Improving Water Use Efficiency

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Toossab Consulting Engineers

Iran

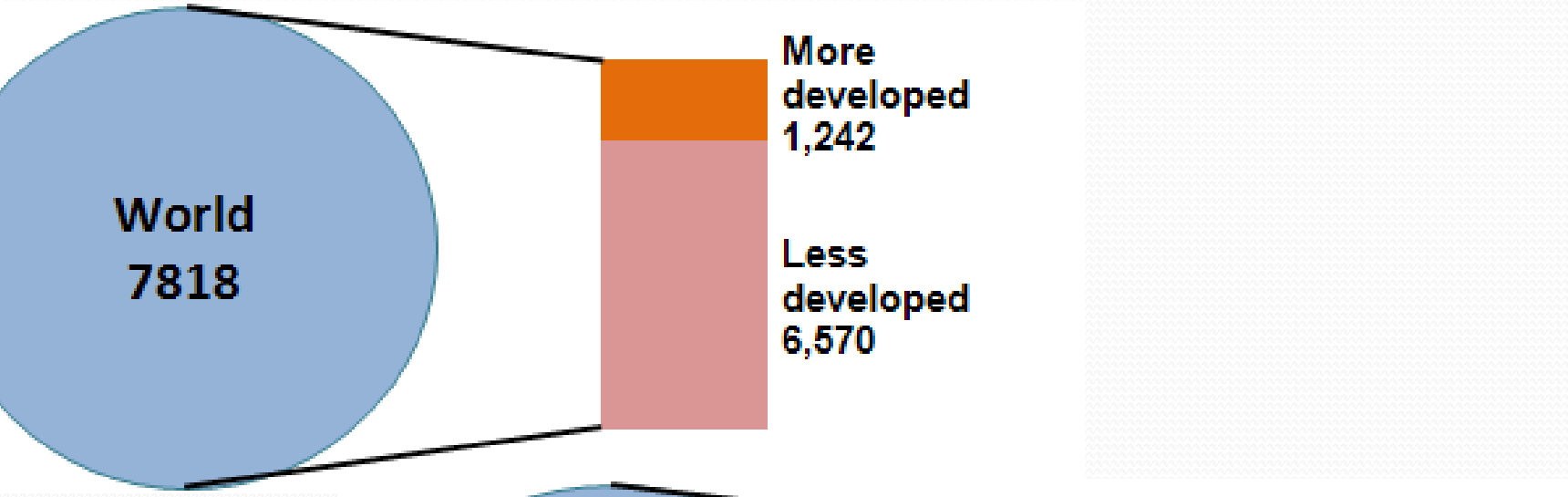
Training Workshop on :

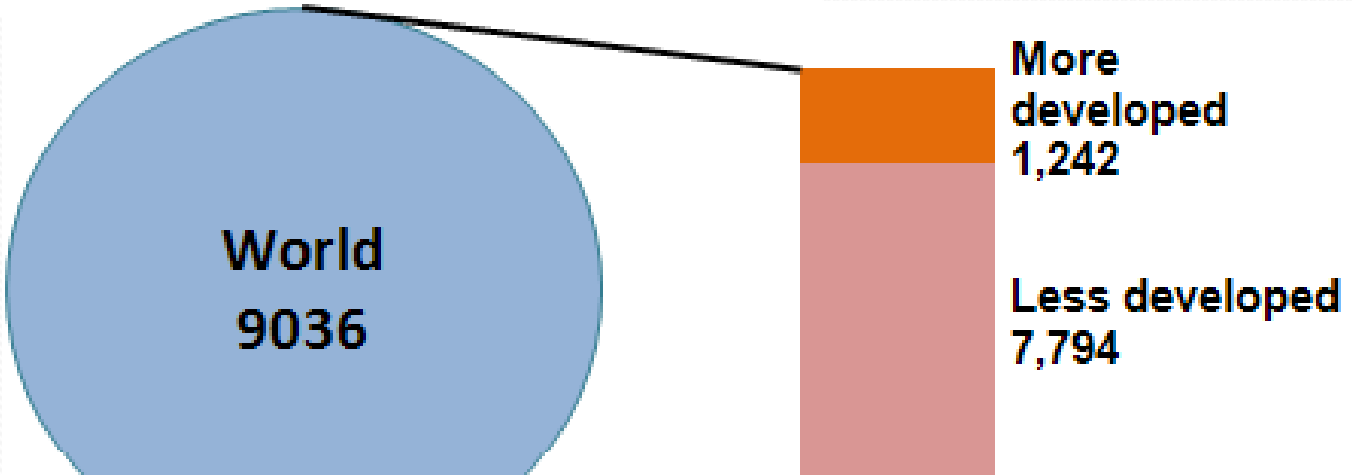
Challenges of Sustainable Water Use in Arid and Semi-Arid Regions

September 2009 Tashkent

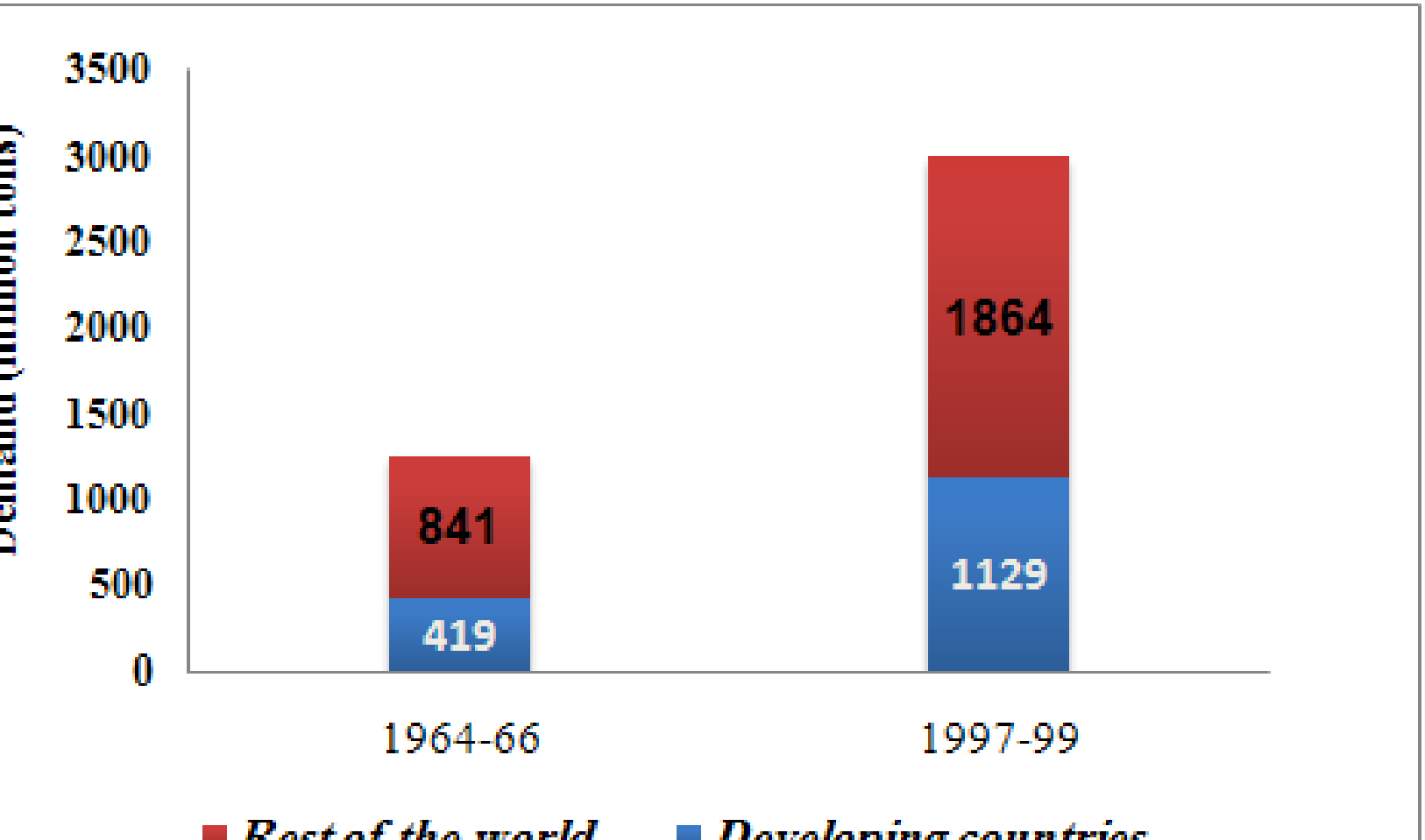
Food Security : Present & Future Dilemma in Less Deloped Countries

Projected population (millions)

