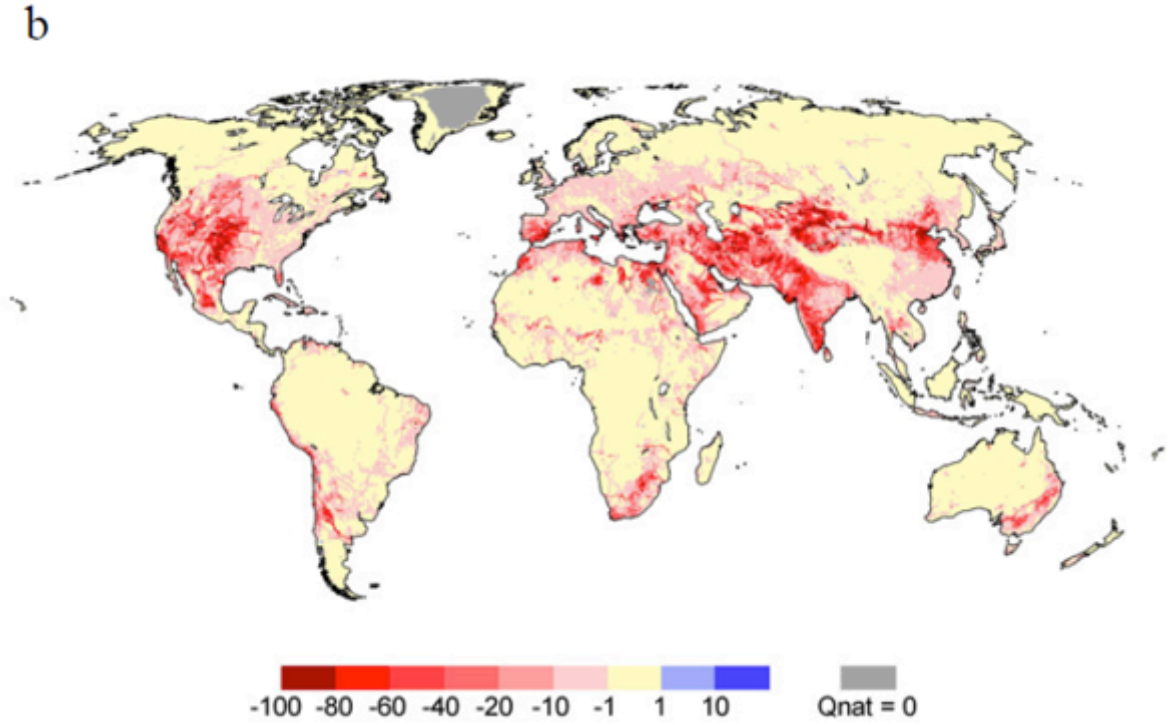
http://www.fao.org/nr/water/aquastat/water_use/index.stm

