



Wasser Konfliktstoff des Jahrhunderts

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Klimawandel

Wasser

Nahrung

Energie



Dublin Konferenz 1992

UNDP 2000 MDG Millenium Development Goal

„Zahl der Menschen ohne Trinkwasser, ohne sanitäre Anlagen und Nahrung bis 2015 halbieren“

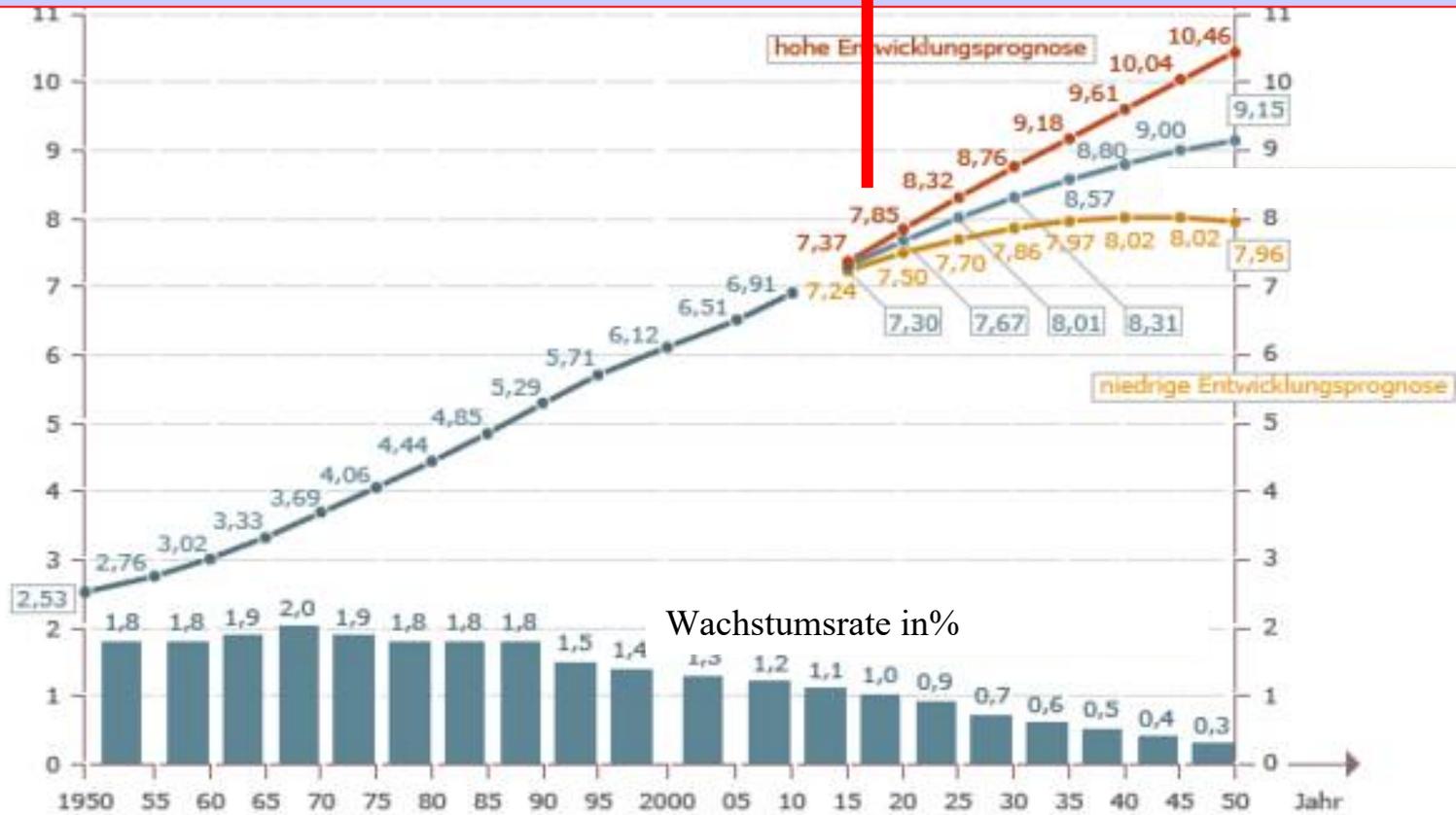
UNDP 2010

„Recht auf sauberes und trinkbares Wasser ist Menschenrecht“

UNDP 2015 SDG Sustainable DG bis 2030

das Jahr 2050 reichen von 8,0 bis 10,5 Milliarden Menschen.

Weltbevölkerung + ca. 2 Milliarden

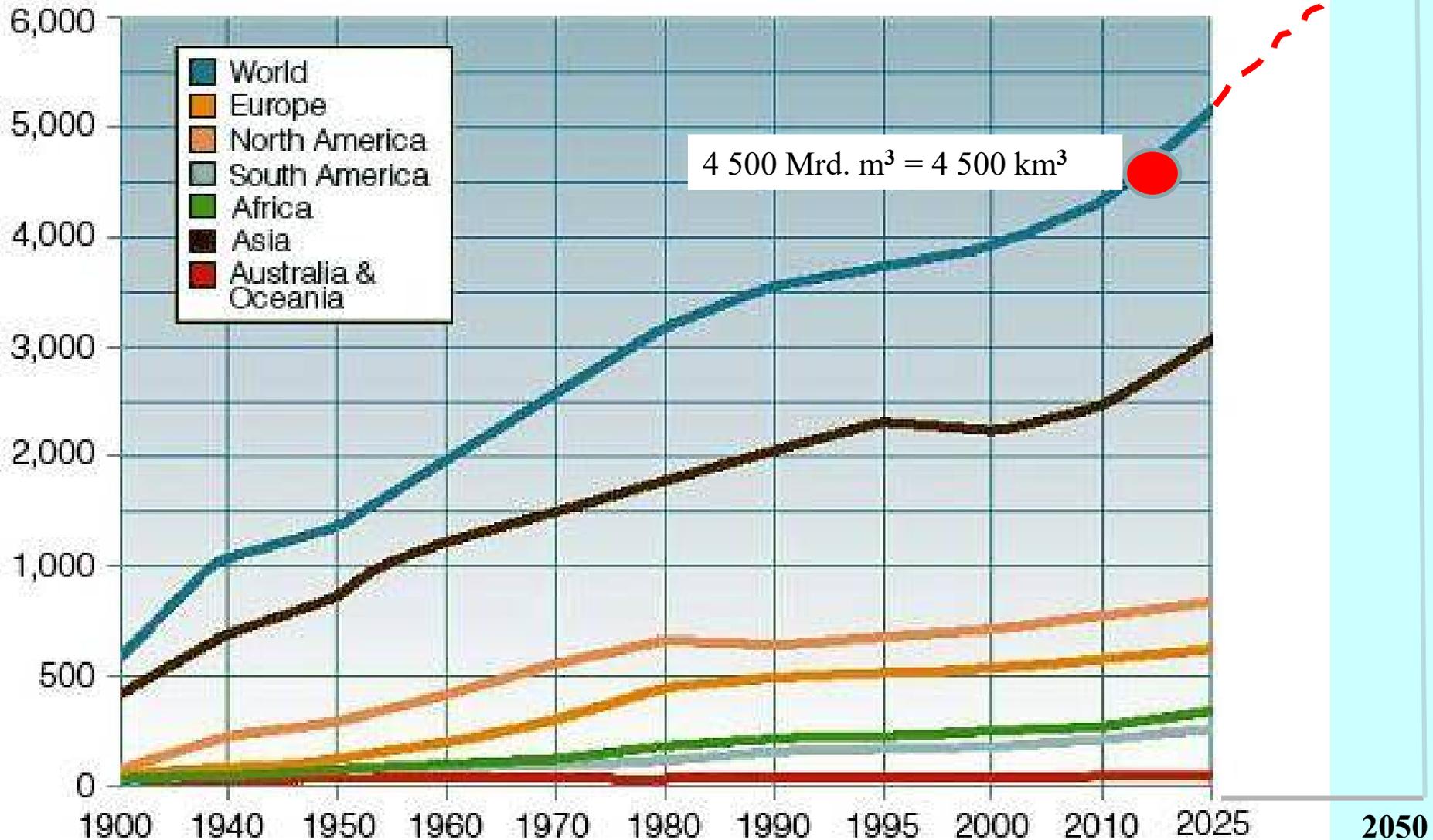


Quelle: UN/DESA: World Population Prospects: The 2008 Revision (Stand: Mai 2010)
Lizenz: Creative Commons by-nc-nd/3.0/de
Bundeszentrale für politische Bildung, 2010, www.bpb.de

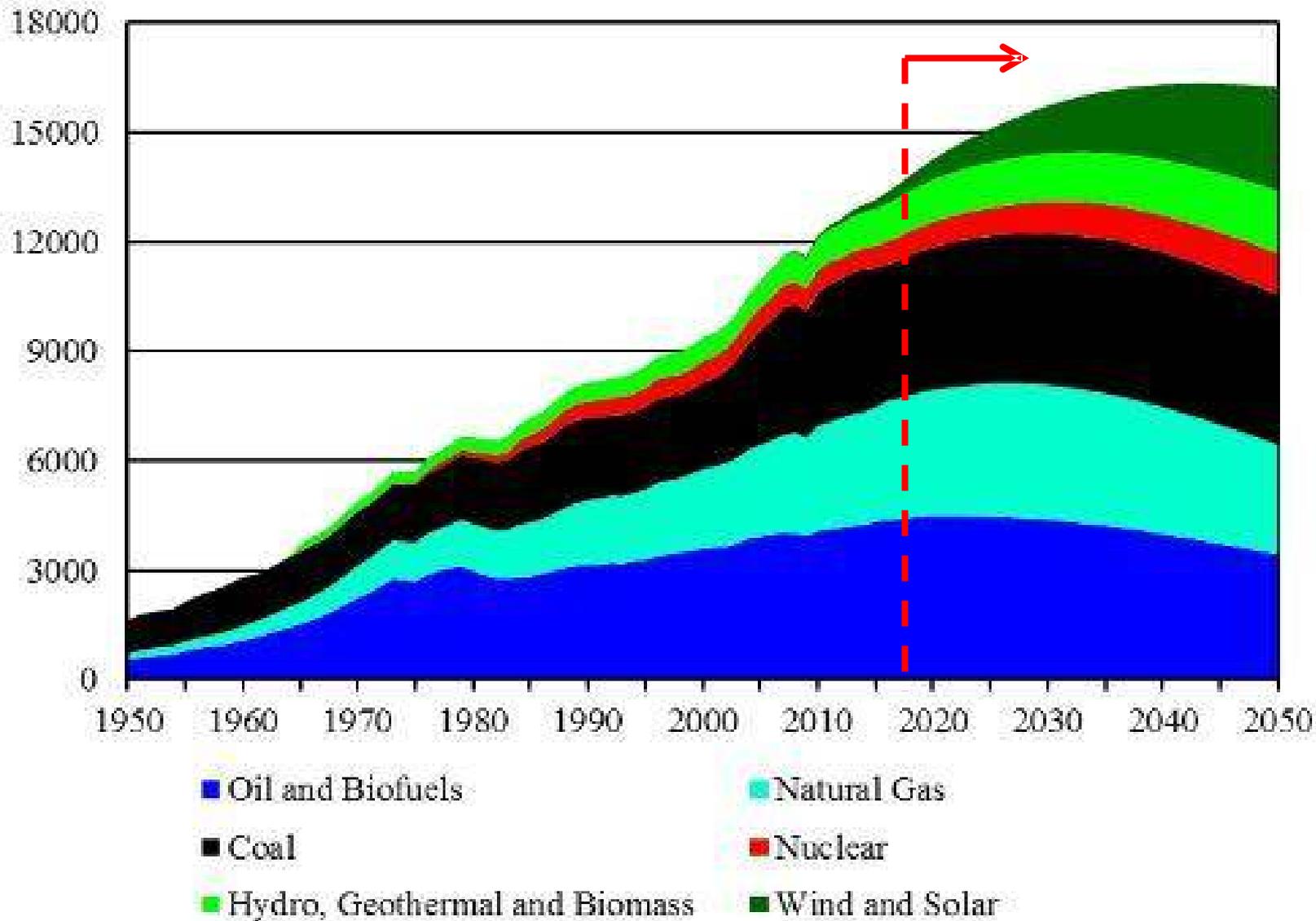


Global Water Consumption 1900 - 2025

(by region, in billions m³ per year)



World Primary Energy Consumption
(Million Tons of Oil Equivalent, 1950-2050)



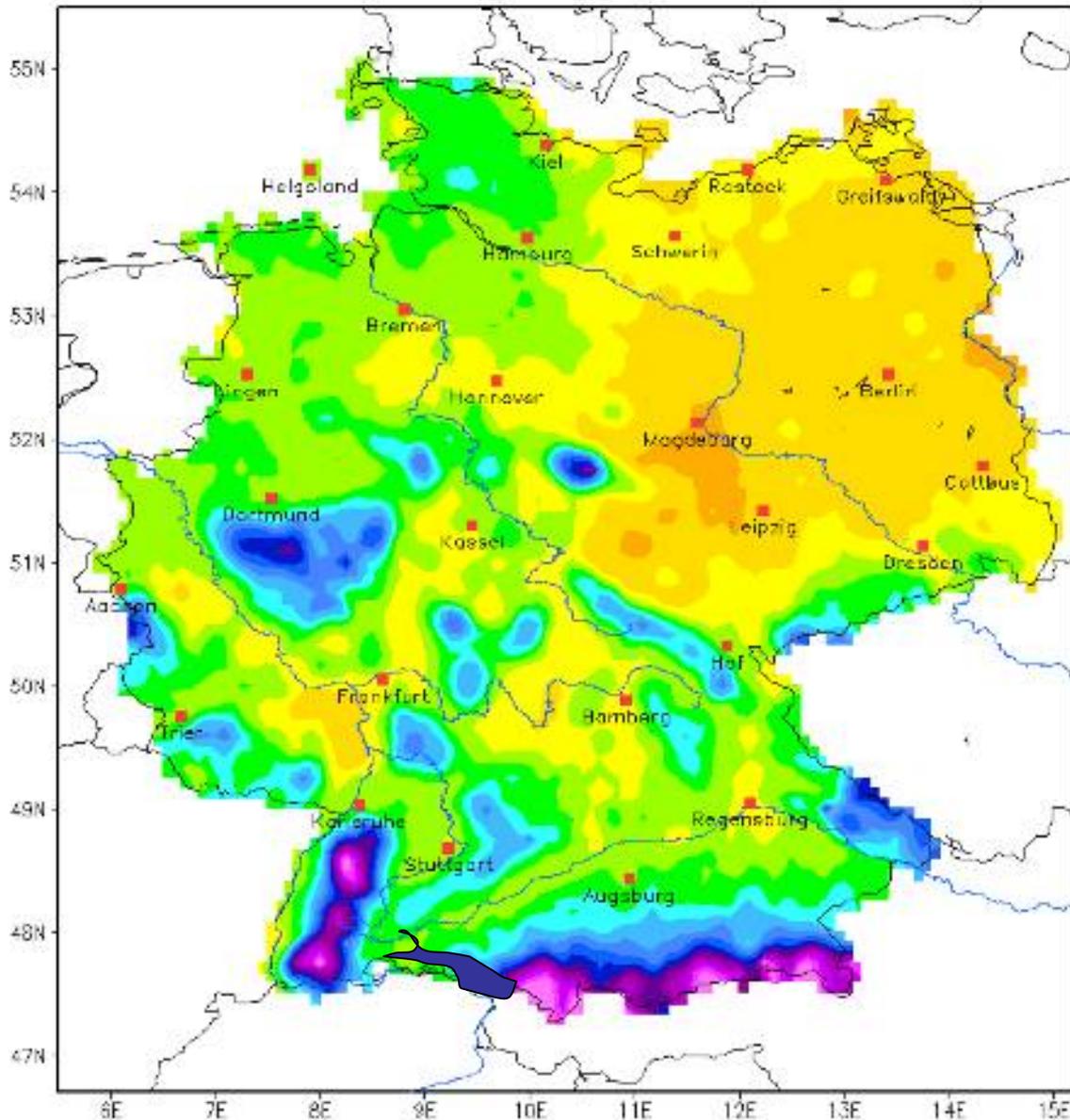
Basisdaten

Deutschland

Europa

Mittlerer Niederschlag im Jahr [mm]

Mittel: 1961–1990



Deutschland:

Verteilung mittlere (1961- 1990)
Niederschlagshöhe im Jahr
Gesamtmittel 790 mm / Jahr

blaues Wasser
Oberflächenwasser
Grundwasser

grünes Wasser
Verdunstungswasser
Landoberfläche
Vegetation

erneuerbare Wasserressource

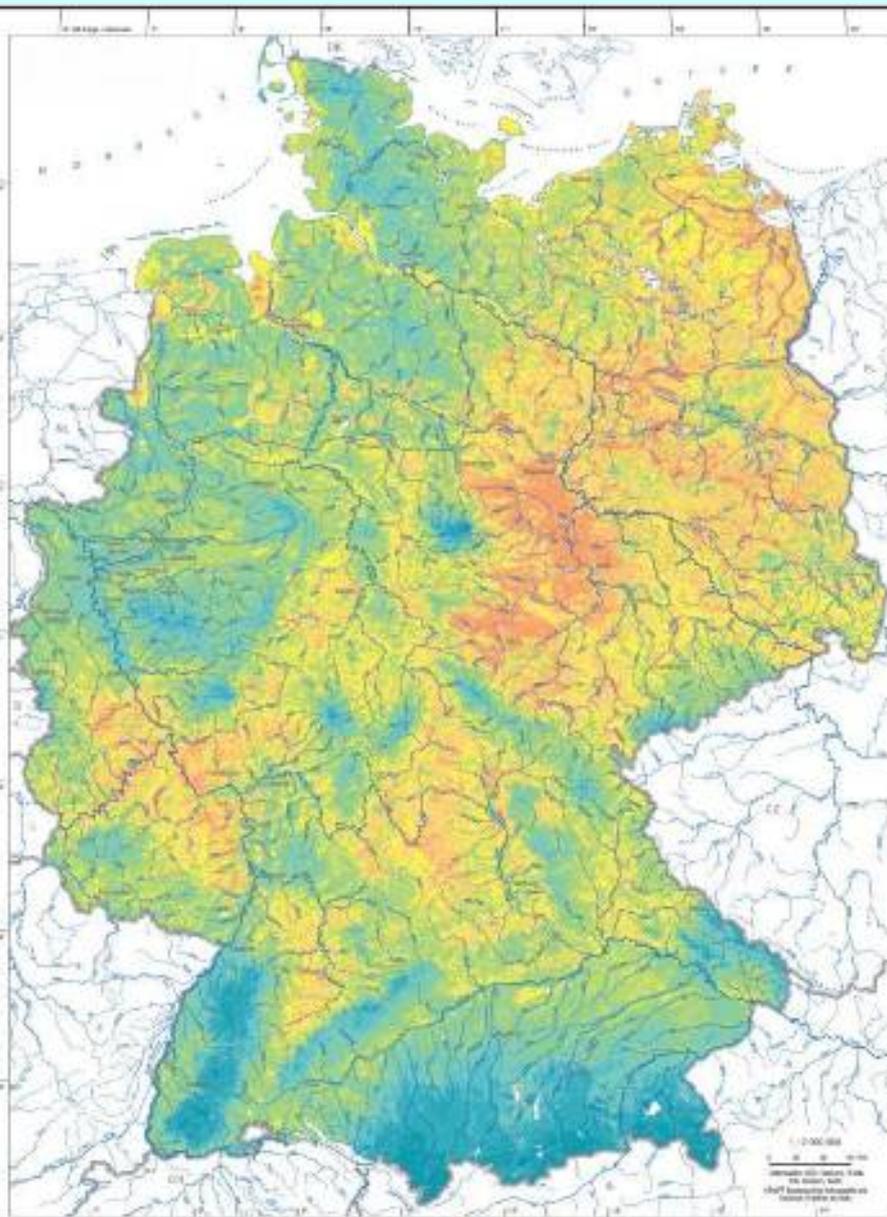
$$N - ET + Q_{\text{extern}}$$

Grundwasserneubildung

$N - ET - Q_{\text{oberfl. rasch}}$

20 - 50 mm /Jahr

300 - 500 mm /Jahr



**HYDROLOGISCHER ATLAS
VON DEUTSCHLAND**
Herausgegeben vom Bundesamt für Umwelt,
Bundesministerium für Umwelt, Naturschutz
und nukleare Sicherheit

**5,5 Millionen jährliche
Grundwasserneubildung**

© 2008
Herausgeber: BfU
Verlag: BfU
Druck: BfU
Kartographie: BfU
Kartographie: BfU

Wasserbilanz: Deutschland in Mrd. m³

Niederschlag	+ 278 Mrd.
Zuflüsse	+ 71 Mrd.
Verdunstung	- 161 Mrd.

**erneuerbar
insgesamt**

188 Mrd. →

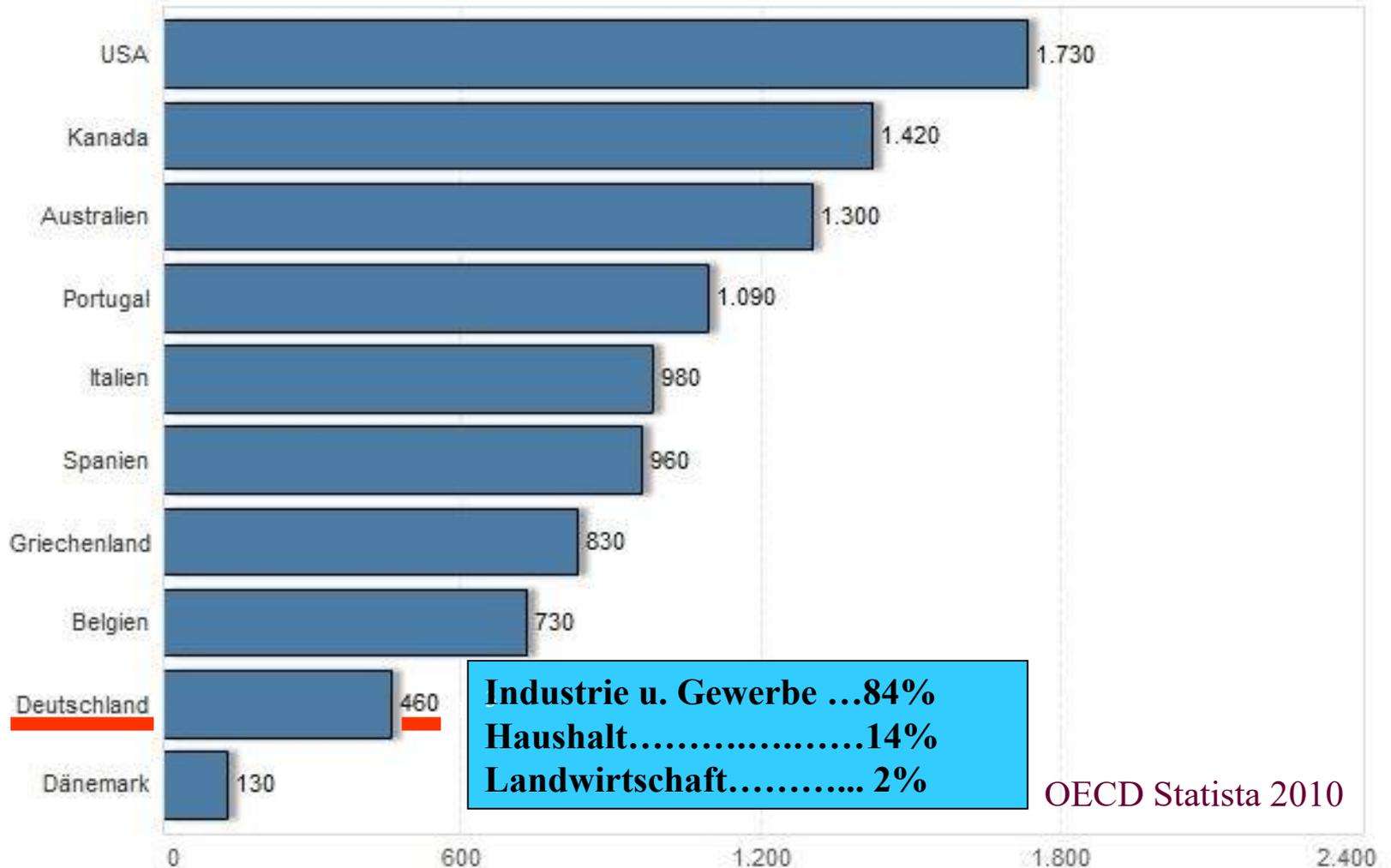
2300 m³ pro Kopf u. Jahr

GW Neubildung

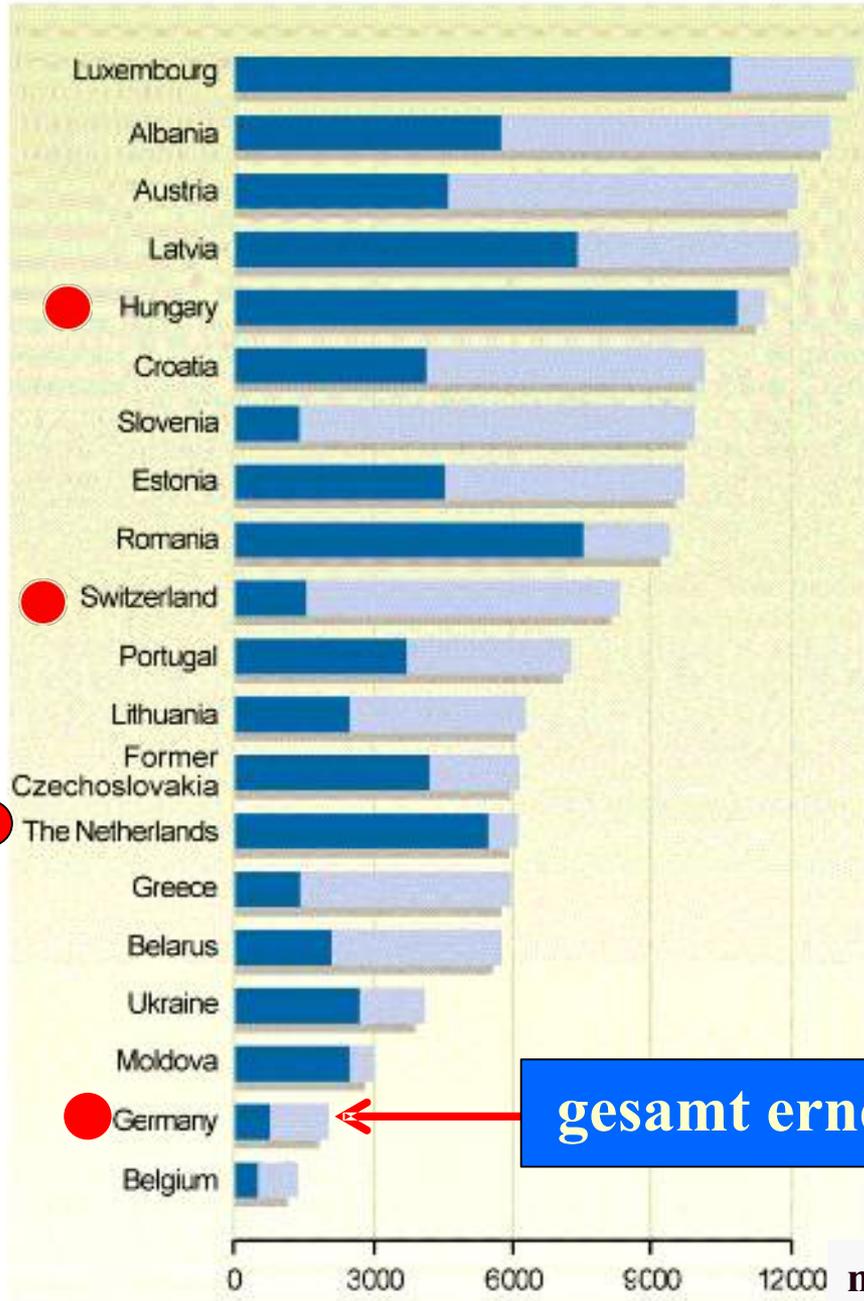
45 Mrd. →

120 mm pro Jahr

Jährlicher Wasserverbrauch in ausgewählten Ländern pro Kopf (in Tausend Litern)



Internal and external contributions to the total renewable water resource in Europe



externe Zuflüsse

internes Wasser

gesamt erneuerbar 2300 m³ pro Kopf u. Jahr

m³ per capita and year

Europäische Wasserpolitik

EU – WRRL Wasser Rahmen Richt Linie

2015 „...gute Qualität von
Oberflächenwasser u. Grundwasser“

IKSR ...Rhein

IKSEElbe

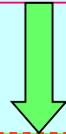
Wasserbedarf für gesunde Ernährung in m³ pro Kopf und Jahr

3 000 kcal braucht ein Mensch pro Tag für gesunde Ernährung

2400 kcal pflanzlich + 600 kcal tierisch

1200 Liter + 2400 Liter

3600 Liter
pro Kopf und Tag



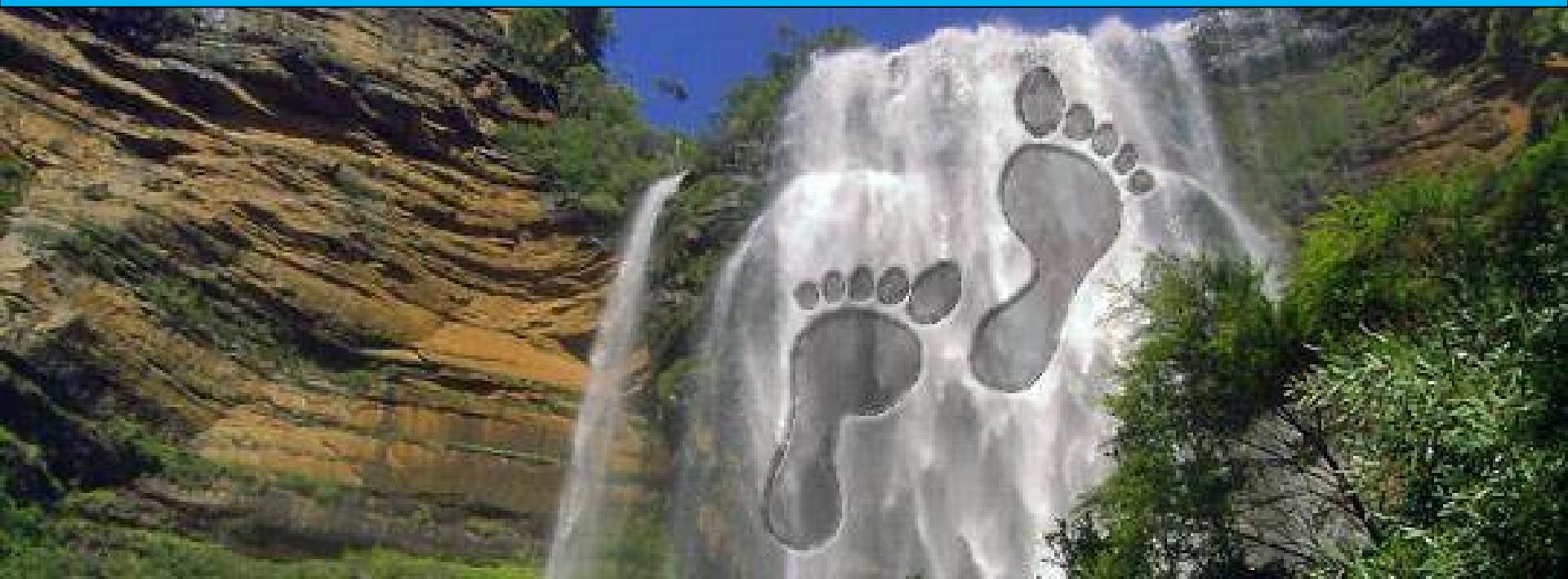
1300m³ pro Kopf u. Jahr für Getreide, Gemüse und Fleisch
= Verdunstungswasser“grünes Wasser“

UN- FAO: 1300 + 400 = min 1700 m³ pro Kopf und Jahr

Virtuelles Wasser

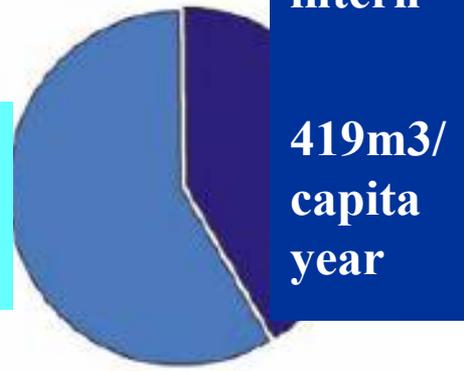
„...Wasser, das gebraucht wird, verschmutzt wird oder verdunstet bei der Herstellung von Nahrungsmittel und industriellen Produkten“