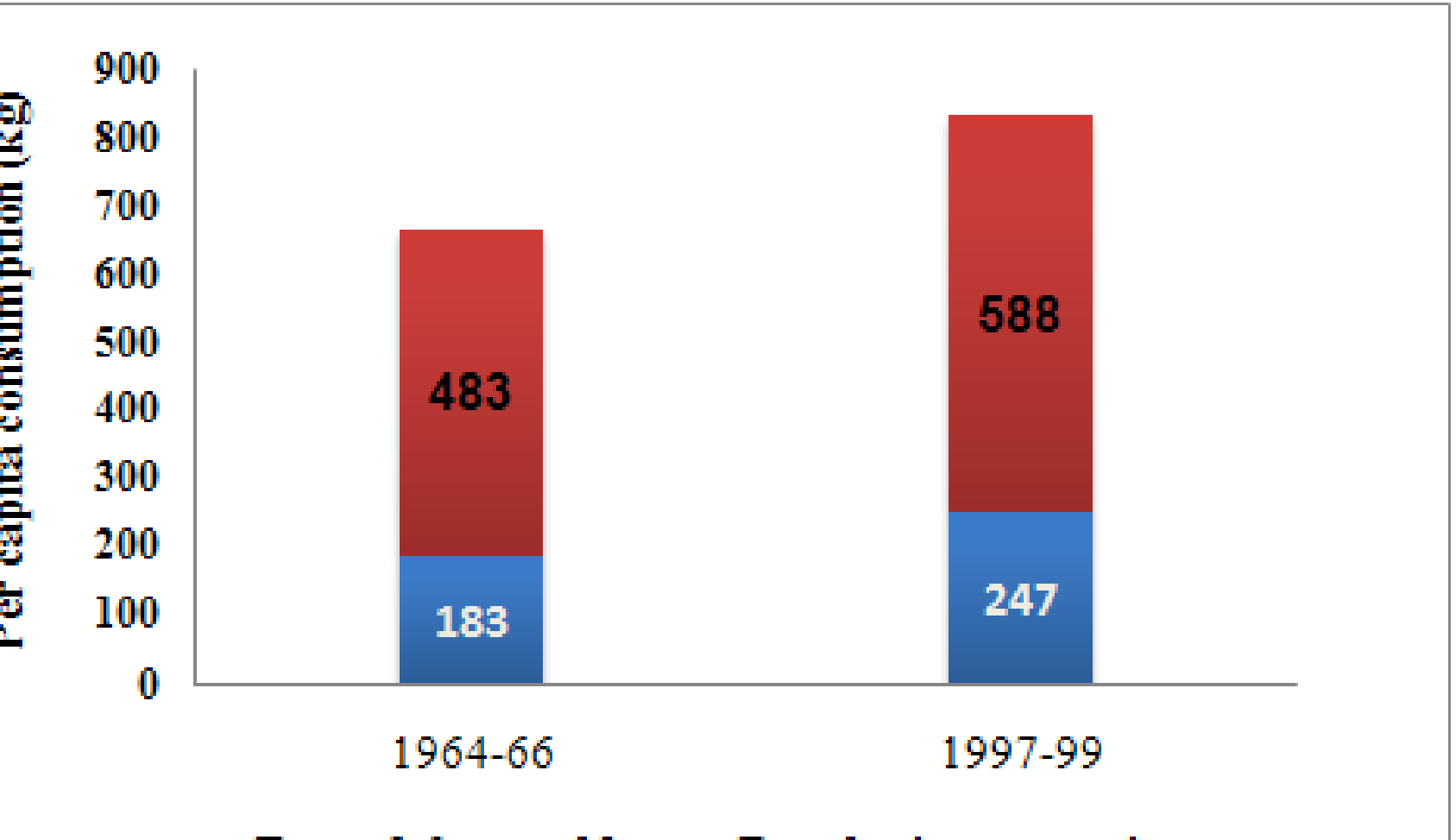




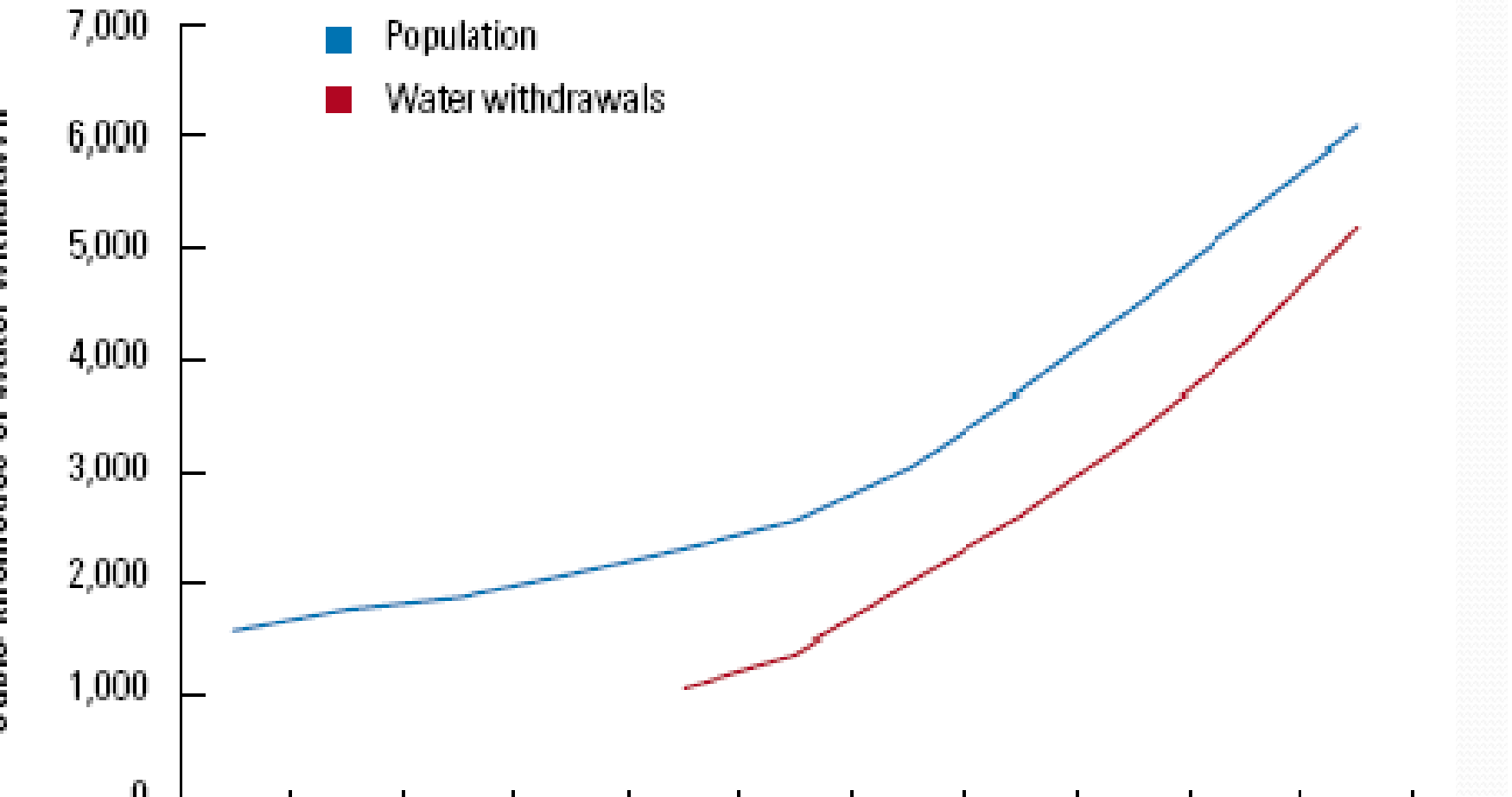
Total Cereals Demand



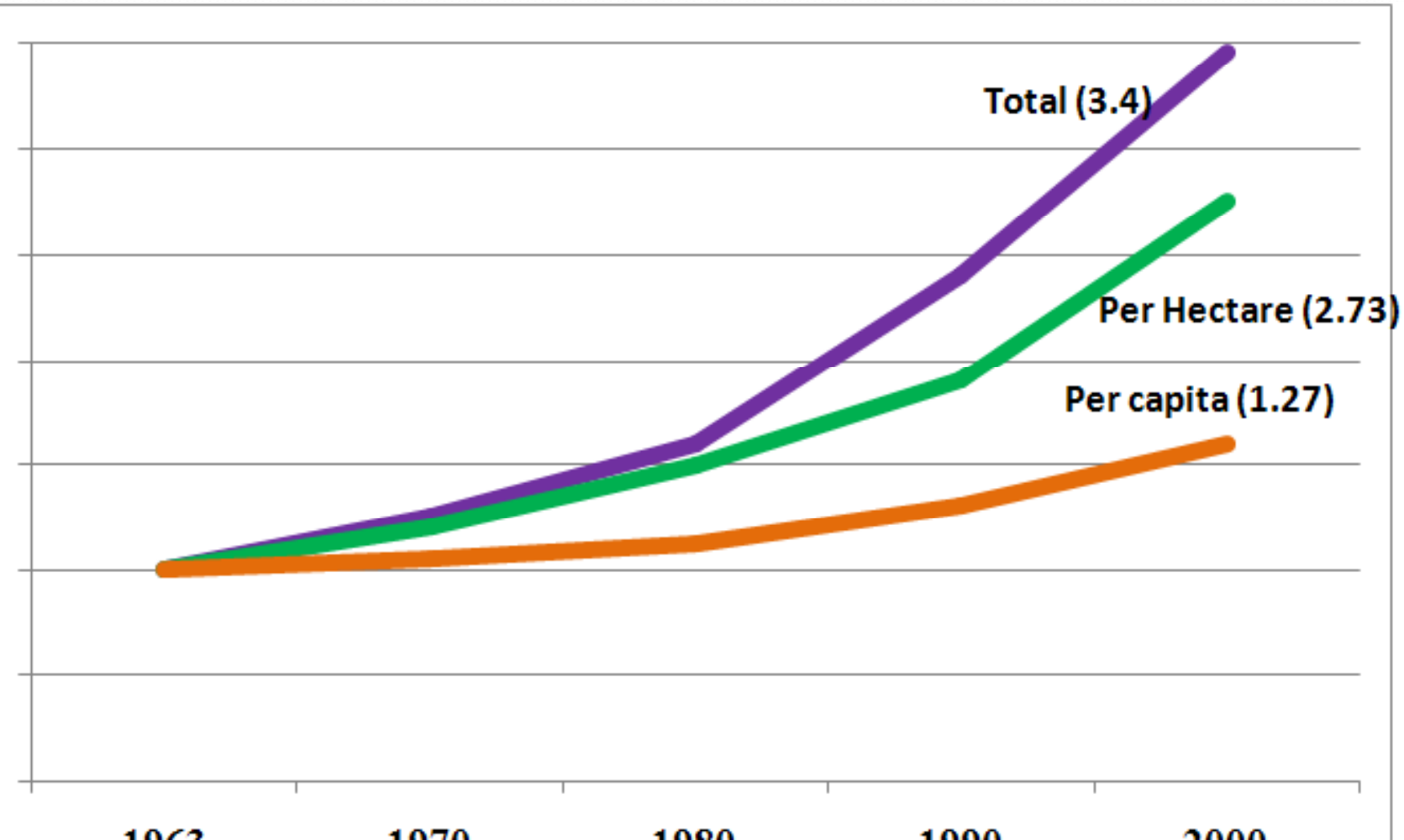
Total Cereals Per Capita Consumption



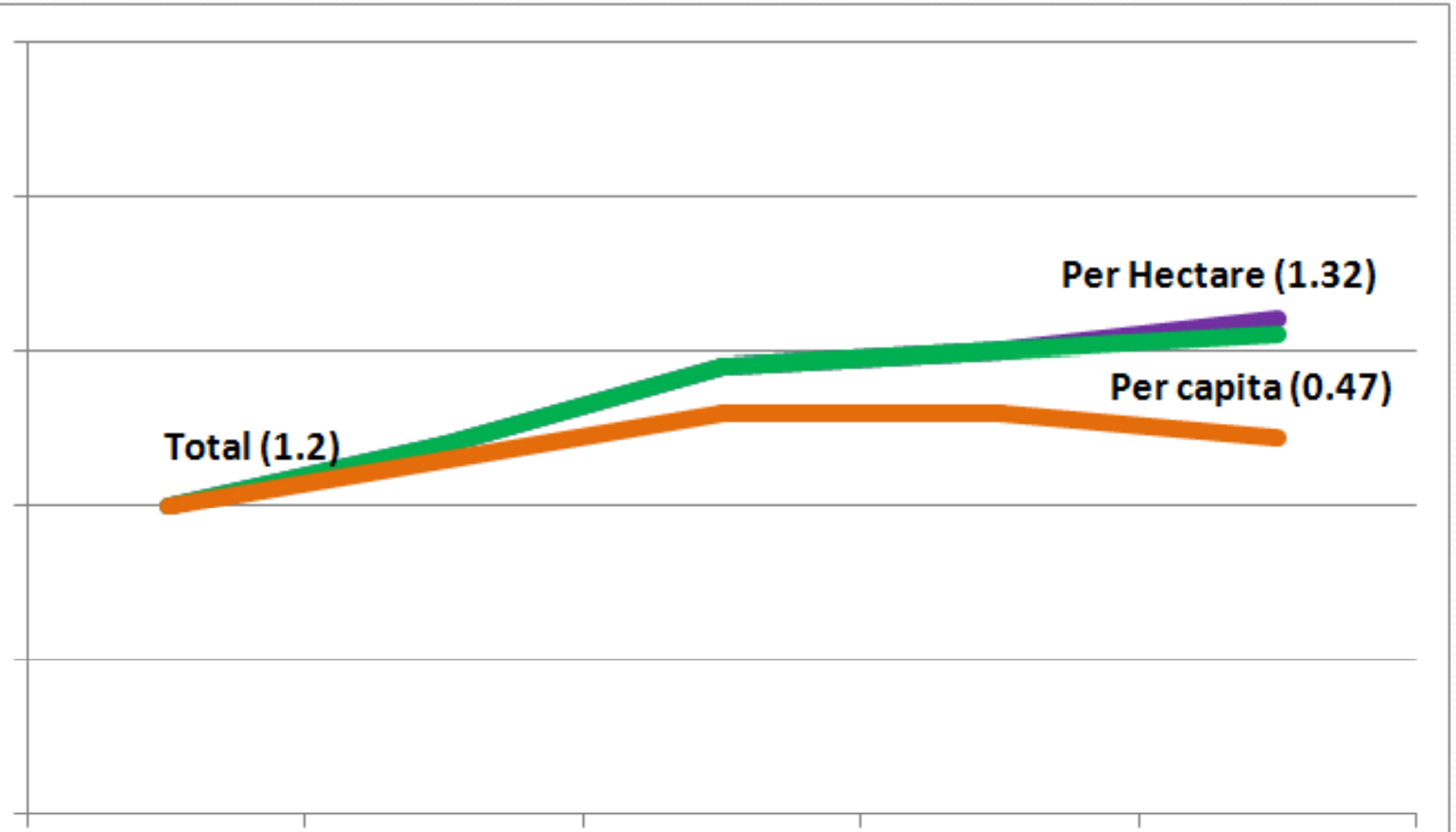
World population and freshwater use



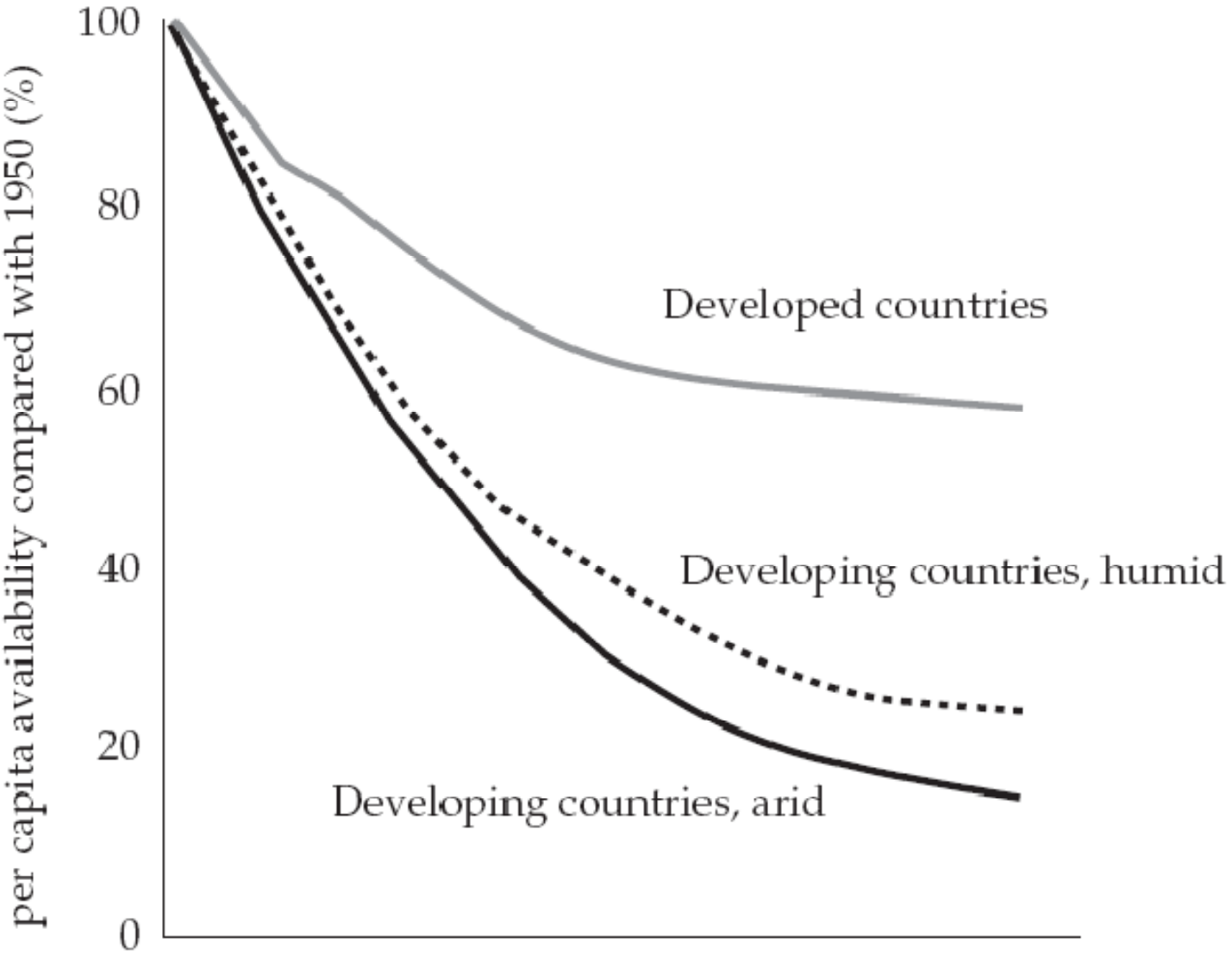
Developing countries



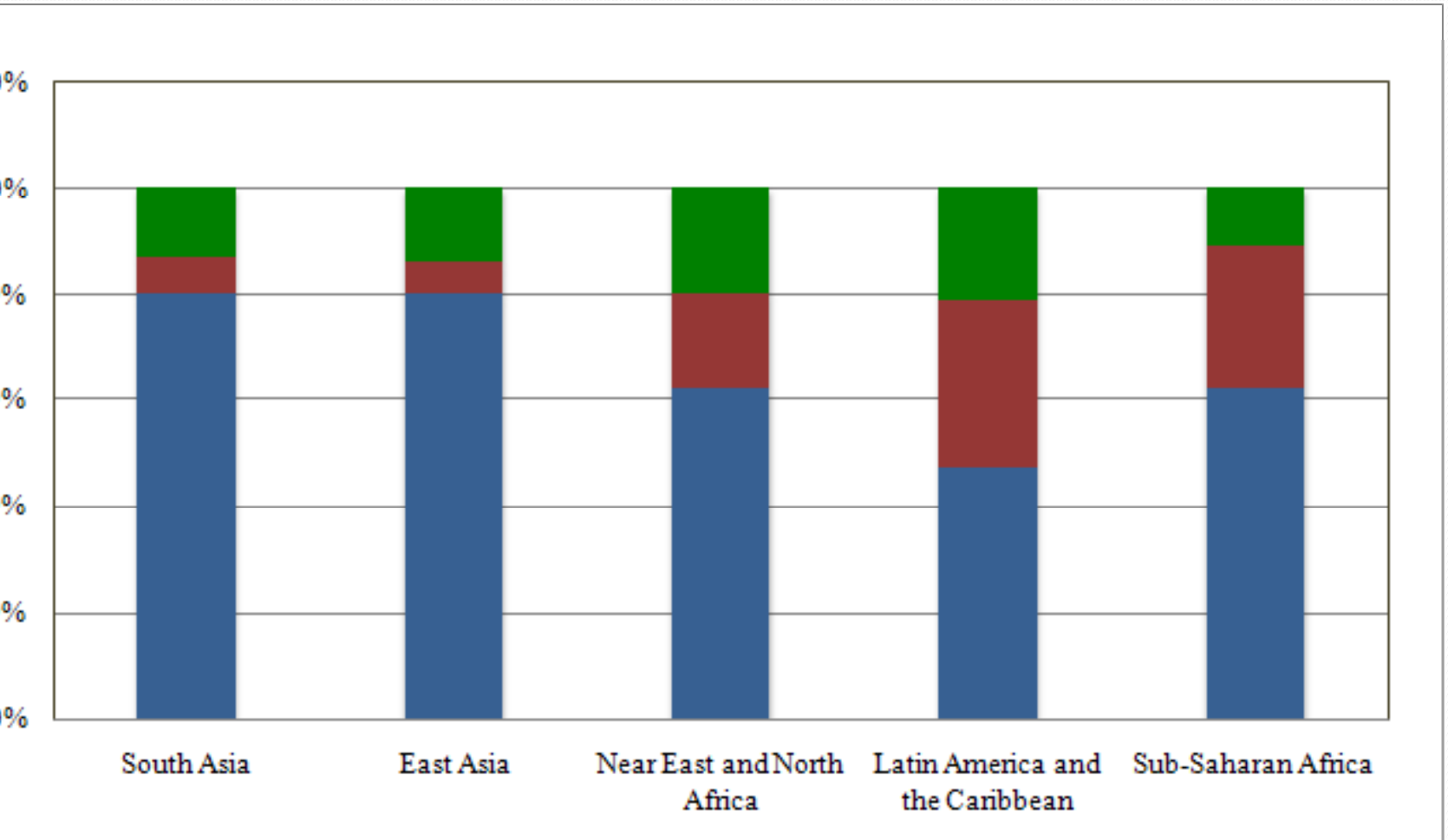
Developed countries



he Decline of Water Availability in developing Countries



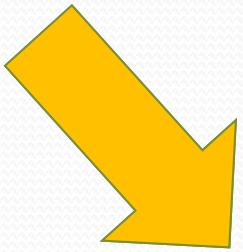
Anticipated Sources of Growth in Crop Production, 1997-2030



AO Reports :

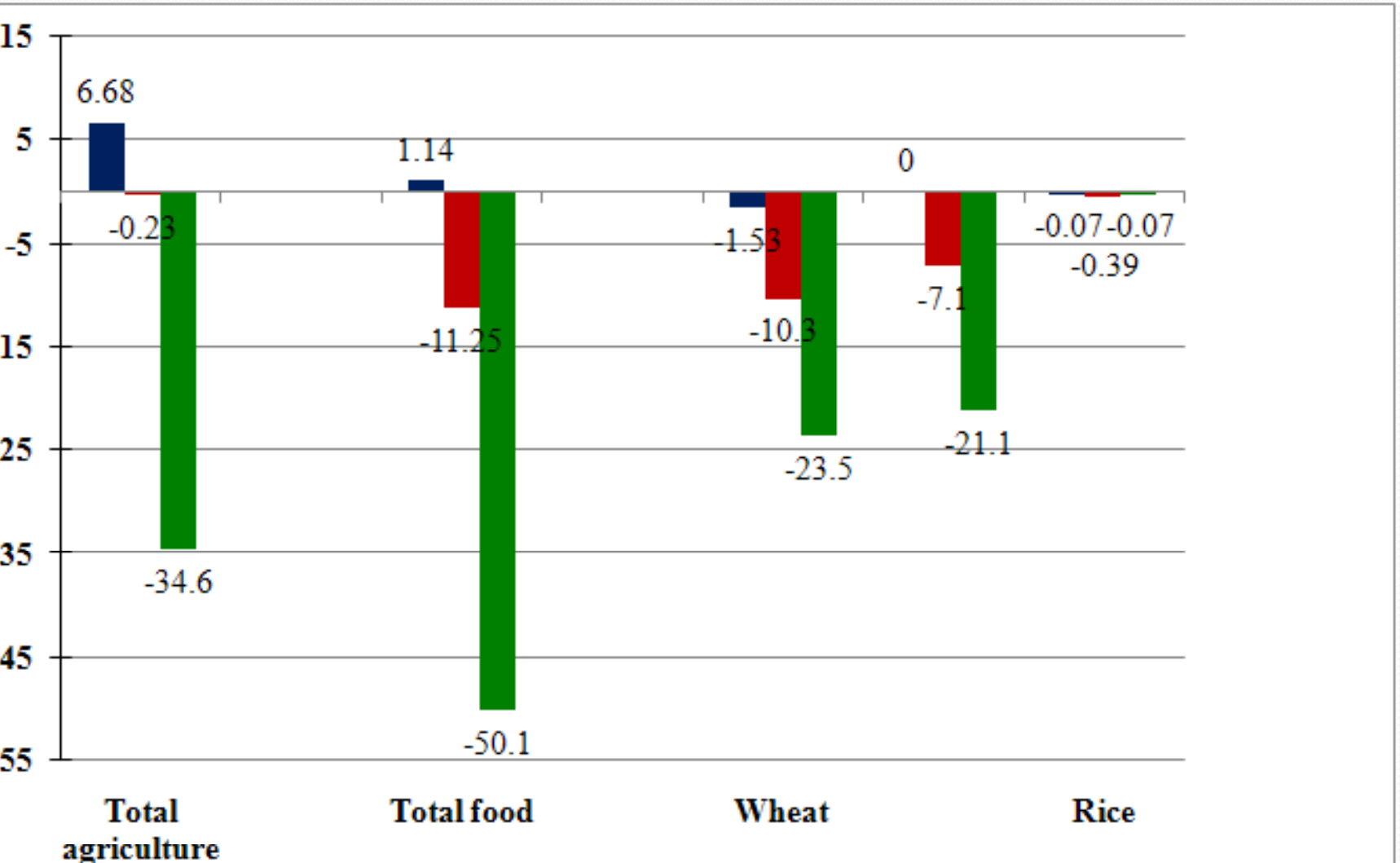
veloping Countries Food Self Sufficiency