Date of preparation: September 2015

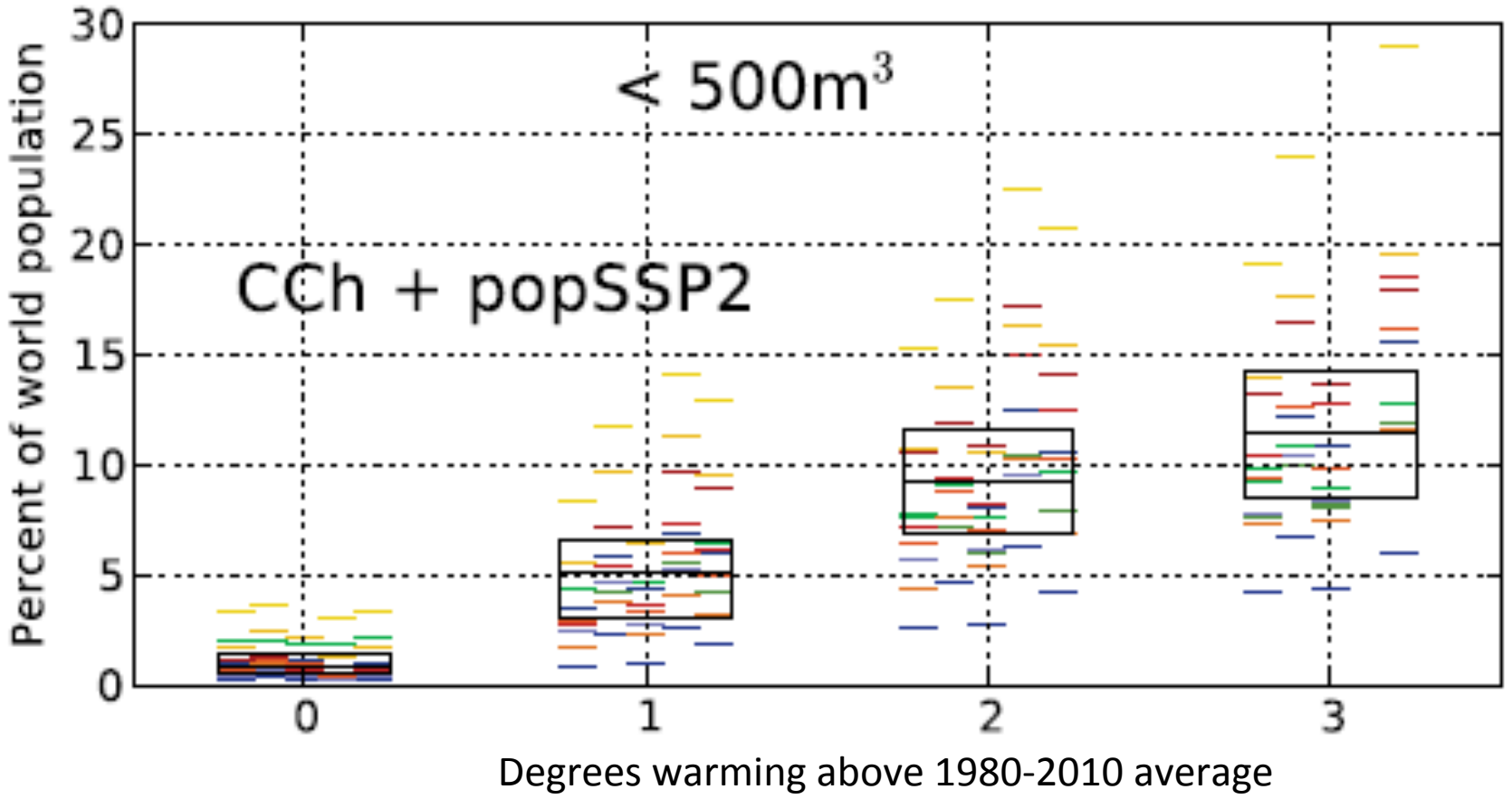
Global Water Resources

Total annual land precipitation = 115 x 10^3 km^3
Total annual runoff = 49 x 10^3 km^3
Total capacity of reservoirs = 7.4 x 10^3 km^3
Annual water use for irrigation = ~1.5 x 10^3 km^3
Unsustainable groundwater extraction = 0.23 x 10^3 km^3 yr^{-1}

Anthropogenic impact on average river discharge



Doll et al 2009



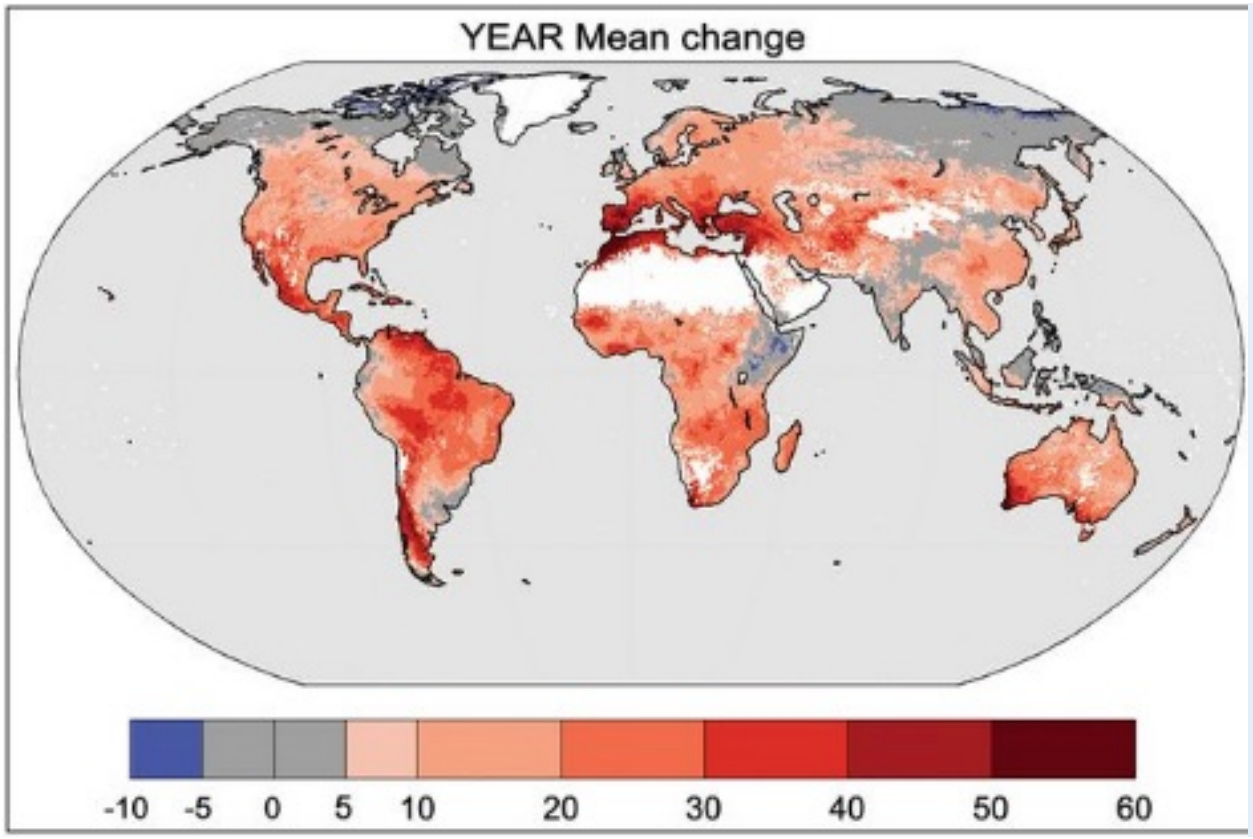
Five climate models and nine hydrology/land surface models