Wasser –Fußabdruck

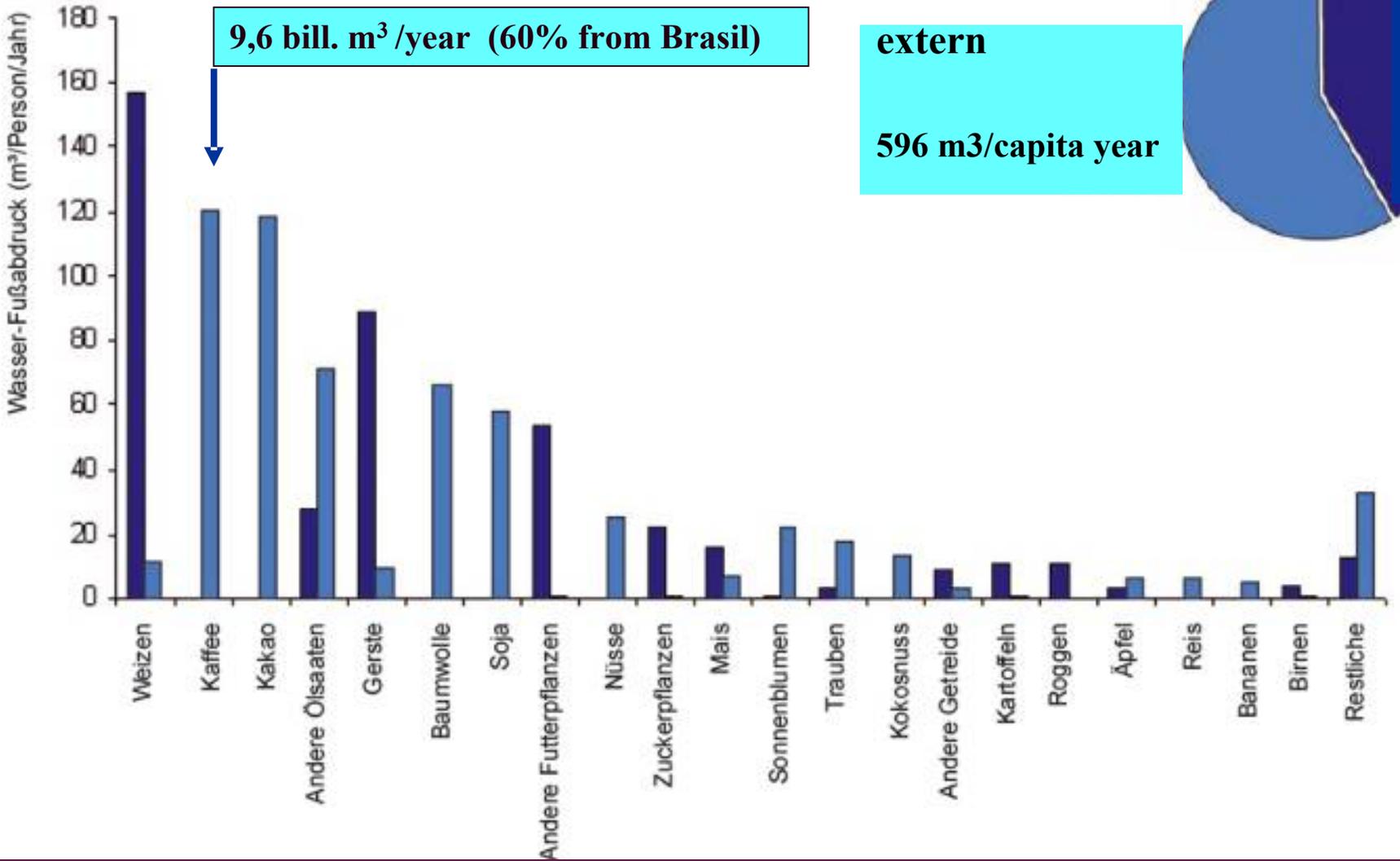


intern

extern
596 m3/capita year



9,6 bill. m³/year (60% from Brasil)



Internal and external water - footprint of agricultural products for Germany

extern + intern = total water consumption for agricultural products

Virtual Total Water

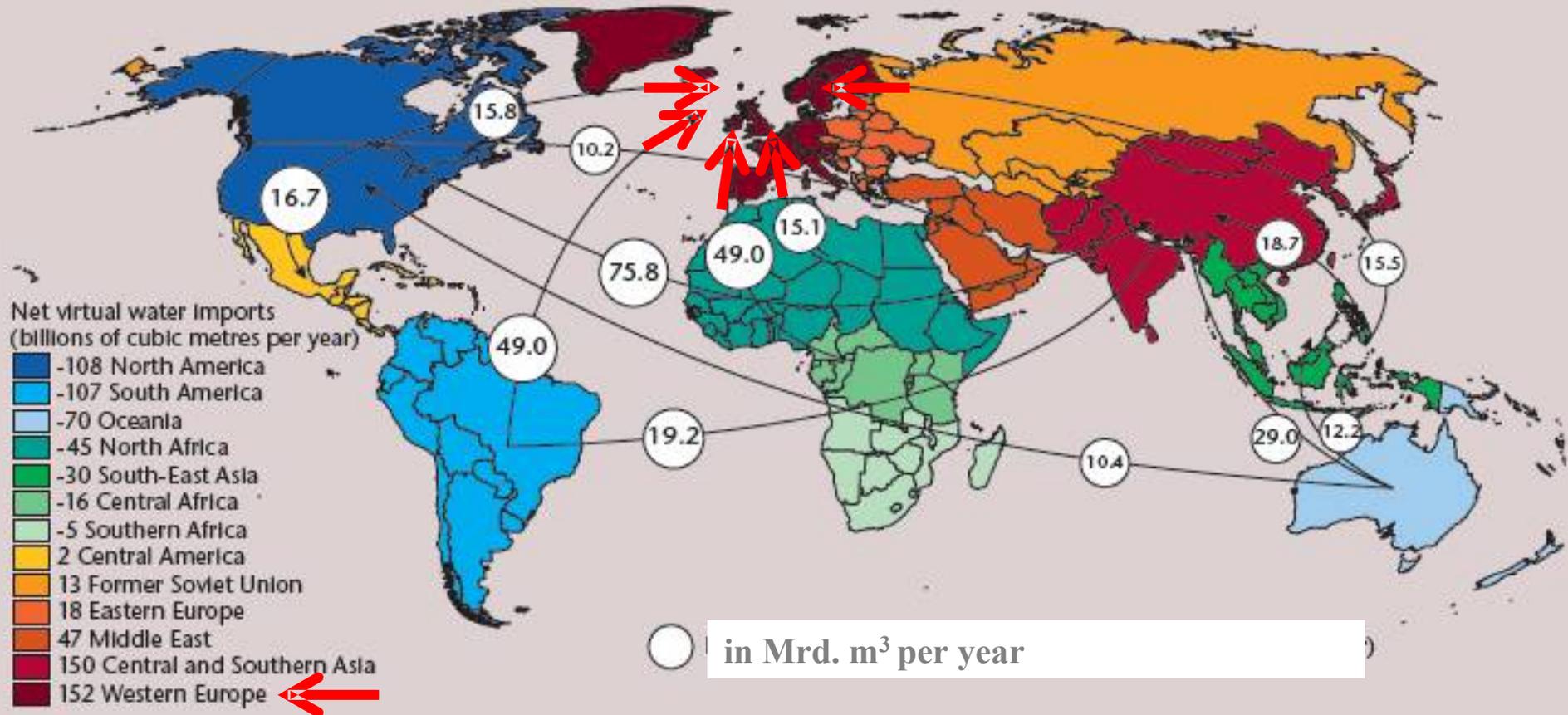
Export

Countries	Mrd. m ³ /year
USA	229.3
Canada	95.3
France	78.5
Australia	73.0
China	73.0
Germany	70.5
Brazil	67.8
Netherlands	57.6
Argentina	50.6
Russia	47.7
Thailand	42.9
India	42.6
Belgium-Luxembourg	42.2
Italy	38.2
Cote d'Ivoire	35.1

Import

Countries	Mrd. m ³ /year
USA	175.8
Germany	105.6
Japan	98.2
Italy	89.0
France	72.2
Netherlands	68.8
United Kingdom	64.2
China	63.1
Mexico	50.1
Belgium-Luxembourg	47.1
Russia	46.1
Spain	45.0
Korea Rep.	39.2
Canada	35.4
Indonesia	30.4

National virtual water- footprint for agroproducts



Source: Based on Hoekstra and Chapagain 2008.

International transfer of virtual water in Mrd. m³ per year

on the market with agricultural products in the period 1997 -2001

(United Nations World Water Development Report 3, Hoekstra & Chapagain 2008)

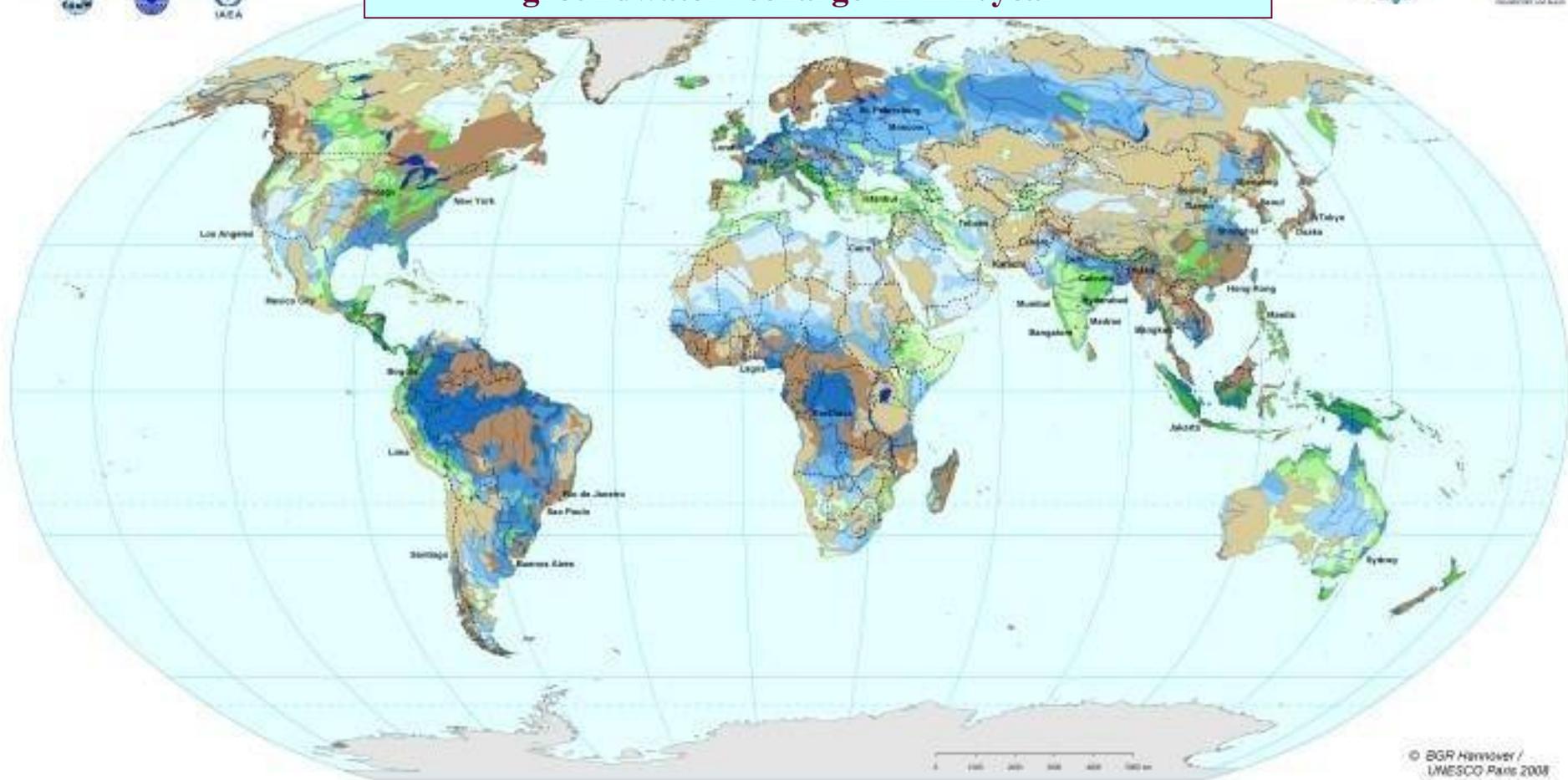
Übernutzung

von

Wasserreserven

blaues Wasser

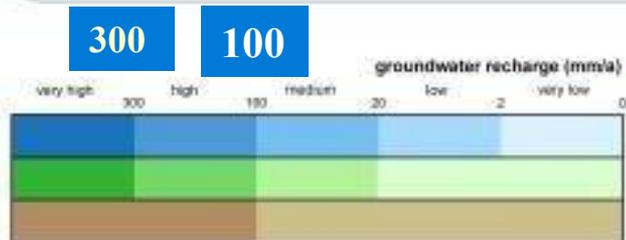
Groundwater resources of the world groundwater recharge in mm/year



© BGR Hannover / UNESCO Paris 2008

Groundwater resources

- in major groundwater basins
- in areas with complex hydrogeological structure
- in areas with local and shallow aquifers



Surface water & Geography

- major river
- large freshwater lake
- large saltwater lake
- continuous ice sheet
- selected city

BGR UNESCO 2008

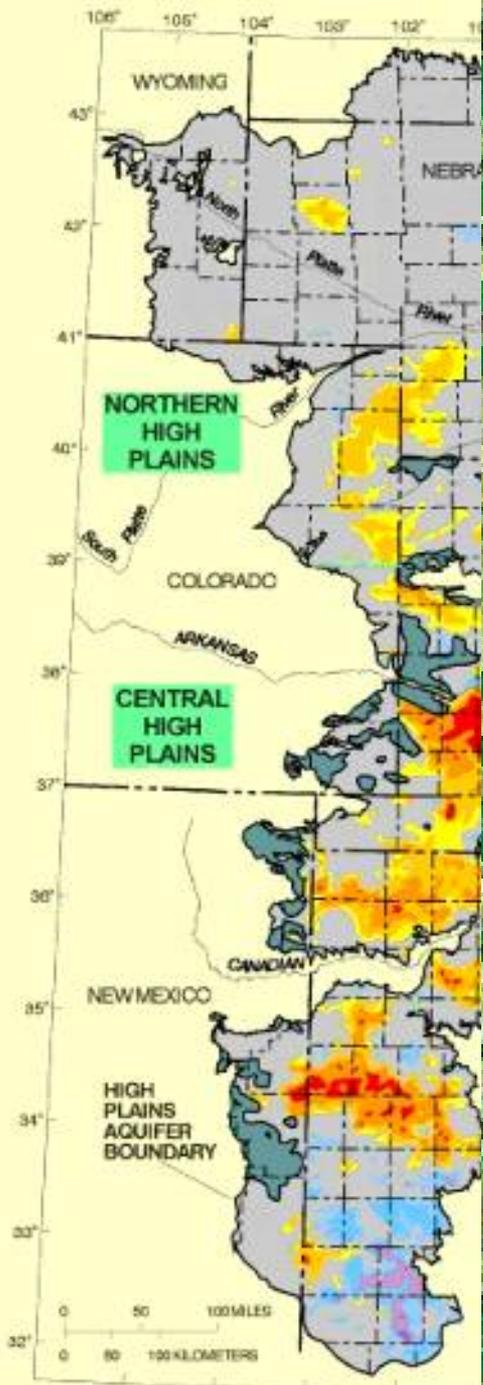
International Geosphere and Biosphere Programme (IGBP) / International Hydrological Programme (IHP) / International Geoscience and Earth Observation Programme (IGEO)



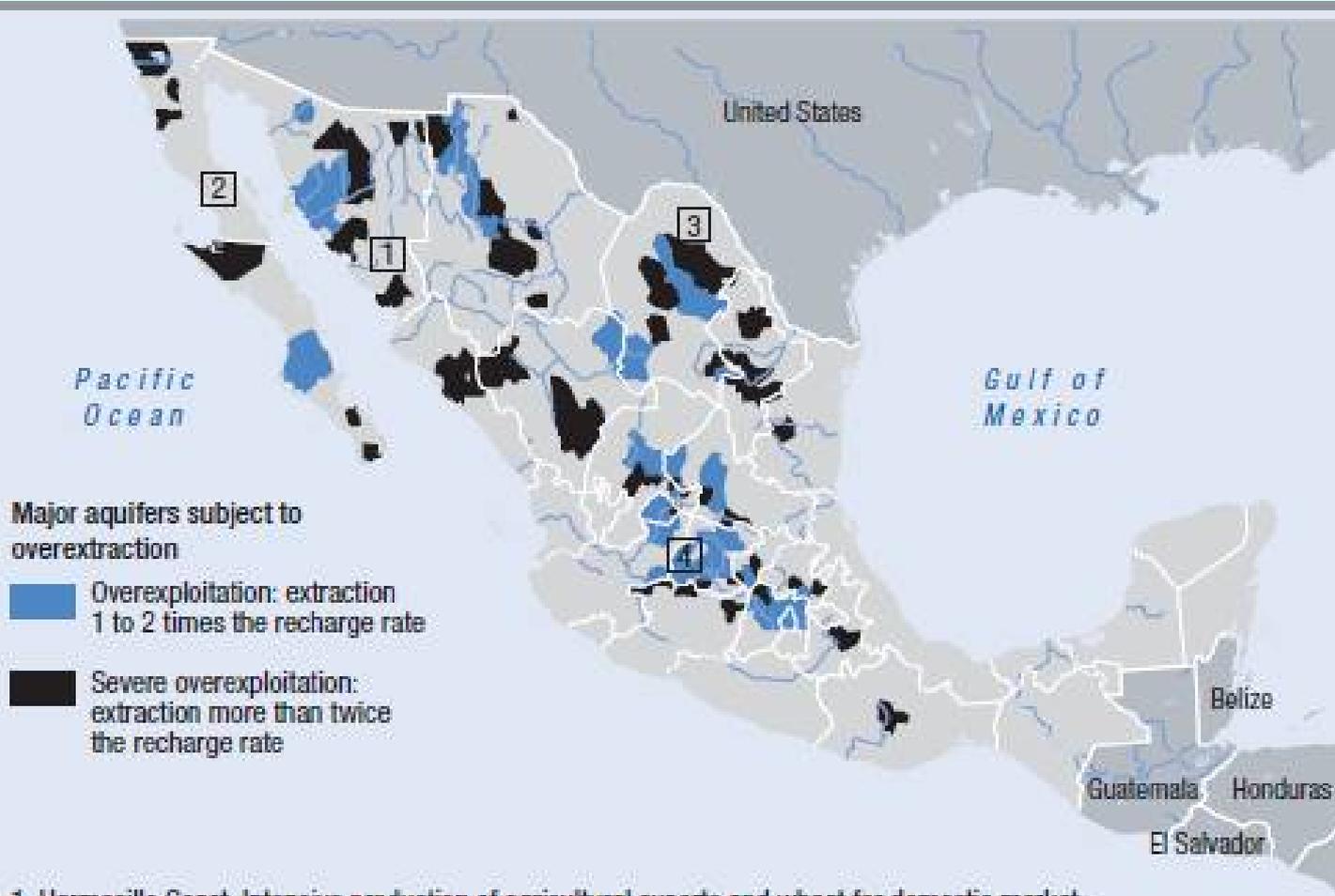
Wasserentnahme: Flüsse, Seen, GW.....4 500 km³/Jahr (2015)

.....2 900 km³ für Bewässerungslandwirtschaft70%

.....davon 800 km³ aus Grundwasserspeicher25%



Absenkung der Grundwassersstände in Mexiko



Major aquifers subject to overexploitation

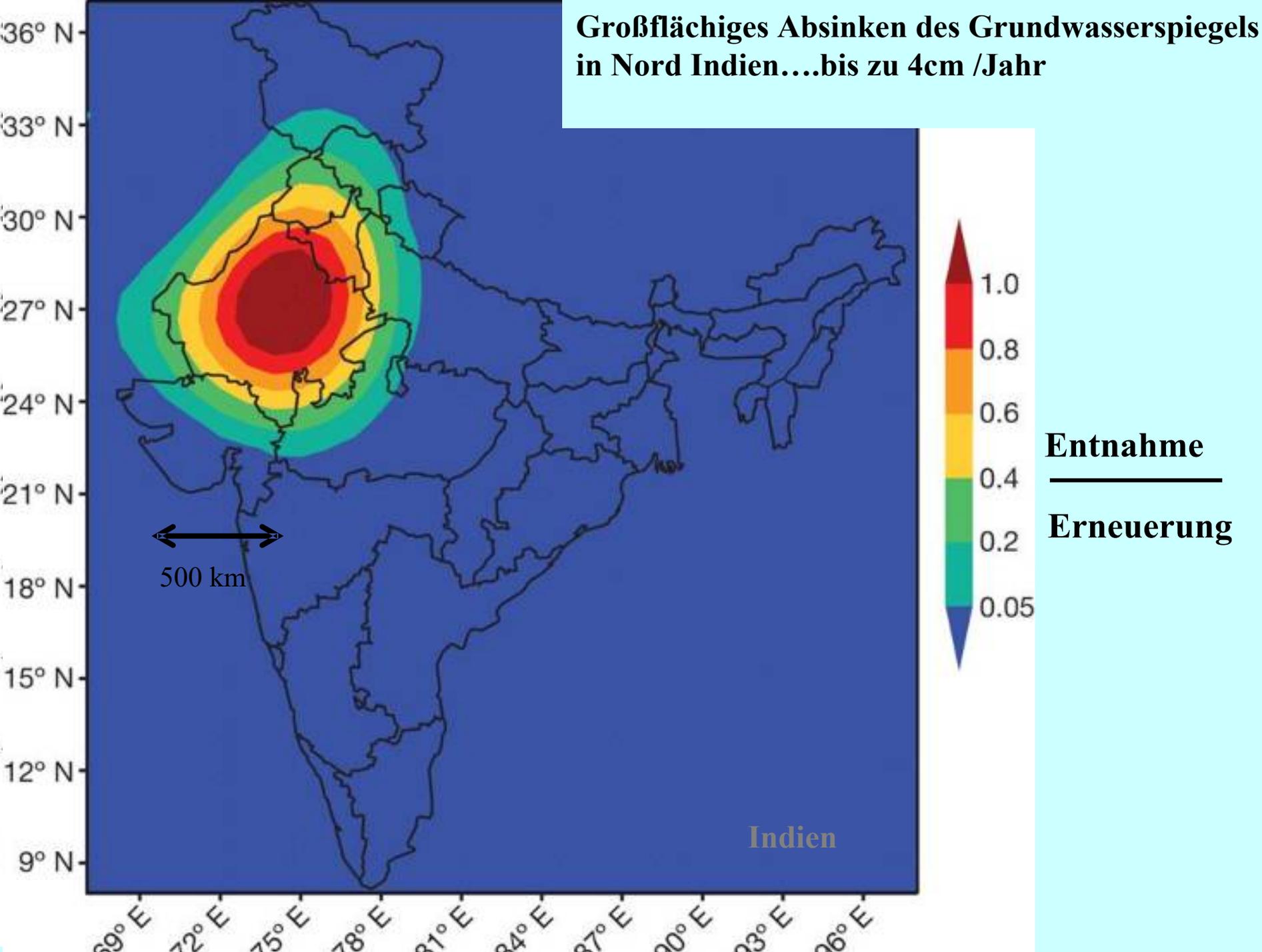
-  Overexploitation: extraction 1 to 2 times the recharge rate
-  Severe overexploitation: extraction more than twice the recharge rate

1. Hermosillo Coast. Intensive production of agricultural exports and wheat for domestic market.
2. Baja California. Large-scale commercial production of fruit and vegetables by companies linked to US market.
3. Coahuila. One of Mexico's fastest sinking aquifers and major site for production of alfafa to supply feed to livestock sector.
4. El Bajío. Source of 90% of Mexico's frozen fruit and vegetable export. Production dominated by large-scale commercial farms and agro-industrial processing plants supplying US market.

Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Source: Guevara-Sanginés 2006.

Großflächiges Absinken des Grundwasserspiegels in Nord Indien....bis zu 4cm /Jahr

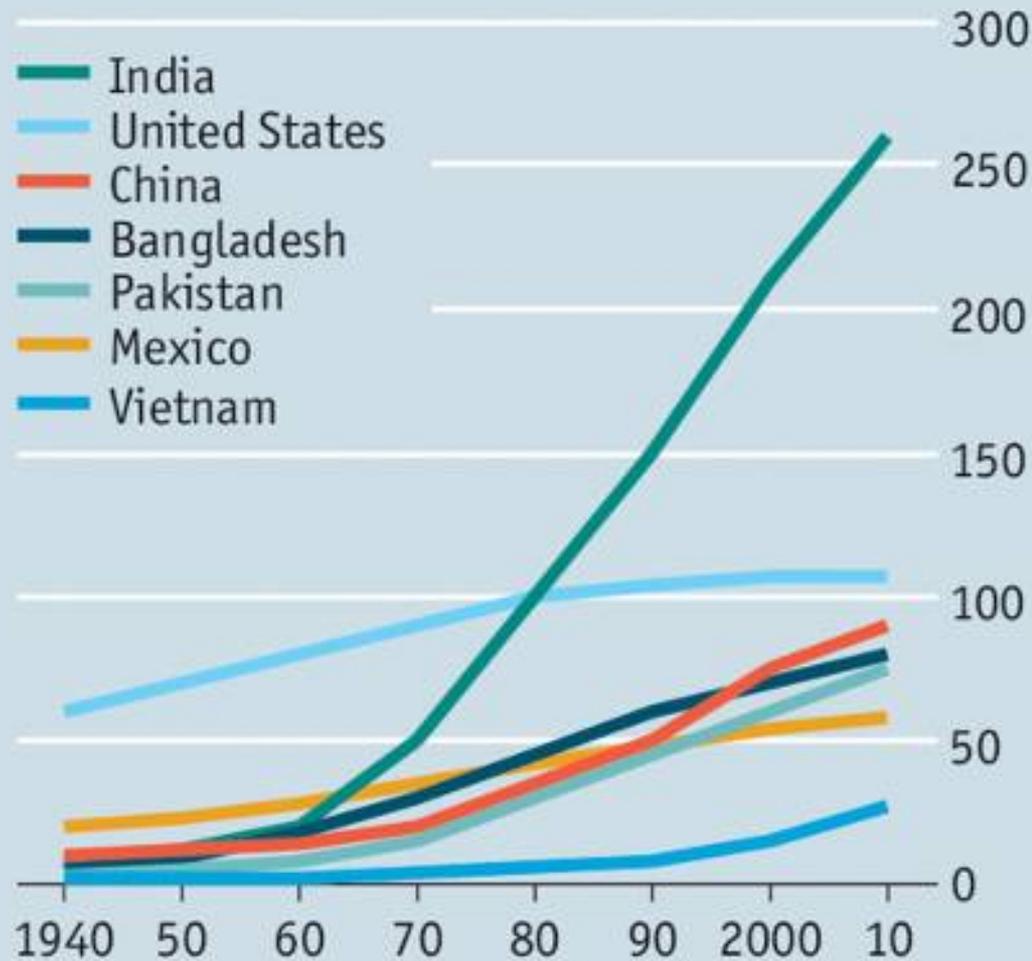


Pump it up

Agricultural groundwater usage

Selected countries, billions of cubic metres per year

total 680 Mrd m³

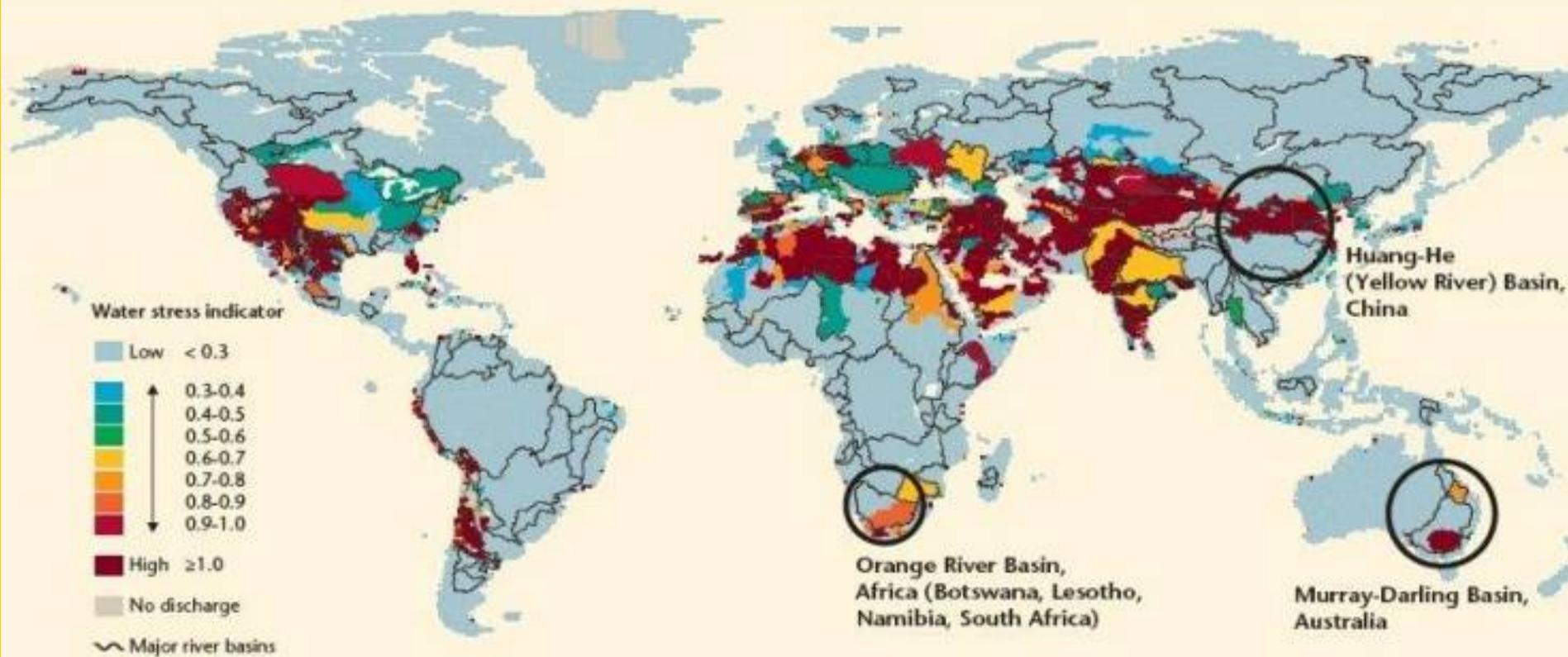


Source: UN World Water Development Report, 2015



**Bangladesh: Grundwasserpiegelabsenkung
Vordringen der Salzwassers**

Wasser Stress Indikator (WSI) unter Berücksichtigung des Wasserbedarfs zur Aufrechterhaltung des Ökosystems (2002)



Source: Based on Smakhtin, Revenga, and Doll 2004.