91 % (at present)

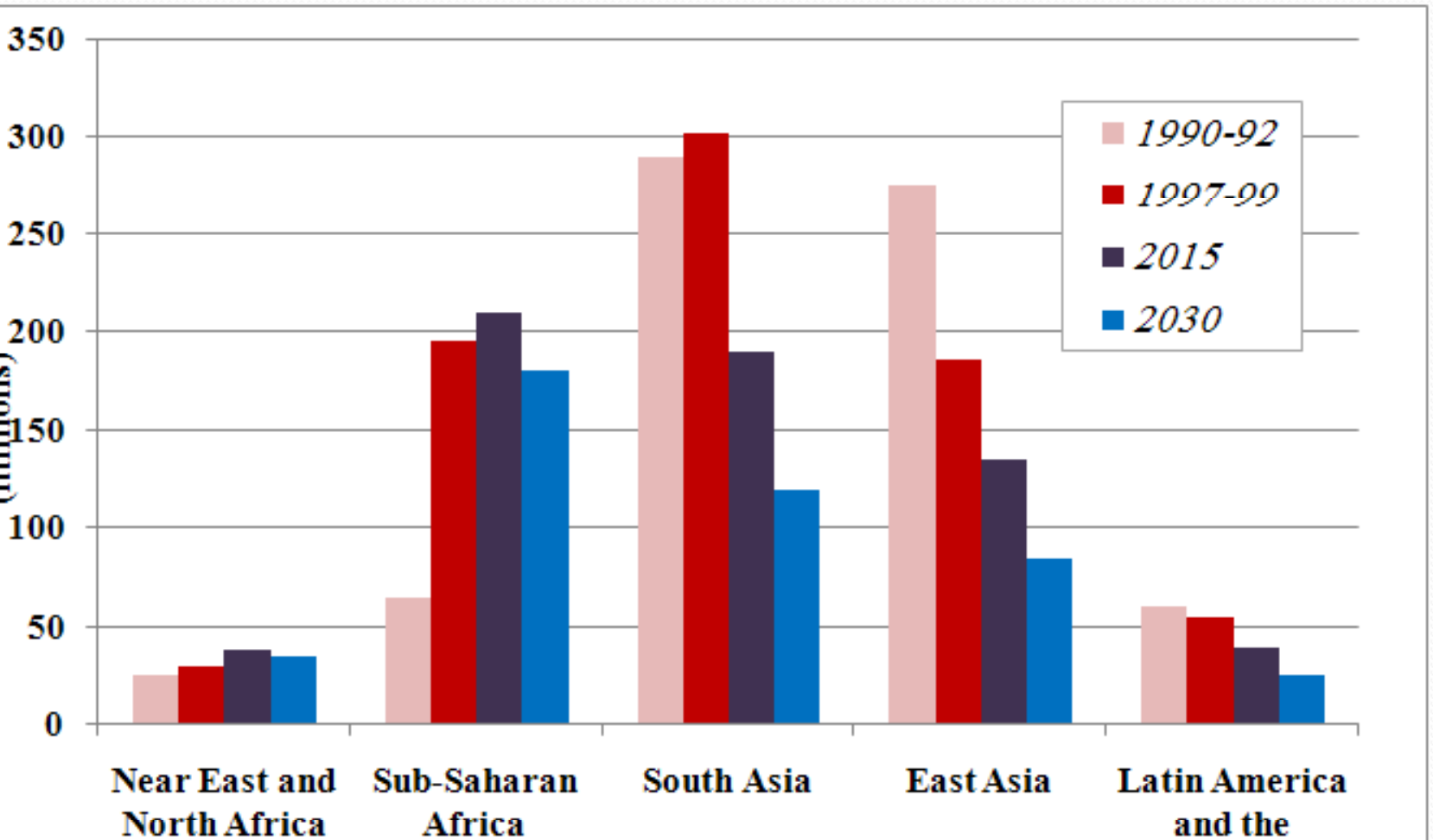


86 % (in 2030)