Percentage of world population living in countries with annual mean Blue Water availability below 500 m^3 per capita ('absolute' water scarcity)

ISIMIP
Inter-Sectoral Impact Model Intercomparison Project

From: Schewe et al 2014

Increasing Occurrence of Drought



Percentage change in the occurrence of days under drought conditions for the period 2070–2099 relative to 1976–2005, based on a multimodel ensemble experiment under RCP8.5

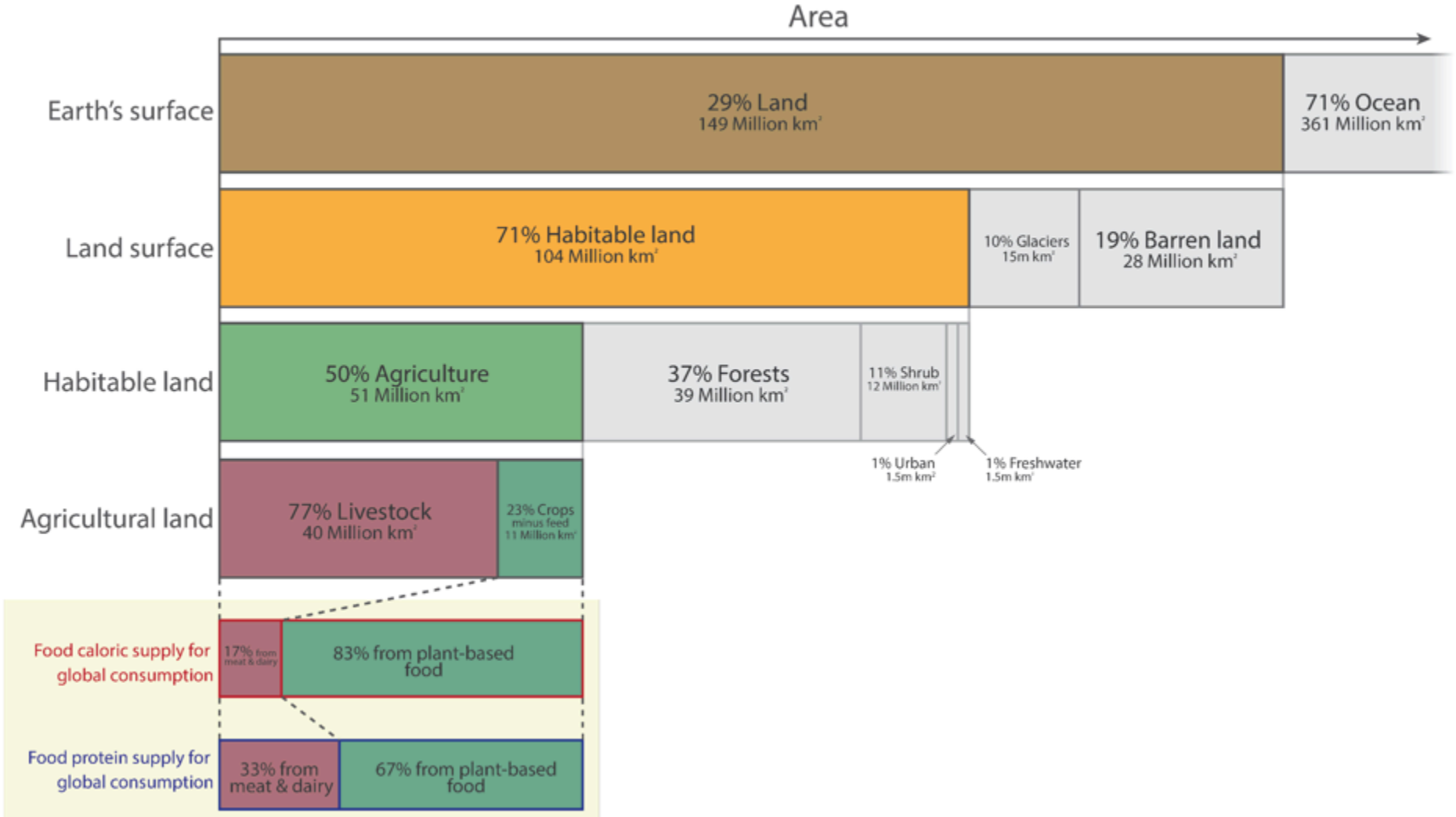
Prudhomme et al 2014

ISIMIP
Inter-Sectoral Impact Model Intercomparison Project

Global surface area allocation for food production

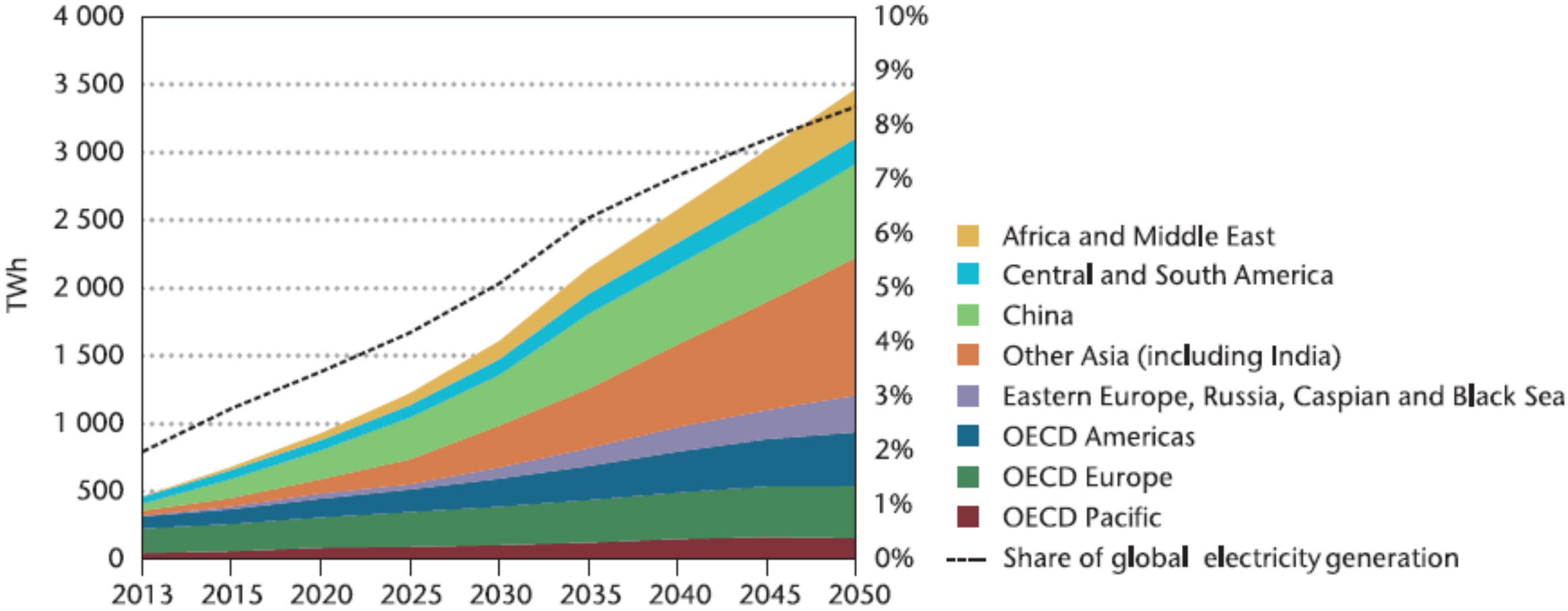
Our World in Data

The breakdown of Earth surface area by functional and allocated uses, down to agricultural land allocation for livestock and food crop production, measured in millions of square kilometres. Area for livestock farming includes grazing land for animals, and arable land used for animal feed production. The relative production of food calories and protein for final consumption from livestock versus plant-based commodities is also shown.