Wasser Stress Indikator $WSI = \text{Wasserentnahme} / \text{Wasserverfügbarkeit}$

kritischer WSI – Wert $\rightarrow 0,4$



Baumwollfeld mit Furchenbewässerung
Uzbekistan 2013





1989



2003



2013

Folgen der Bewässerung

Bodenversalzung

Salzanreicherung im Rest Aralsee

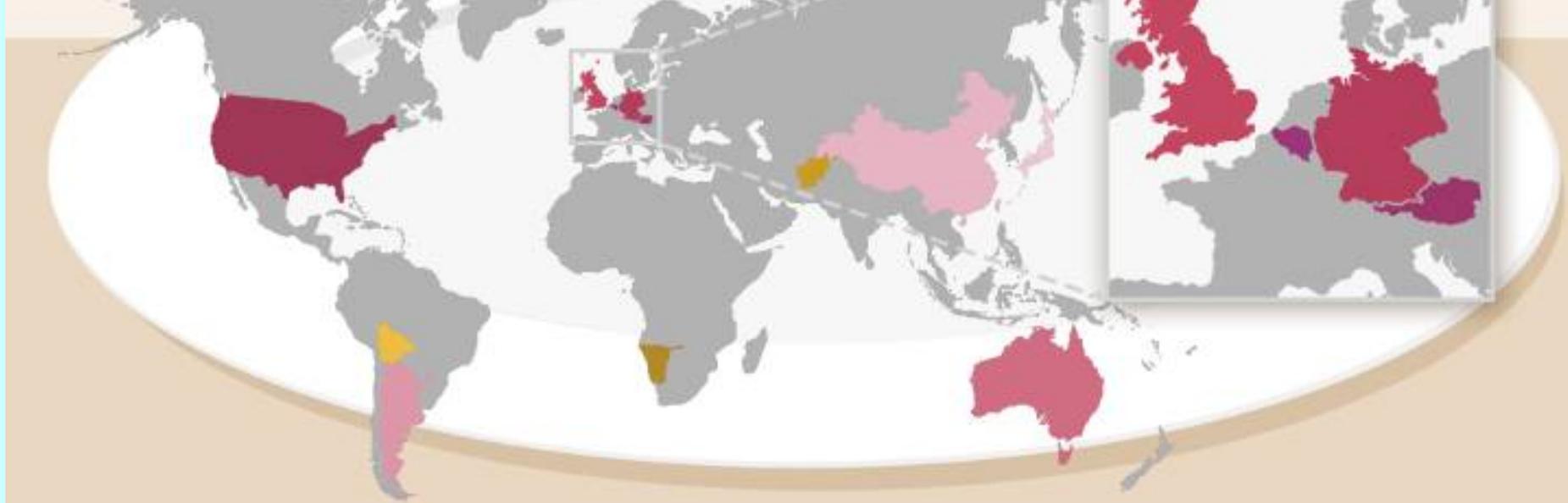
Windverfrachtung der Rückstände aus Agrochemikalien

hoher Salzgehalt im Trinkwasser

chronische Krankheiten, hohe Kindersterblichkeit (W. Mauser 2007)

Nahrungssicherung

Landnahme



FAO UN 2011 - 2013



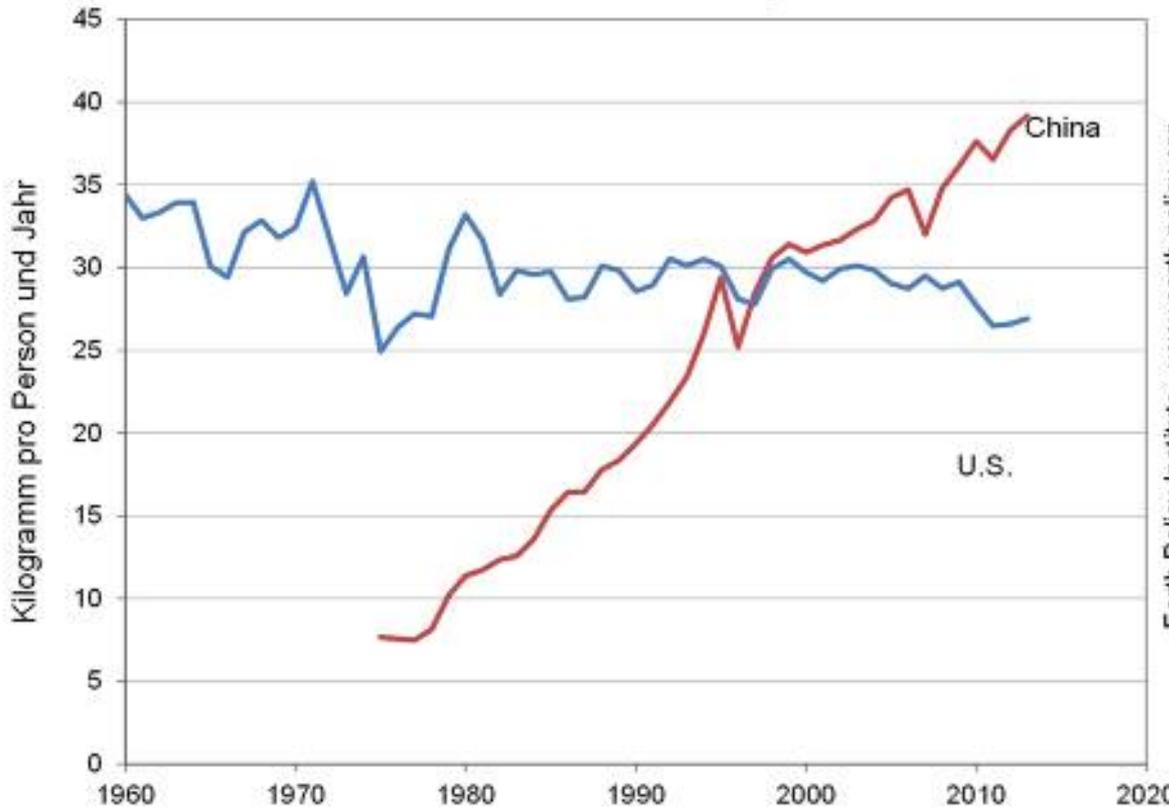
Hunger auf Fleisch nimmt weiter zu

Prognostizierter Fleischkonsum in Kilogramm pro Kopf aktuell und im Jahr 2023¹

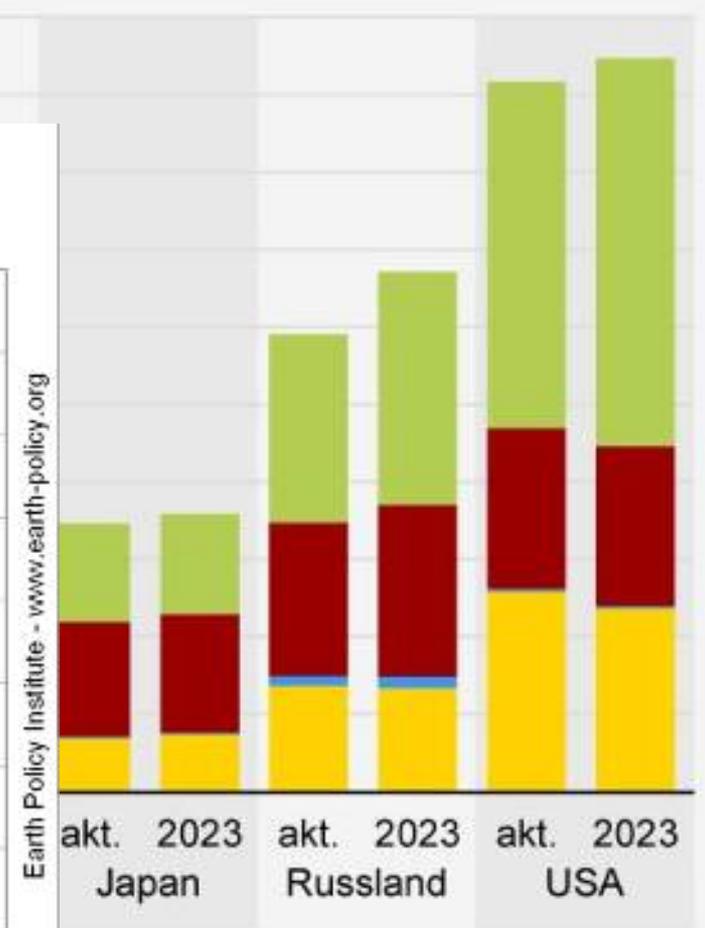
■ Geflügel
 ■ Schwein
 ■ Schaf
 ■ Rind

China
 + 8 Mio t/a

Schweinefleischkonsum pro Kopf und Jahr in China und den USA in Kilogramm



Source: USDA, UNPop



Earth Policy Institute - www.earth-policy.org

Weltproduktion der wichtigsten Getreidearten, Zeitraum 1990-2011

2003 -2013 Getreideproduktion zwischen 2 250 – 2 450 Mio. t
Anbaufläche weltweit 702 Mio. ha

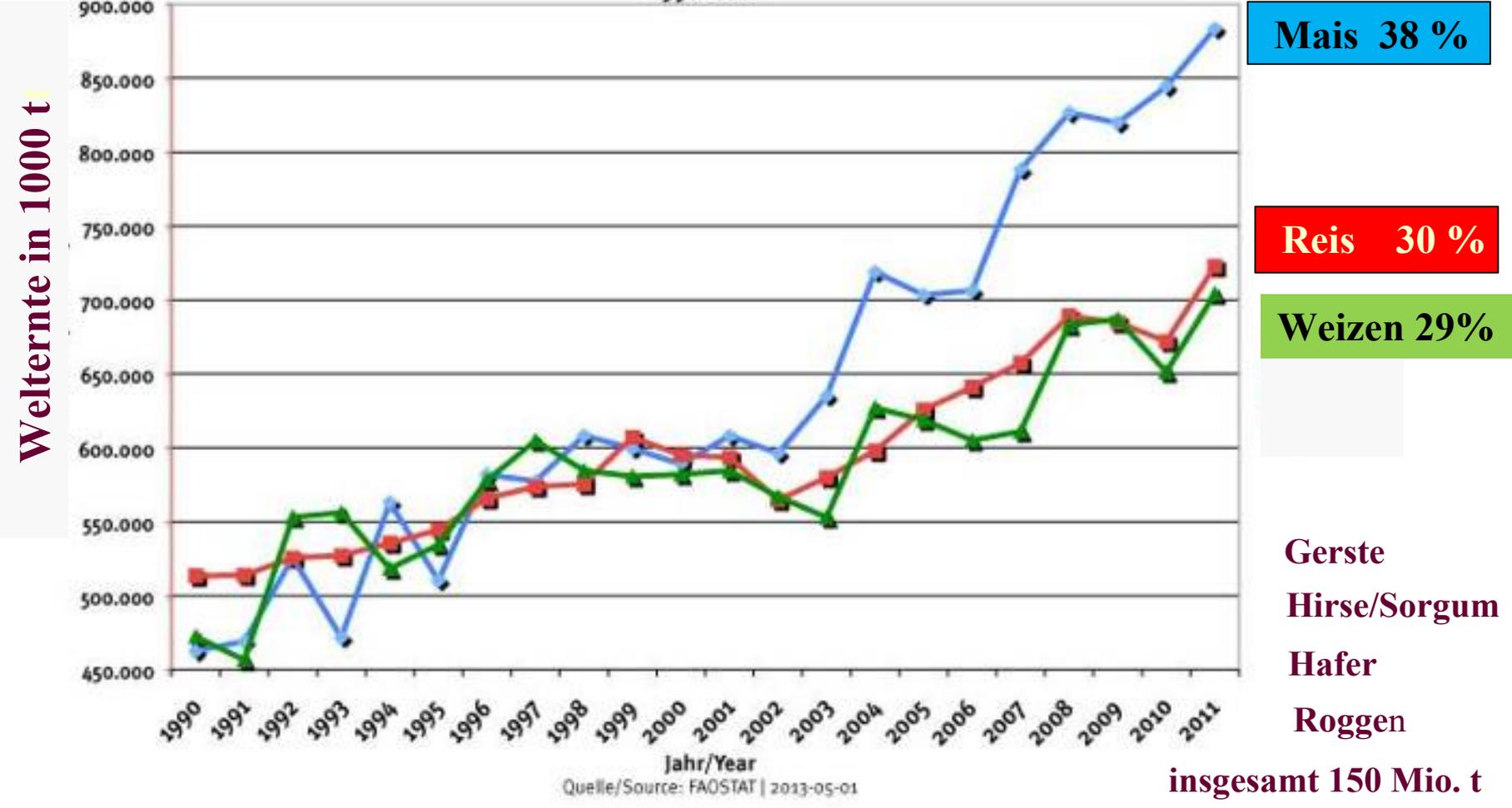
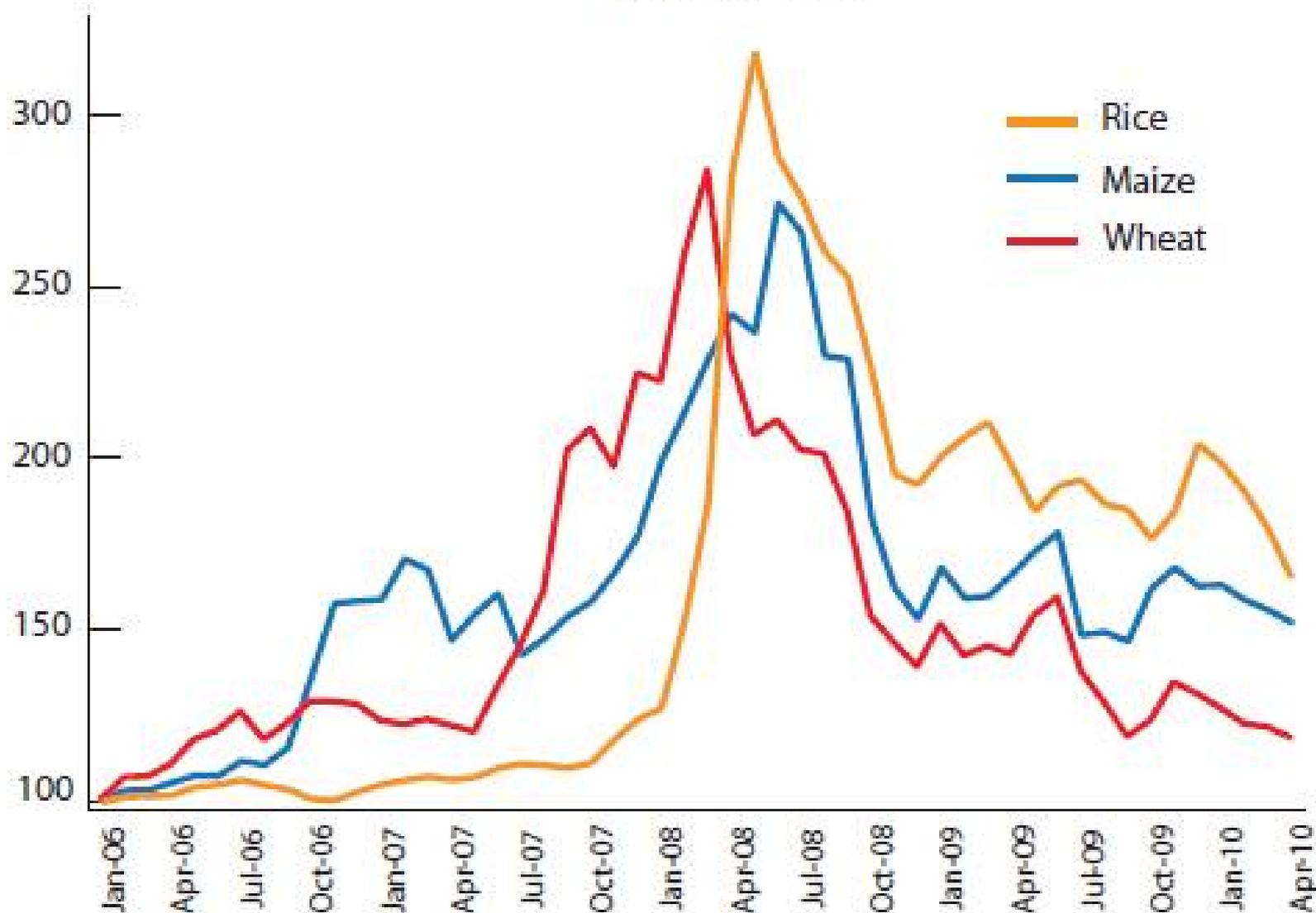


Figure 1:

World price indices of selected cereals

(Jan-06=100)

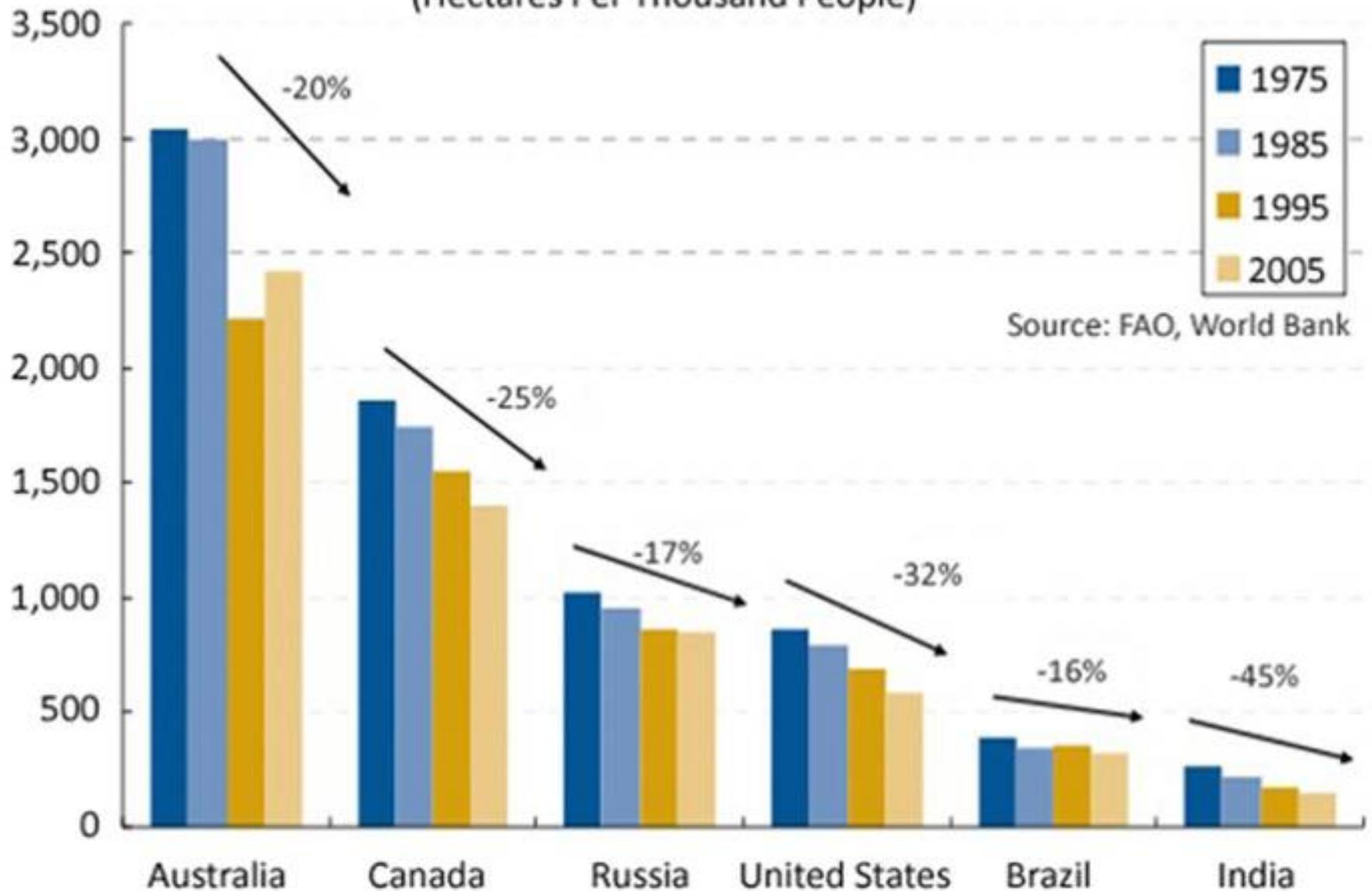


Source: FAO 2010.



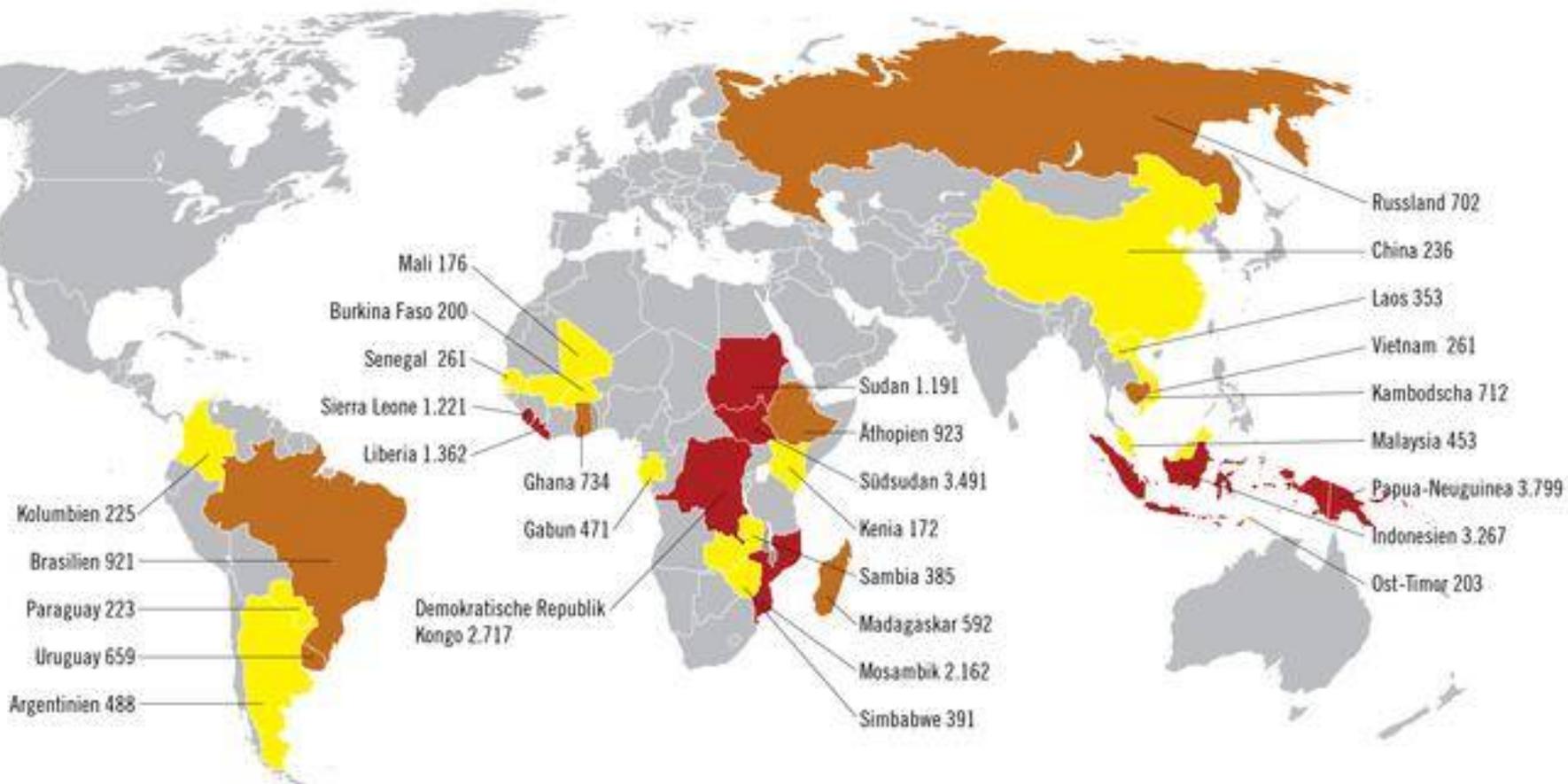
Arable Land Per Capita Is Decreasing

(Hectares Per Thousand People)



Weltweit großflächiger Landkauf, Landpachtung (land grabbing) durch Staaten, Unternehmen, Investmentfonds, Banken, Privatanleger

Großflächiger Landkauf und Pachtgeschäfte (in 1000 Hektar)

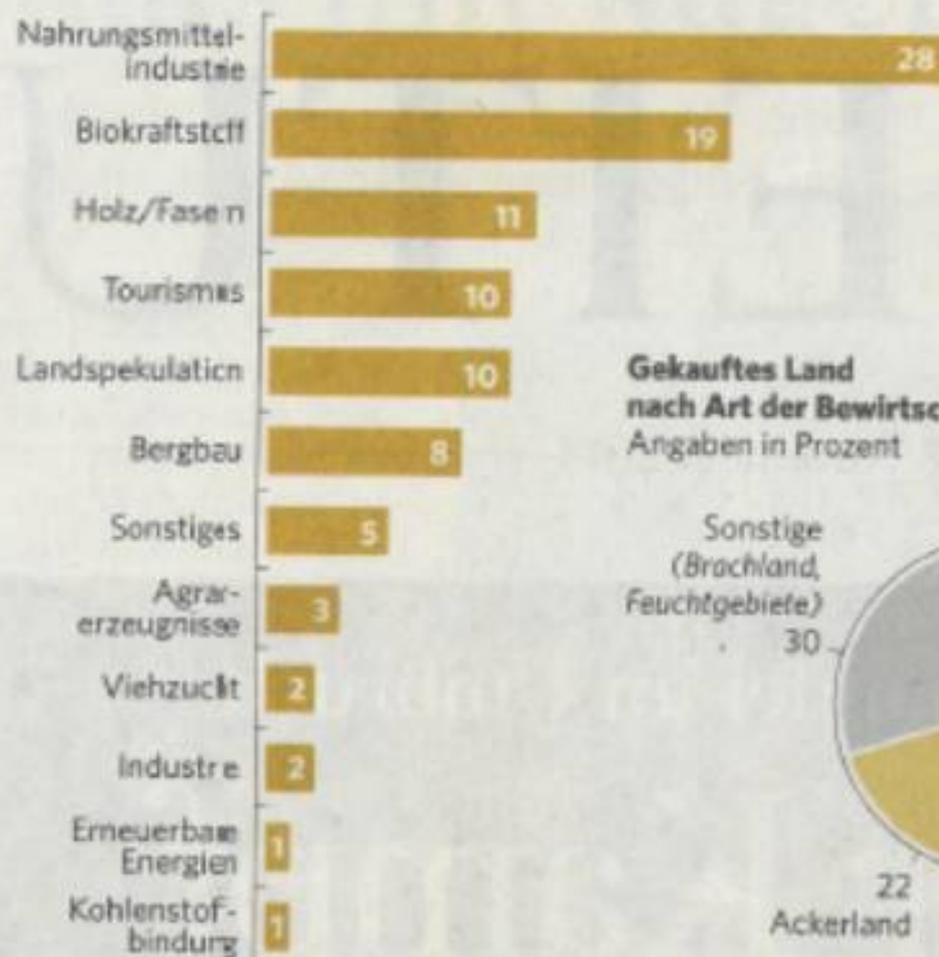


- Gemeldete Fläche über 1 Million Hektar
- Gemeldete Fläche zwischen 500.000 und 1 Million Hektar
- Gemeldete Fläche unter 500.000 Hektar

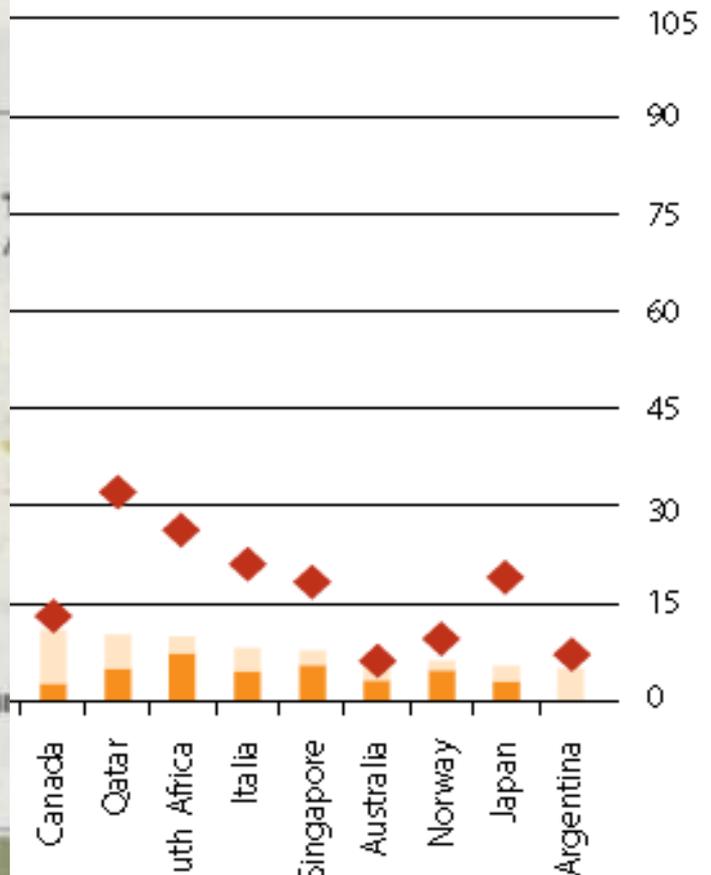
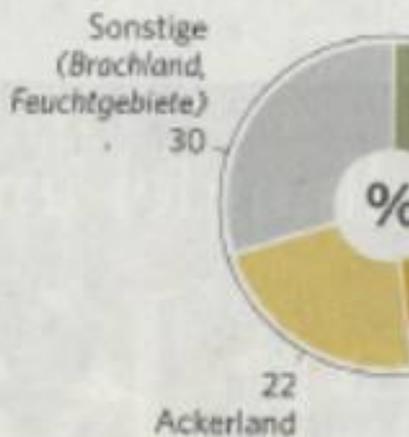
DIE DIMENSION DES LANDGRABBINGS

Wofür das gekaufte Land genutzt wird

Angaben in Prozent



Gekauftes Land nach Art der Bewirtschaftung
Angaben in Prozent

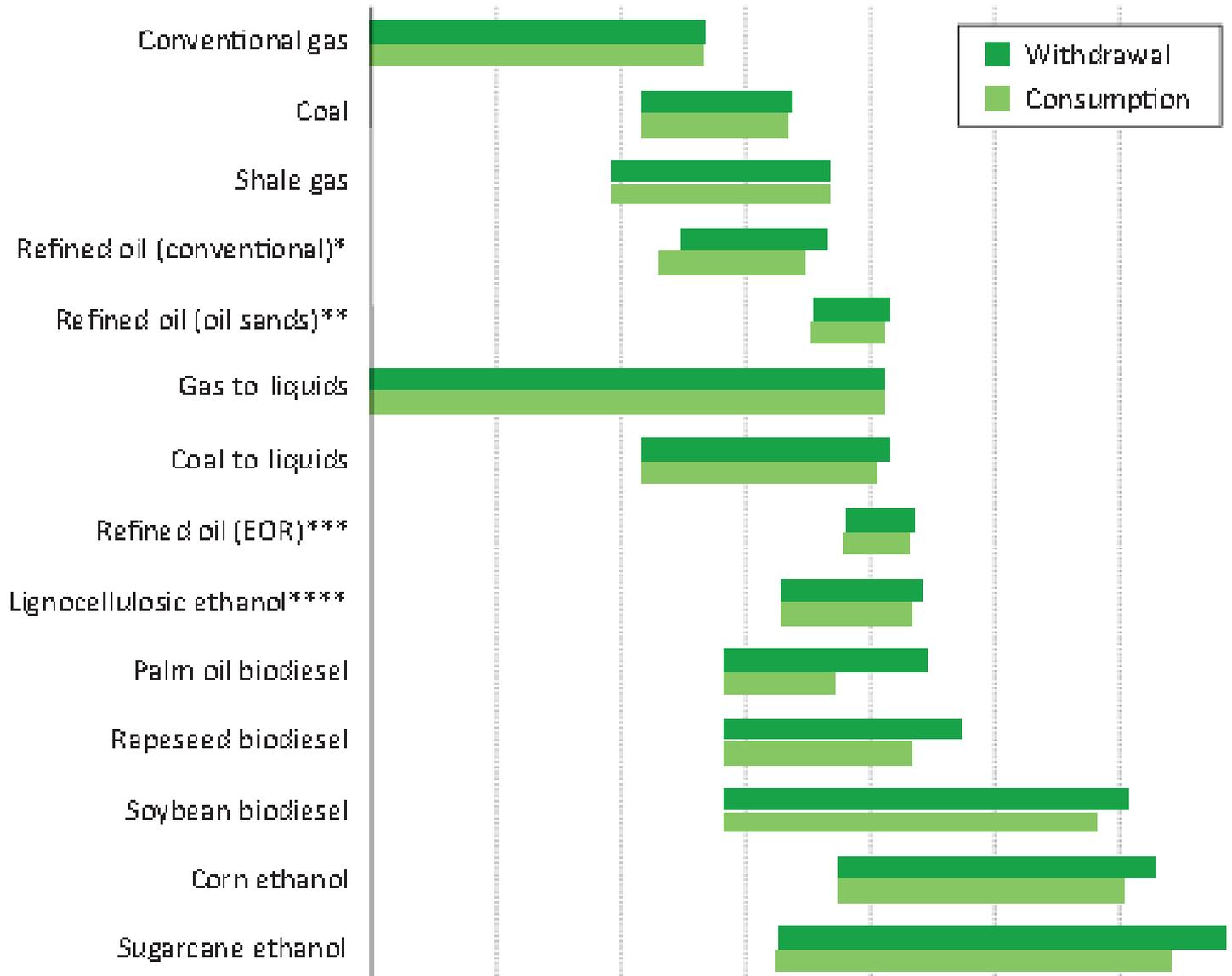


Number of deals

Number of investors from each country are involved. The right vertical axis shows the number of investors involved.