ade Flows between Developing and Developed Countries

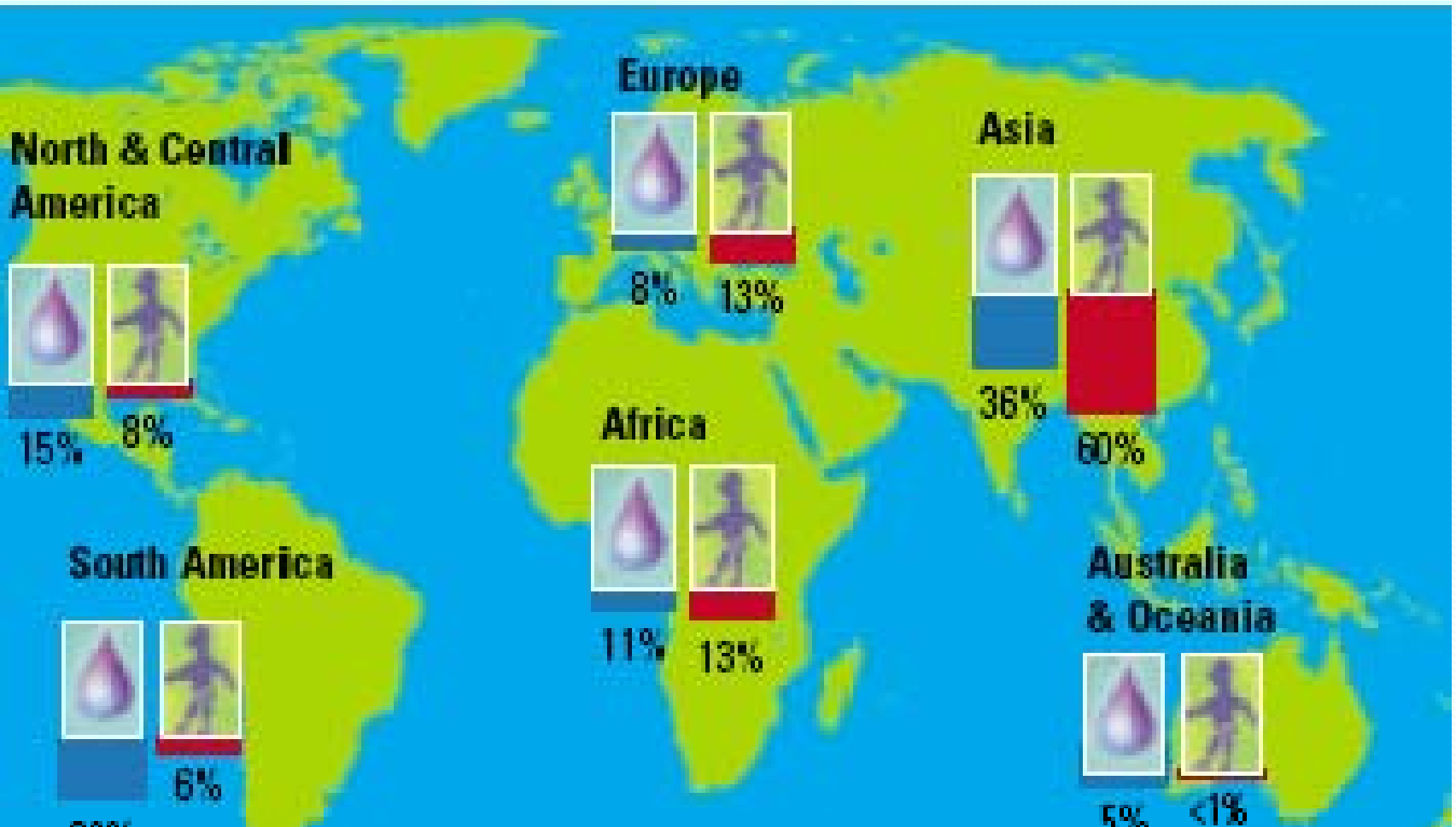


Estimated and projected number of undernourished people by region, 1991-2030

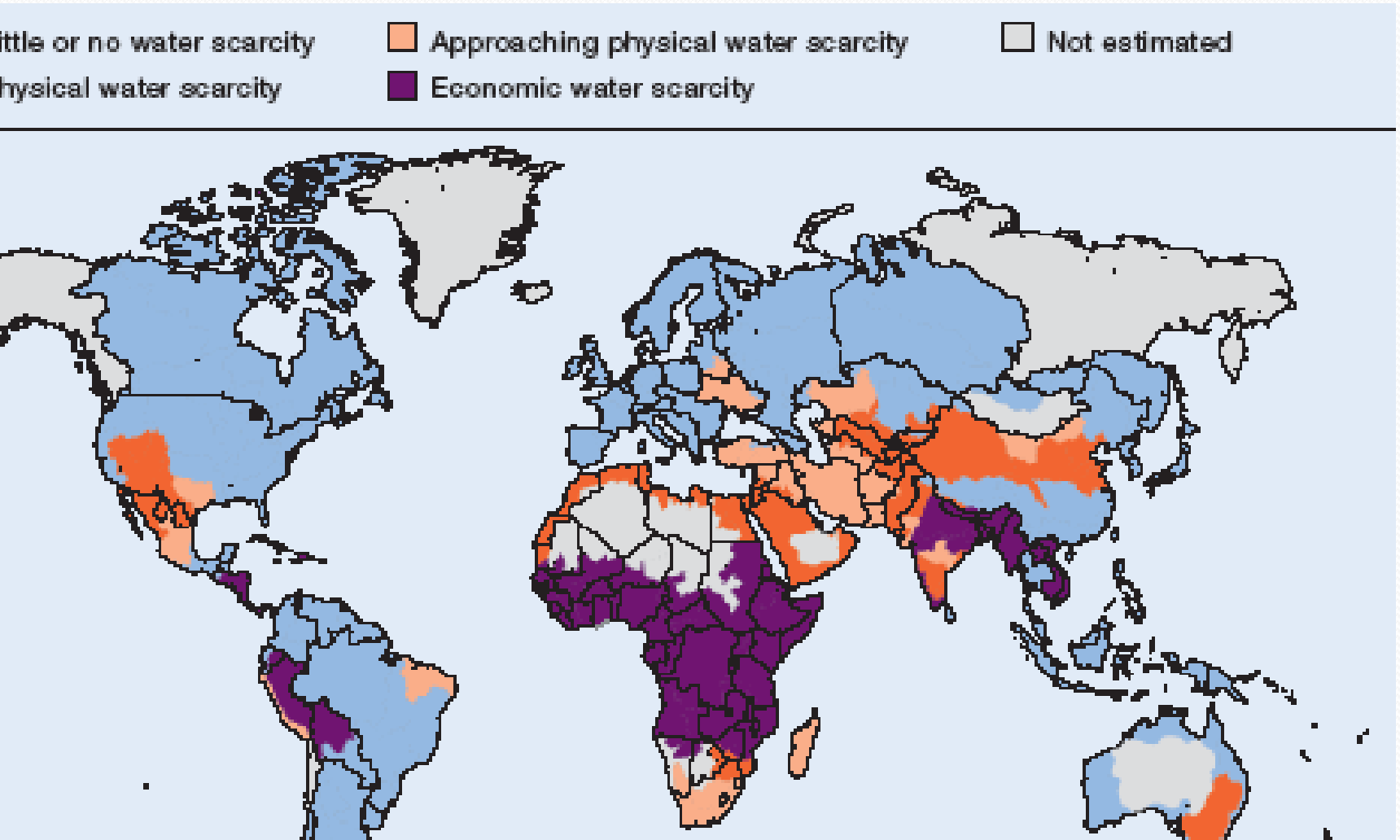


Global freshwater availablity

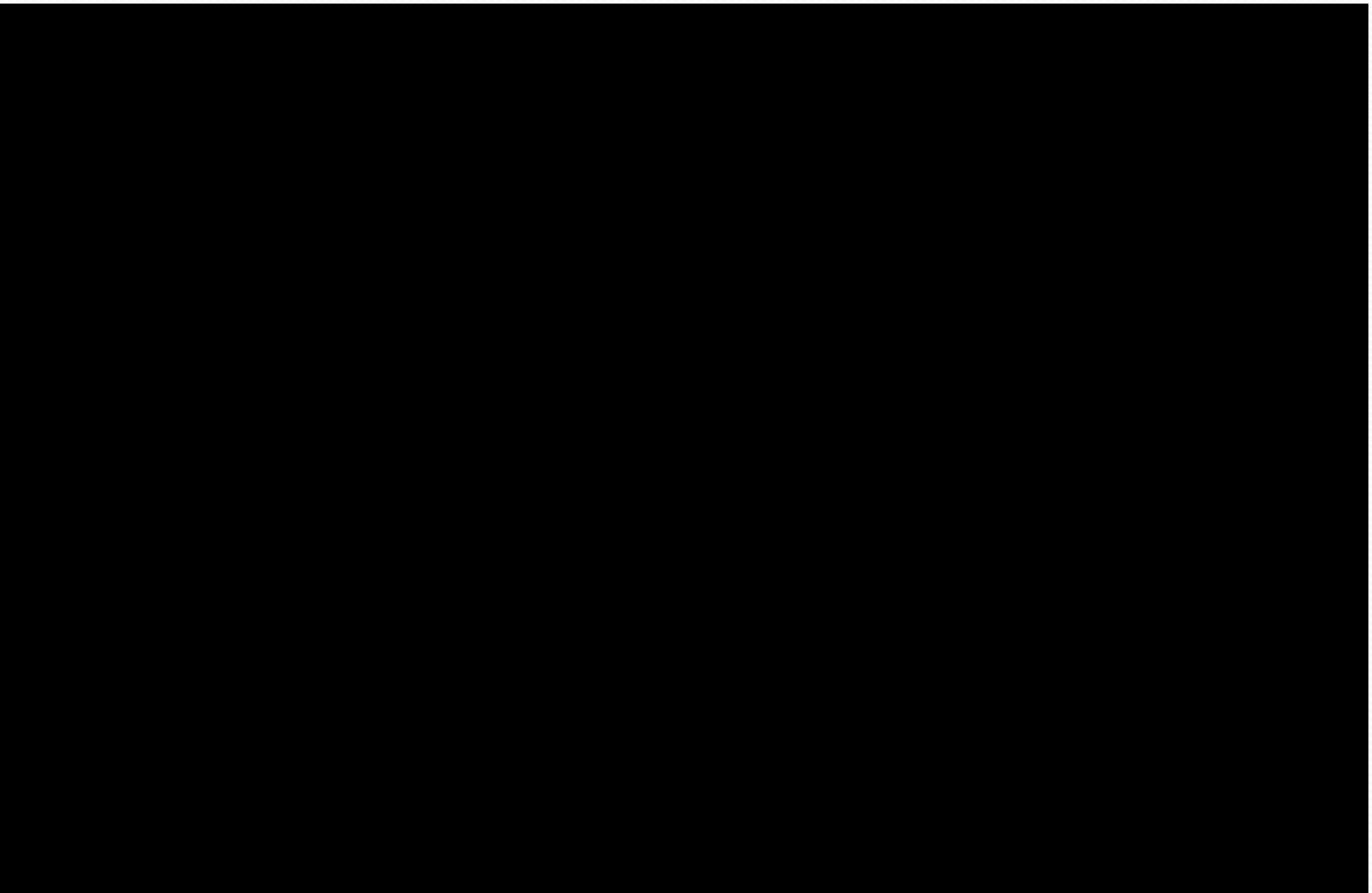
Water Availability versus Population



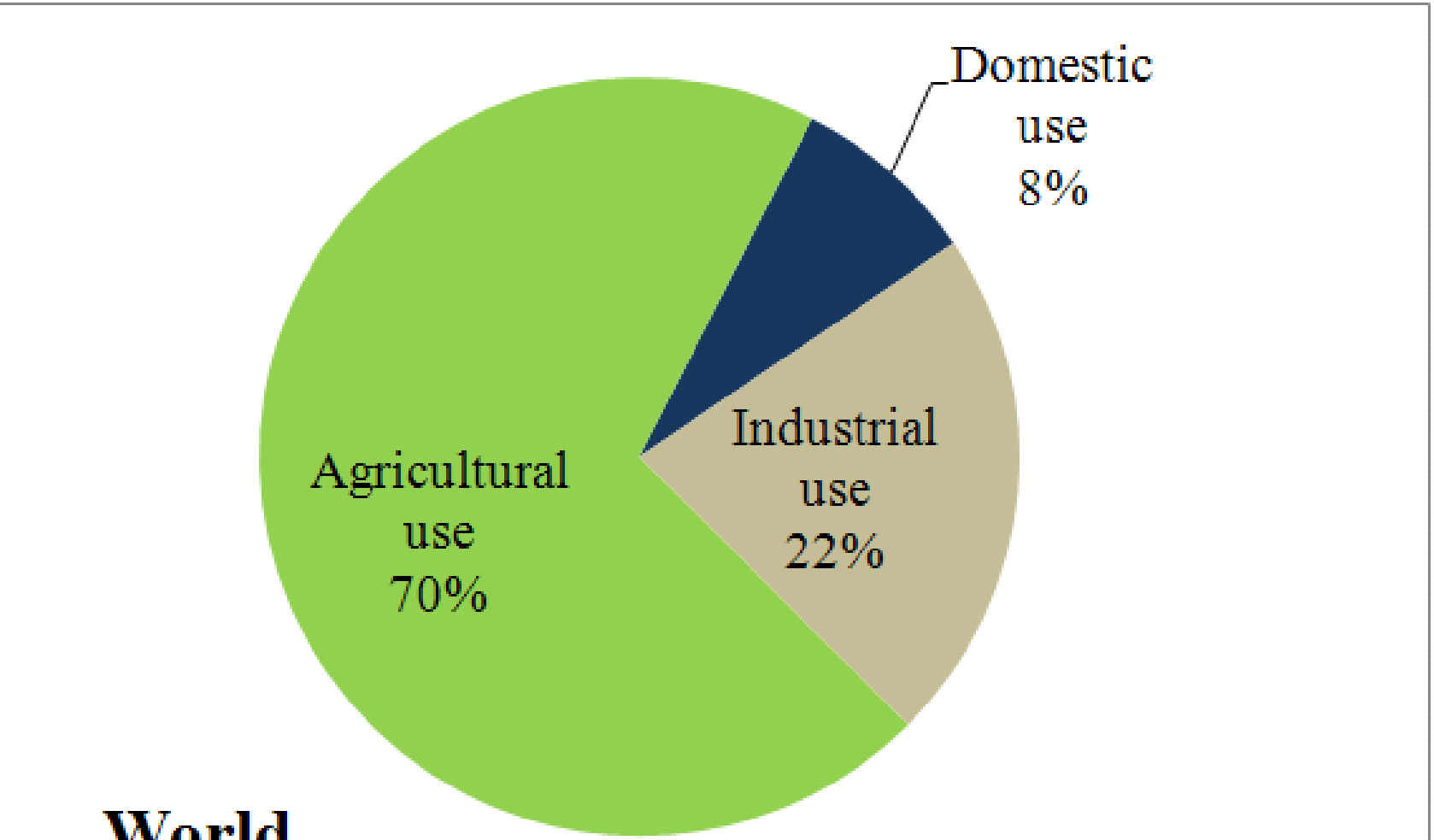
Areas of Physical and Economic Water Scarcity



mpeting water uses for main income groups of countries

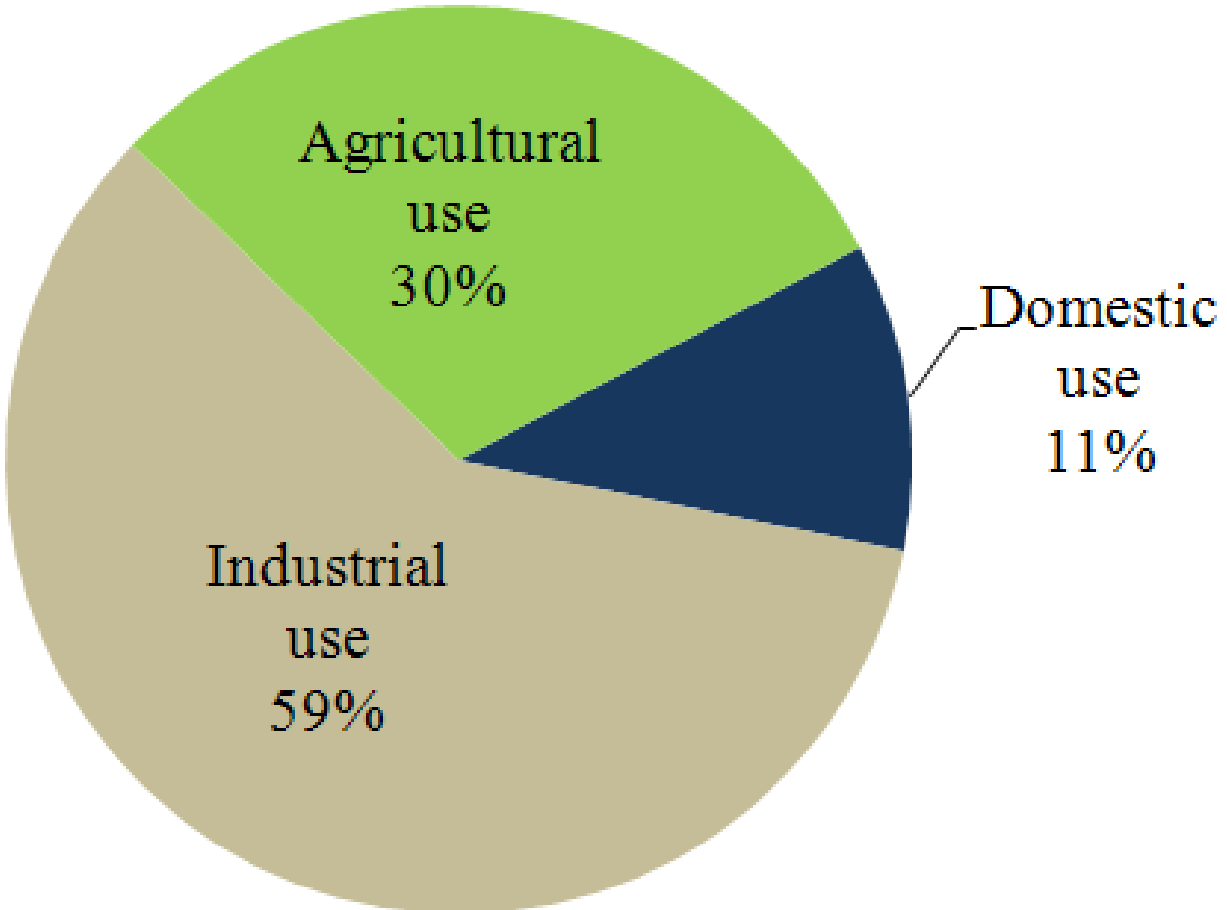


Distribution of Water Use in different Sectors

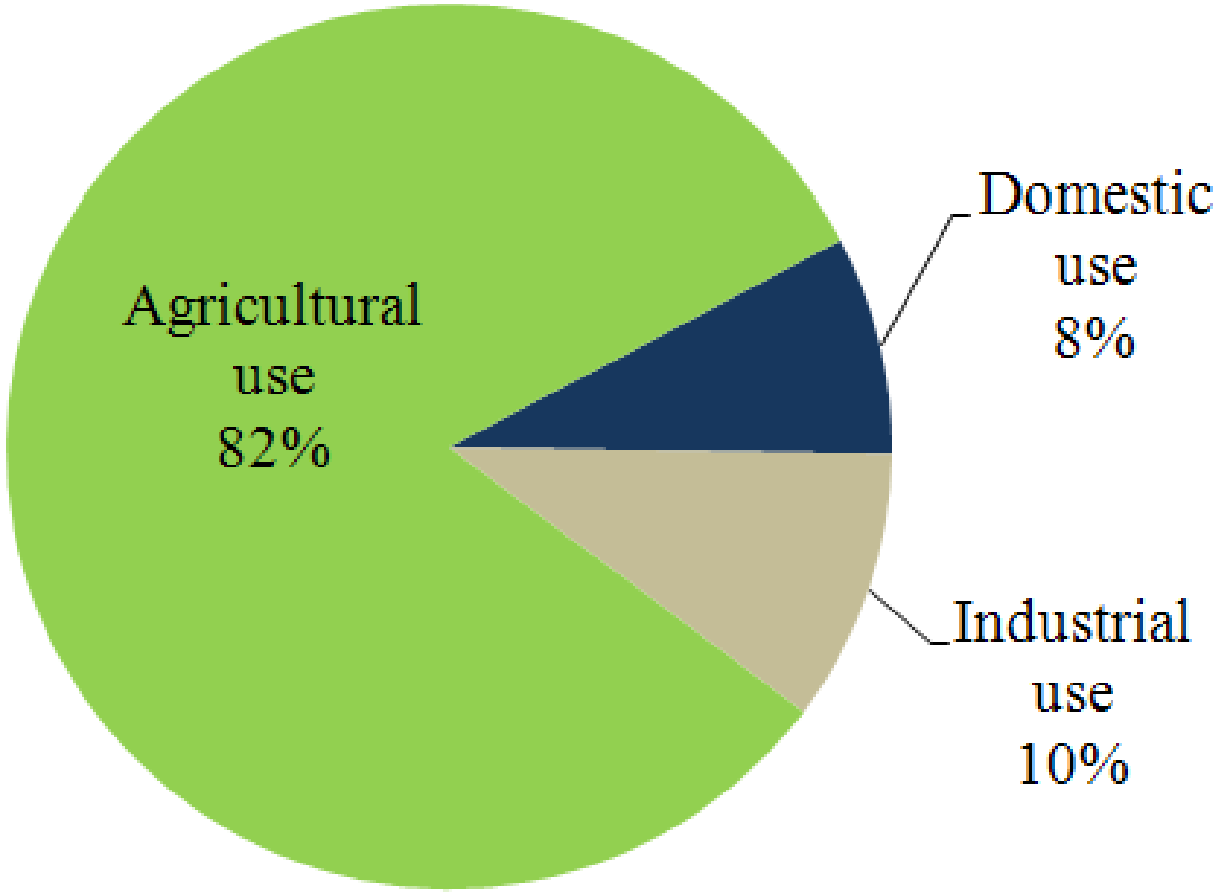


World

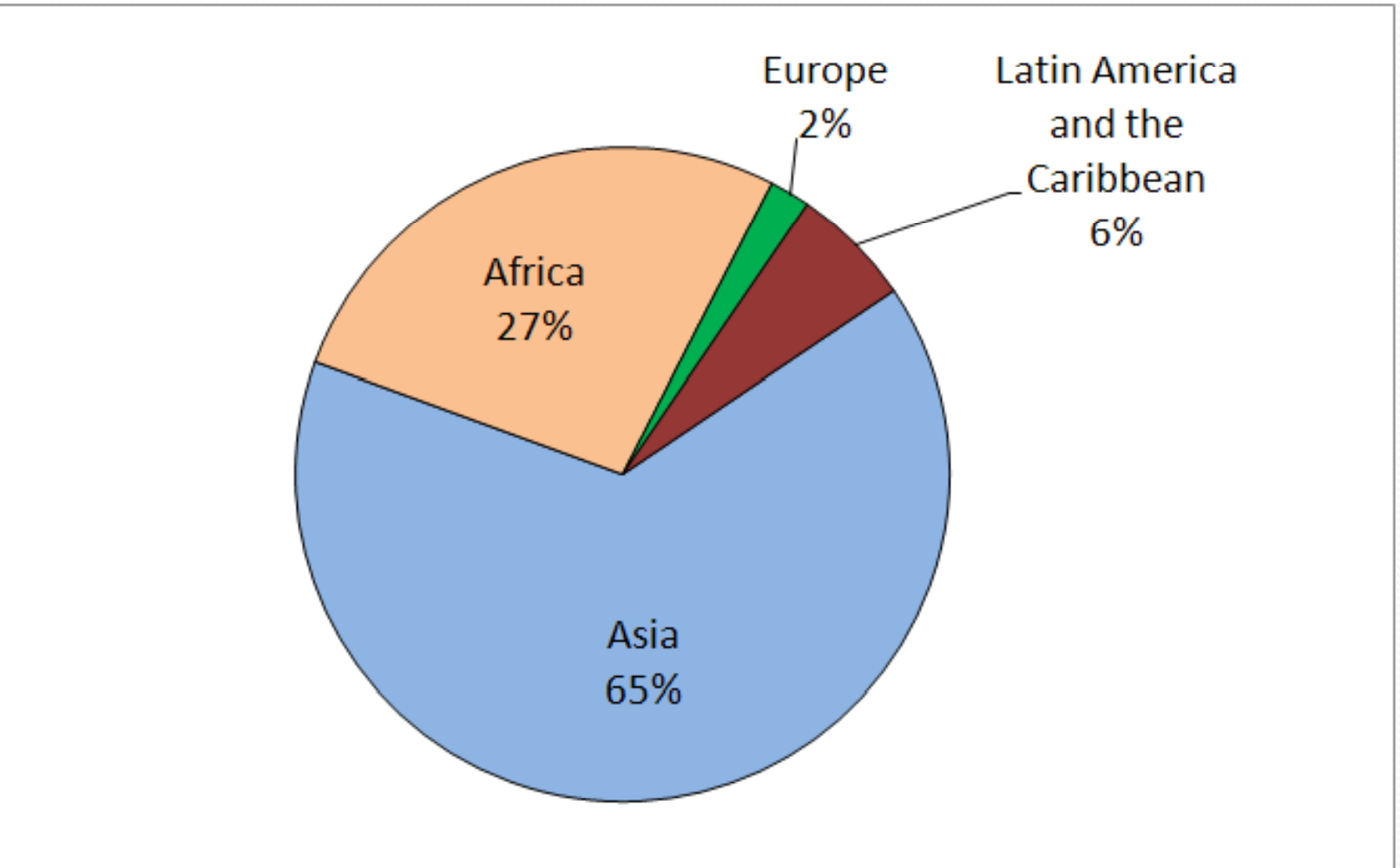
Distribution of Water Use in different Sectors



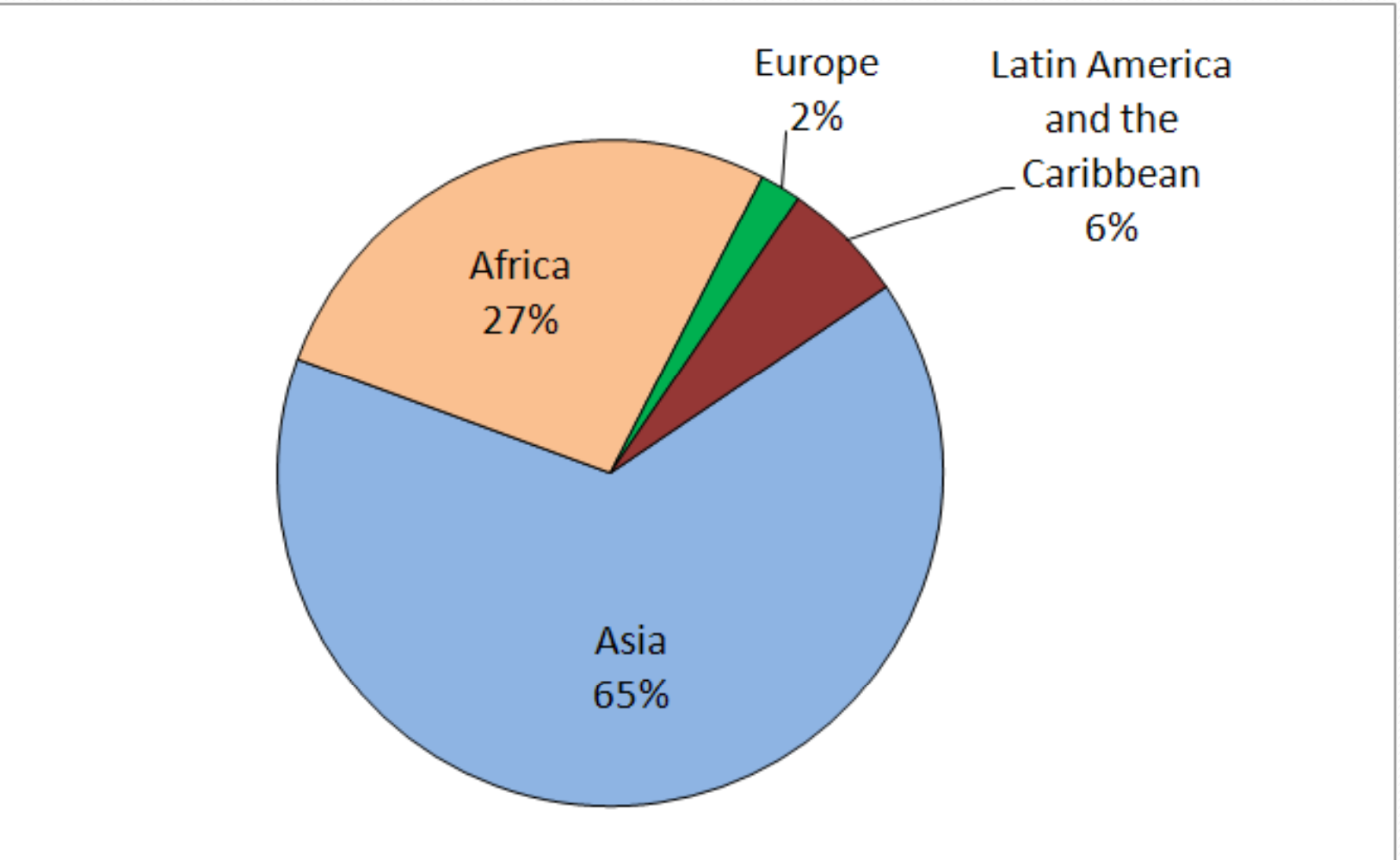
Distribution of Water Use in different Sectors