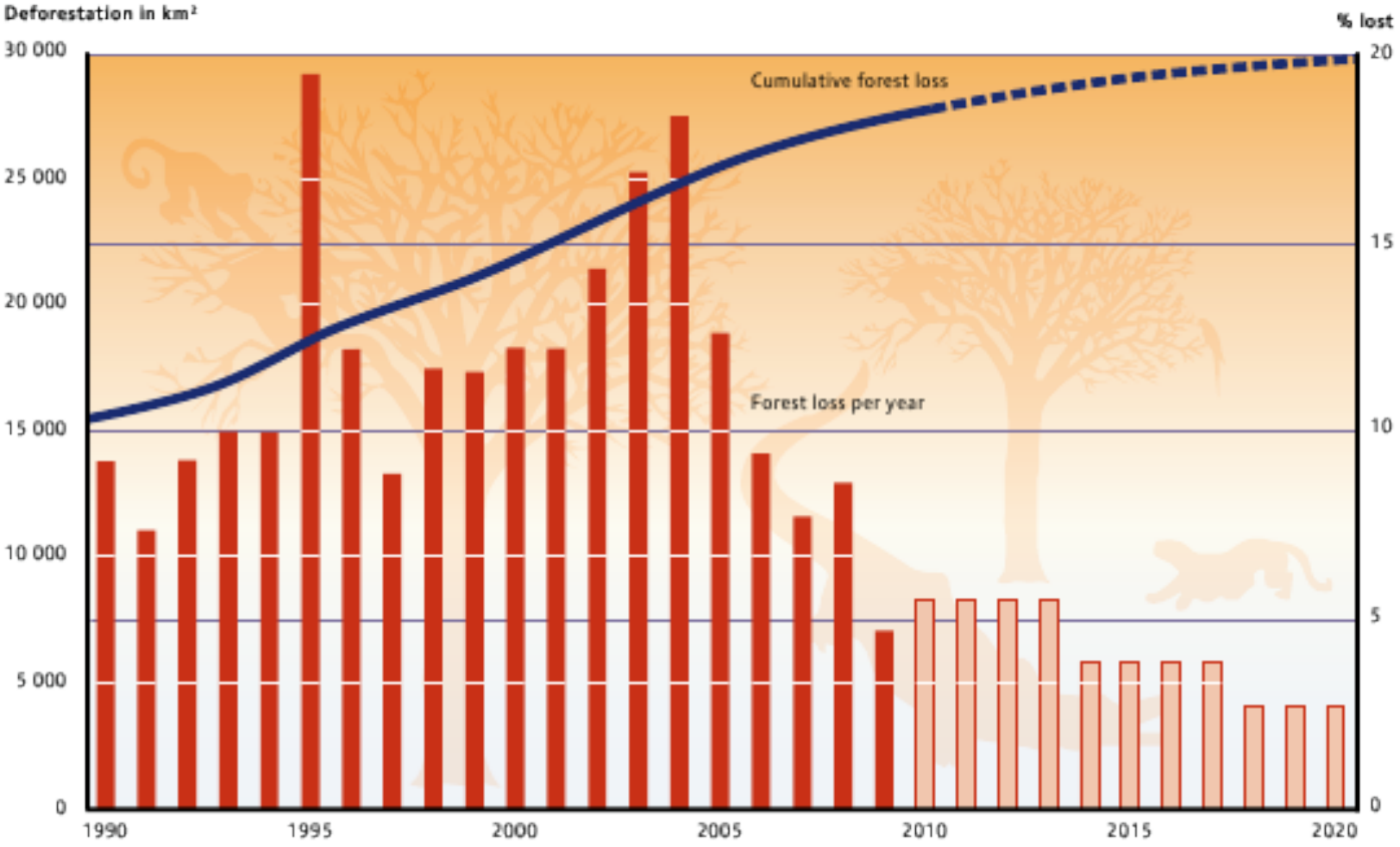


Data source: based on UN Food and Agricultural Organization (FAO) Statistics.
The data visualization is available at OurWorldinData.org. There