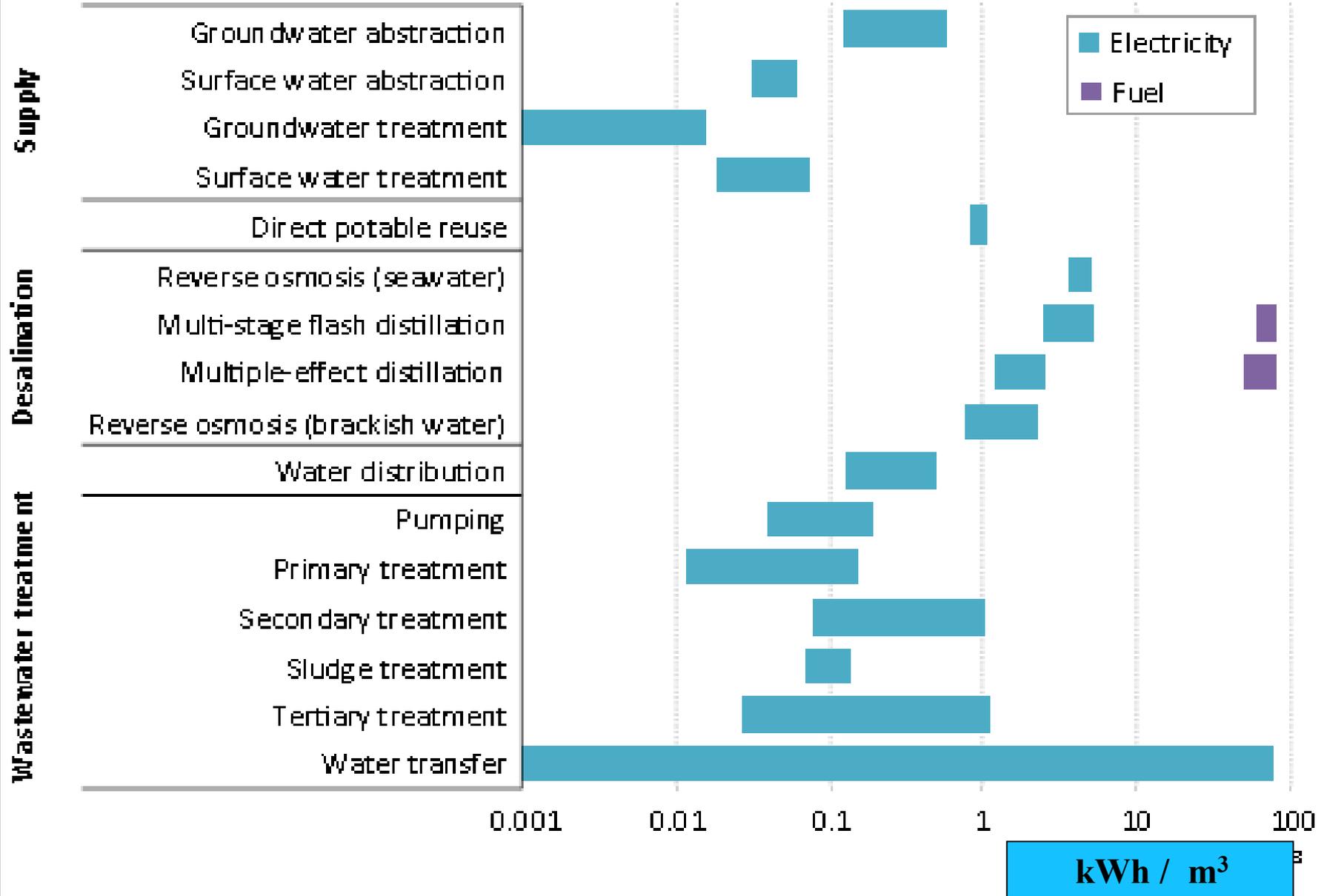
**Wasser
für
Energie
für
Wasser**

Water use for primary energy production in [litres /toe] (IEA 2016)

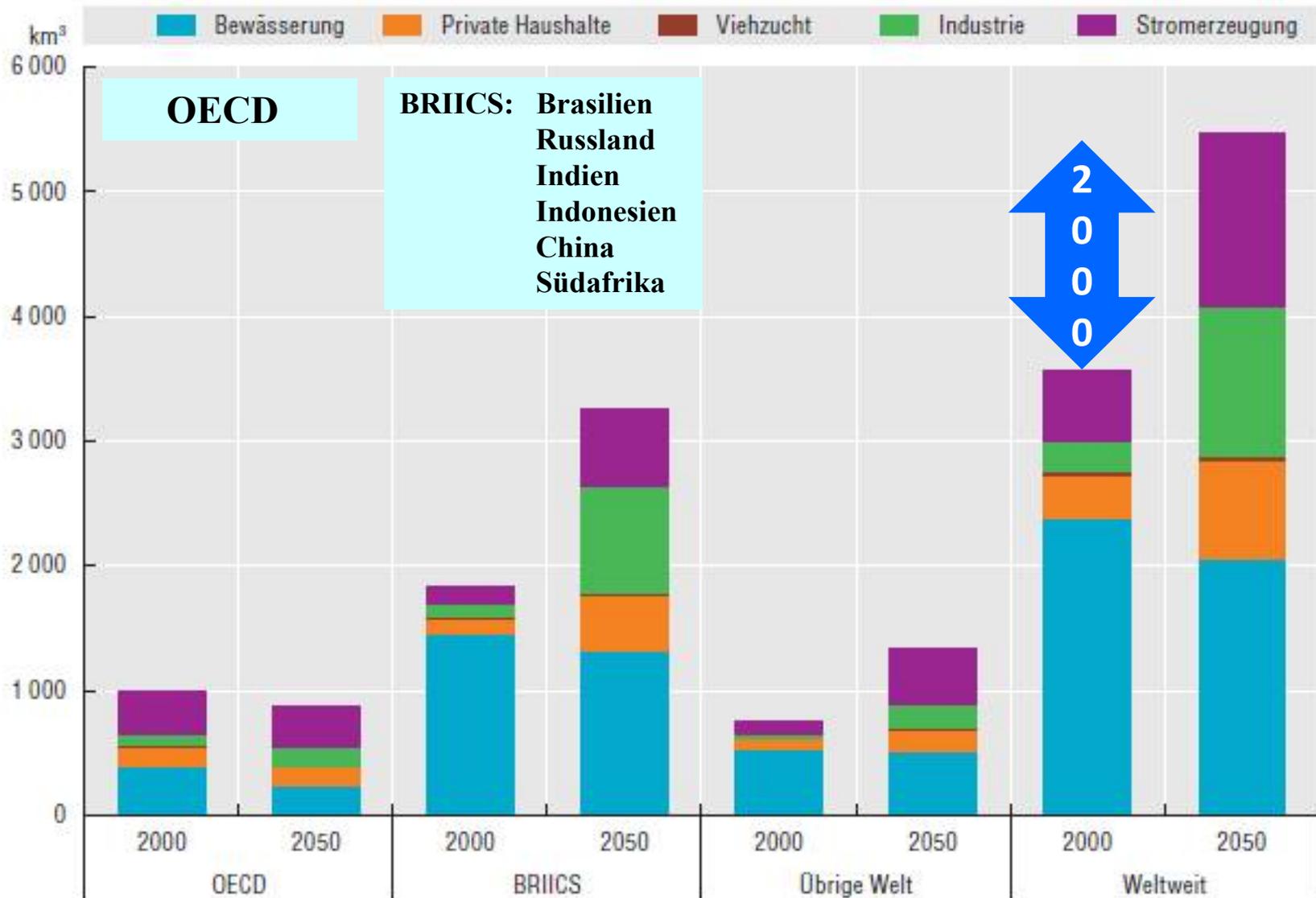


Kühlwasser für thermoelektrische Energiegewinnung: 1 000 MW ca. 30 bis 40 m³/s

Energy use for various processes in the water sector in [kWh/m³] (IEA 2016)



Weltweiter Wasserbedarf: Basisszenario, 2000 und 2050



Anmerkung: In dieser Abbildung ist nur der Bedarf an Grund- und Oberflächenwasser (blaues Wasser, vgl. Kasten 5.1) erfasst, die Nutzung von Regenwasser für die landwirtschaftliche Bewässerung ist nicht berücksichtigt. Wegen einer Erläuterung von BRIICS und „übrige Welt“ vgl. Kapitel 1, Tabelle 1.3.

Quelle: Basisszenario des *OECD-Umweltausblicks*; Ergebnisse von Berechnungen anhand der IMAGE-Modellreihe.

Anstieg des Wasserbedarfs von 2005 bis 2030 (OECD)

Landwirtschaft

Industrie

Kommune & Haushalt

China 178 300 54

Indien 338 89 40

Afrika südl. Sah. 320 28 92

restl. Asien 234 117 80

Nordamerika 181 124 21

Europa 72 100 12

Südamerika 89 68 23

mittl. Osten +
Nordafrika 85 6 9

Ozeanien 21 7 28

insgesamt : 2 710 Mrd. m³

Prognose 2010 bis 2050 (W. Mauser 2007)

Bedarf an grünem Wasser ^{5 000} = Verdunstungswasser

9,5 Mrd. Menschen d.h. + 3 Mrd.

Auslöschung Hunger (1300 m³ pro Kopf u. Jahr)

Effizienzsteigerung in Bewässerungstechnik

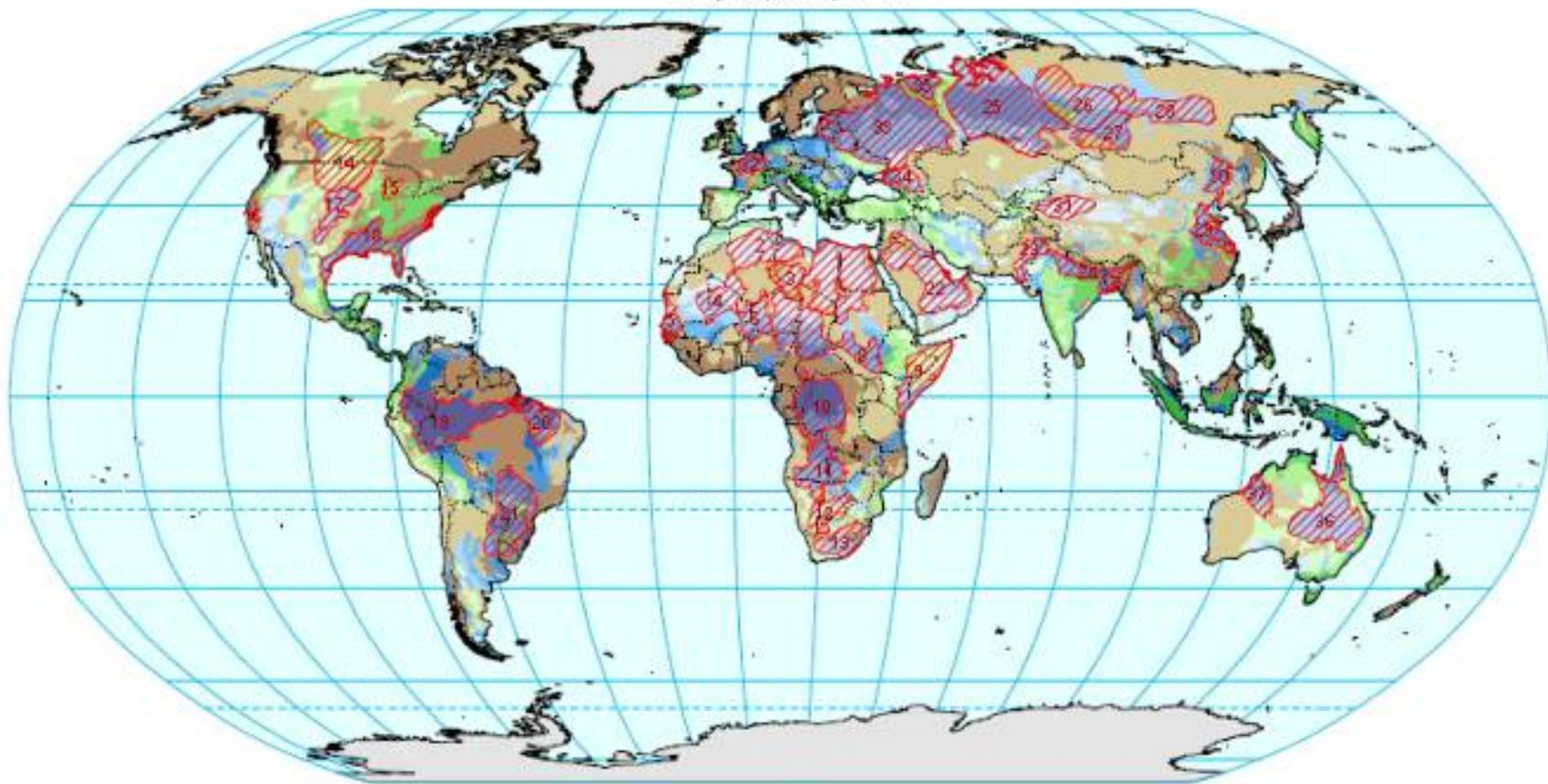
Defizit global 5 400 km³ pro Jahr

woher ?blauesgrünes Wasser ?

Wasserpolitik

Groundwater Resources of the World

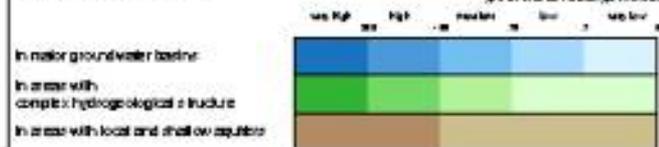
- Large Aquifer Systems -



Large Aquifer Systems

- | | | | |
|---|---|--------------------------------------|----------------------------------|
| 1. Kuban Aquifer System (KAS) | 11. Northern Kalahari Basin | 21. Gauran Aquifer System | 31. Tain Basin |
| 2. Korbweil Sahara Aquifer System (KWSAS) | 12. Southeast Kalahari Basin | 22. Arabian Aquifer System | 32. Pakistan Basin |
| 3. Muzuk-Nadi Basin | 13. Karoo Basin | 23. Indus Basin | 33. East European Aquifer System |
| 4. Toubouli-Banzirouf Basin | 14. Northern Chad Plains / Niger Plains Aquifer | 24. Ganges-Brahmaputra Basin | 34. North Caucasus Basin |
| 5. Senegal-Niakharan Basin | 15. Cameroon-Gabon Aquifer System | 25. Virel-Siberian-Arctic Basin | 35. Pechora Basin |
| 6. Malmgren-Itasser Aquifer System | 16. California Central Valley Aquifer System | 26. Tungus Basin | 36. Great Arctian Basin |
| 7. Chad Basin | 17. High Plains-Ogallala Aquifer | 27. Angara-Lena Arctian Basin | 37. Canning Basin |
| 8. Sudd Basin (Sudd-Rukuba Aquifer) | 18. OutCOastal Plains Aquifer System | 28. Yakut Basin | |
| 9. Ogaden-Juba Basin | 19. Amazonia Basin | 29. North China Plain Aquifer System | |
| 10. Congo-Infraorbic Basin | 20. Maranhao Basin | 30. Songlao Basin | |

Groundwater resources



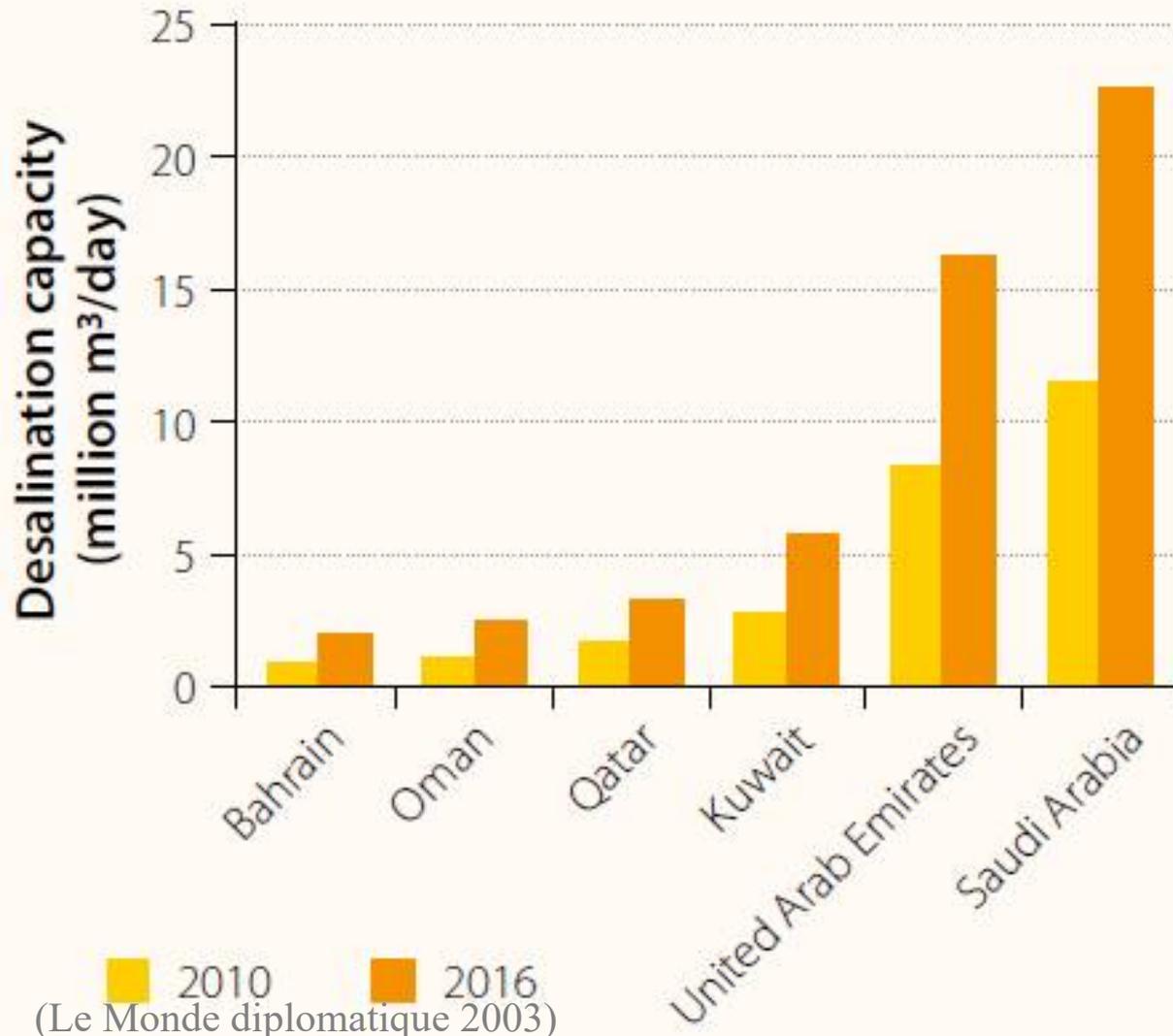


Der **Nubische Aquifer**, den sich die Länder Ägypten, Libyen, Sudan und Tschad teilen, ist das größte fossile **Frischwasservorkommen** der Welt.

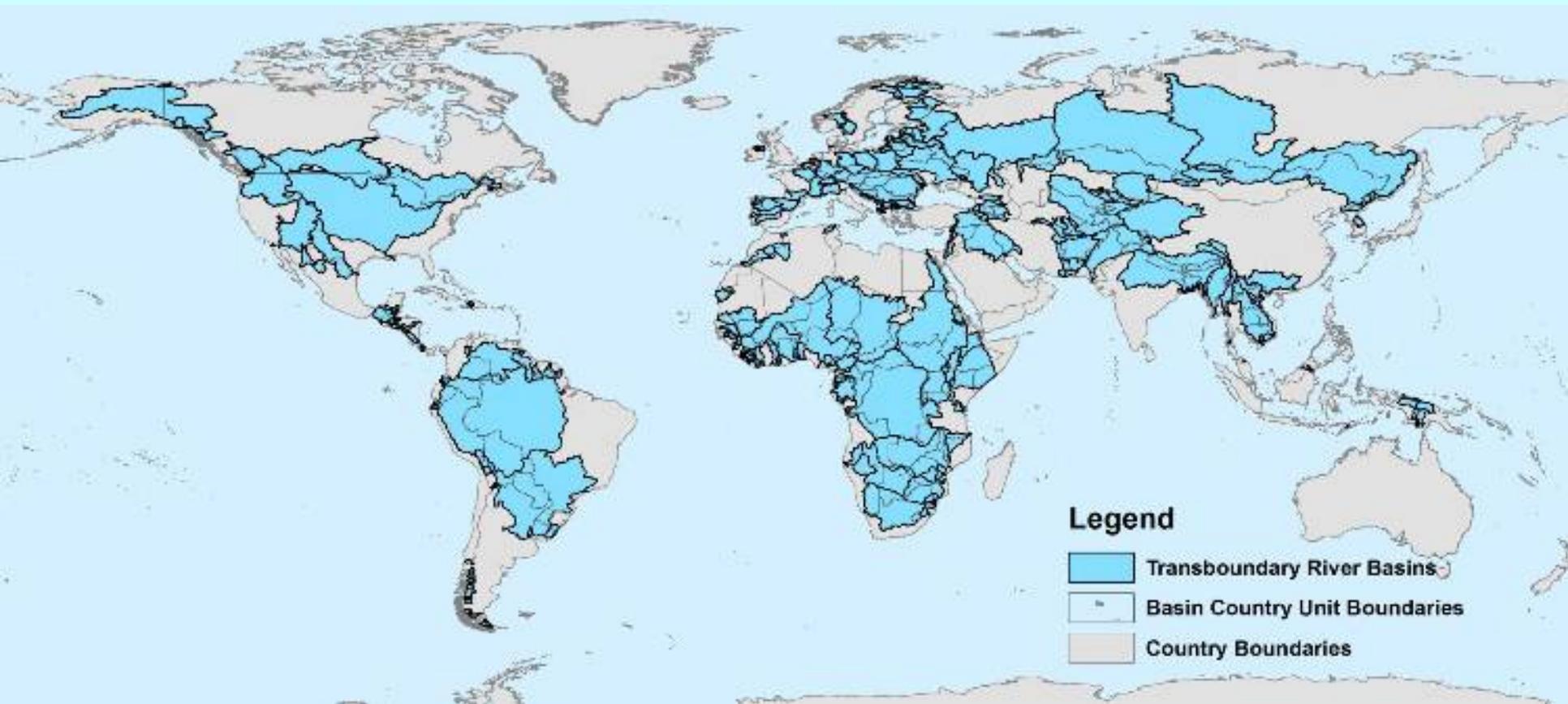
Das Wasser ist zwischen 35.000 und 15.000 Jahre alt und stammt aus der letzten Eiszeit.

Die Vereinten Nationen schätzen das Gesamtvolumen auf mindestens 373.000 Milliarden Kubikmeter, von denen aber nur rund 9000 Milliarden Kubikmeter abpumpbar sind.

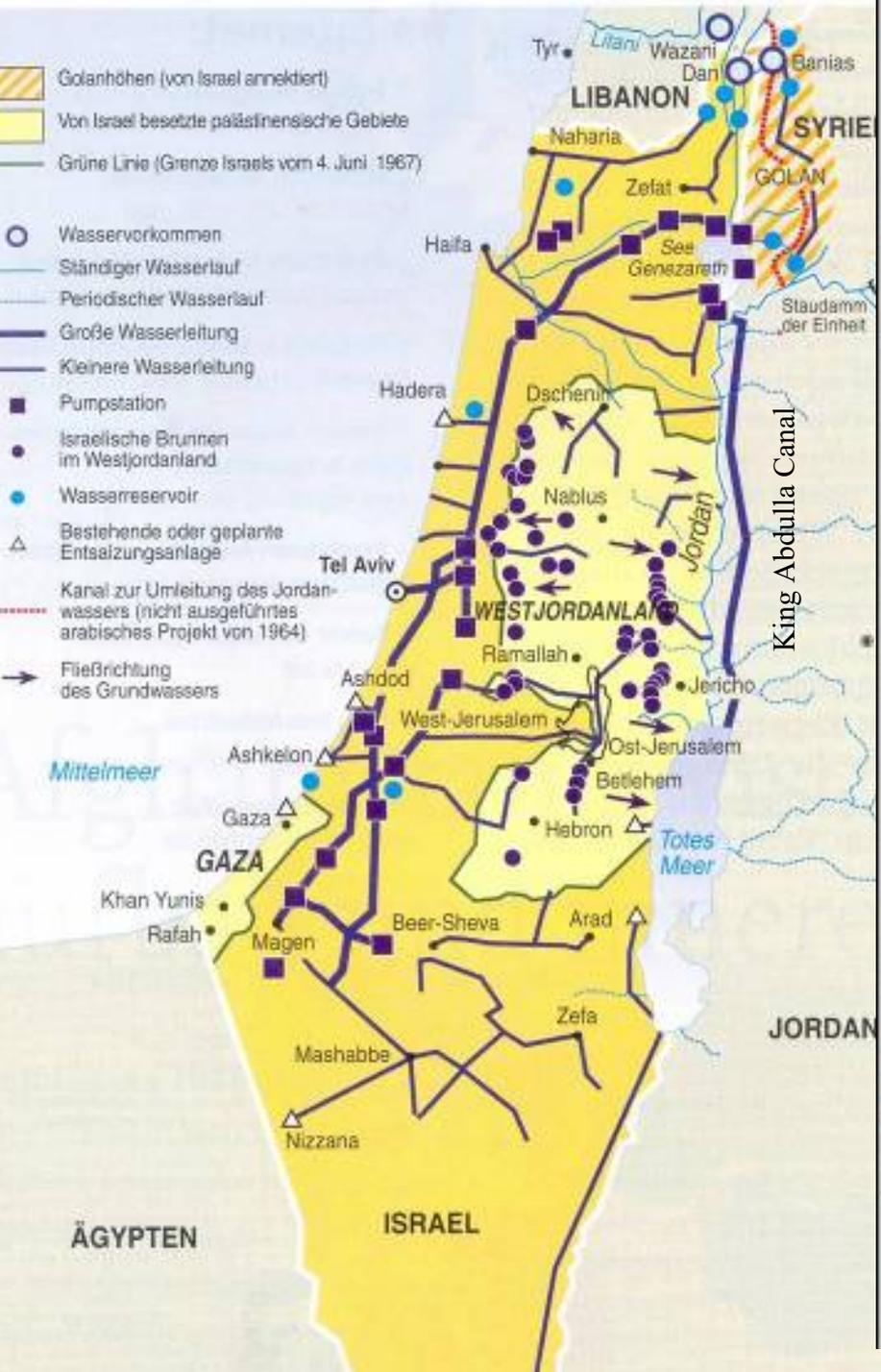
Current (2010) and contracted (2016) desalination capacity in the Gulf Cooperation Council countries



erentsalzungsanlagen



Global map of the 286 transboundary river basins (Lehner and Grill 2013)



Wasser für Israel

- 43% aus eigenem Land
- 53% für Landwirtschaft
- 80% des Wasserdargebots in Westbank und Golanhöhen nach Israel

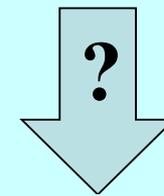


Grundwasserspiegel - 15cm / Jahr



Euphrat und Tigris

Türkei
Südoanatolien - Projekt



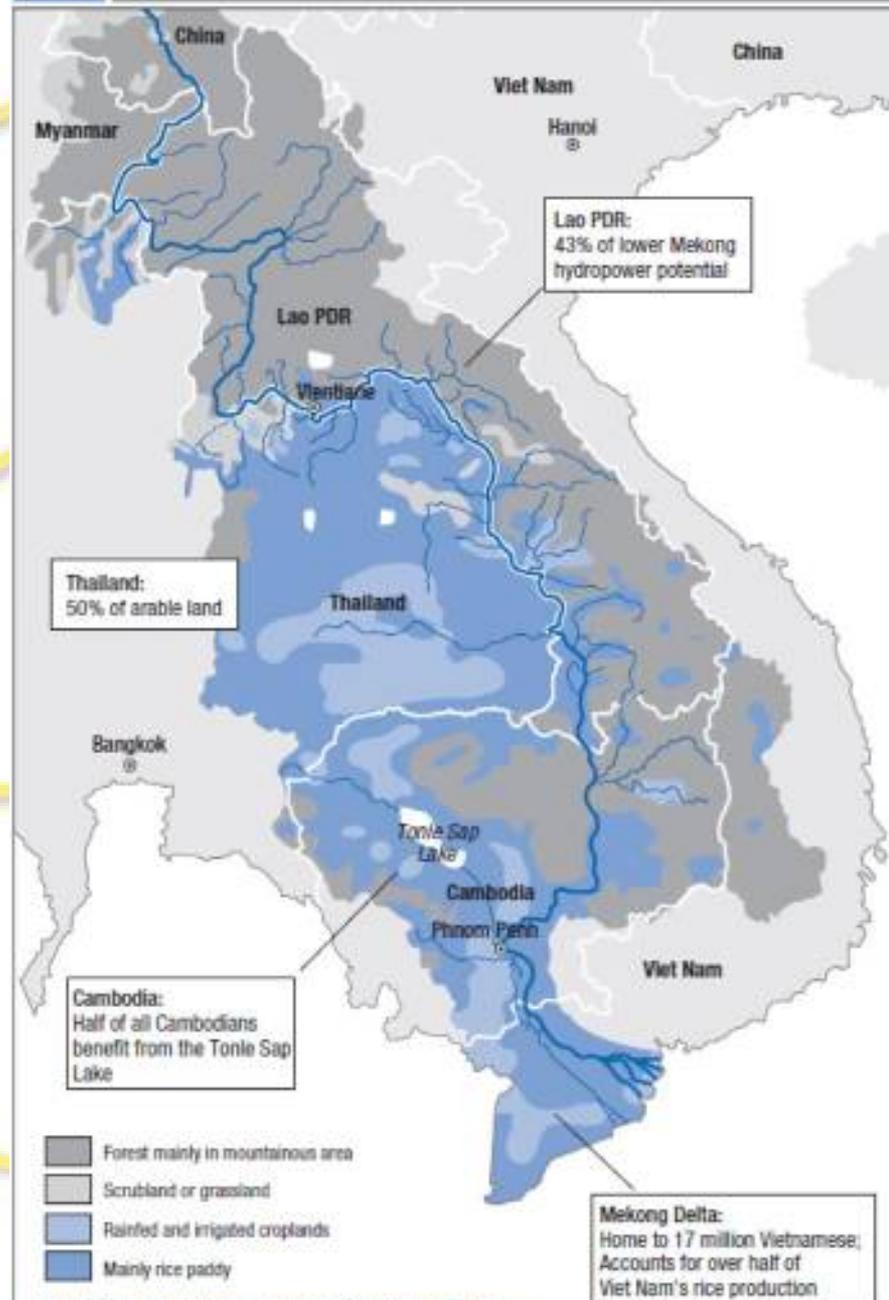
Syrien



Irak



Map 6.2 The Mekong binds livelihoods across borders



Note: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

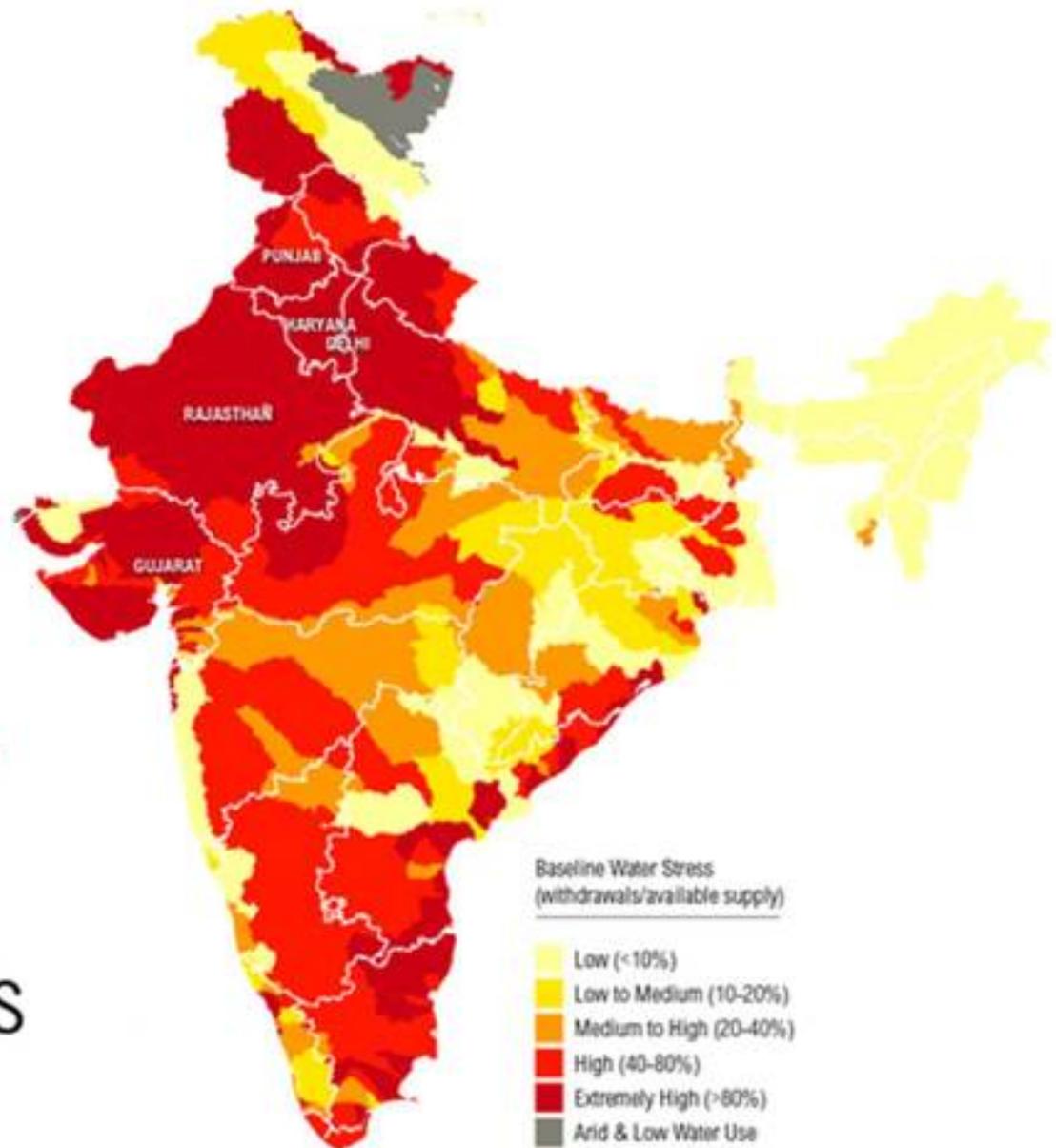
Source: The Mekong River Commission.