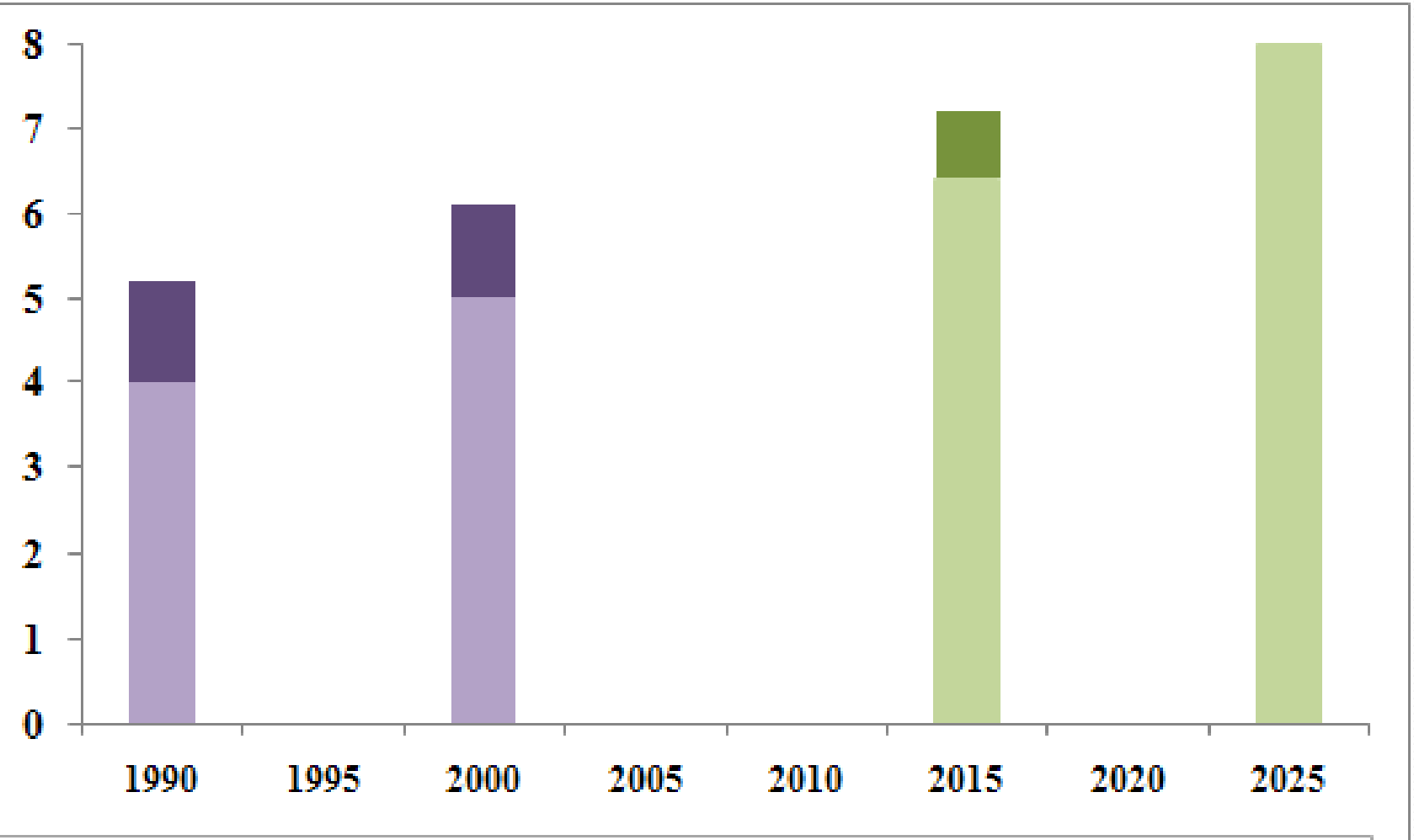
Water supply, distribution of unserved population



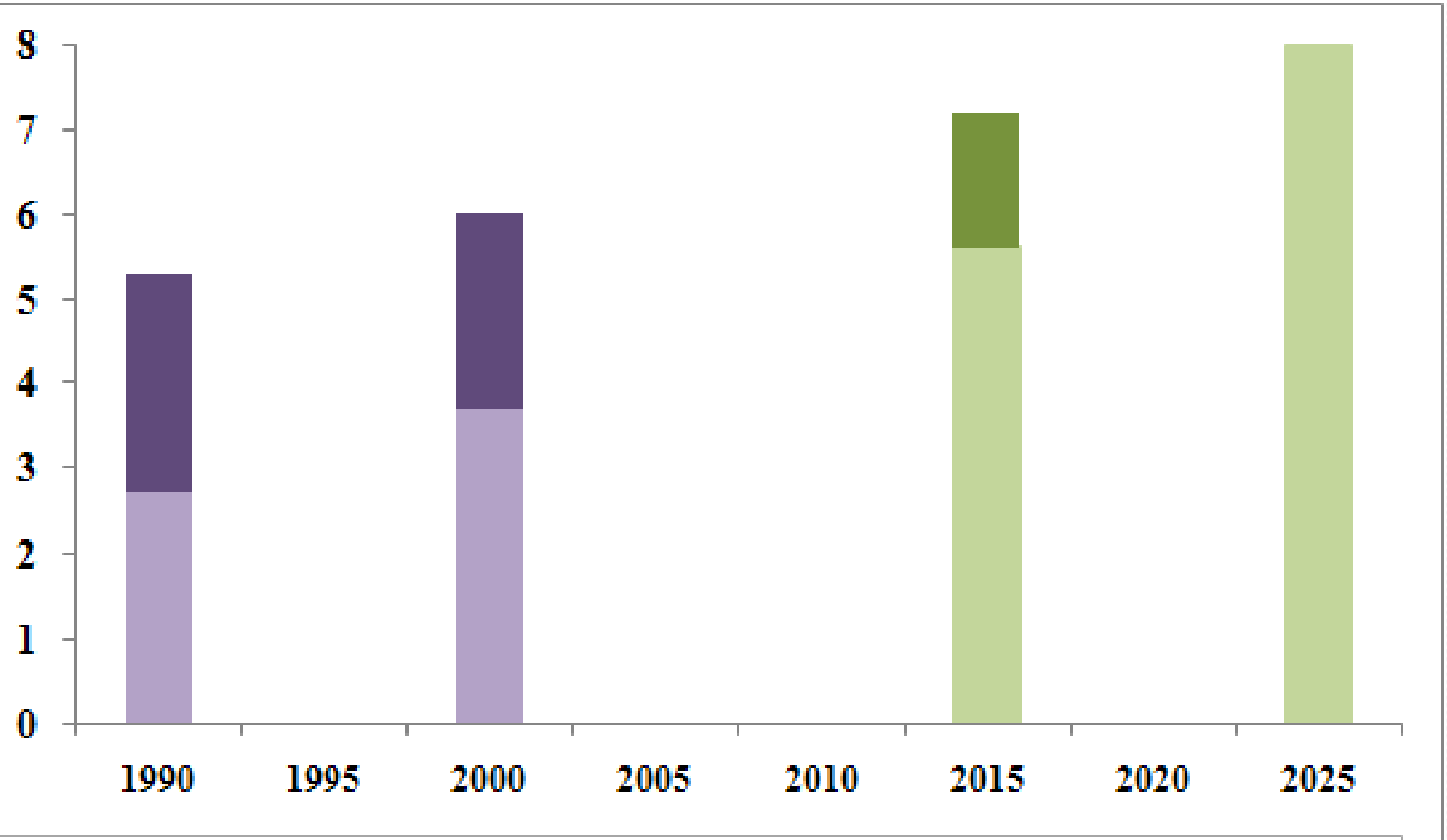
Sanitation, distribution of unserved population



Actual and target water supply coverage



Actual and target sanitation coverage



Focus on :

Water Productivity = Water use Efficiency

sical Water Productivity = $\dfrac{\text{Mass of agricultural output}}{\text{Unit of water}}$

onomic Water Productivity =

$$\frac{\text{Value of derived from agricultural output}}{\text{Unit of water}}$$

Water use Efficiency

- End use efficiency
- Allocation efficiency
- Environmental efficiency

ater productivity :

- **Agricultural water productivity**
- **Municipal water productivity**
- **Industrial water productivity**

Agricultural Water Productivity

- **Rainfed Agriculture**
- **Irrigated Agriculture**

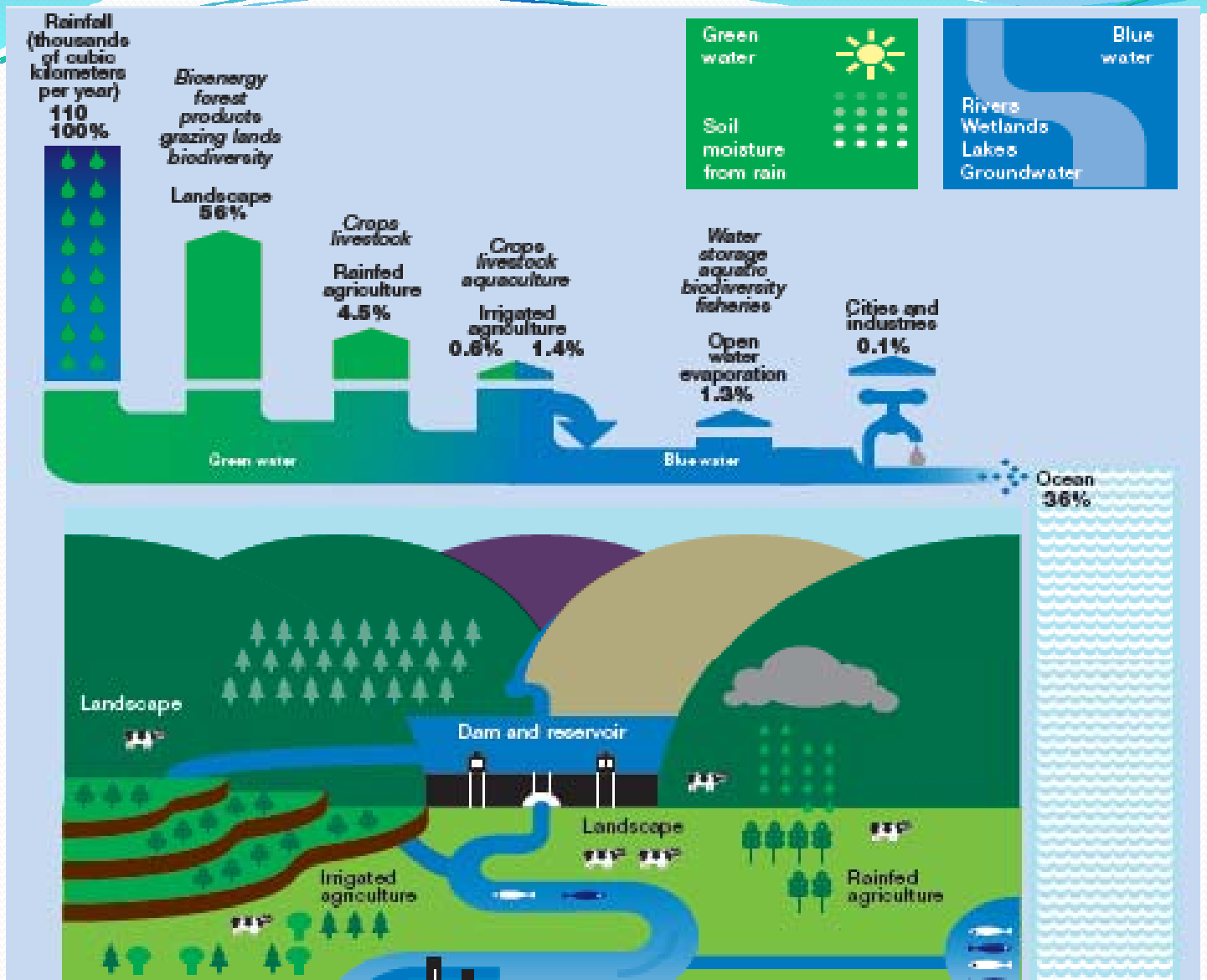
Improving Water Productivity in Rainfed Agriculture