you find research and more visualizations on this topic.

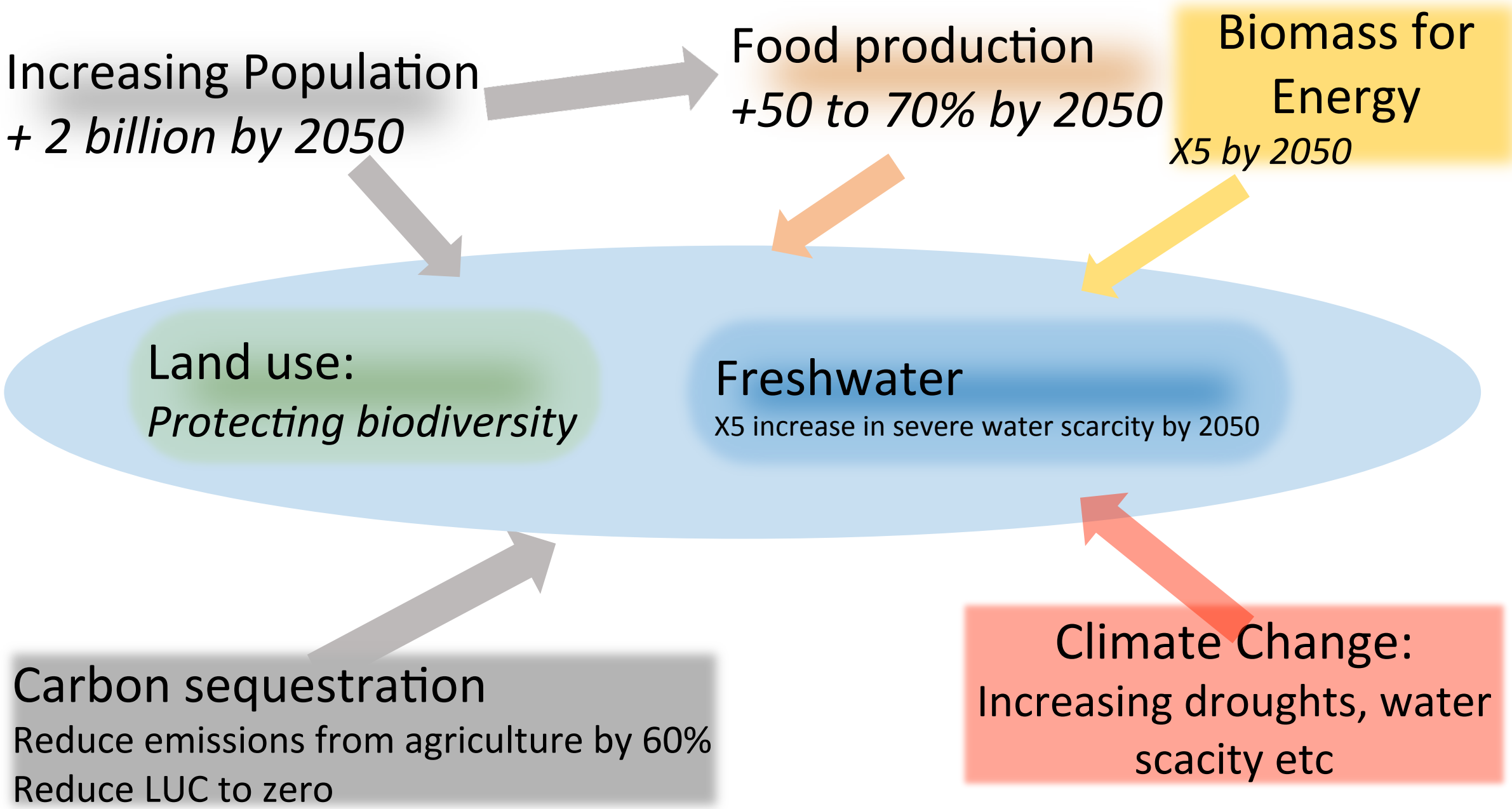
Figure 9: Global vision of biomass for electricity generation