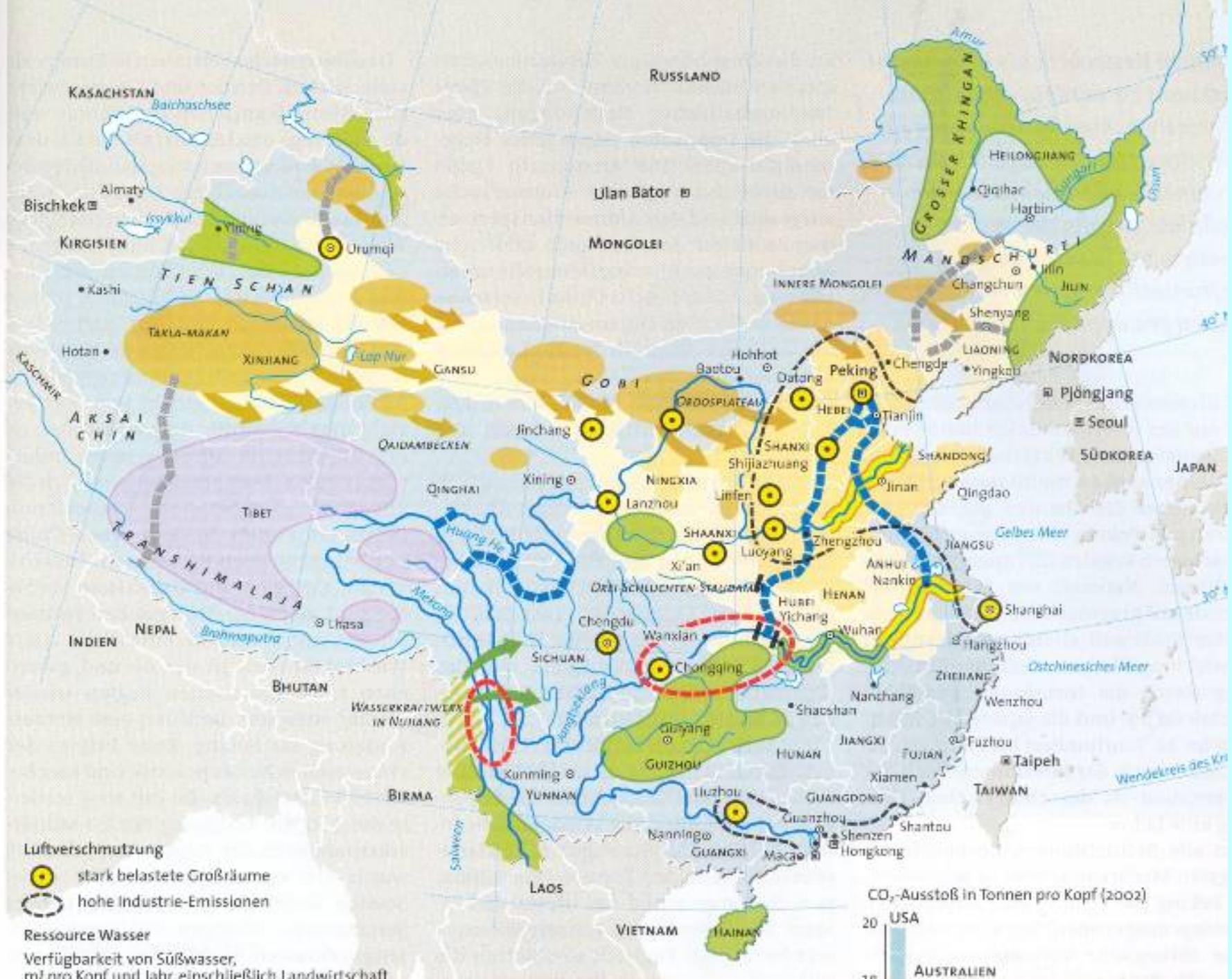
54%

of India
Faces

**High to
Extremely
High**

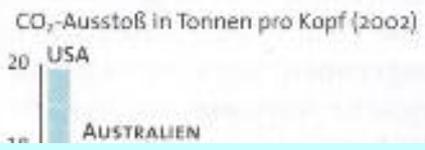
Water Stress





- Luftverschmutzung**
- stark belastete Großräume
 - hohe Industrie-Emissionen

Ressource Wasser
 Verfügbarkeit von Süßwasser, mit nur Konf und Laub einschließlich Landwirtschaft



South-to-North Water Diversion Project

(Source: Wang et al. 2007 & <http://www.nsbdc.cn/>)



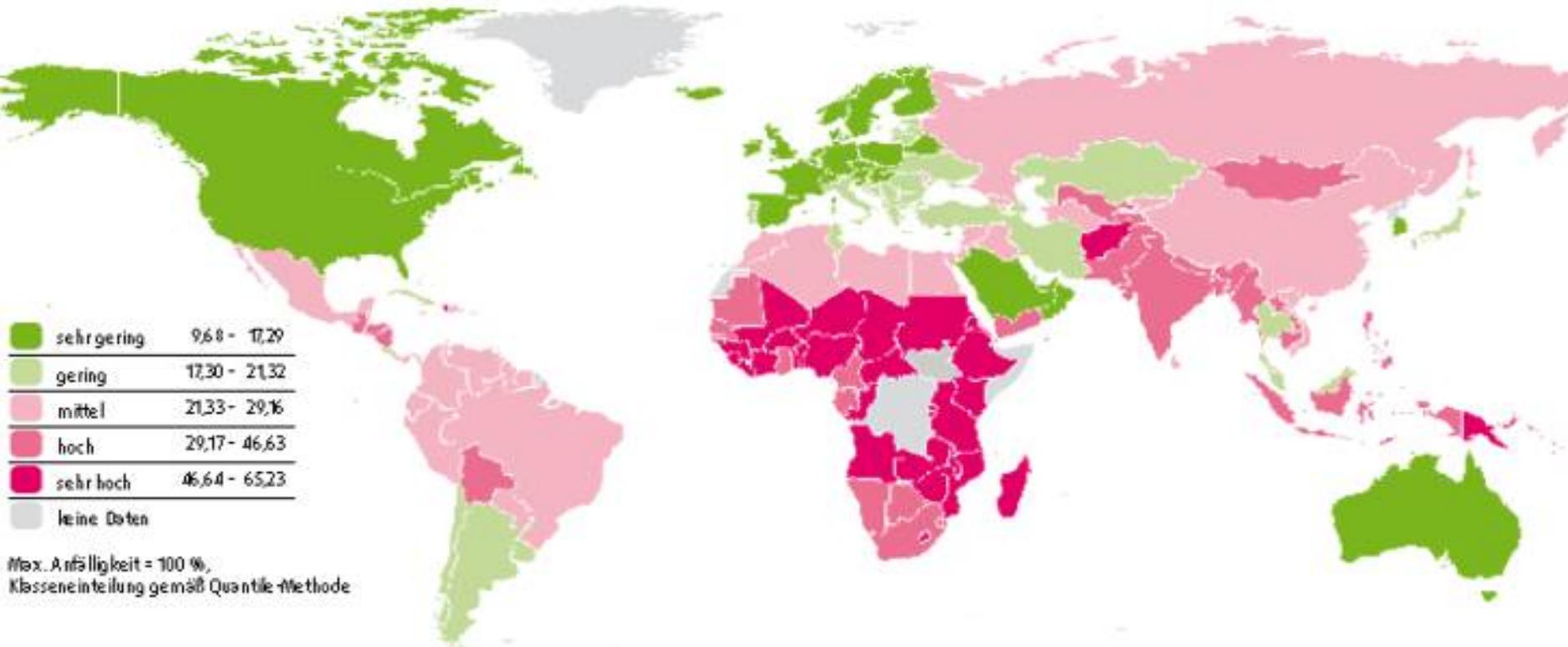
World Risk Report 2016

Vulnerabilität.....

- Bewältigungskapazität → Ernährung !
- Anpassungskapazität

Anfälligkeit

in Abhängigkeit von Infrastruktur, Ernährung, Einkommen und ökonomischen Rahmenbedingungen



Schlussbemerkungen

- **Wasser für pflanzliche & tierische Nahrungsproduktion reicht nicht für alle**
- **Ganzheitliche Lösungen für Wasser - Nahrung - Energie**
- **Klimawandel verschärft die ungleiche Verteilung der Wasserressourcen**

- **Wasserwirtschaft als integraler Teil einer fairen Weltwirtschaftsordnung**
- **Öffentlich rechtliche Kontrolle des Wassersektors**
- **Effizienzsteigerung in der Bewässerungswirtschaft**
- **Ertragssteigerung bei Kulturpflanzen**
- **Investitionen und Wissenstransfer in Wassertechnologie & Agrarwissenschaften**
- **Flächennutzung mit Priorität für Nahrungsmittel**

- **Einzugsgebietsbezogene grenzübergreifende Bewirtschaftung der Wasserressourcen**
- **Transparente, demokratisch legitimierte Lizenzvergabe bei Land - und Wasserkauf**
- **Speicherbau und Speicherbewirtschaftung mit fairer Wasserzuteilung**

- **Entwicklung von Klimaanpassungsstrategien für den gesamten Wassersektor**
- **Wasserwirtschaftliche Modelle als Planungsinstrument und Entscheidungshilfe**

UN-Water Members		UN-Water Partners	
FAO	UNECLAC	AquaFed	WaterAid
IAEA	UNEP	Global Compact	WBCSD
IFAD	UNFCCC	GWP	WSSCC
UNCBD	UN-HABITAT	IAH	WWC
UNCCD	UNHCR	IAHS	WWF
UNCTAD	UNICEF	KID	
UNDESA	UNIDO	IJCIN	
UNDP	UNISDR	IWA	
UNECA	UNU	IWMI	
UNESCAP	UNWTO	PSI	
UNESCO	WHO	RAMSAR	
UNESCWA	WHO	SIWI	
UNECE	World Bank	UNSGAB	

World Water Forum Stockholm 2014

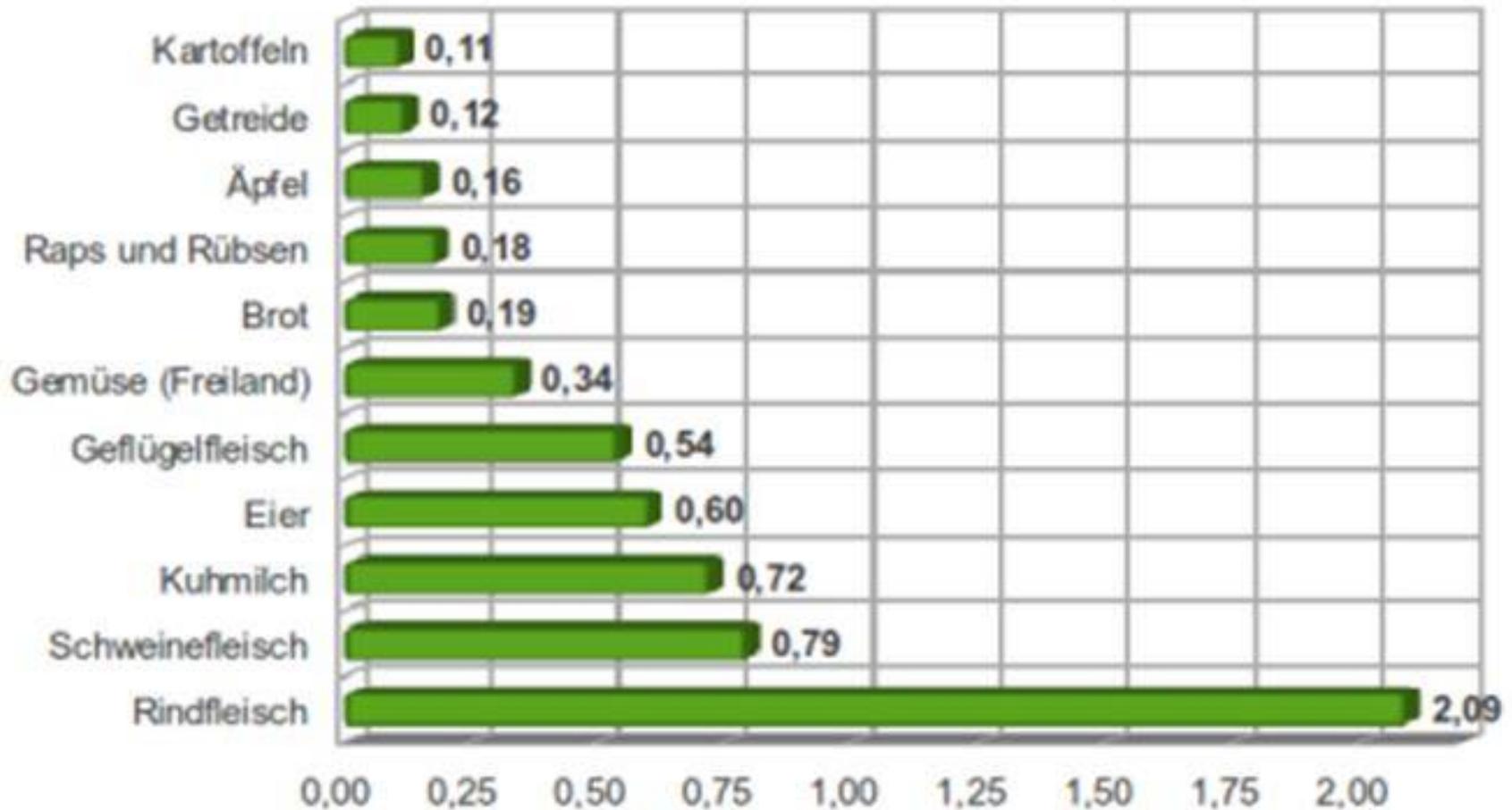


Danke
für
Ihr Interesse

Bernhard.Westrich@igs.uni-stuttgart.de

<http://www.uni-stuttgart.de>

Flächenbedarf ausgewählter Lebensmittel in m² pro Megajoule



Grafik: Cyberling / Wissenschaft und Schreie // Daten: aus SRU 2012

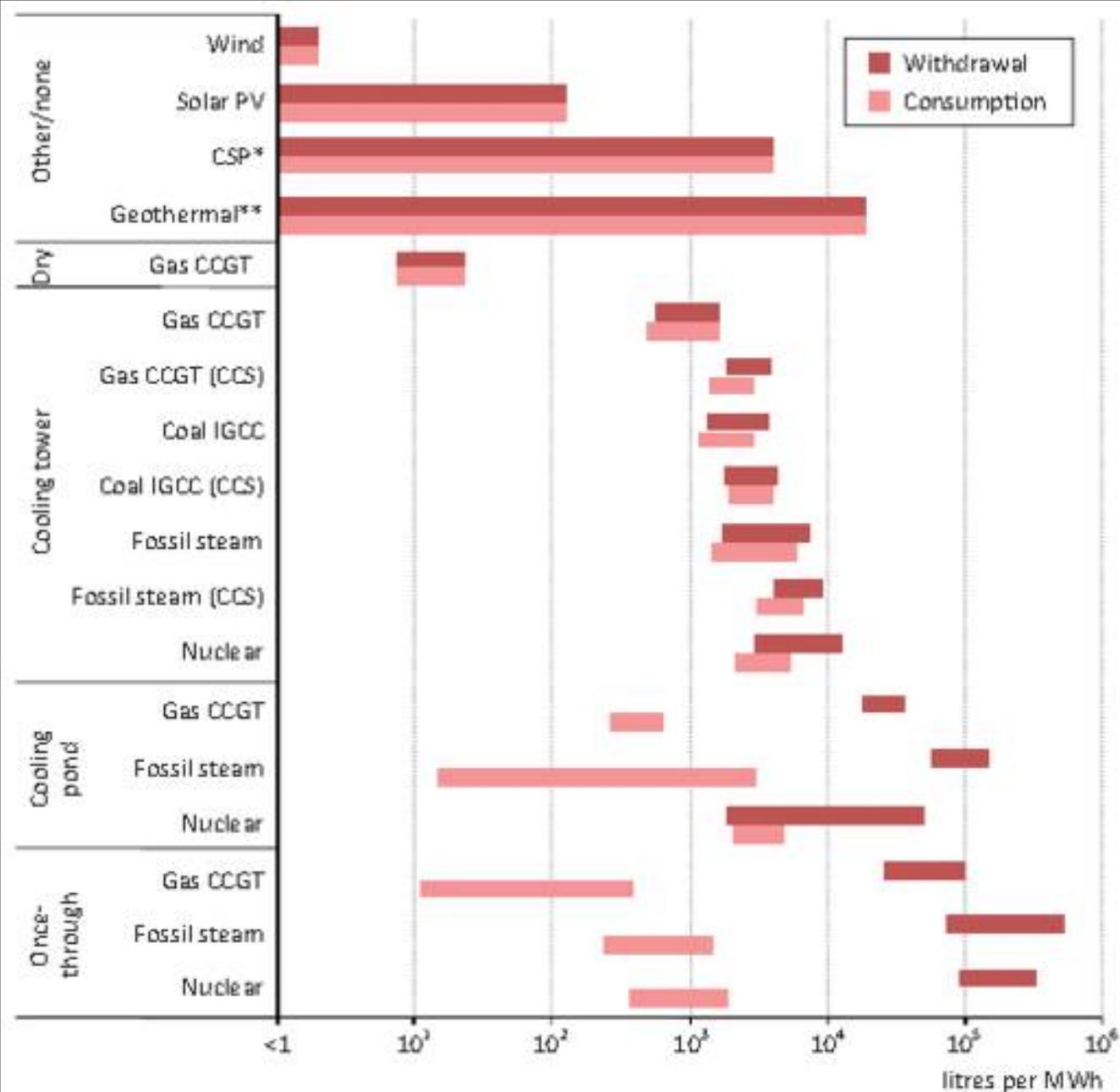
Amount of energy required to provide 1 m³ water safe for human consumption from various water sources



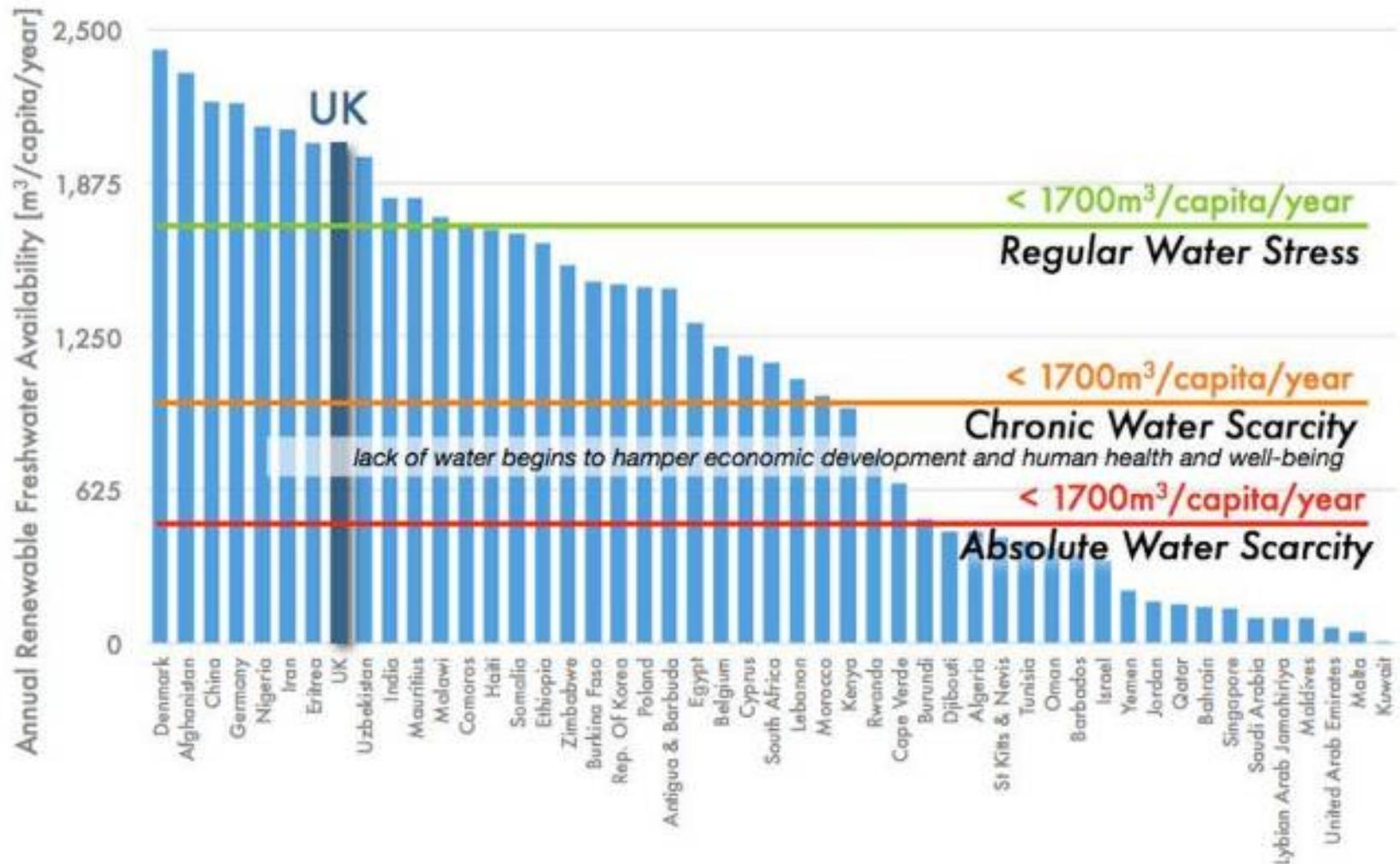
Note: This diagram does not incorporate critical elements such as the distance the water is transported or the level of efficiency, which vary greatly from site to site.

Source: WBSCD (2009, fig. 5, p. 14, based on source cited therein).

Water use for electricity generation by cooling technology



Water Scarcity



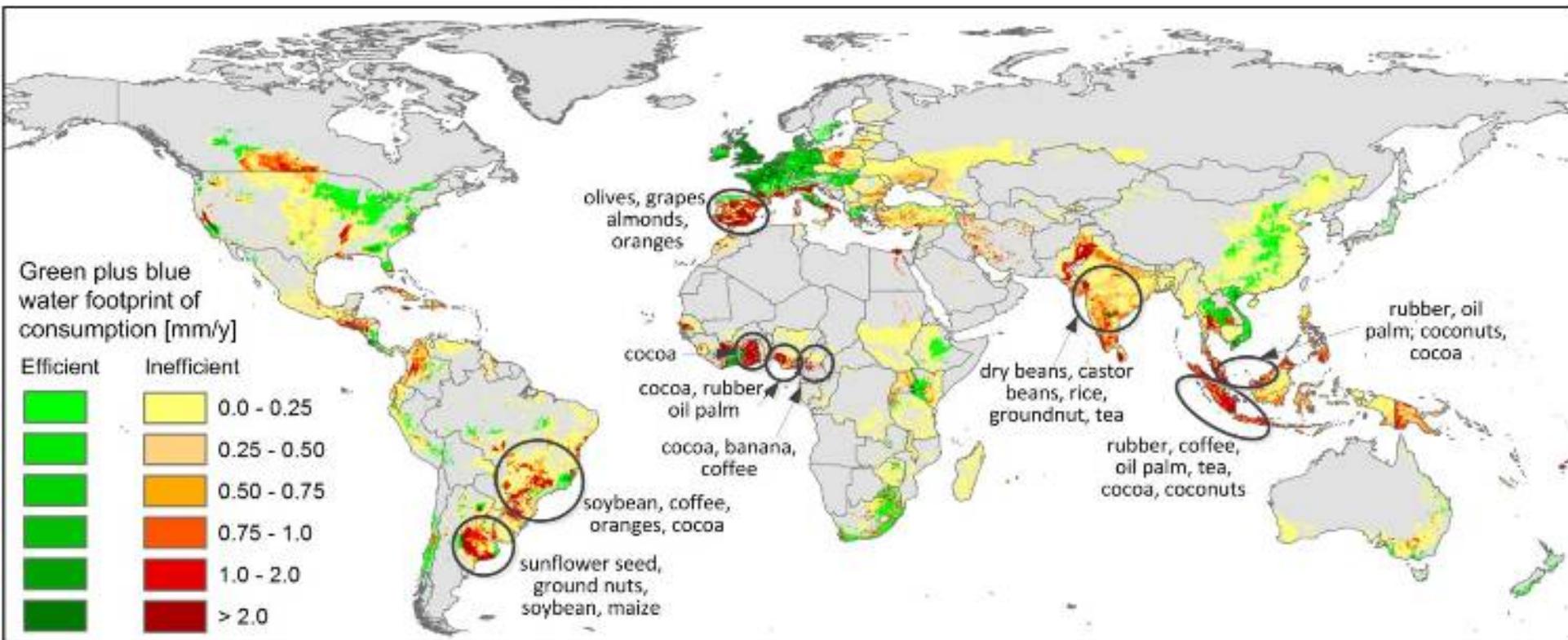
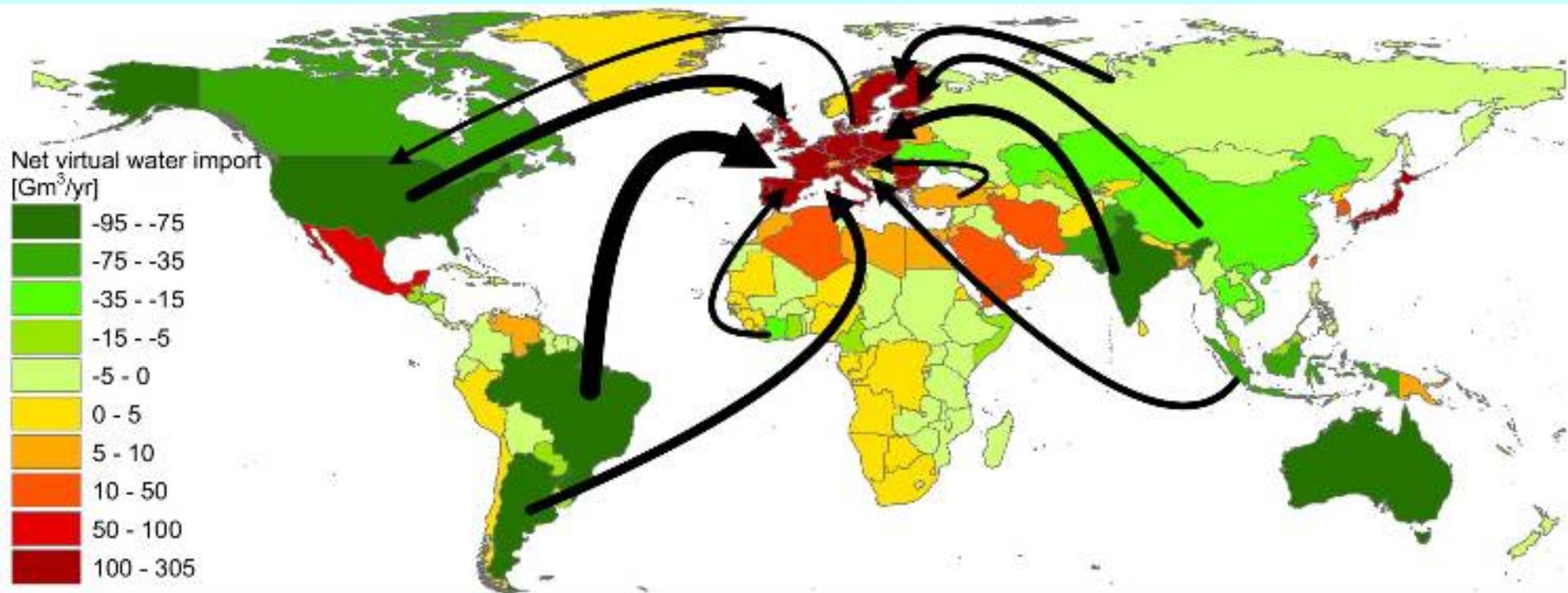
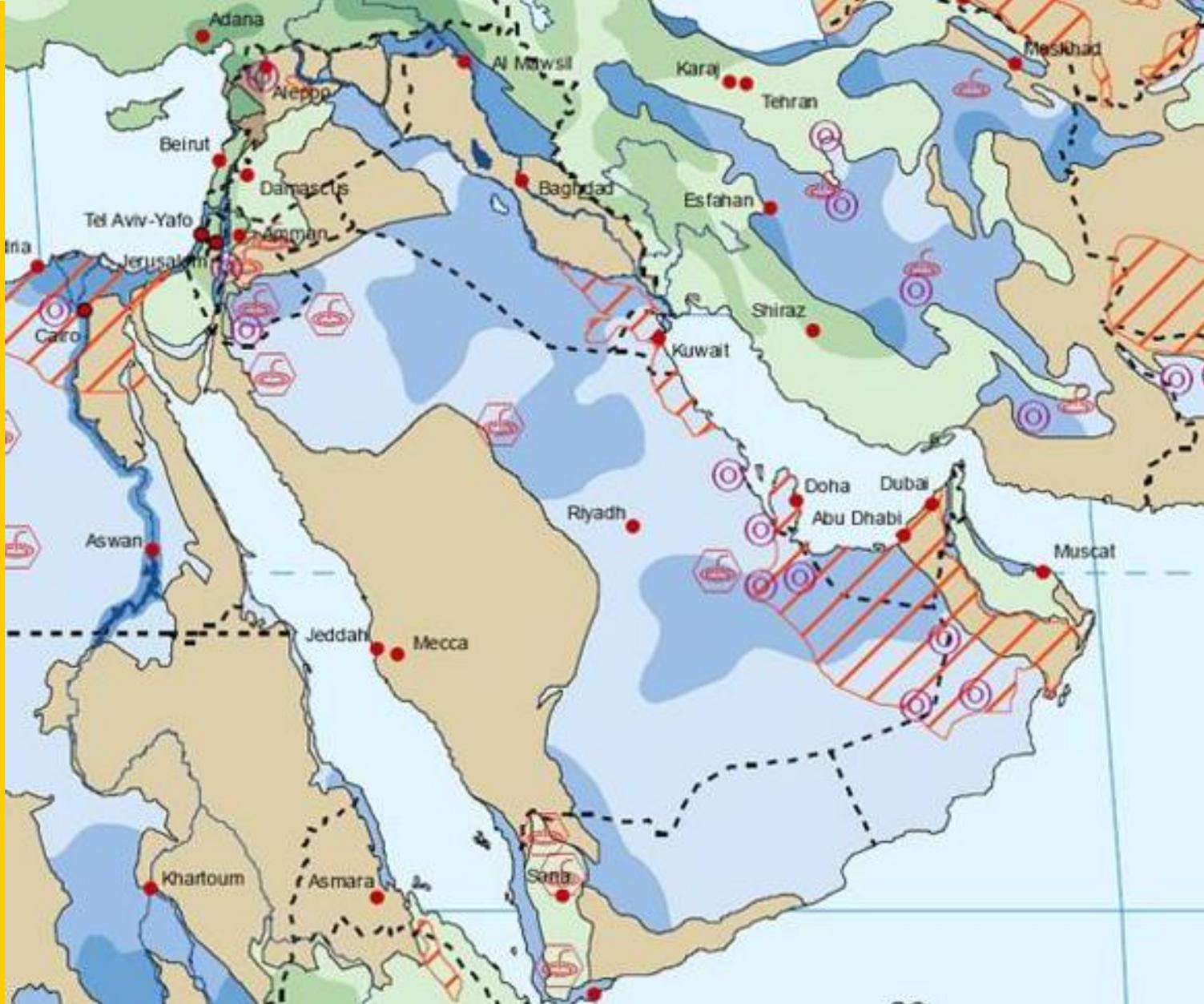


Figure 2. The efficient (green) and inefficient (yellow to red) parts of the global consumptive water footprint of the UK's direct and indirect crop consumption, with an indication of crops for which water productivity can be substantially increased and through which water footprints can thus be reduced.