Present status

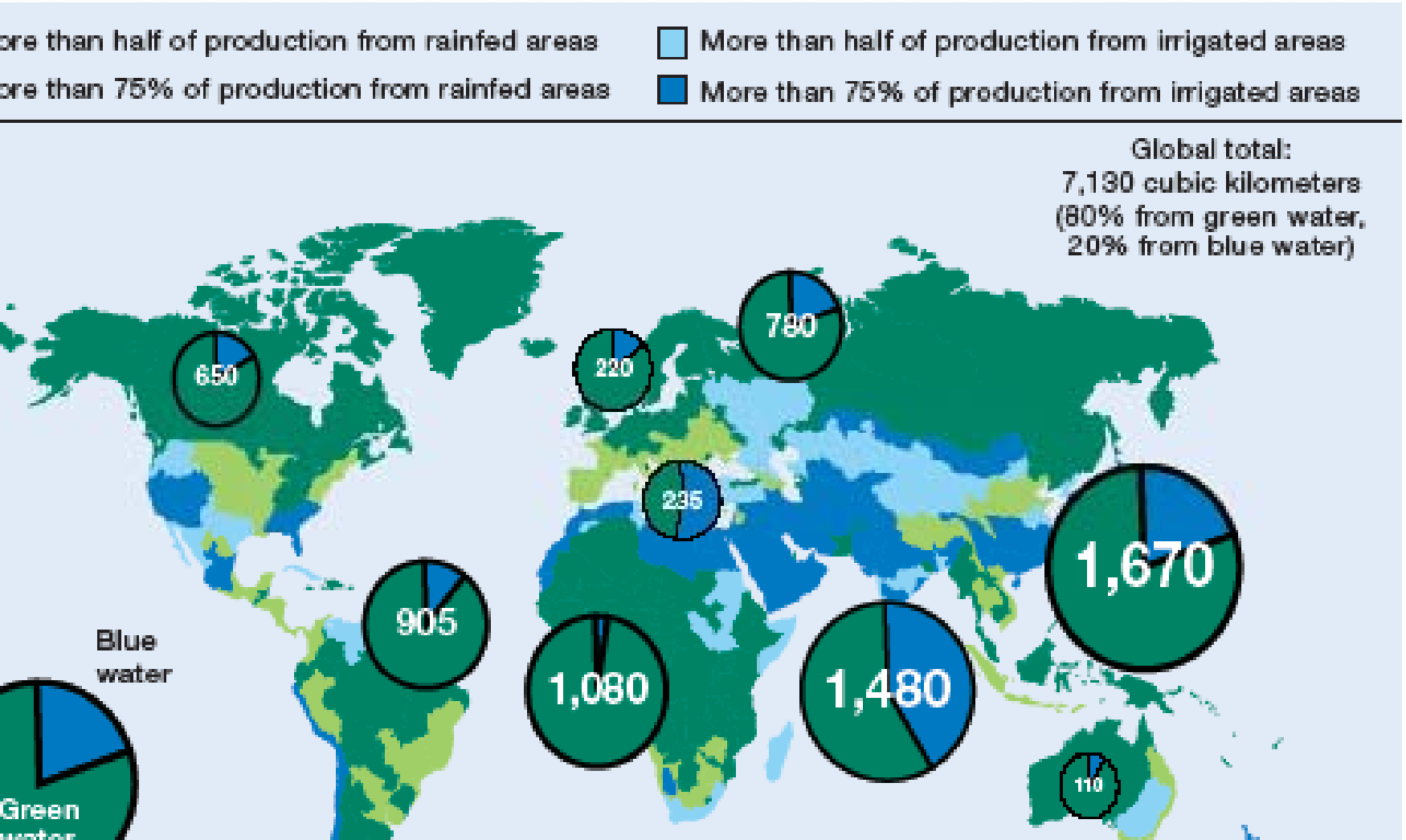
&

Future Hopes

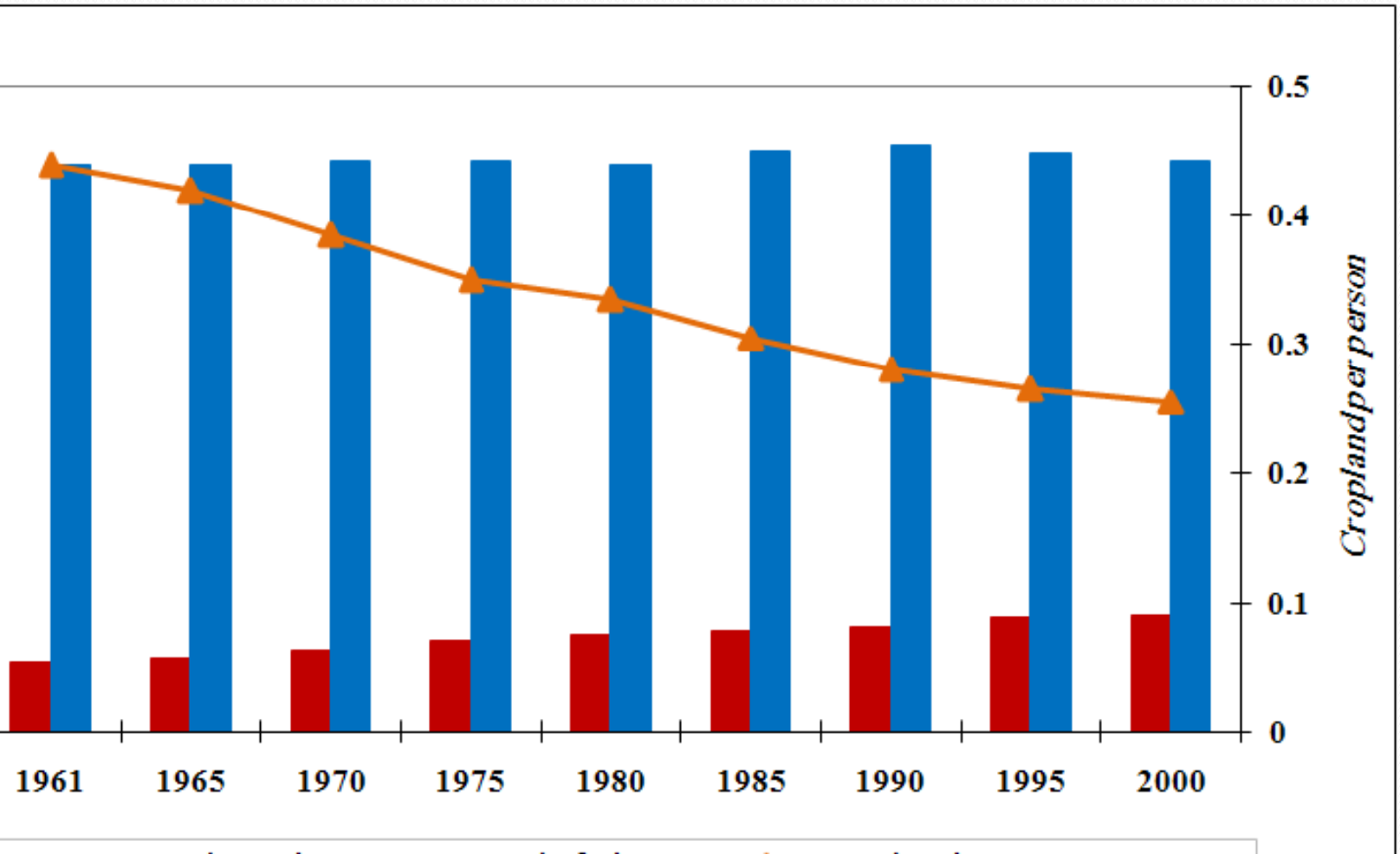
Water Use in Rainfed and Irrigated Agriculture



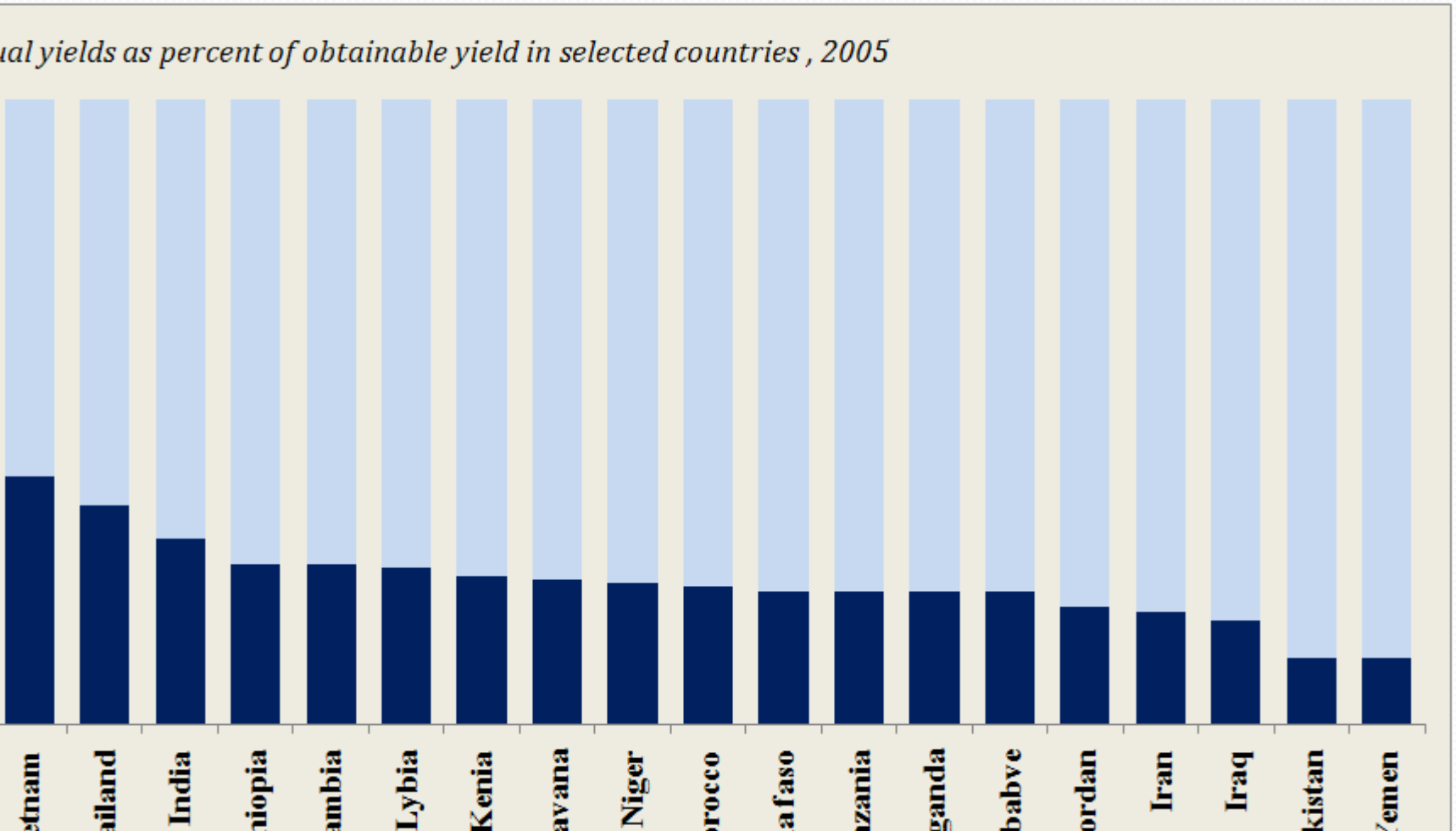
Regional Variation in Evapotranspiration in Rainfed and Irrigated Agriculture



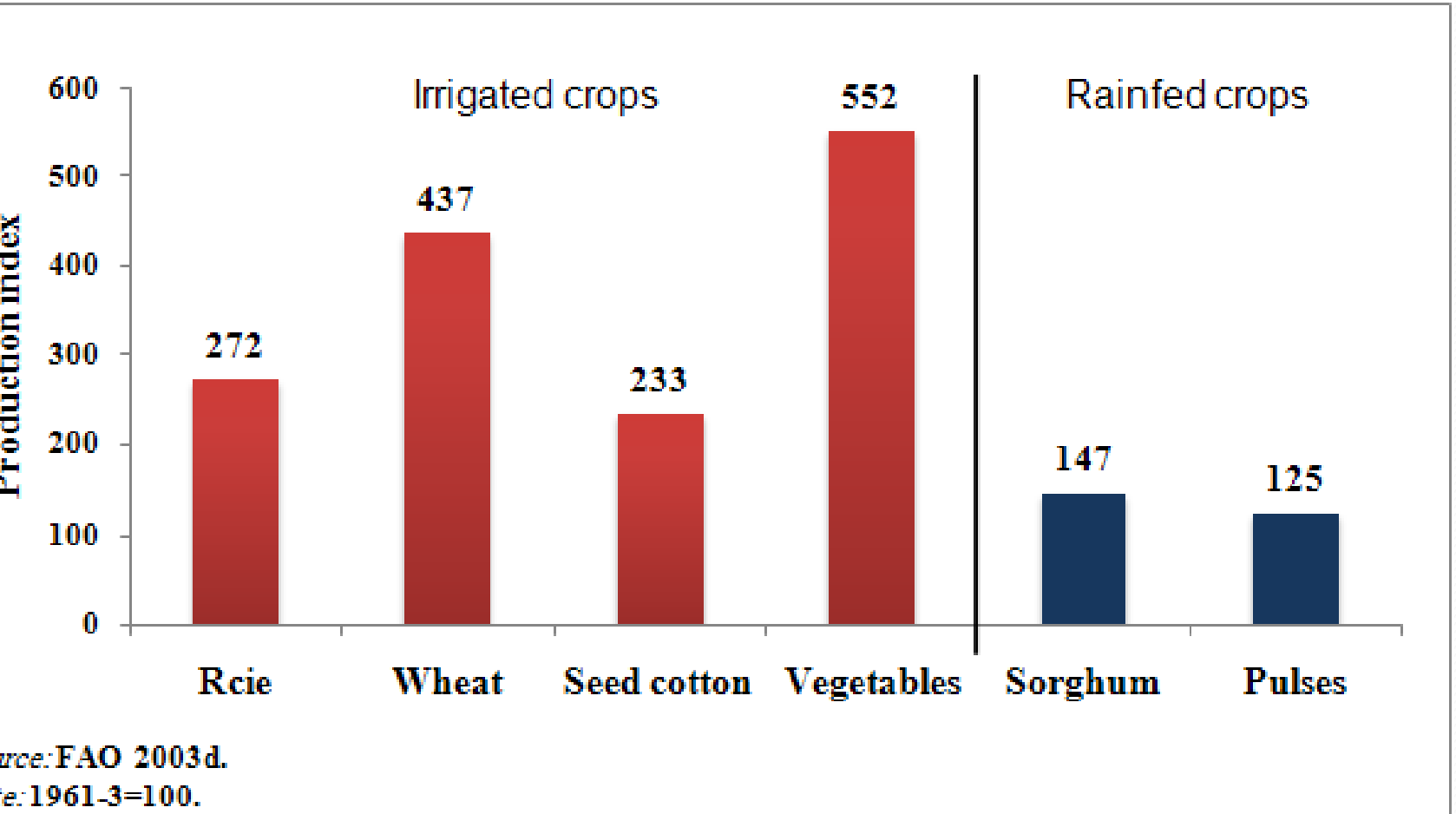
Evolution of cropland, 1961-2000



Gaps are large between farmer's actual yield and achievable yields for major rainfed cereal crops

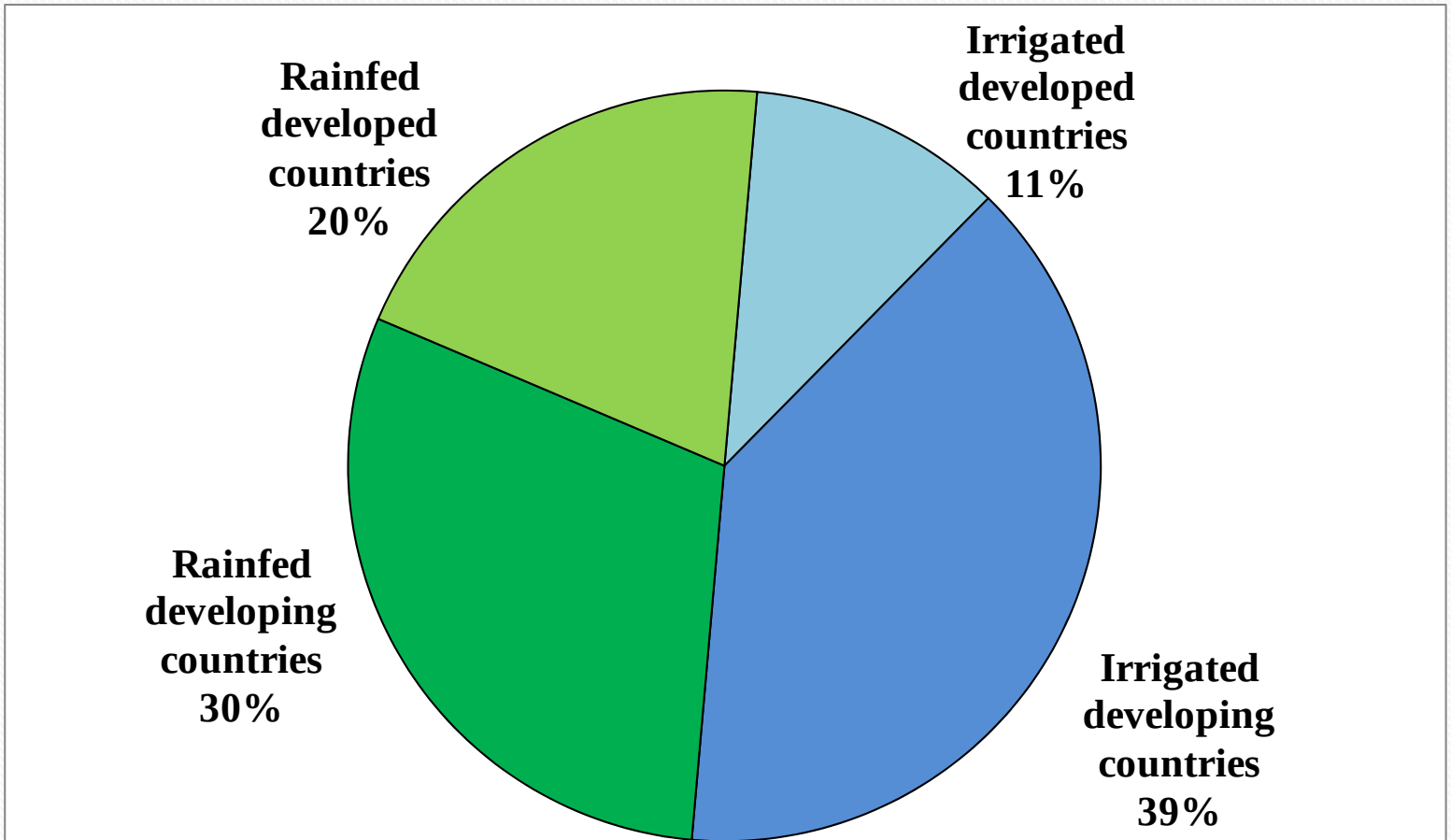


Production Indices for Mainly Irrigated and Mainly Rainfed Crops , 1997-99



rce: FAO 2003d.
e: 1961-3=100.

Share of Irrigated and Rainfed in Cereal Production Increase , 1995-2025



hare of Rainfed and Irrigated Production in Total Crop Production in Developing Countries *(percent)*

Rainfed Farming System are Characterized by:

- **Poor and variable water availability**
- **High level of vulnerability to risk**
- **Prevailing poverty**
- **Low yielding technological production package**

The Challenge of Rainfed Farming is :

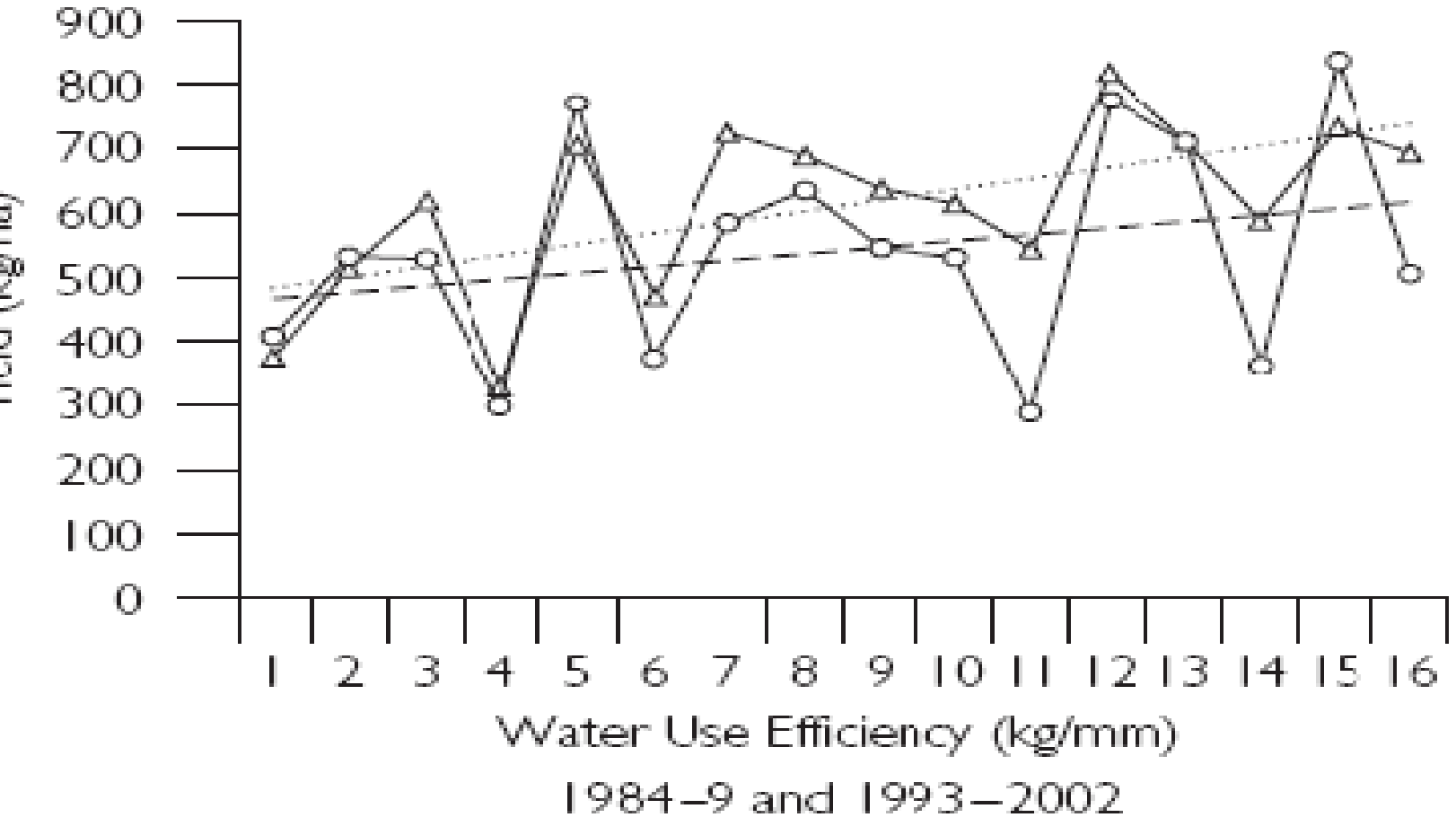
- **Improving income**
- **Reducing vulnerability and risk**
- **Accessible technical solution**