Source: IEA analysis based on data from the *Energy Technology Perspectives* (ETP) 2°C Scenario (2DS) (IEA, 2016c).



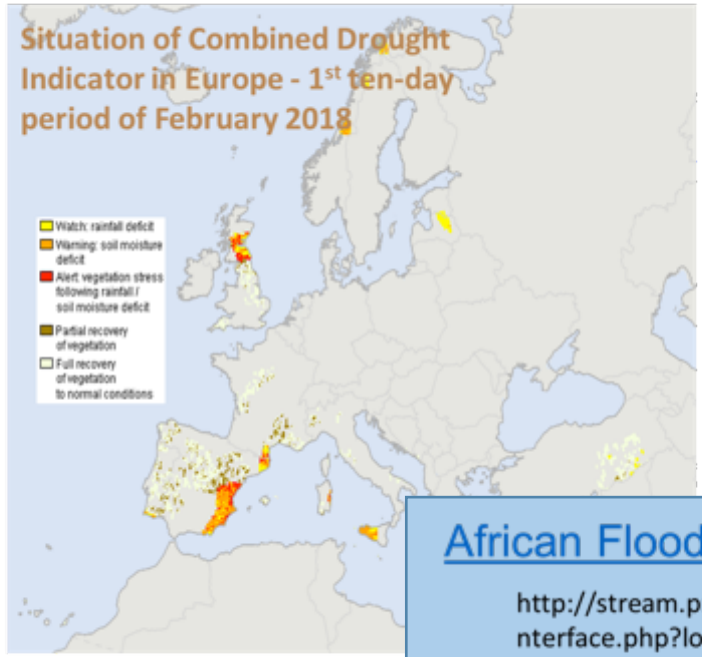
Source: Brazilian National Space Research Agency (INPE), graph compiled by
Secretariat of the Convention on Biological Diversity (2010) Global Biodiversity Outlook 3, May 2010, p.33


Increasing Population
+ 2 billion by 2050
Food production
+50 to 70% by 2050
Biomass for Energy
X5 by 2050
Land use:
Protecting biodiversity
Freshwater
X5 increase in severe water scarcity by 2050
Carbon sequestration
Reduce emissions from agriculture by 60%
Reduce LUC to zero
Climate Change:
Increasing droughts, water scacity etc

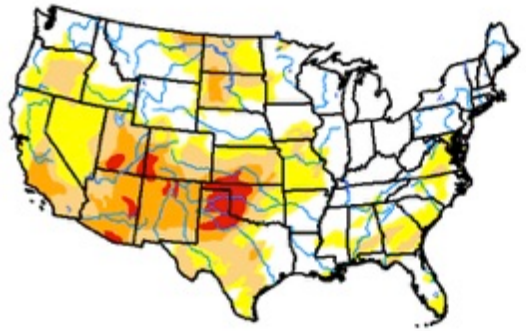
Solutions:

- Climate-smart water management
- Good soil management
- Agriculture risk management tools
- Disaster management
- Agriculture information systems
- Promoting carbon sequestration