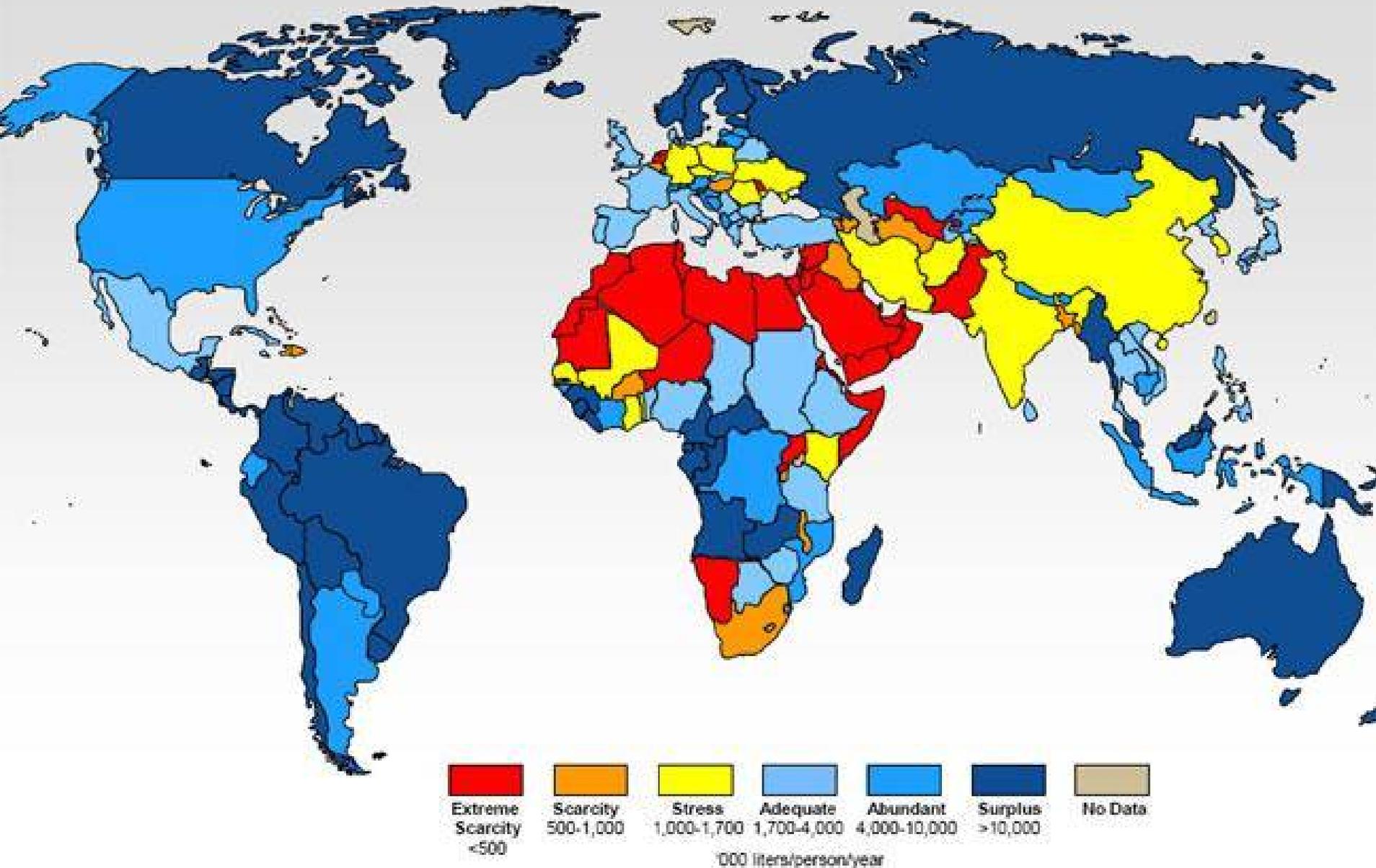
Instead it results from protection of their domestic water resources, land availability and land uses. In Europe as a whole, 40% of the water footprint lies outside of its borders.

(Mekonnen, M.M. and Hoekstra, A.Y. (2011))



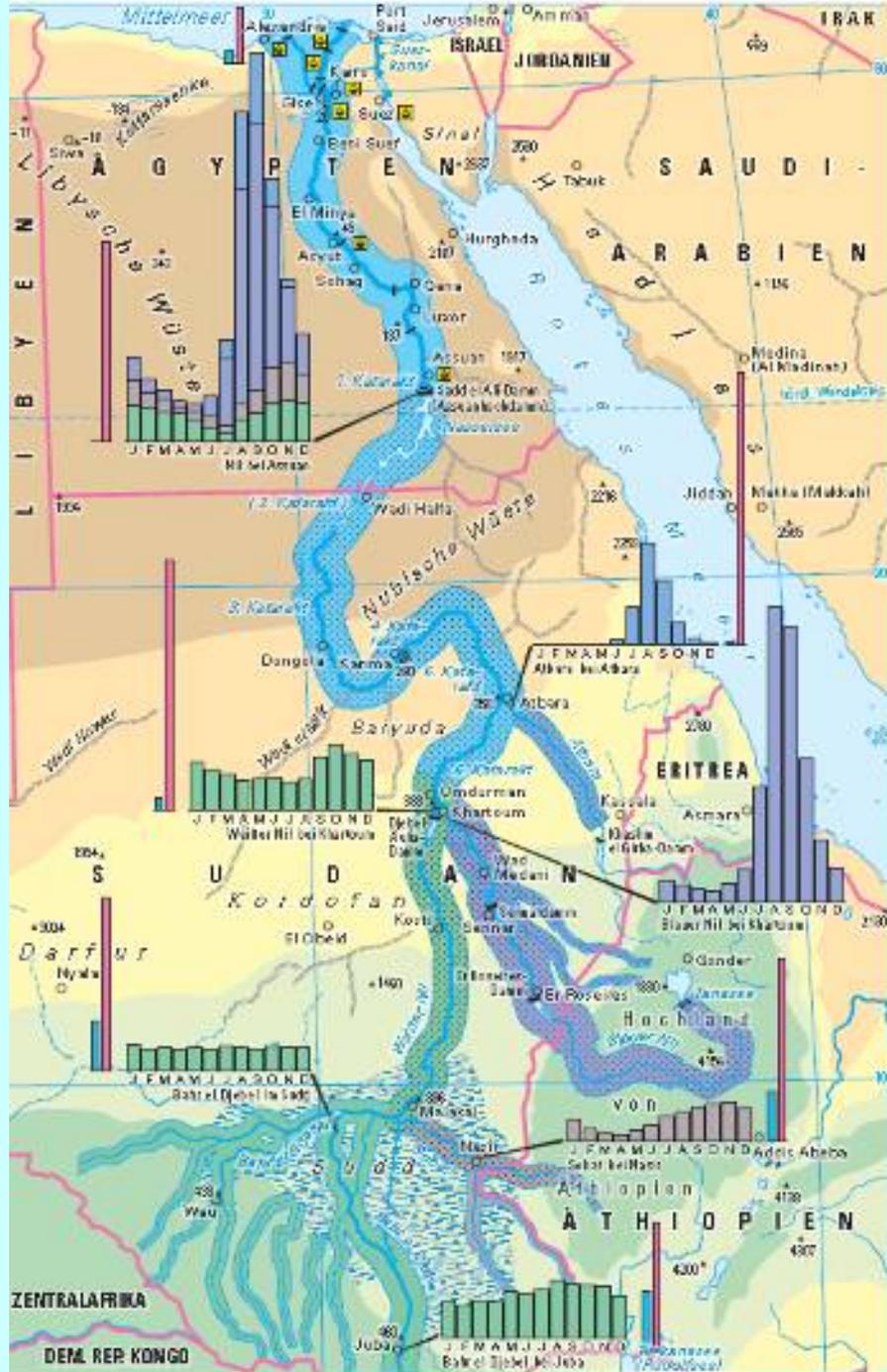
Arabische Halbinsel: In den ölreichen Ländern am Persischen Golf muss viel Wasser aus großen Tiefen gepumpt werden. Die Reservoirs werden ausgebeutet - jedoch nicht aufgefüllt.

Global Per Capita Water Availability (2025)

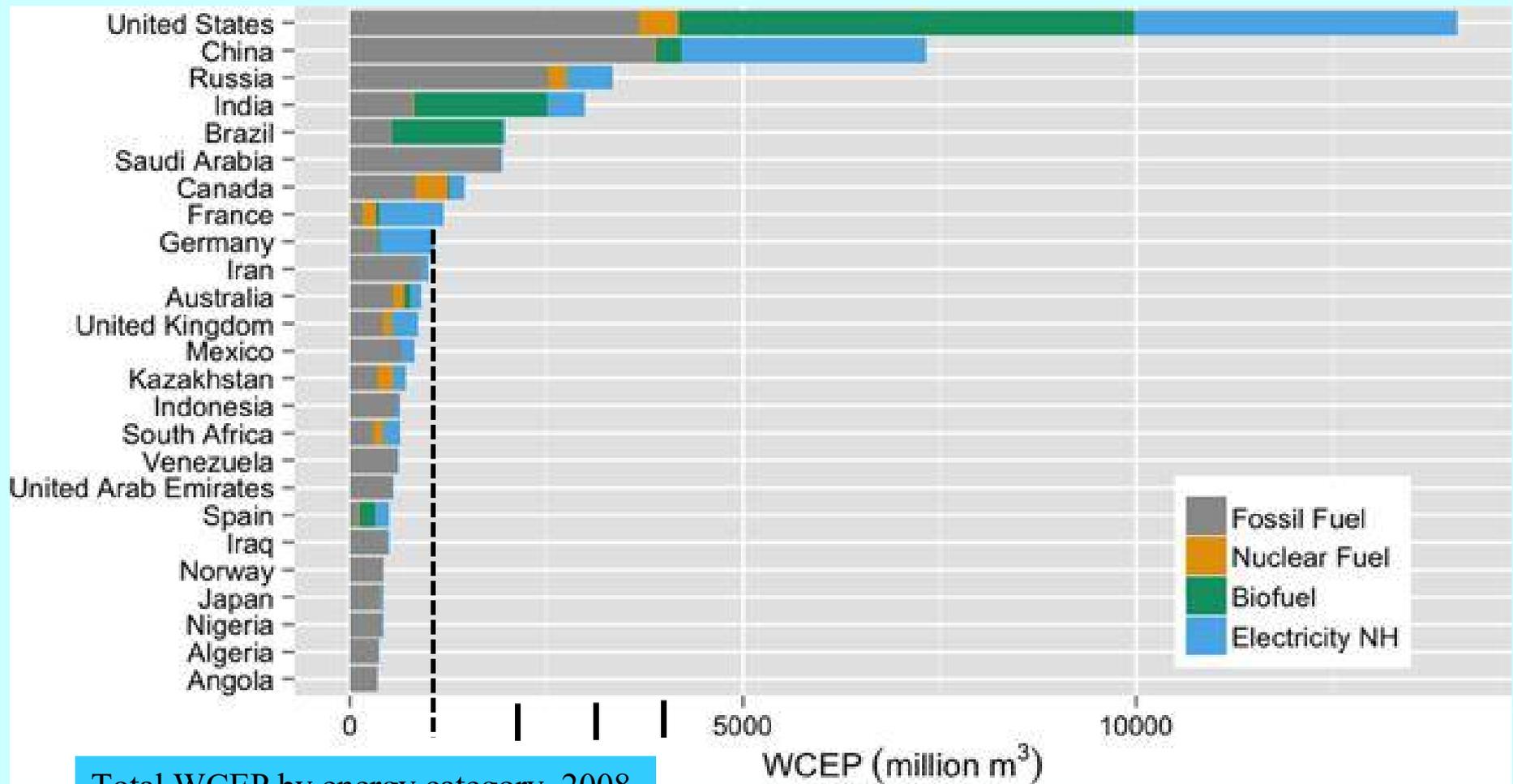


Source: 'Global Water Initiative' (June 2005), GEF International Waters Conference, The Coca-Cola Company

Unterzeichnung des Vertrags zur gerechten Verteilung und Nutzung des Nil Wassers durch die Anrainer Staaten Ägypten, Ruanda, Uganda, Tansania, (Kenia) 2010



Wasserführung des Nils – Niederschlag, Wasserabfluss und Verdunstung

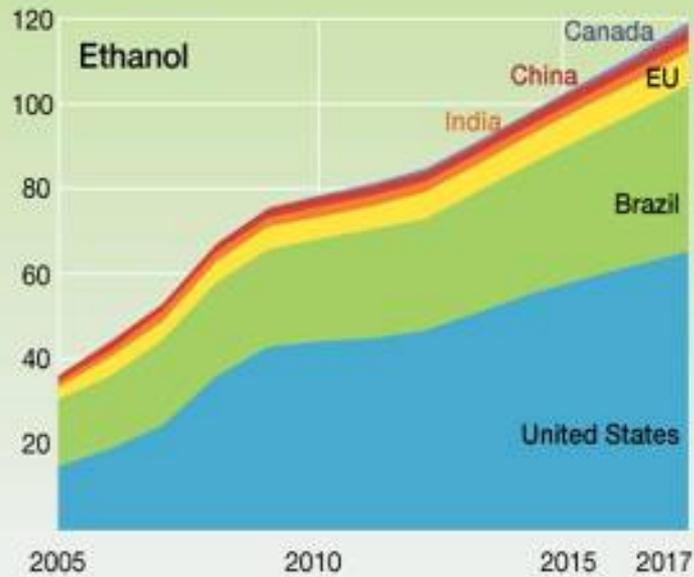


Total WCEP by energy category, 2008.

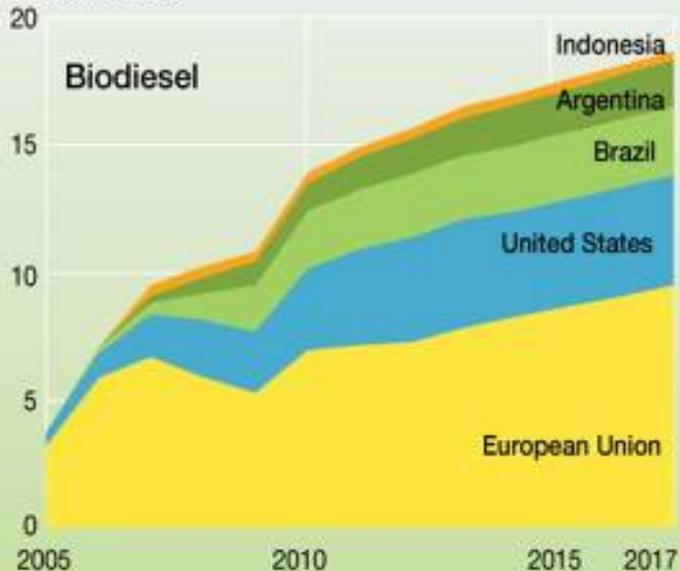
Disaggregating WCEP by energy subcategory (figure 5) shows fossil fuels consuming significant proportions of water in most countries (less so for India, Brazil, Germany, and France within the top ten.) Nuclear fuel production plays a minimal role overall, with the United States and Canada having the highest nuclear fuel WCEP values. Biofuel WCEP is significant in the United States, India, and Brazil. Meanwhile, the United States and China consume by far the most water for electric power generation.

World biofuels production trends

Billions of litres



Billions of litres



Source: FAPRI, U.S. and World Agricultural Outlook, 2008.

ANBAU NACHWACHSENDEDER ROHSTOFFE IN DEUTSCHLAND

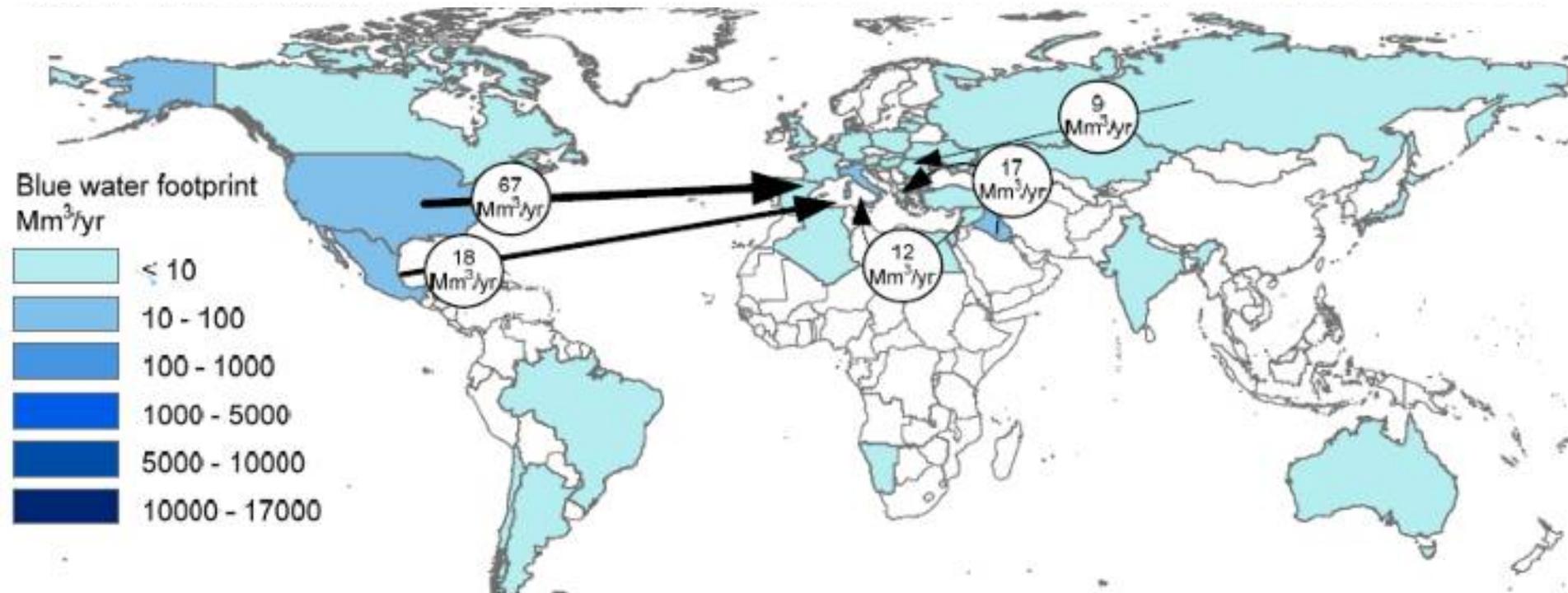
Anbaufläche in 1.000 Hektar



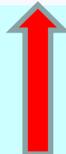
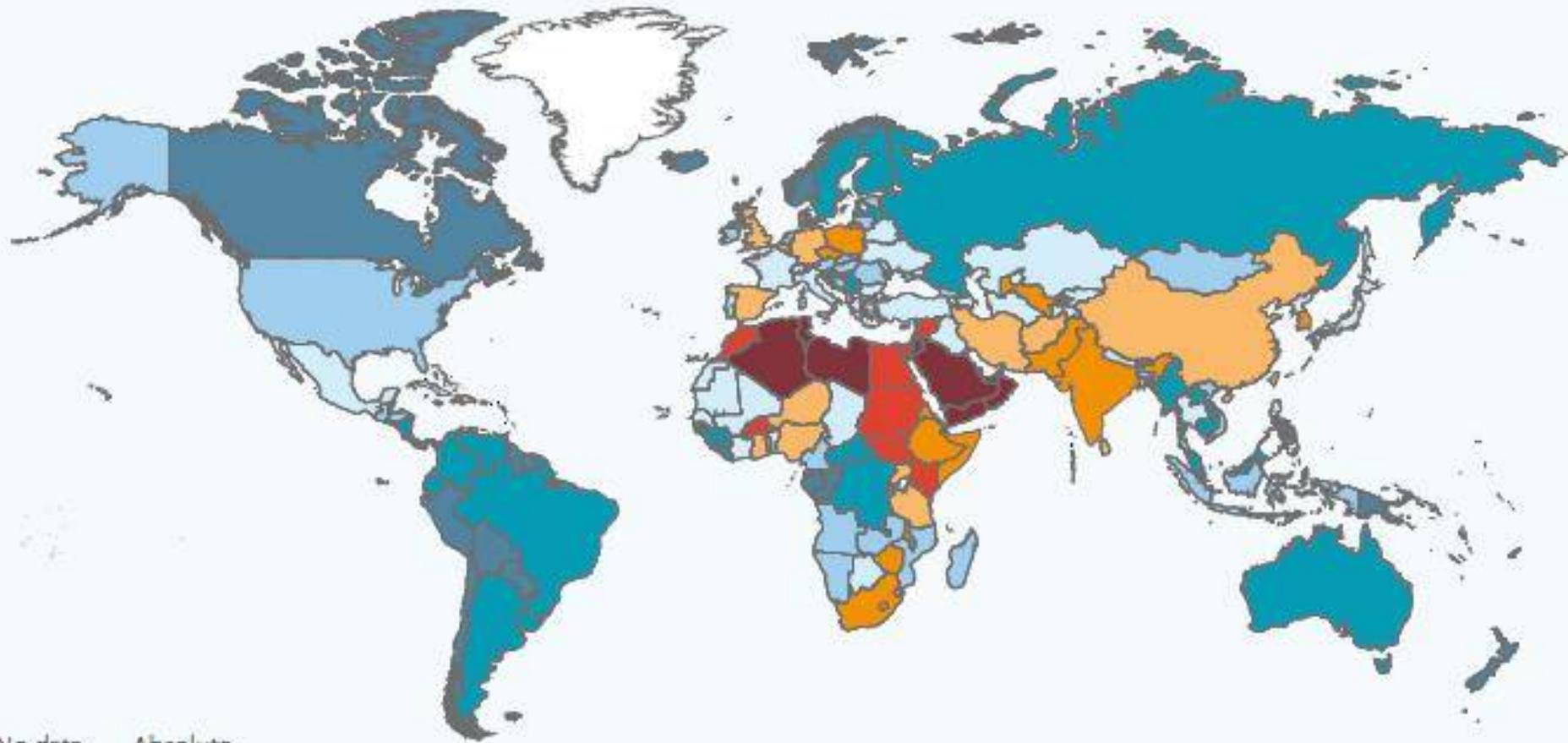
4.3. The external water footprint of wheat consumption in Italy and Japan

In the previous two sections we have looked into the water footprint of wheat production in specific areas of the world and analysed how this water footprint could be linked to consumers elsewhere. In this section we will do the reverse: we will consider the wheat consumers in two selected countries – Italy and Japan – and trace where their water footprint lies.

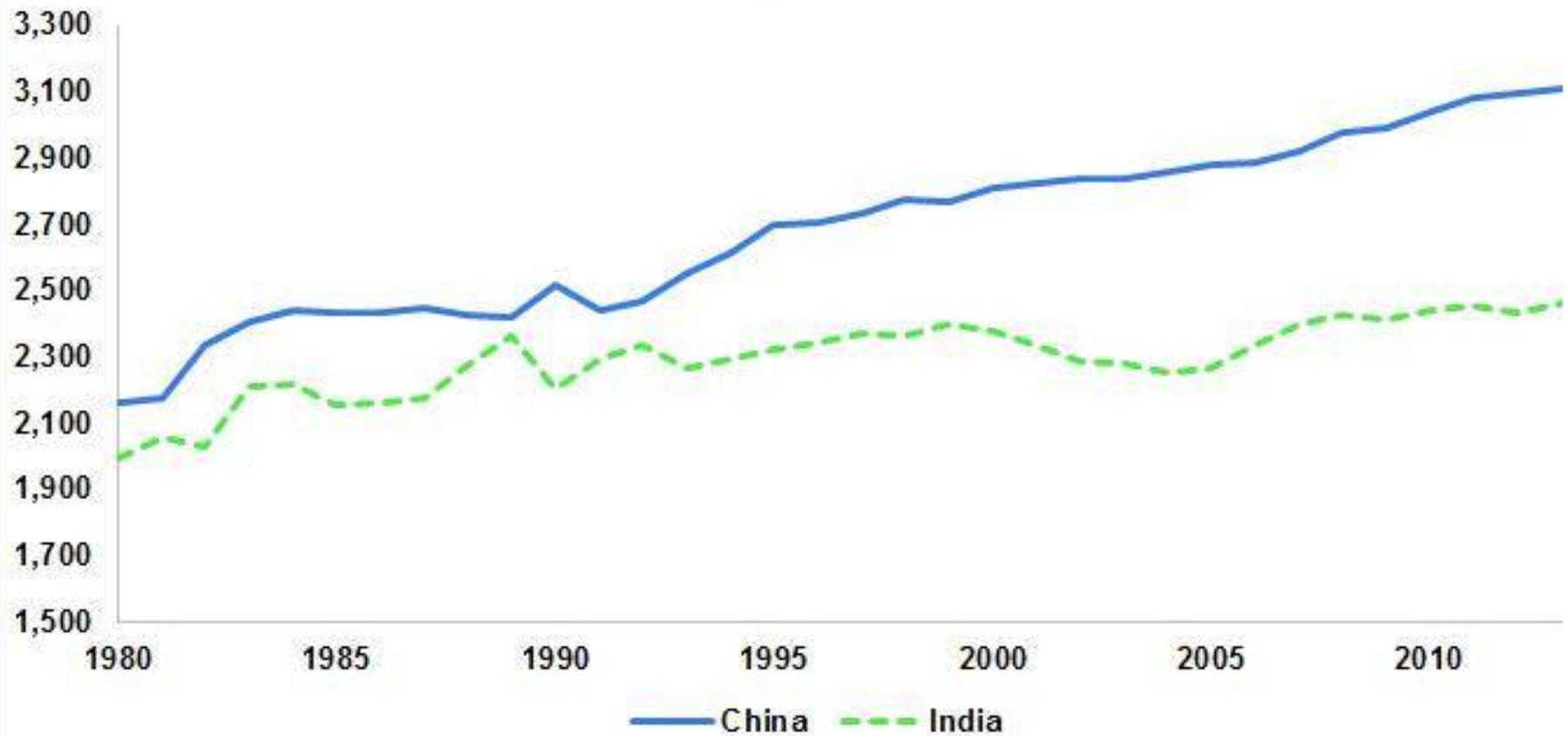
Italy's water footprint related to the consumption of wheat products for the period 1996-2005 was 17.4 Gm³/yr. More than half (56%) of Italy's water footprint is pressing on domestic water systems. The rest of the water footprint of Italian wheat consumption lies in other countries, mainly the USA (20%), France (19%), Canada



Total renewable water resources per capita (2013) in m³

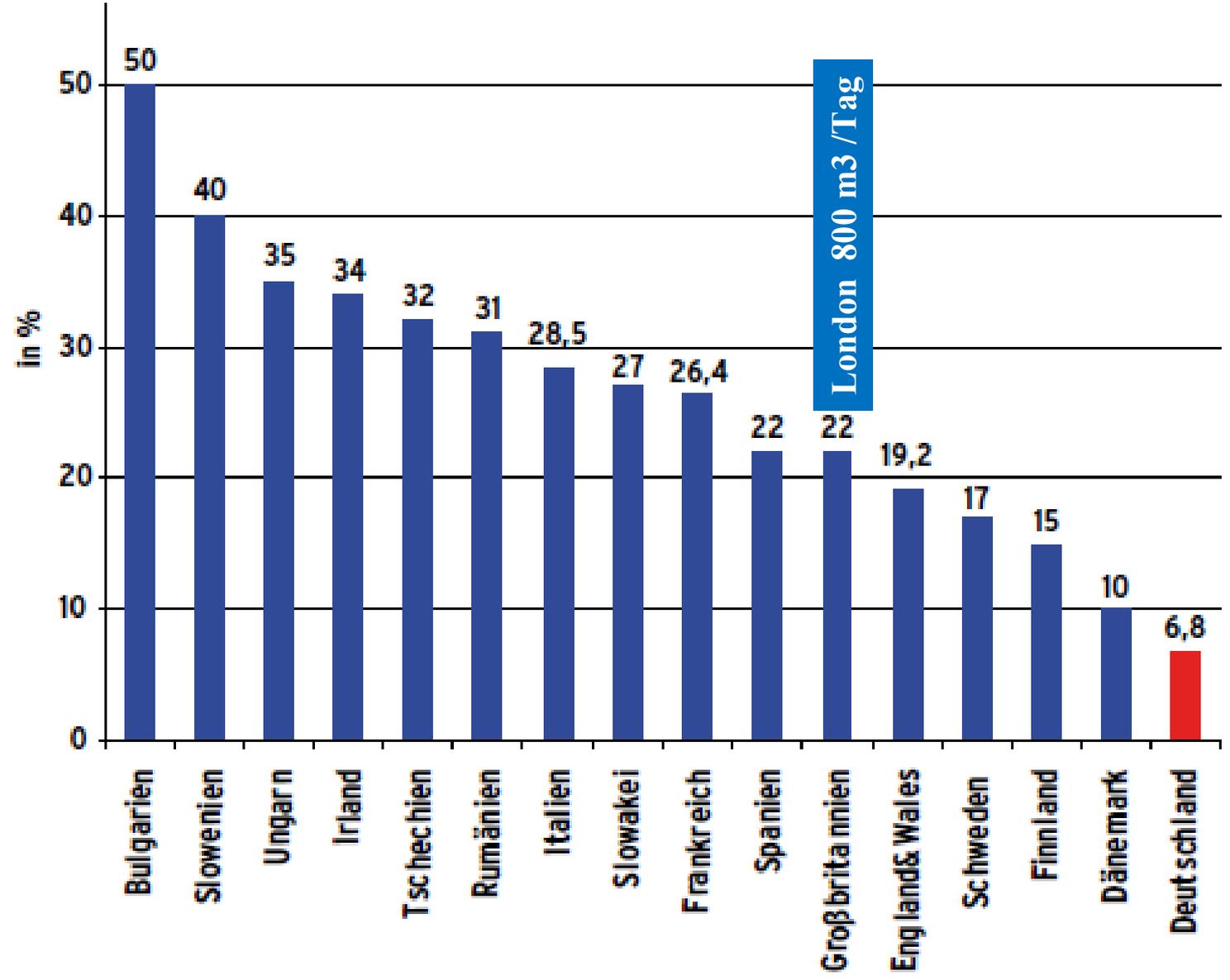


**kilo Calories Consumed Per Capita Per Day,
China and India, 1980-2013**

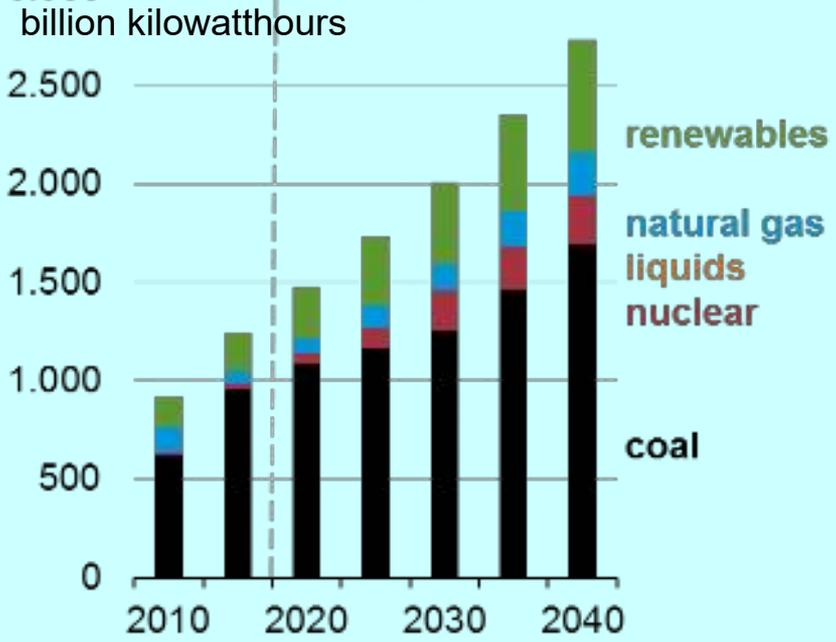


Water loss in drinking water supply systems in % (2008)

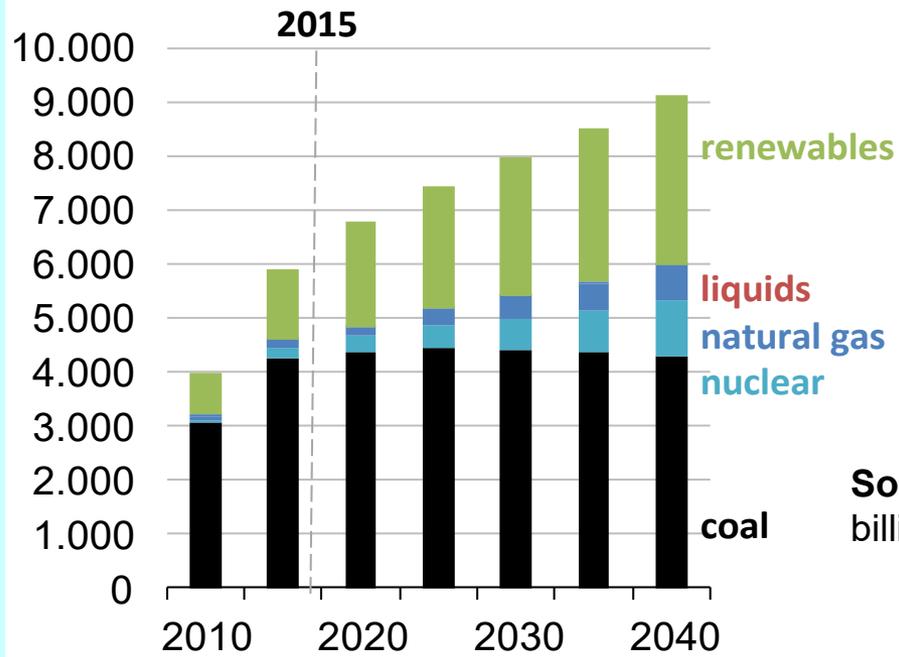
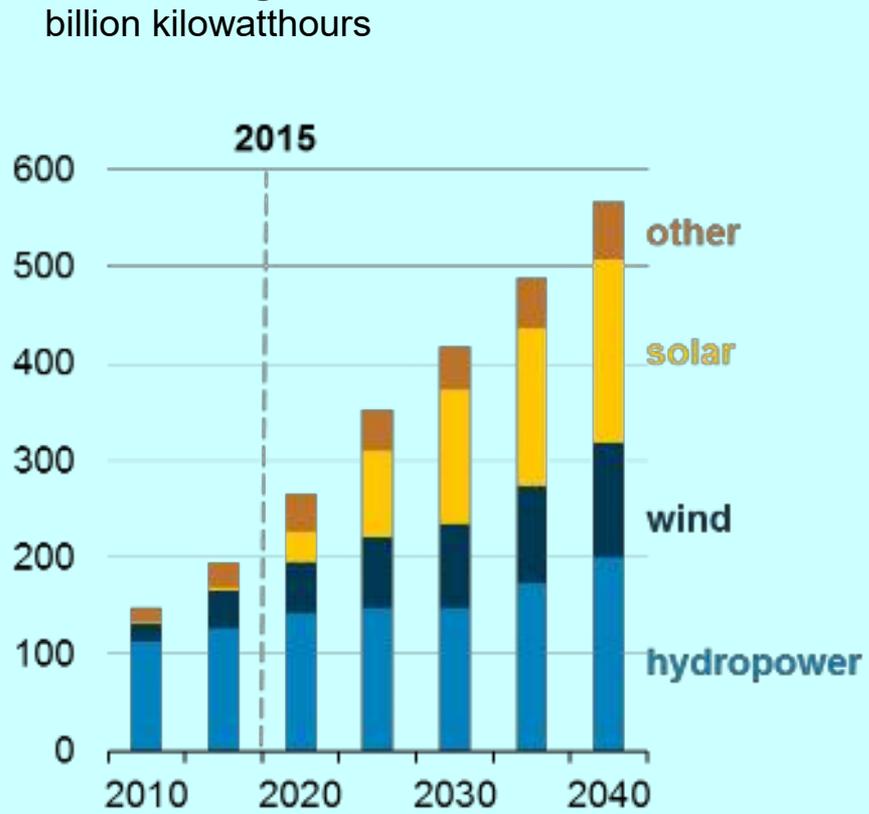
Wasserverlust in Trinkwassersystemen in % (2008)