Accessible technical solution :

- **Soil moisture conservation technique**
  - ✓ **Minimum to no-till system**
  - ✓ **Manure and mulching**
  - ✓ **Recycling city waste**
- **Water harvesting**
  - ✓ **Small furrows**
  - ✓ **Terracing and bunds**
  - ✓ **Small dams**
- **Improving varieties and cropping pattern**

Supplemental irrigation

Joint Water and Soil Fertility Management on the Mossi Plateau , Burkina Faso



Wheat Grain Production Scenarios for a Four-Hectare Farm with Various Strategies of Supplemental Irrigation in Northern Syria

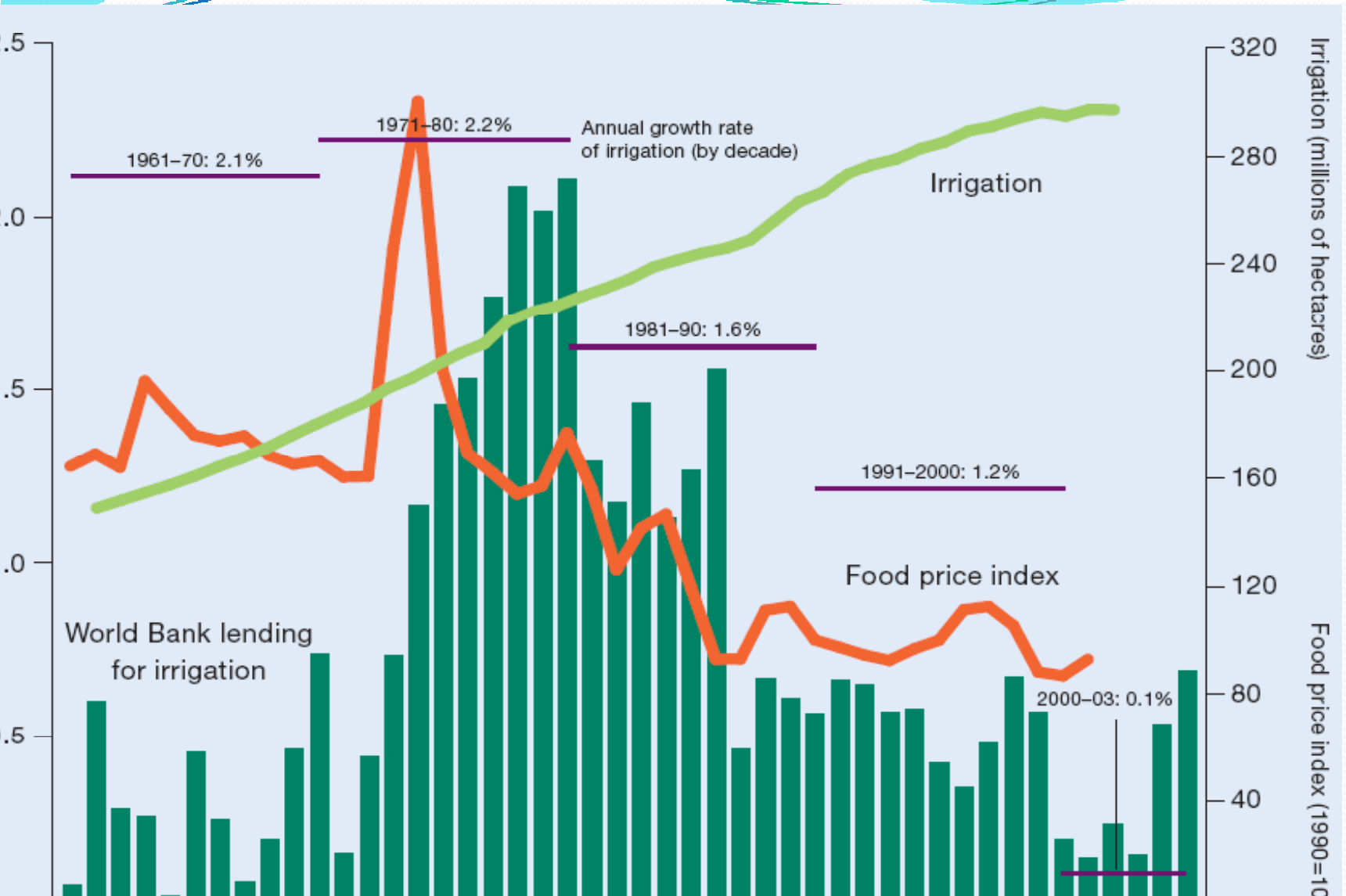
management strategy	Rainfed (342 mm)	Farmer's practice	Applying full SI water	Applying 50 percent of full SI
epth applied (mm)	0	298	222	111
(t/ha)	1.8	4.18	4.46	4.15
ductivity (kg/m^3)	0.53	0.70	1.06	1.85
uction (ton), water is not a limiting factor	7.2	16.7	17.8	16.6
uction (ton), if only 50 percent of full irrigation ent is available	7.2	10.8	12.5	16.6
e average production (ton)	1.4	2.7	3.12	4.15

eis and Hachum 2003.

Improving Water Productivity in Irrigated Agriculture

Present status
&
Future Hopes

Irrigation Expanding , Food Price Falling



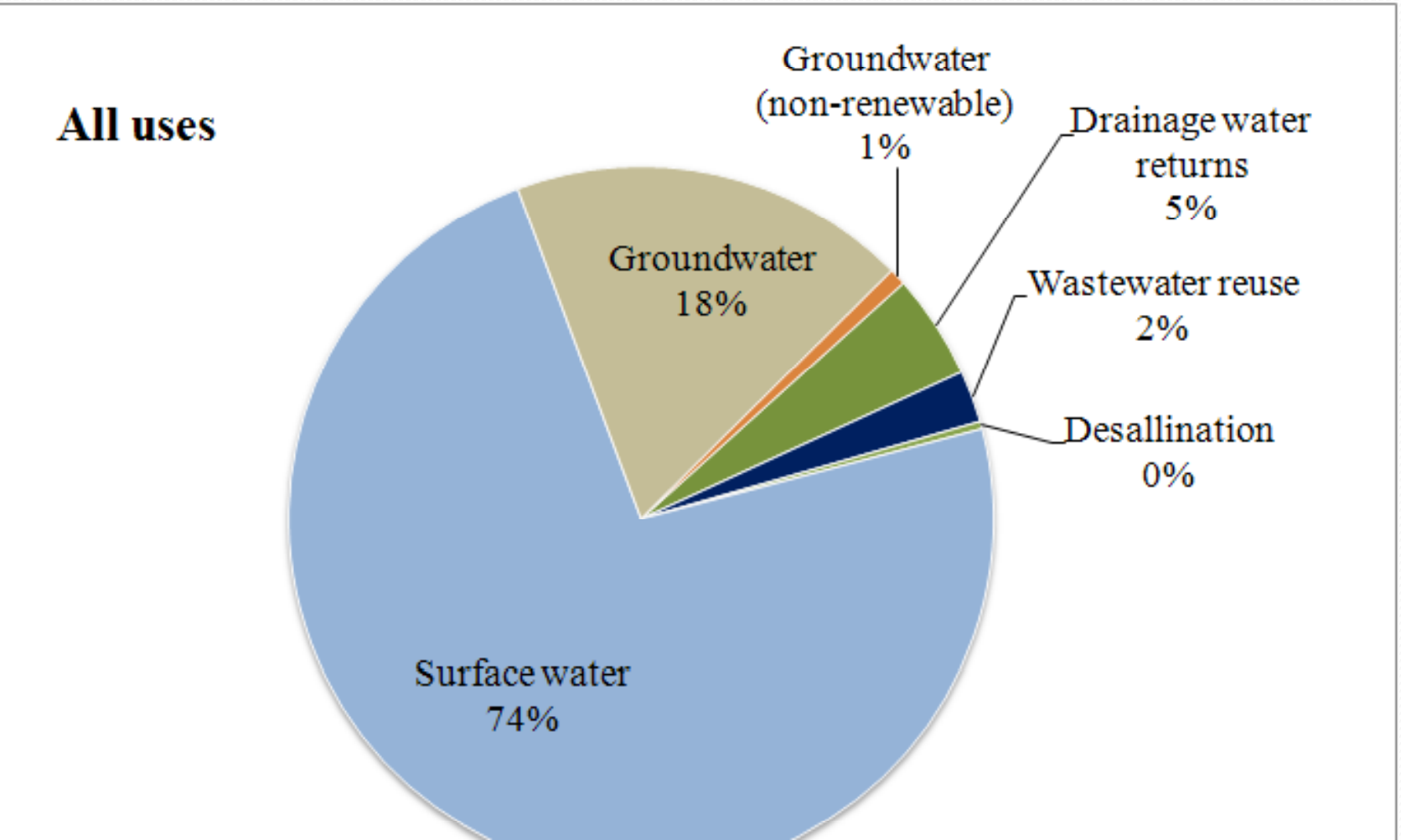
Freshwater resources and withdrawal, 2000

(cubic kilometers per year unless otherwise indicated)

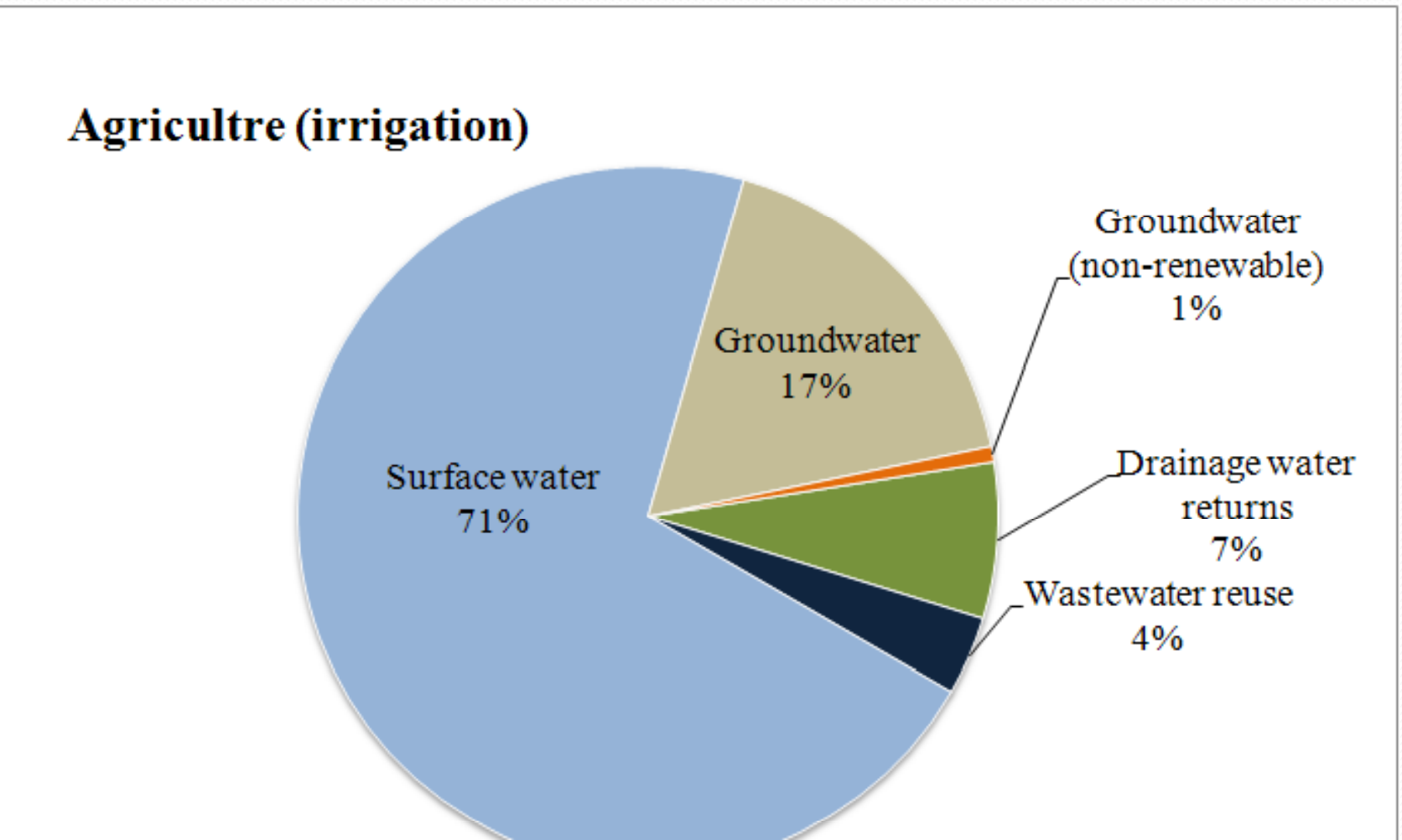
gion	Renewable freshwater resources	Total freshwater withdrawal	Freshwater withdrawals						Withdrawal as share of renewable resources (%)
			Agriculture		Industry		Municipalities		
			Amount	Share (%)	Amount	Share (%)	Amount	Share (%)	
	3936	*217*	*186*	*86*	*9*	*4*	*22*	*10*	*5.5*
	11594	*2378*	*1936*	*81*	*270*	*11*	*172*	*7*	*20.5*
merica	*13477*	*252*	*178*	*71*	*26*	*10*	*47*	*19*	*1.9*
ean	*93*	*13*	*9*	*68*	*1*	*9*	*3*	*23*	*14.4*
America	*6253*	*525*	*203*	*39*	*252*	*48*	*70*	*13*	*8.4*
a	*1703*	*26*	*19*	*72*	*3*	*10*	*5*	*18*	*1.5*
	6603	*418*	*132*	*32*	*223*	*53*	*63*	*15*	*6.3*
	43650	*3830*	*2664*	*70*	*785*	*20*	*381*	*10*	*8.8*

rojected Increases in World Water Consumption Total and Irrigation *(billions of cubic meters)*

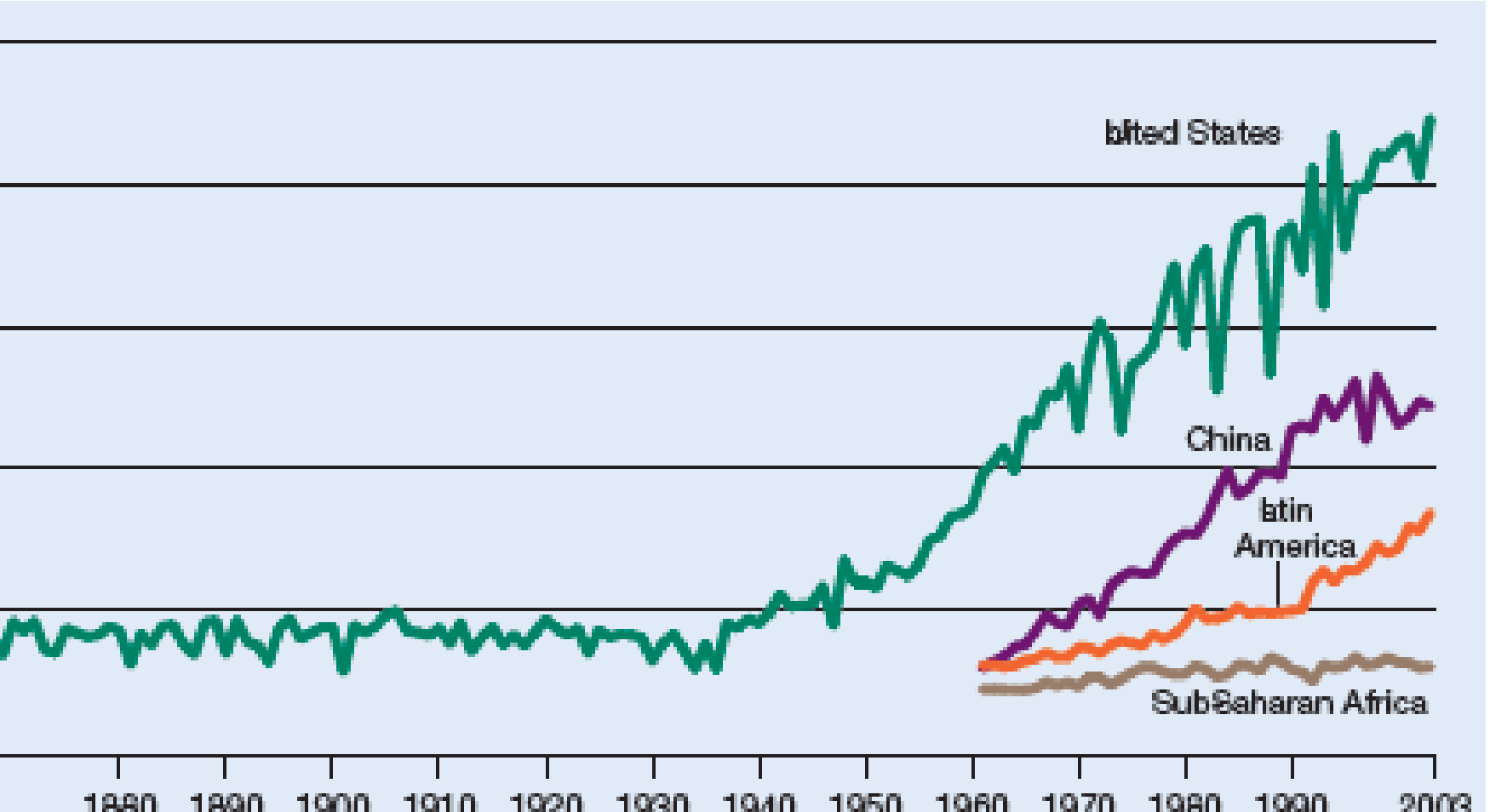
Sources of Water use Globally and for major Sectors , 2000