European Drought Observatory



http://edo.jrc.ec.europa.eu/edov2



February 27, 2018
(Released Thursday, Mar. 1, 2018)
Valid 7 a.m. EST

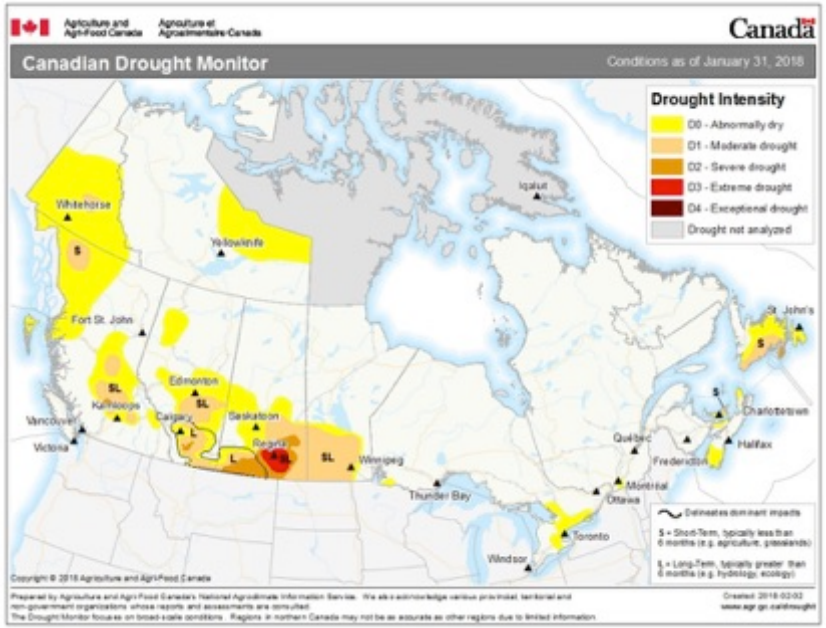
Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	45.34	54.66	31.30	14.31	3.22	0.00
Last Week 02-20-2018	40.71	59.29	36.48	17.75	3.22	0.00
3 Months Ago 11-28-2017	57.34	42.66	21.14	4.88	1.03	0.00
Start of Calendar Year 01-02-2018	44.46	55.54	27.70	7.46	0.83	0.00
Start of Water Year 09-26-2017	63.07	36.93	13.81	4.99	2.36	0.87
One Year Ago 02-28-2017	66.28	33.72	14.08	3.68	0.49	0.00

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

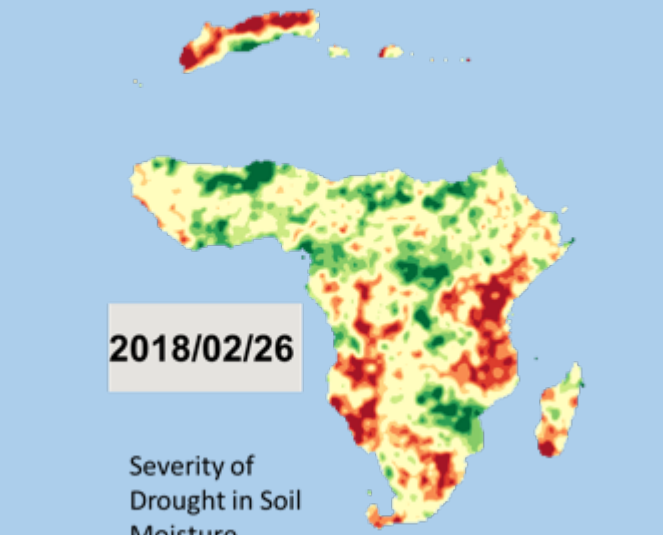
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Deborah Bathke
National Drought Mitigation Center



African Flood and Drought Monitor

http://stream.princeton.edu/AWCM/WEBPAGE/interface.php?locale=en



WMO Global Hydrological Status and Outlook System (HydroSOS)

http://www.wmo.int/pages/prog/hwrp/chy/hydrosos/

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WORLD METEOROLOGICAL ORGANIZATION
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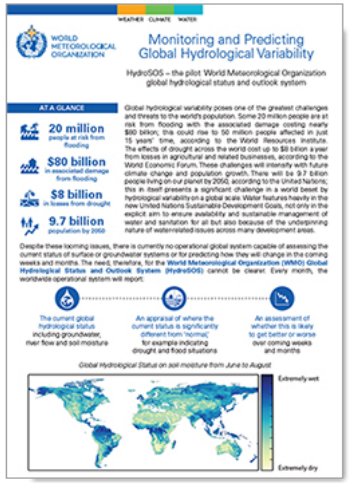
WMO Global Hydrological Status and Outlook System (HydroSOS)

The challenge

Globally hydrological variability poses one of the greatest threats to the world's population. There are an increasing number of people at risk from water-related hazards and rapidly growing demands on water resources. However, there is currently no global system which is capable of assessing the current status of surface and groundwater systems or predicting how they will change in the immediate future.