Sources of electricity generation in India



Renewable generation in India



Sources of electricity generation in China
billion kilowatthours

thirsty energy

energy
and water's
interdependence

energy needs water

Energy production
processes require
water

- hydropower
- thermoelectric cooling
- power plant operations
- fuel extraction and refining
- fuel production

water needs energy

Water production, processing,
distribution, and end-use require
energy

- extraction
- treatment
- transportation

Meerwasserentsalzung



Globale Wasserpolitik

ist unverzichtbar als Beitrag zur

Sicherung der materiellen Lebensgrundlage

Stabilisierung von Staatengemeinschaften

Verhinderung von Flüchtlingsströmen

Friedenssicherung

und **menschenwürdiges Leben aller**

Bevölkerung in verschiedenen Höhenlagen über Meeresspiegel in Meter

Weltweit
ca. 60% der Weltbevölkerung

Mio 400

Mio 300

200

100

0

0-5

5-10m

95-100

200

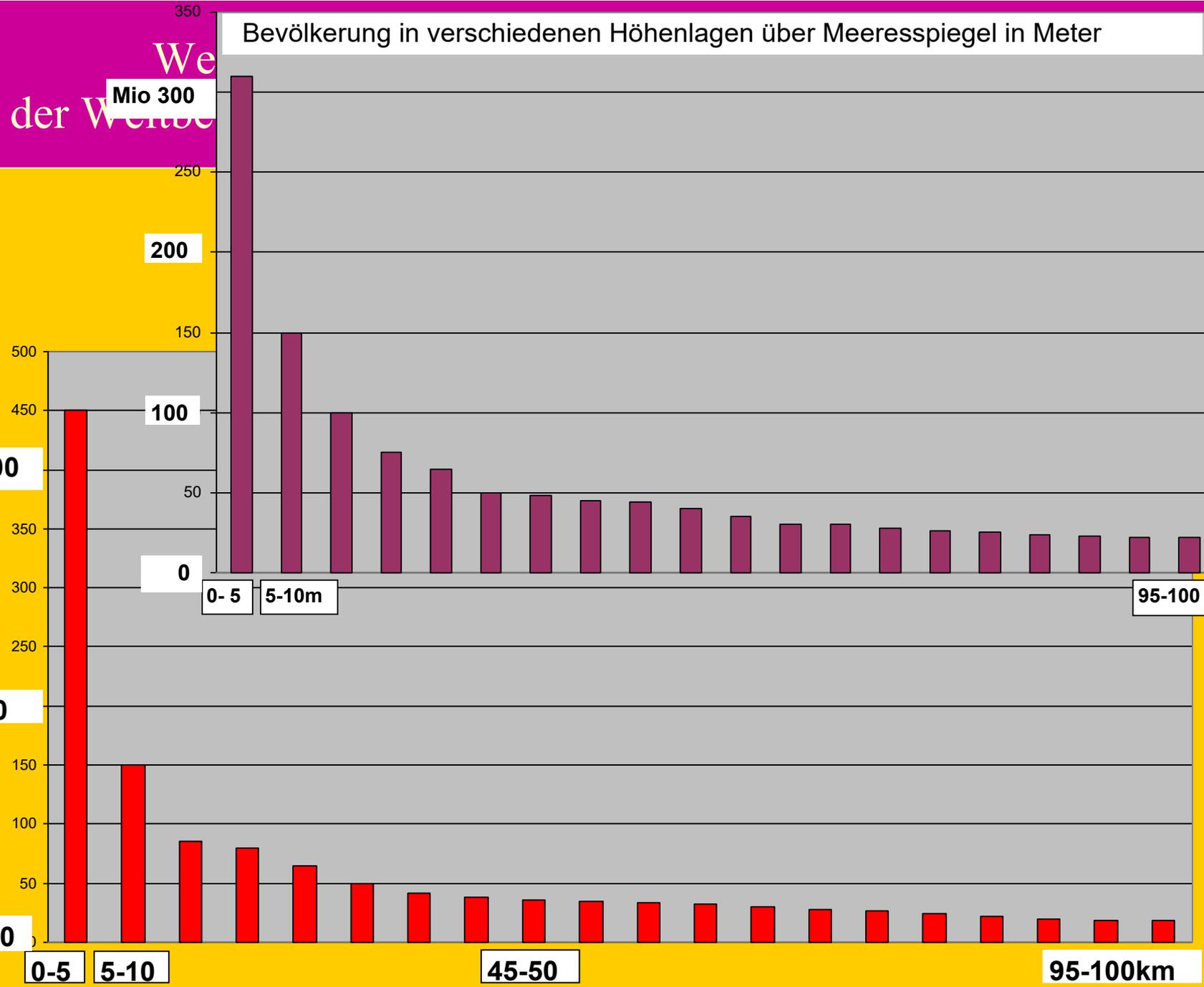
0

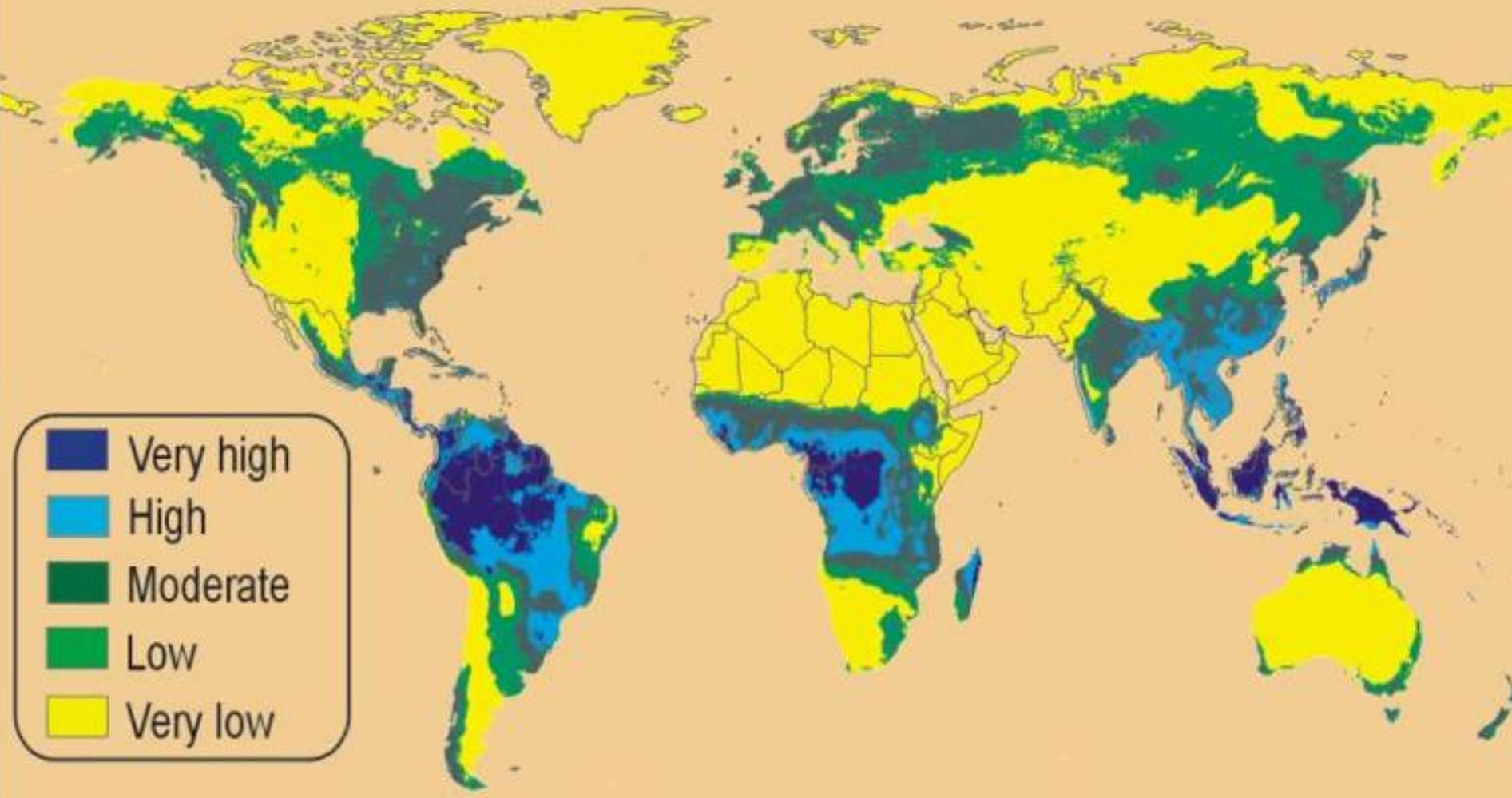
0-5

5-10

45-50

95-100km





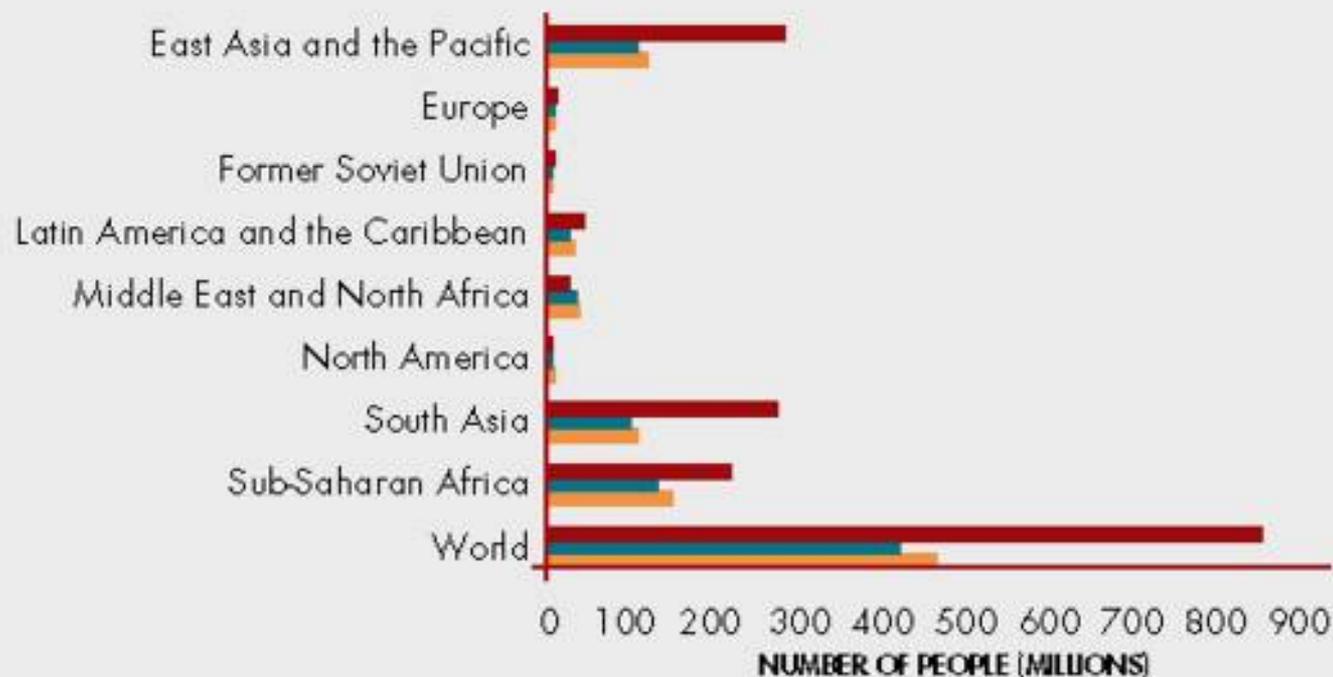
Potential rain-fed yield

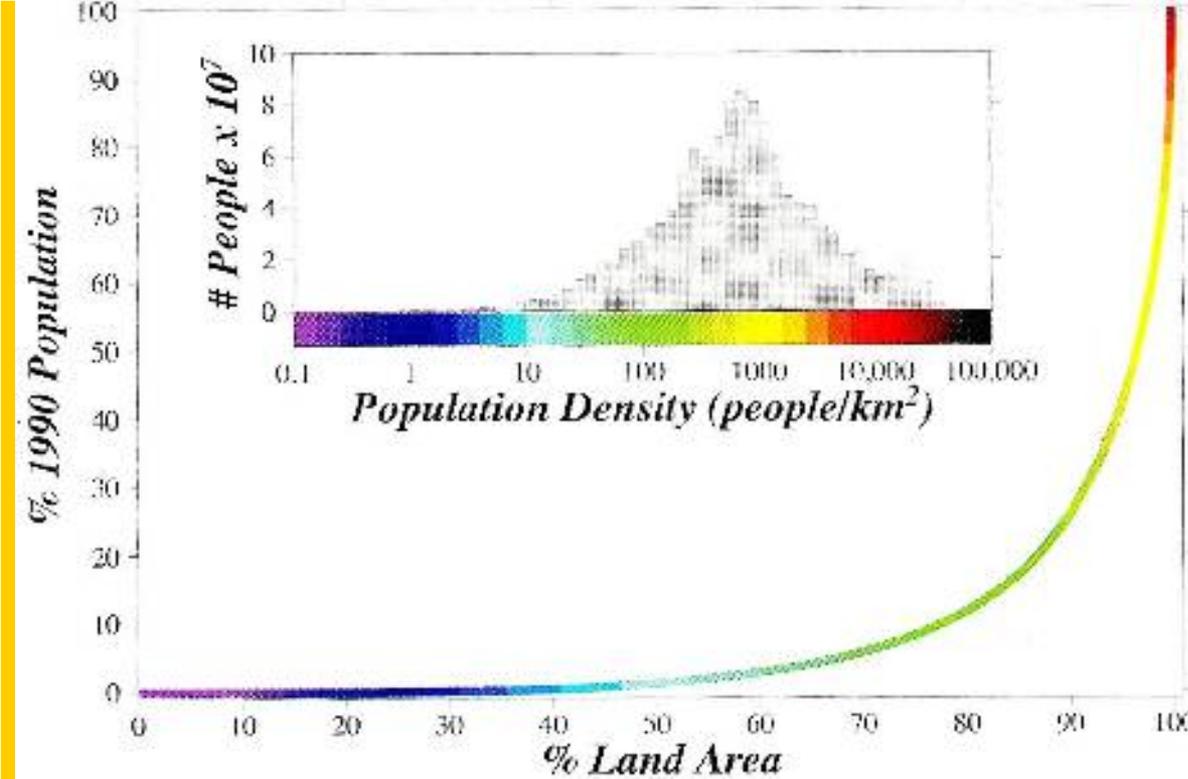
IMPACTS OF CLIMATE CHANGE ON POPULATION AT RISK OF HUNGER IN 2050, BY REGION

- 2010
- 2050-NoCC
- 2050-CC

Notes: IMPACT model results for SSP2 and RCP 8.5. See Box 7 for an explanation of RCPs and SSPs. Population at risk of hunger is estimated as a function of the availability of food energy relative to requirements.

SOURCE: Wiebe *et al.*, 2015.





Coastal Population (cont. from page 301)

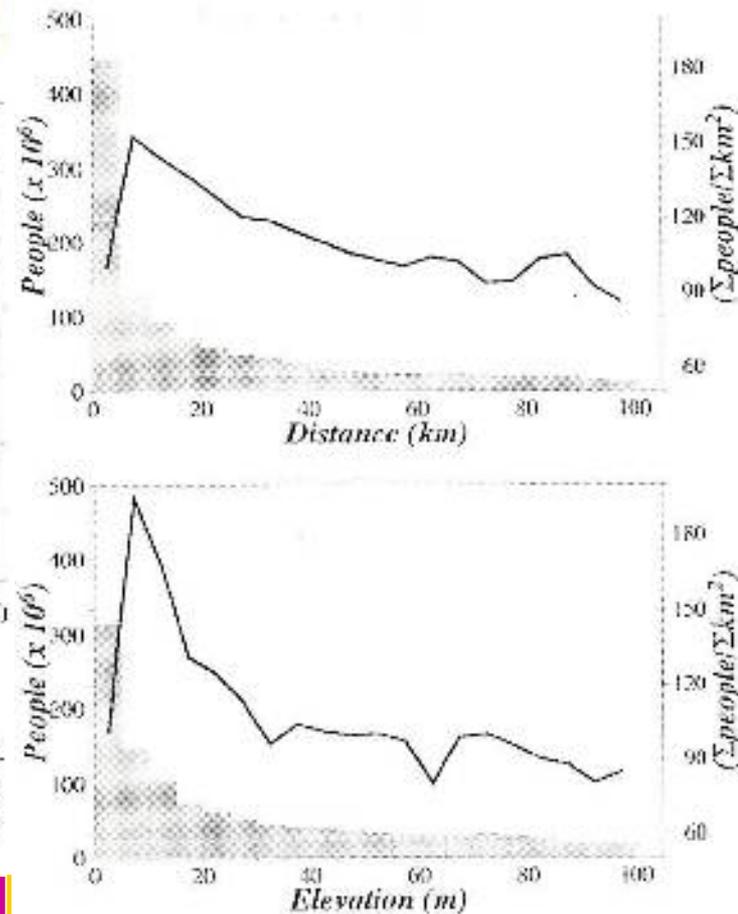
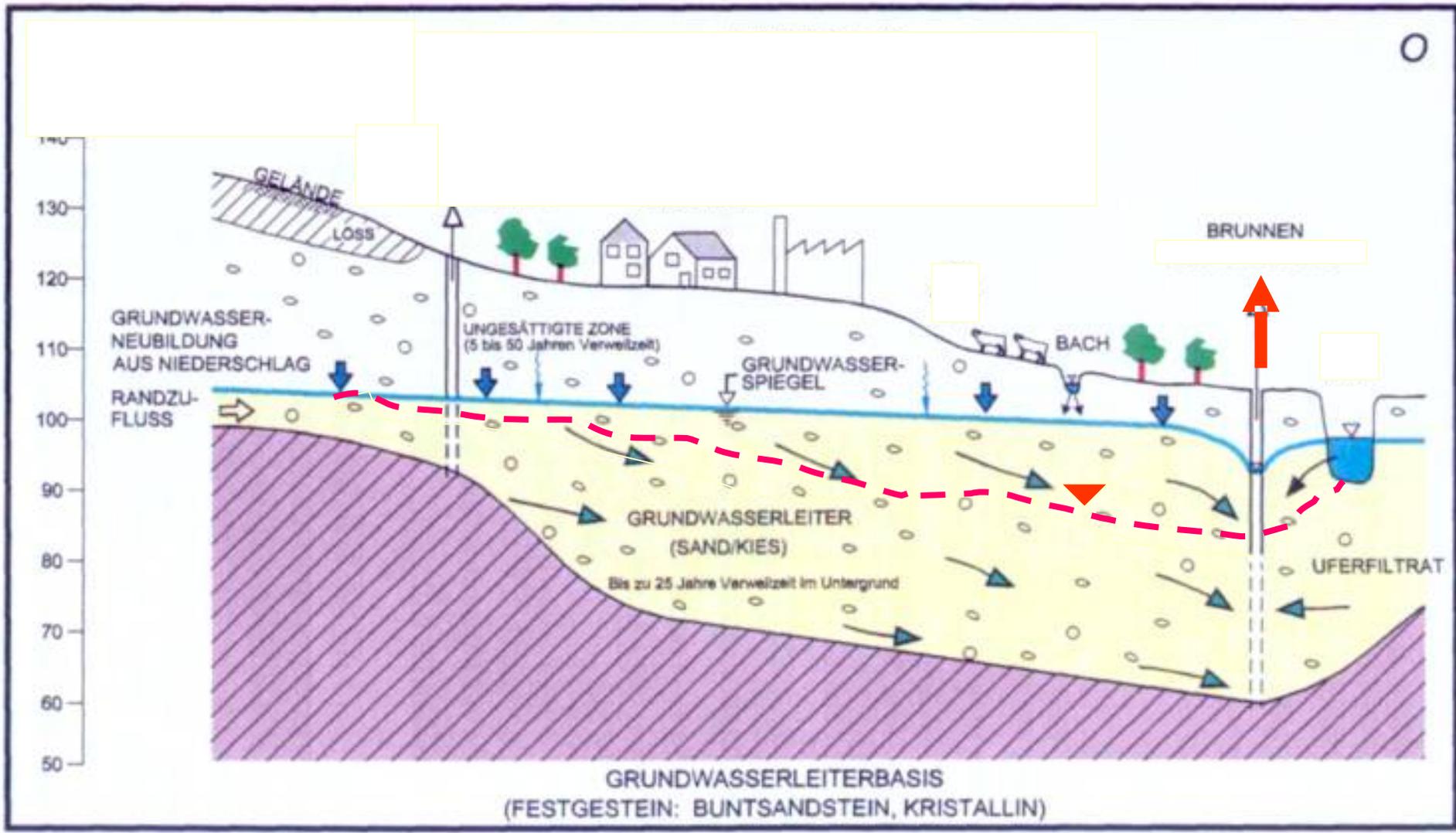


Fig. 2. Global population and integrated population density are shown versus distance and elevation from the shoreline. Population decreases with elevation and distance inland, but so does land area. Integrated population density (population divided by land area) accounts for this and indicates how average population density diminishes away from the shoreline.

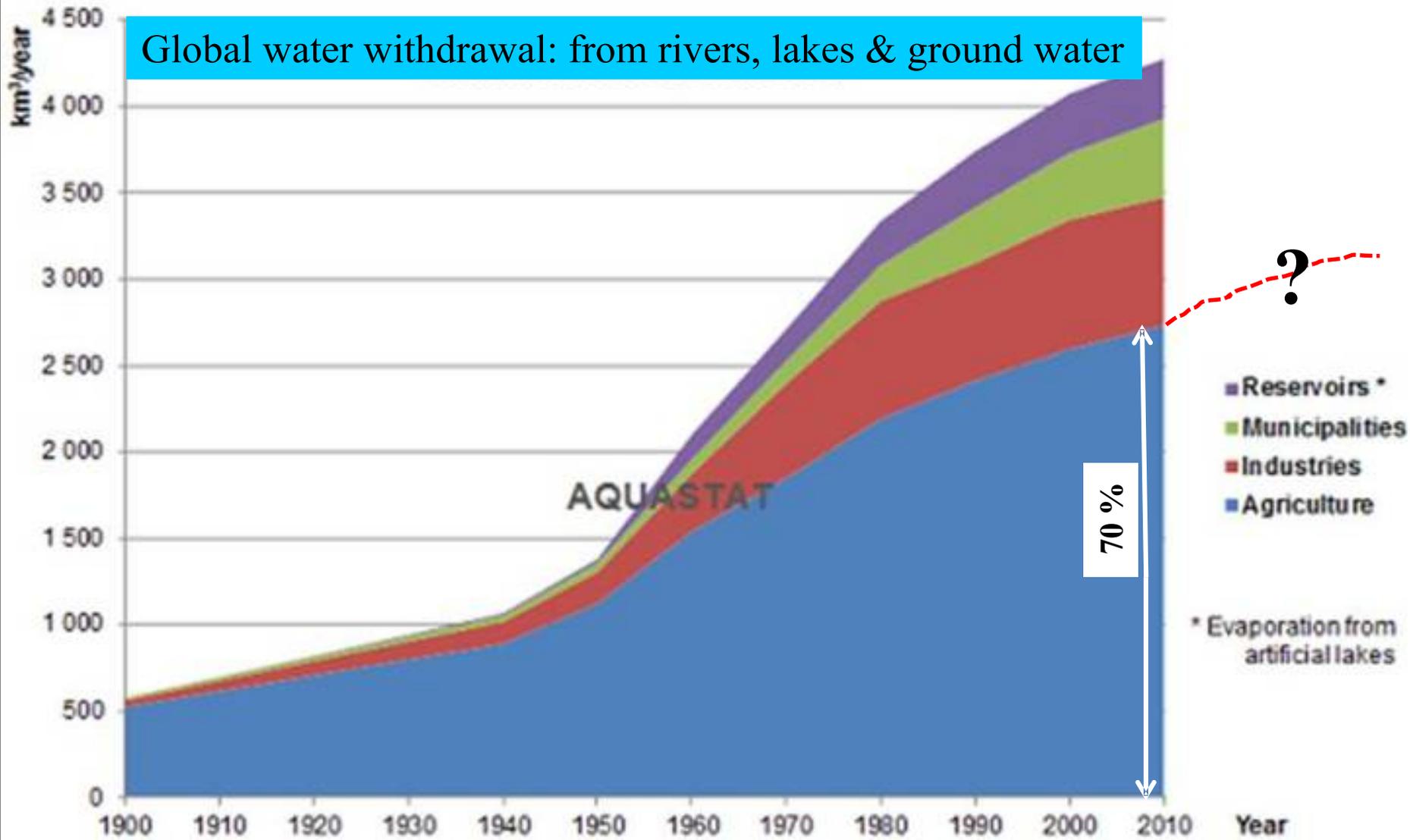
Weltbevölkerungsdichte

50% der Weltbewohner leben in einem 50km Breiten Küstenstreifen nahen Regionen



Grundwasserspeicher

Global water withdrawal: from rivers, lakes & ground water





Der **Nubische Aquifer**, den sich die Länder Ägypten, Libyen, Sudan und Tschad teilen, ist das größte fossile **Frischwasservorkommen** der Welt.

Das Wasser ist zwischen 35.000 und 15.000 Jahre alt und stammt aus der letzten Eiszeit.

Die Vereinten Nationen schätzen das Gesamtvolumen auf mindestens 373.000 Milliarden Kubikmeter, von denen aber nur rund 9000 Milliarden Kubikmeter abpumpbar sind.

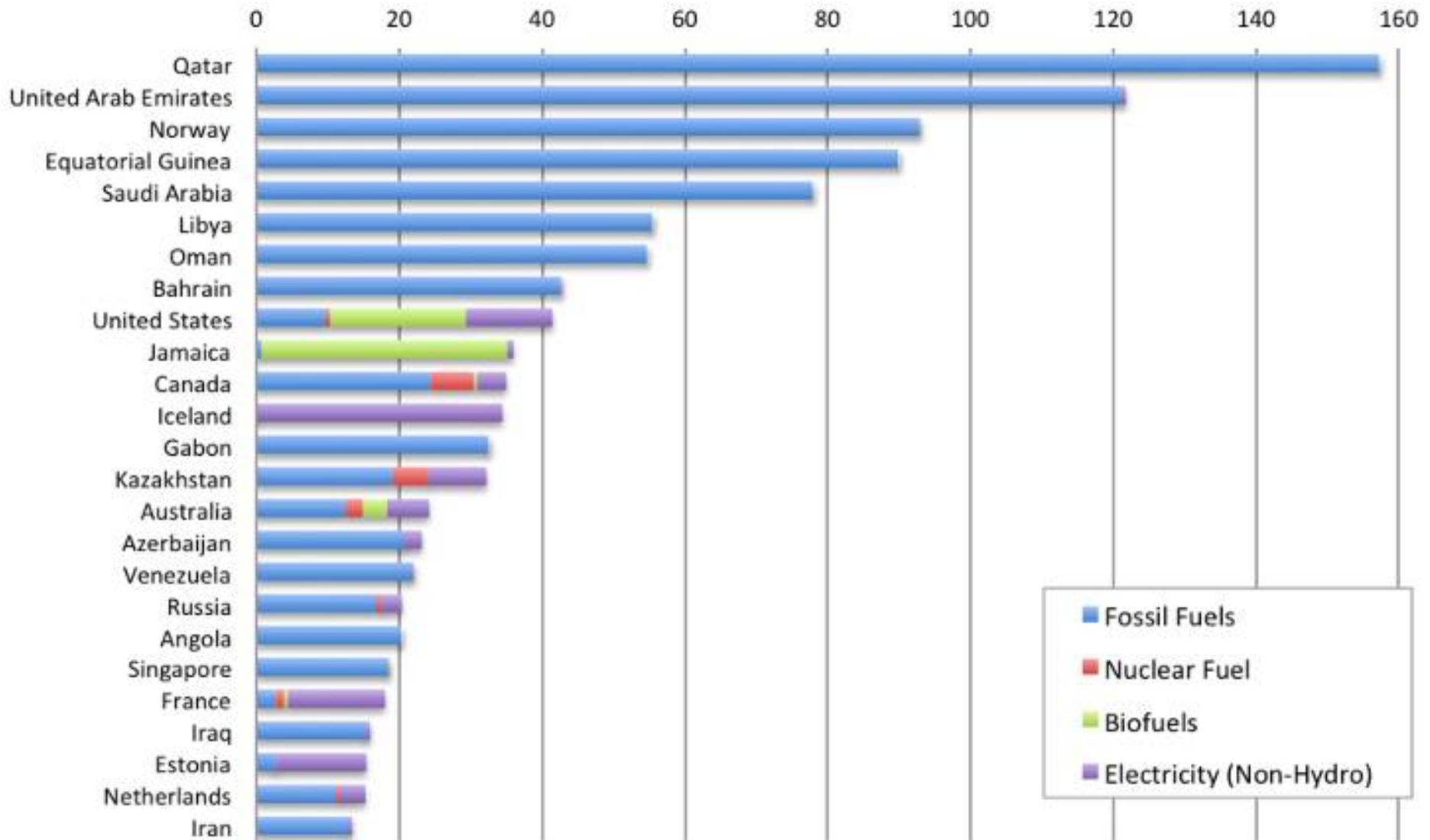
Im Jahr 2007 ließ Gadhafi den Gurdabiya-Damm während eines Staatsbesuchs öffnen – der Damm ist Teil des künstlichen Flusses, der durch Libyen führt. Es ist das wohl monumentalste Bewässerungsprojekt des Globus.

Seit 25 Jahren baut Libyen an seinem "achten Weltwunder", in das bisher 20 Milliarden Euro geflossen sind und dessen Gesamtkosten bis 2030 auf gut 27 Milliarden Euro kalkuliert werden.

Der Diktator Muammar al-Gadhafi schmückt sich gerne mit dem Mammut-Projekt, das aus Wüsten Oasen macht und das karge Land an der Küste fruchtbar.

Dass für den künstlichen Fluss aus Pipelines fossiles Wasser verbraucht wird, stört ihn nicht.

Per Capita Water Consumption for Non-Hydro Energy Systems (m³/person)

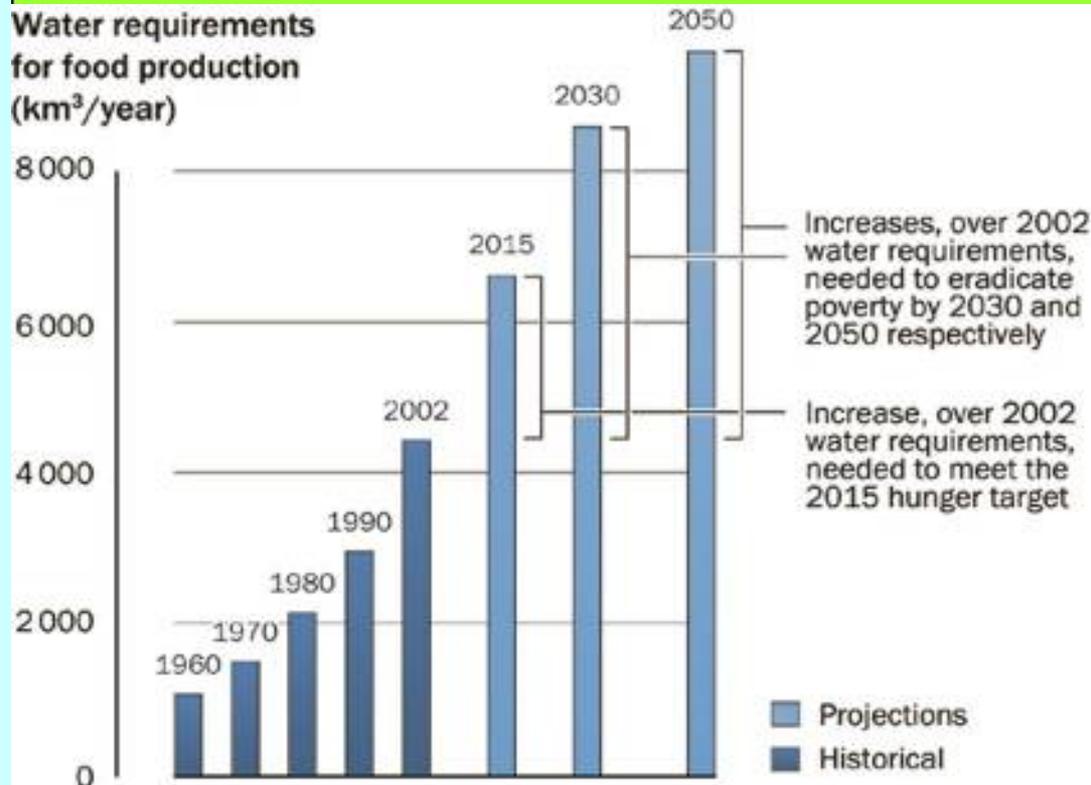


Prognose 2015 bis 2030 ...2 800 km³ (OECD FAO)

Prognose 2010 bis 2050 (W. Mauser 2007)

Bedarf an grünem Wasser = Verdunstungswasser

5 000



h. + 3 Mrd.

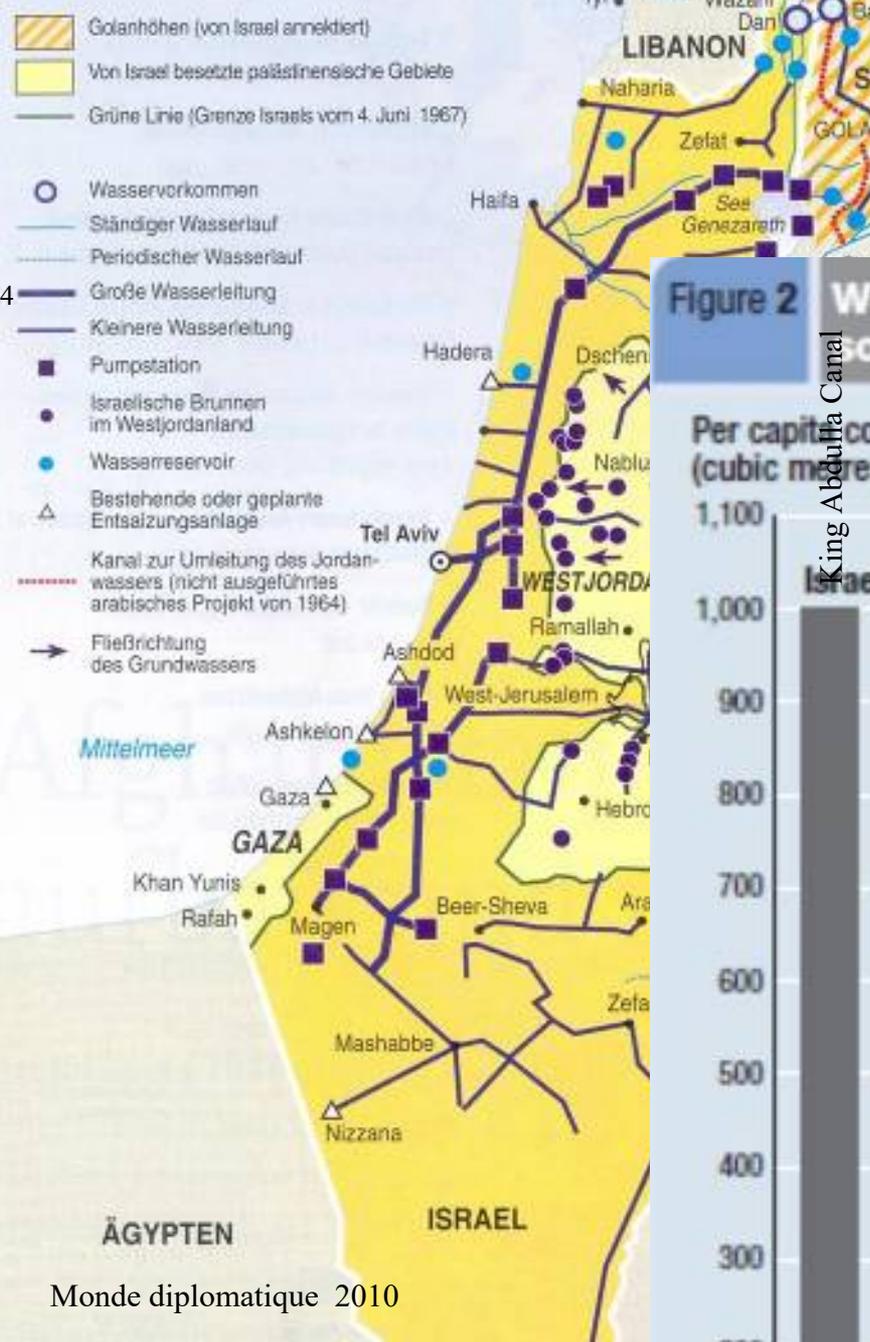
(1300 m³ pro Kopf u. Jahr)

Bewässerungstechnik

km³ pro Jahr

Wasser ?

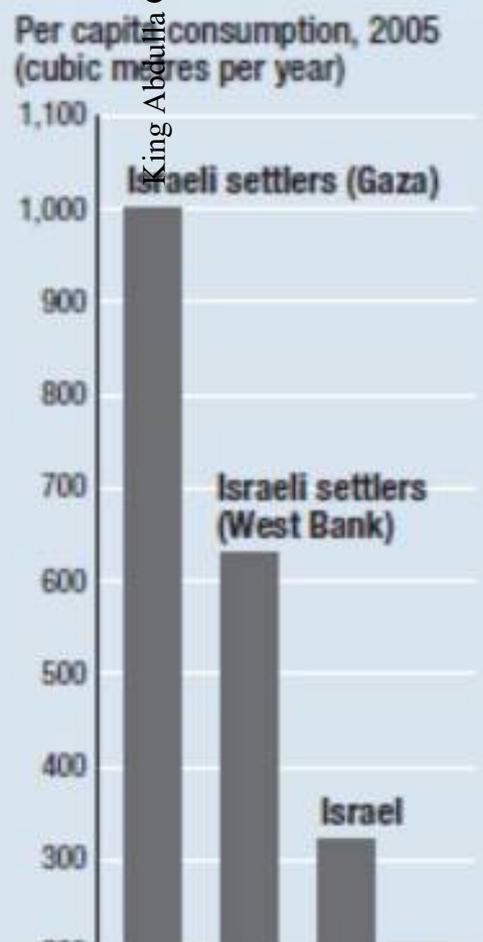
Managing the aquifers - Palestinians and Israelis share groundwater unequally



- Water flow direction
- Israeli wells
- Western Basin
- Coastal Basin
- Borders

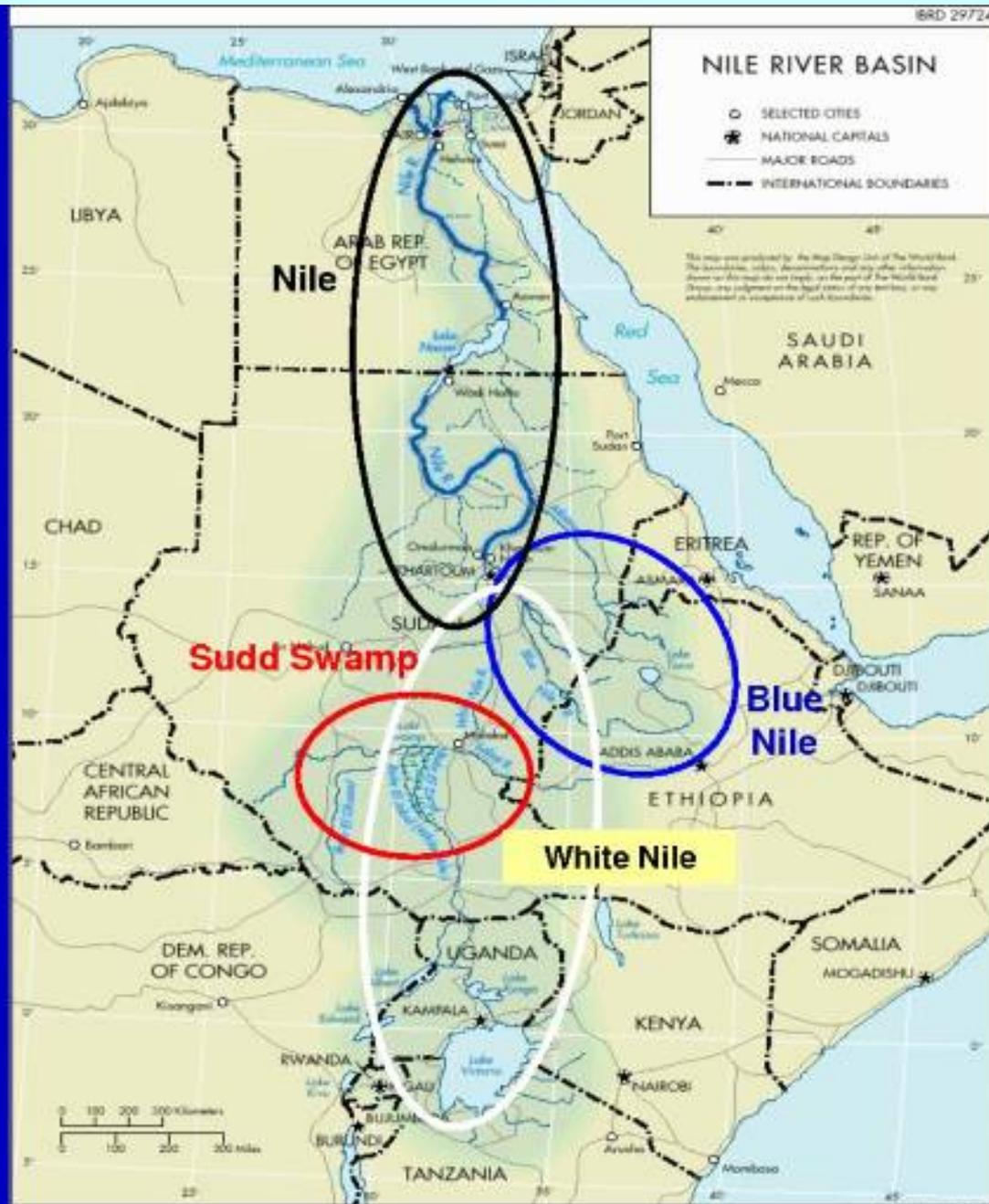


Figure 2 Water is scarcer for some than for others

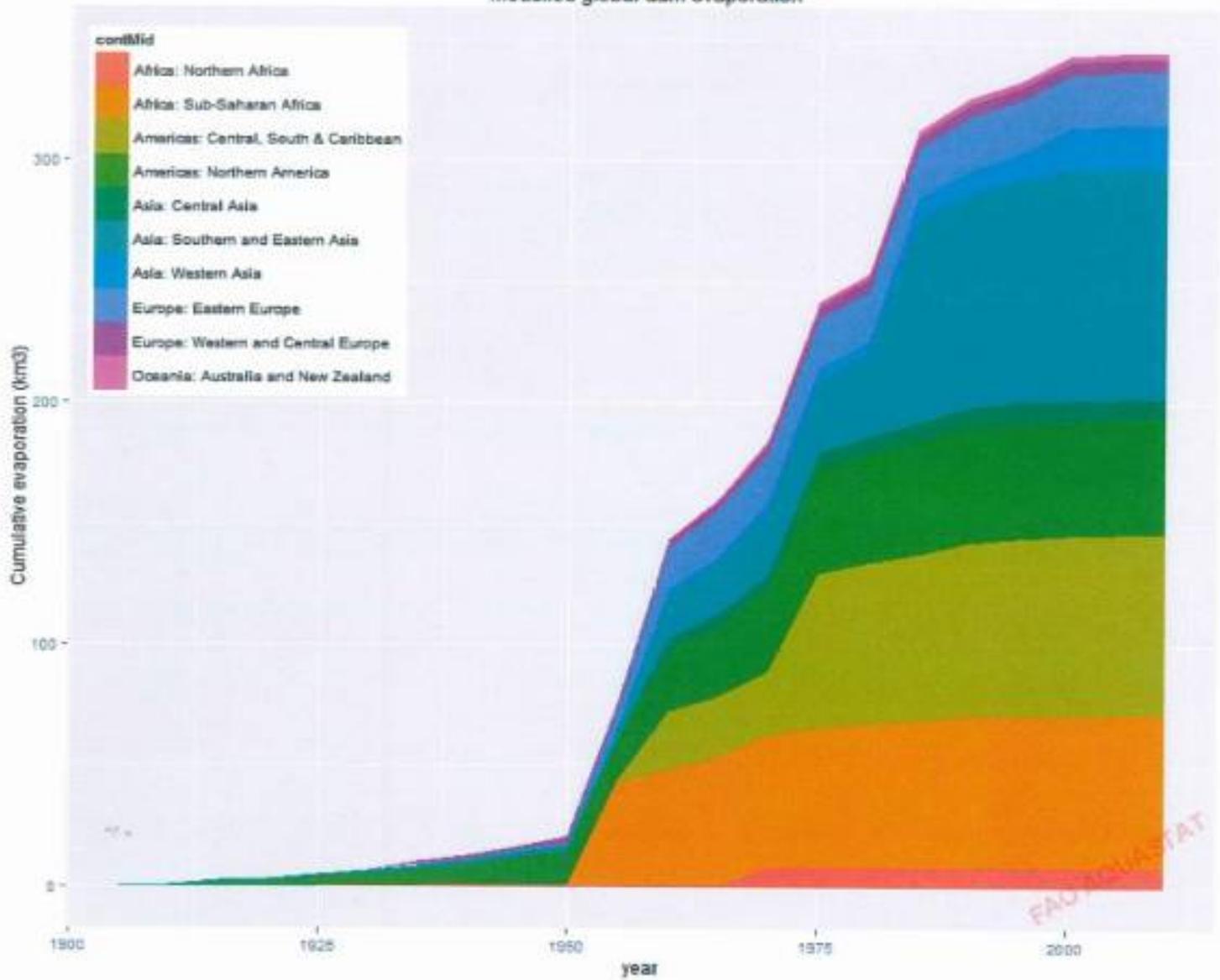


N W C 1964

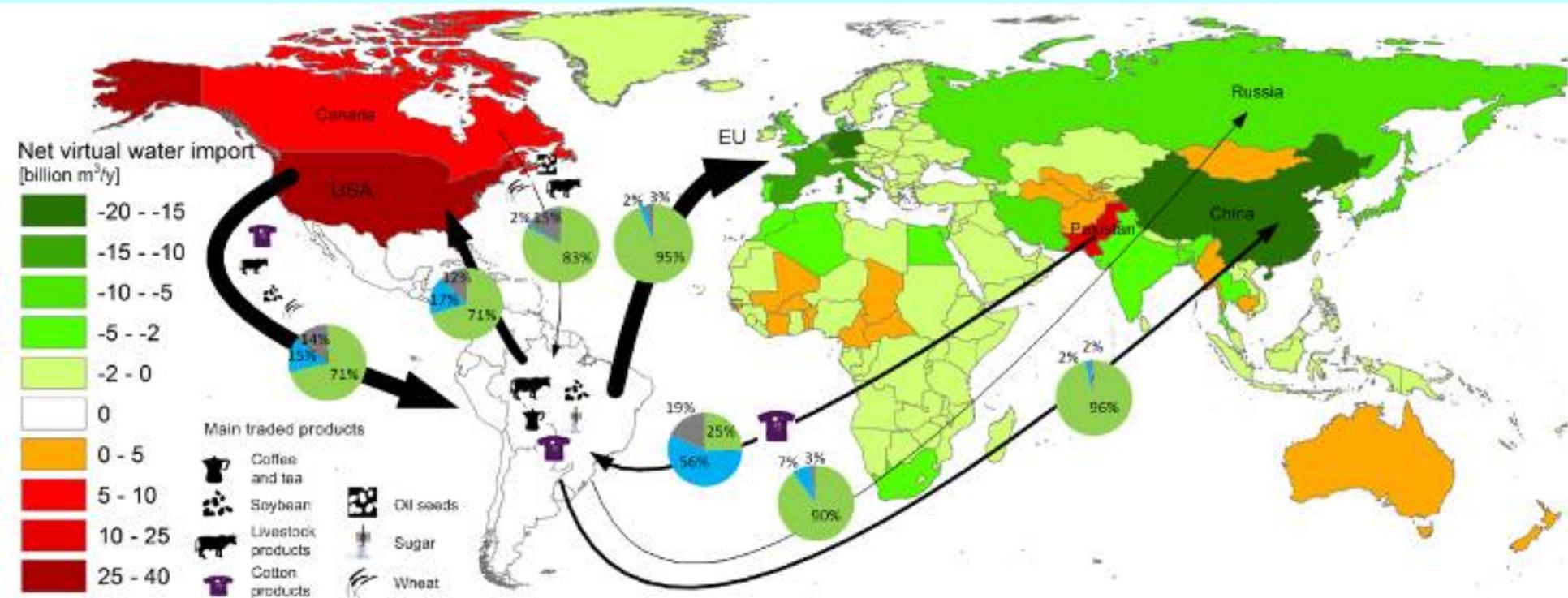
Nile River Basin



Modelled global dam evaporation



FAO AQUASTAT



Legend: Global map showing countries with net virtual water import related to import of agricultural and industrial products from Latin American countries (green) and countries with net virtual water export due to agricultural and industrial exports to Latin American countries (red) over the period 1996-2005. Only the biggest gross virtual water flows (over 10 billion cubic meters per year) are shown.

Source: Mekonnen, M.M., Pahlow, M., Aldaya, M.M., Zarate, E. and Hoekstra, A.Y. (2015)

[Sustainability, efficiency and equitability of water consumption and pollution in Latin America and the Caribbean, Sustainability, 7\(2\): 2086-2112.](#)

Countries can both import and export virtual water through their international trade relations. Globally, the major gross virtual water exporters are USA, China, India, Brazil, Argentina, Canada, Australia, Indonesia, France and Germany and the major gross virtual water importers are the USA, Japan, Germany, China, Italy, Mexico, France, the UK and the Netherlands. The largest net exporters of virtual water are found in North and South America (the USA, Canada, Brazil and Argentina), Southern Asia (India, Pakistan, Indonesia and Thailand) and Australia. The biggest net virtual water importers are North Africa and the Middle East, Mexico, Europe, Japan and South Korea.

The total amount of water that would have been required in the importing countries if all imported agricultural products were produced domestically is 2 407 billion cubic meters per year. These products are, however, being produced with only 2 038 billion cubic meters per year in the exporting countries, saving global water resources by 369 billion cubic meters per year (Mekonnen and Hoekstra, 2011). This saving is equivalent to 4% of the global water footprint related to agricultural production (which is 8 363 billion cubic meters per year).

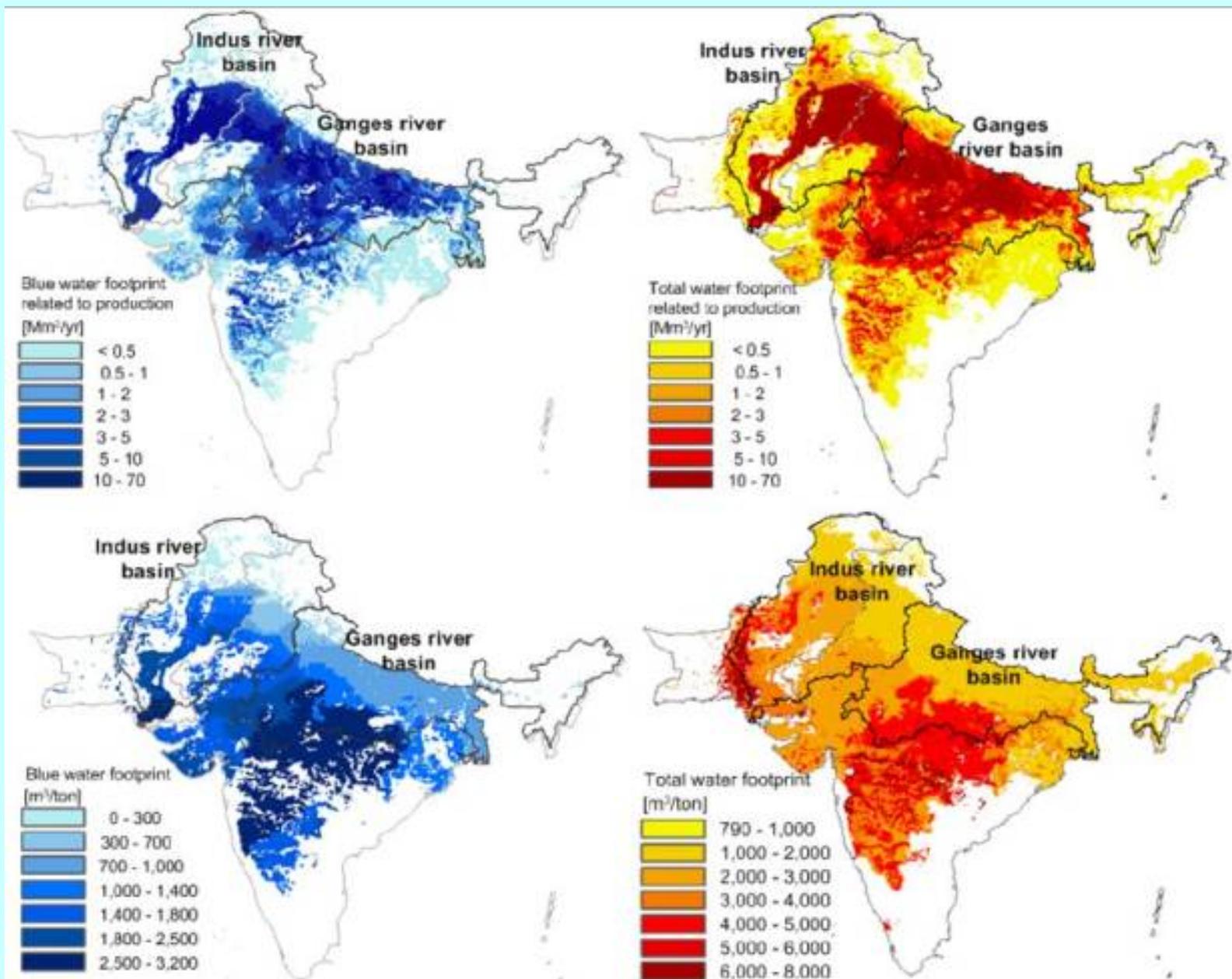


Fig. 8. The total and blue water footprint related to wheat production in India and Pakistan, both expressed as a total (Mm³/yr) and per ton of wheat (m³/ton). Period: 1996–2005.

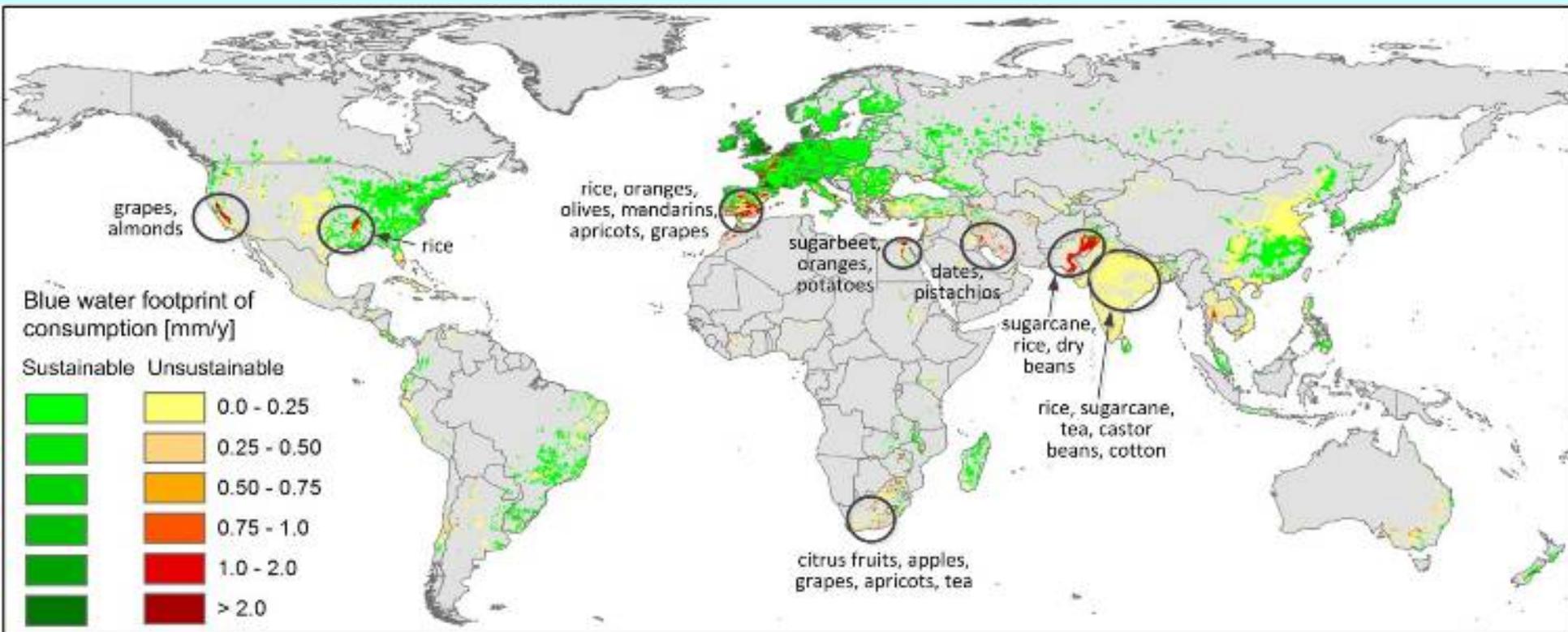
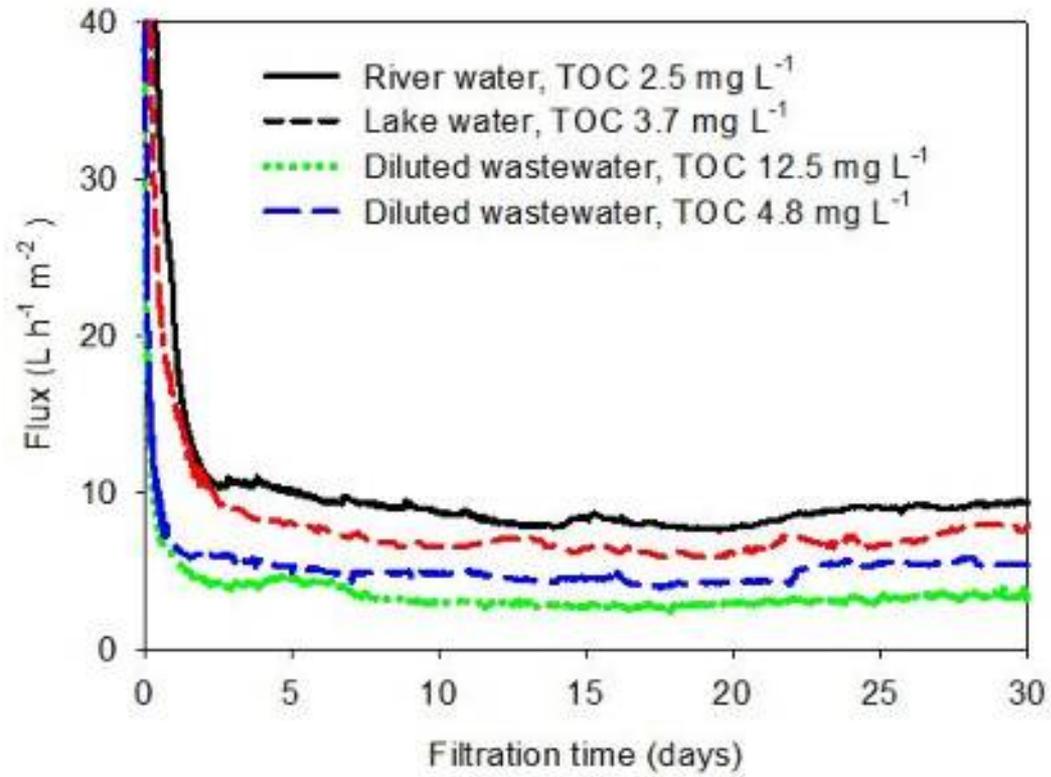


Figure 1. The sustainable (green) and unsustainable (yellow to red) parts of the global blue water footprint of overall UK consumption, with an indication of critical products that significantly contribute to the UK's water footprint in some hotspot areas.

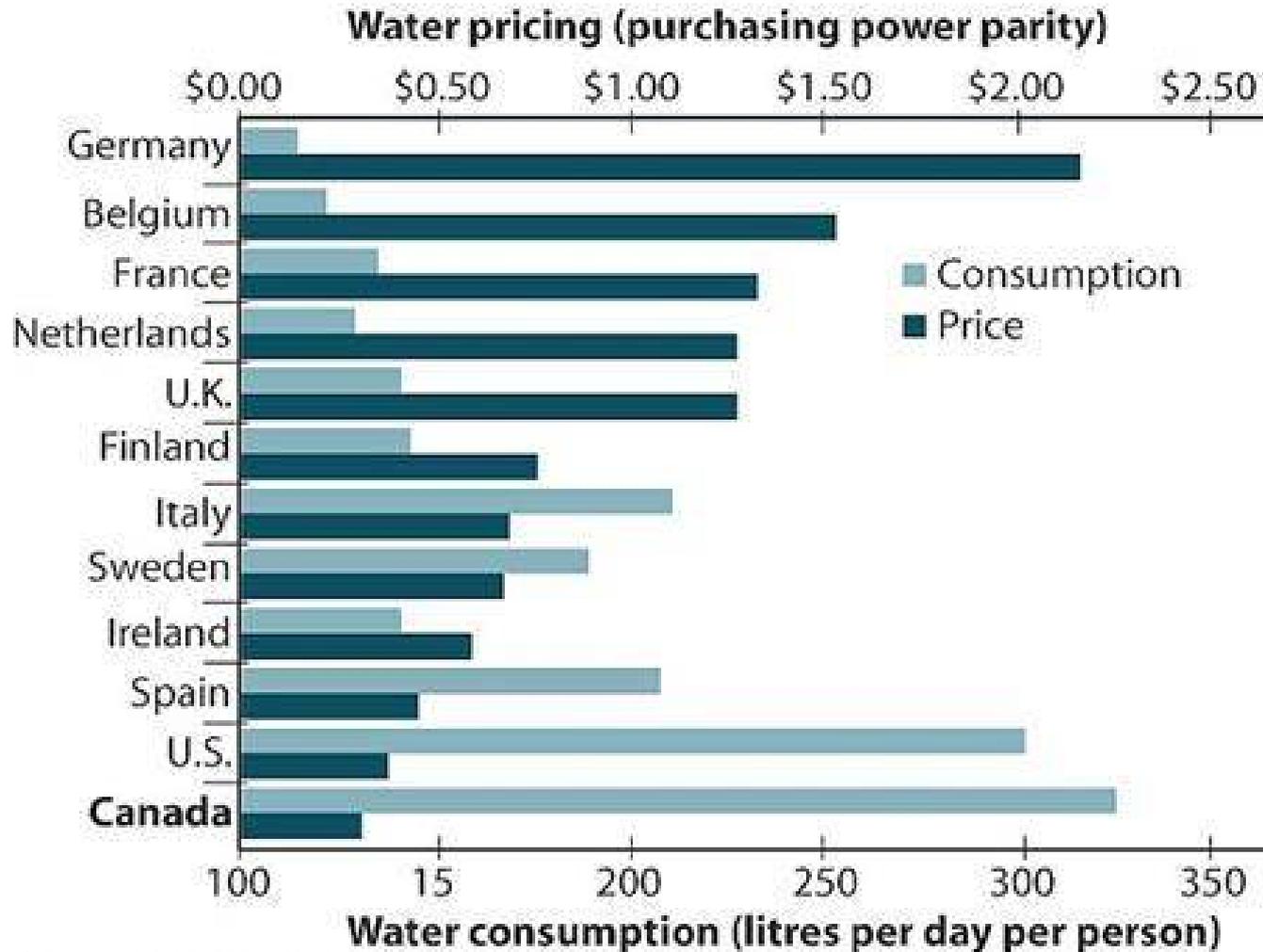


Global freshwater use for energy production 2010

580 Mrd. m³ , 15 % of the world's total water use

Menschen ohne Elektrizität: 1 Milliarde in 2030

Water pricing versus water consumption



Source: Polaris Water Project