HydroSOS plans to provide the crucial global scale information needed to help citizens understand the current status of the world's freshwater systems and adapt in light of the near-future outlook by harnessing new technologies and link up other initiatives to enable us to better answer questions like: "How much water is there in rivers around the world at the moment?", "Is the current situation normal?", and "How might the global flood/drought situation change in the coming few months?".

The ambition

The long-term aim of this initiative would be to develop a worldwide operational system at monthly timescales capable of providing:

1. An indication of the current global hydrological status (including: groundwater, river flow,

Hydrology and Water Resources
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Water Resources Assessment
Hydrological Forecasting and Prediction
Water, Climate and Risk Management
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Publications
Contact

UN WATER
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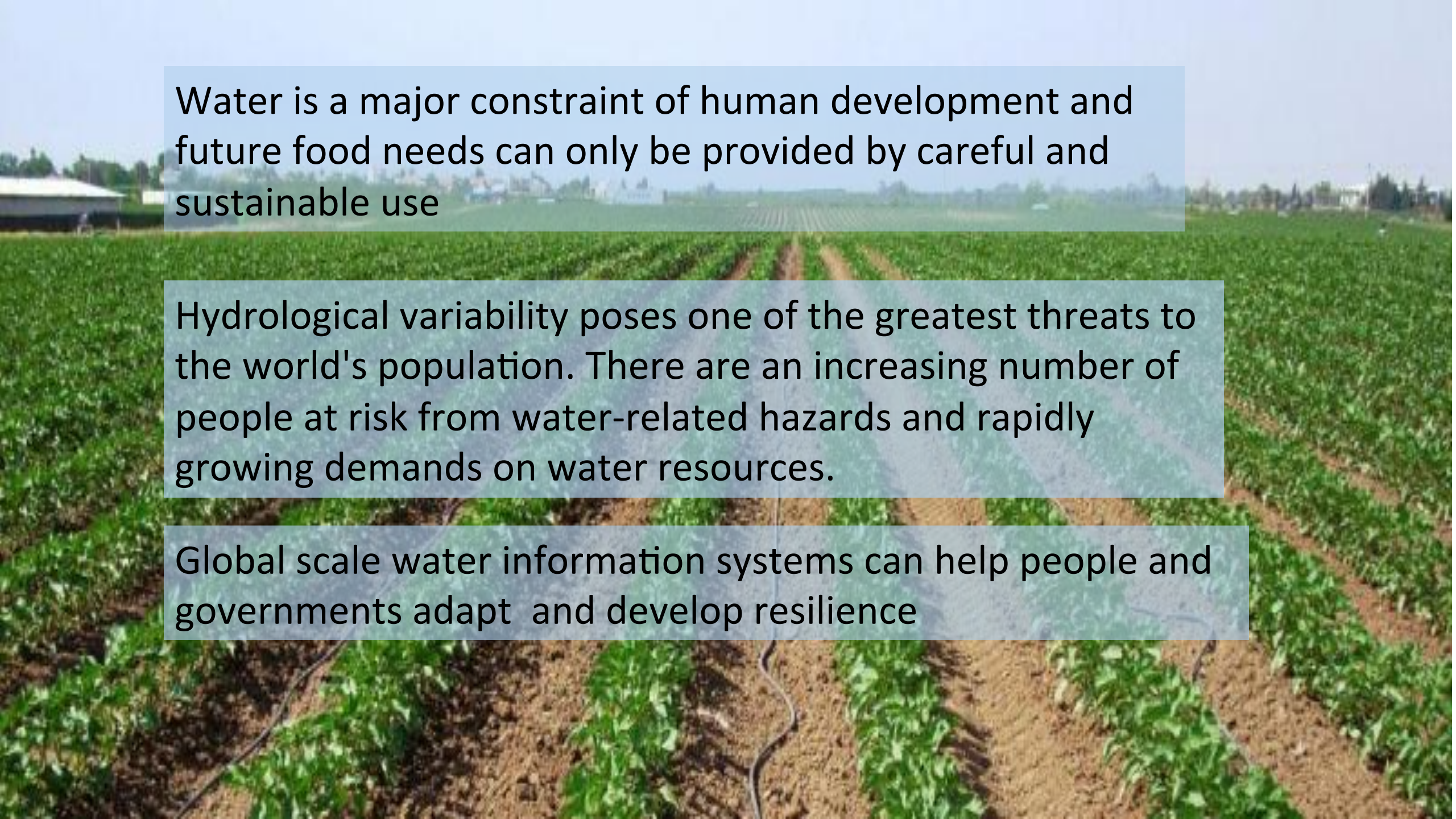

Water is a major constraint of human development and future food needs can only be provided by careful and sustainable use

Hydrological variability poses one of the greatest threats to the world's population. There are an increasing number of people at risk from water-related hazards and rapidly growing demands on water resources.

Global scale water information systems can help people and governments adapt and develop resilience