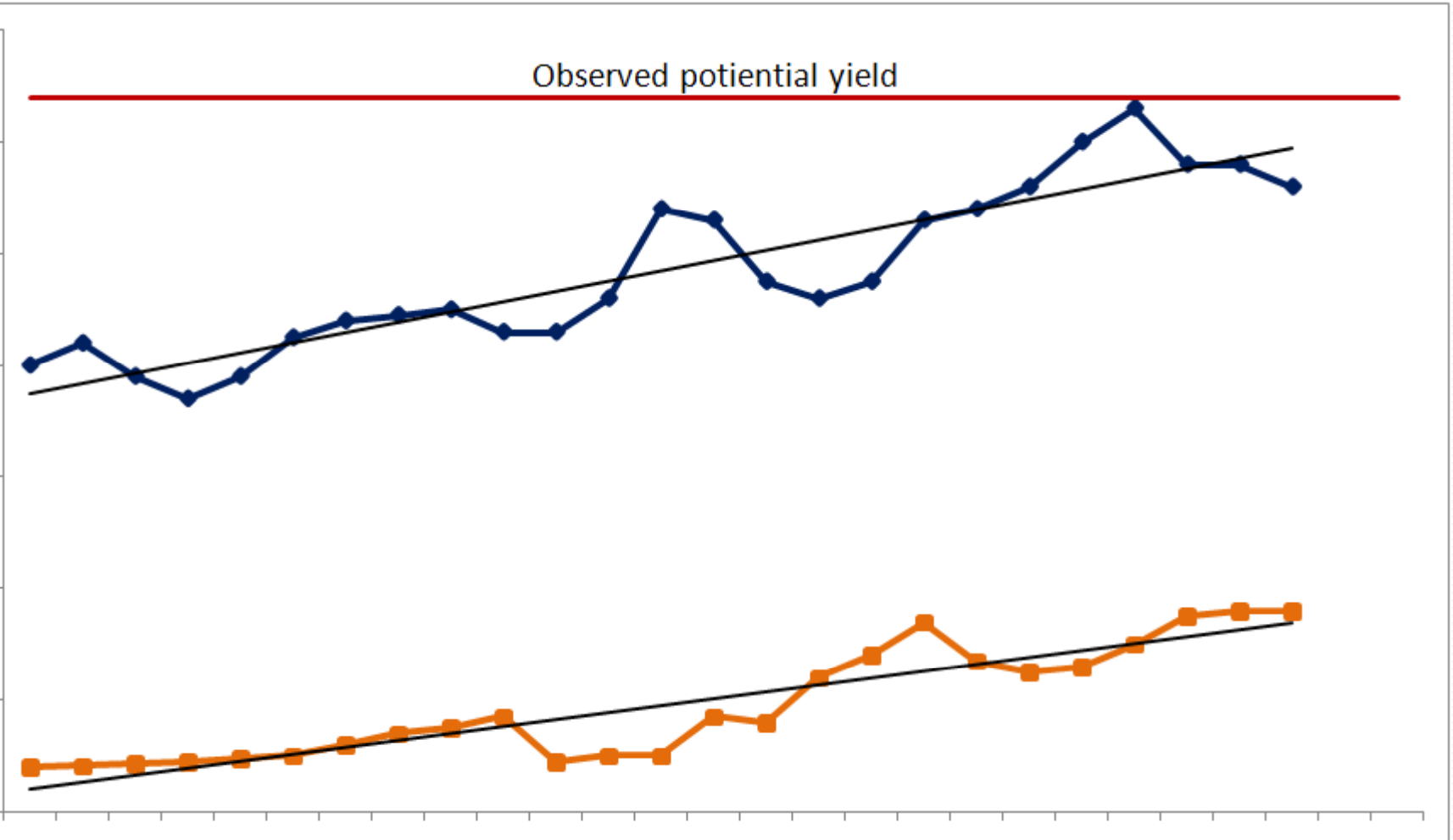
Sources of Water use Globally and for major Sectors , 2000



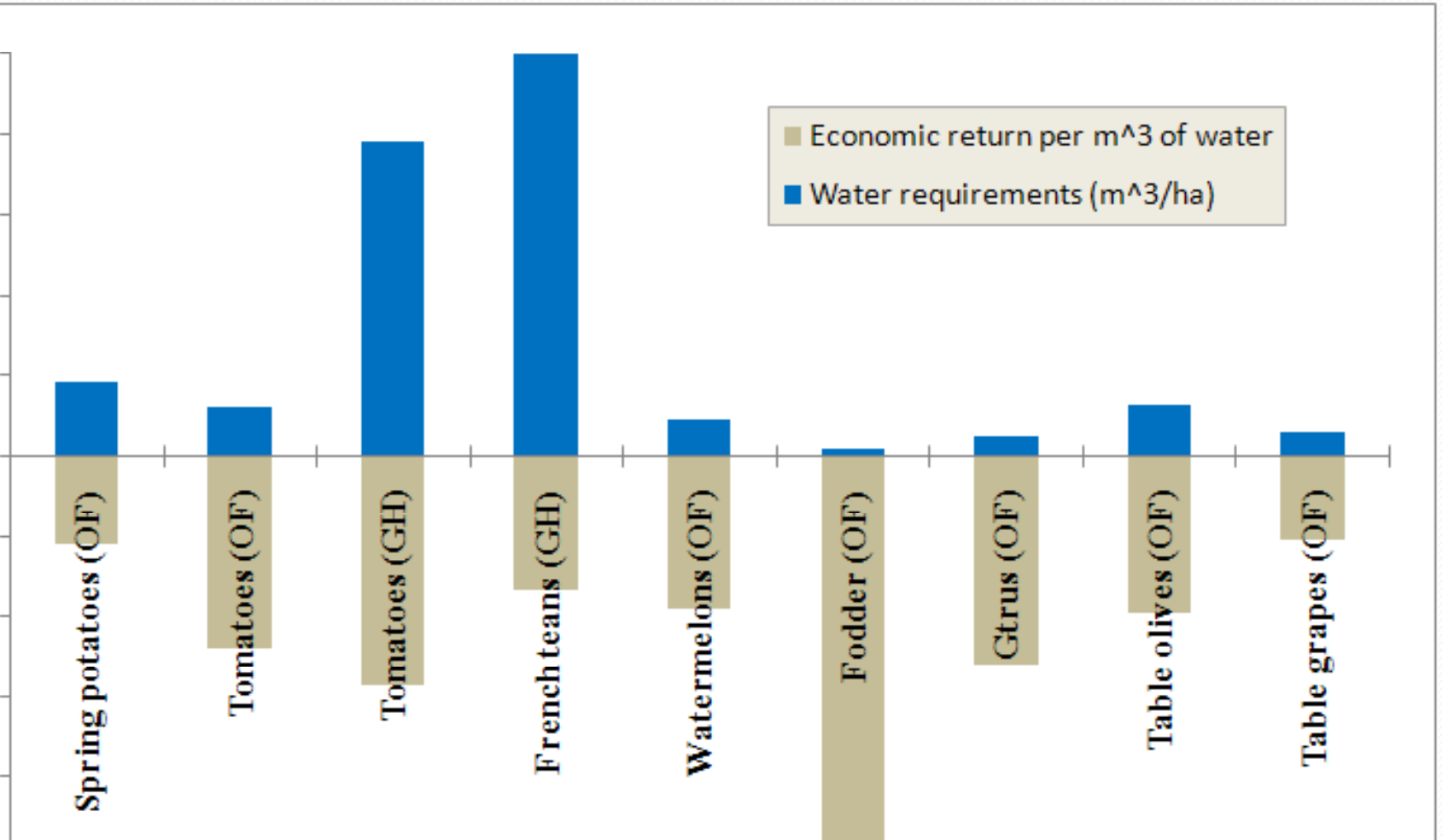
Sub-Saharan Africa has yet to “take off” as Asia and Latin America did in the Green Revolution and Industrial Countries did much earlier



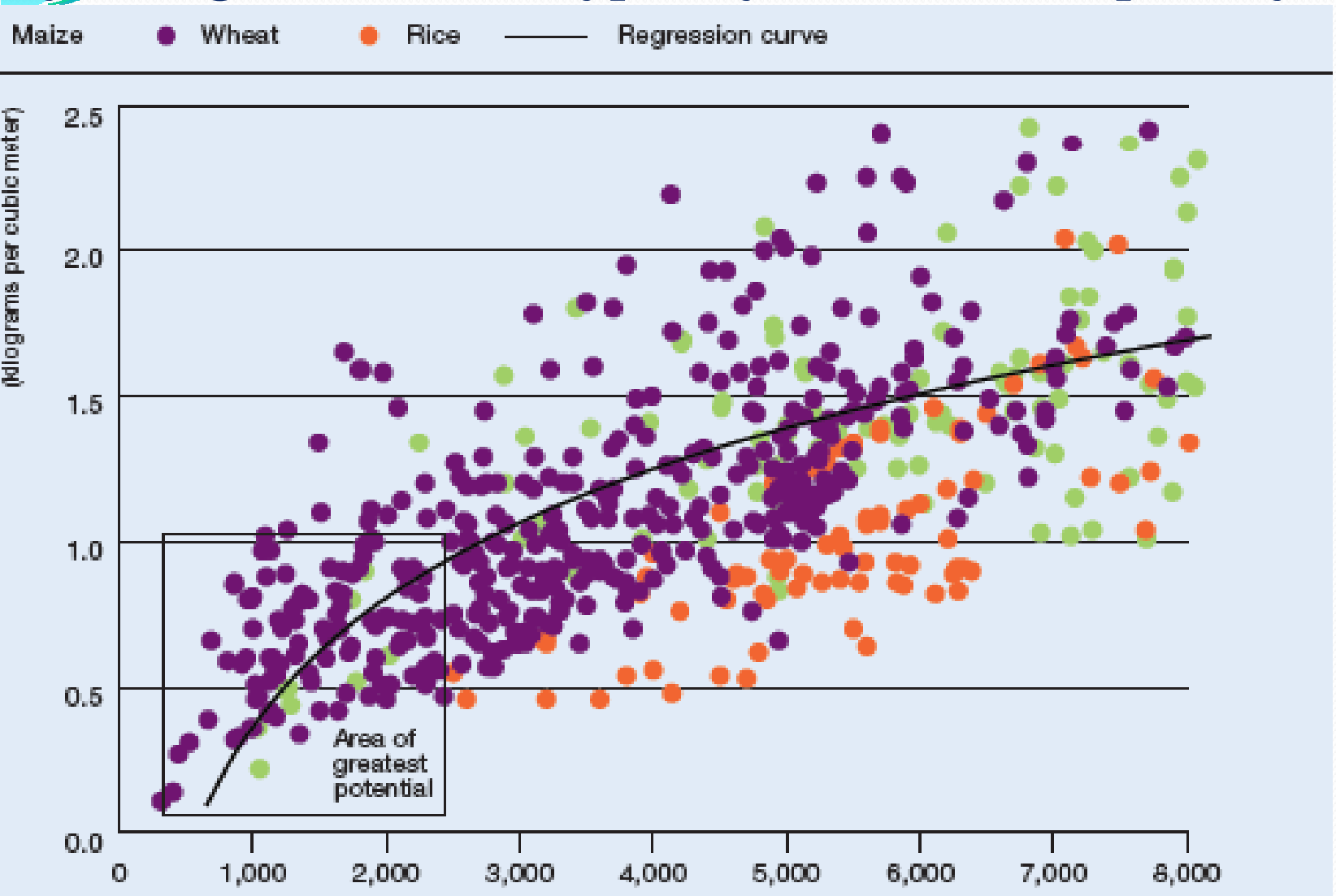
rain yield under improved and traditional technologies , 1977-2001



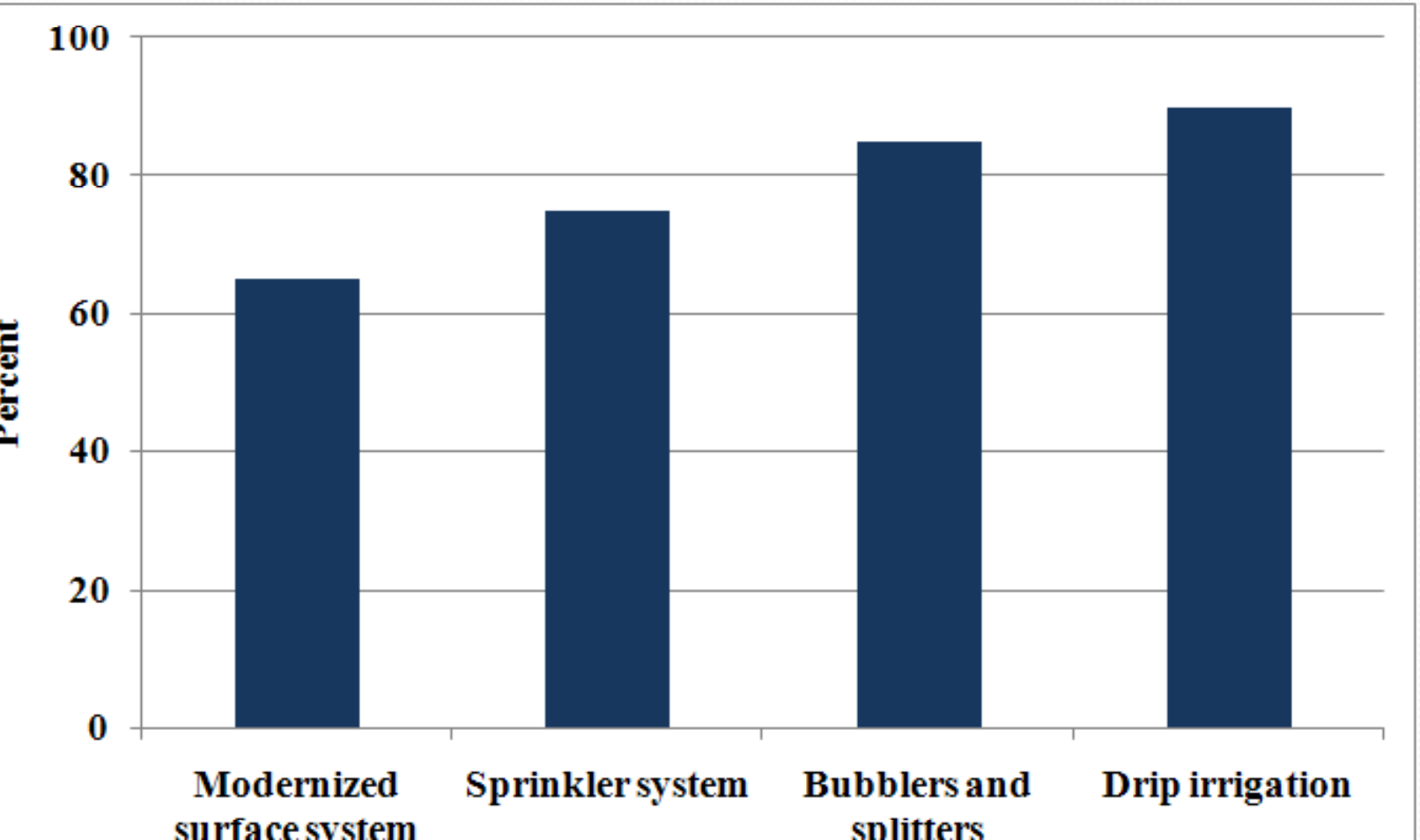
Water productivity of different crops, Cyprus



biggest potential for water productivity gains is in very w-yielding areas, which typically coincide with poverty



Potential Efficiency of Alternative Irrigation Systems

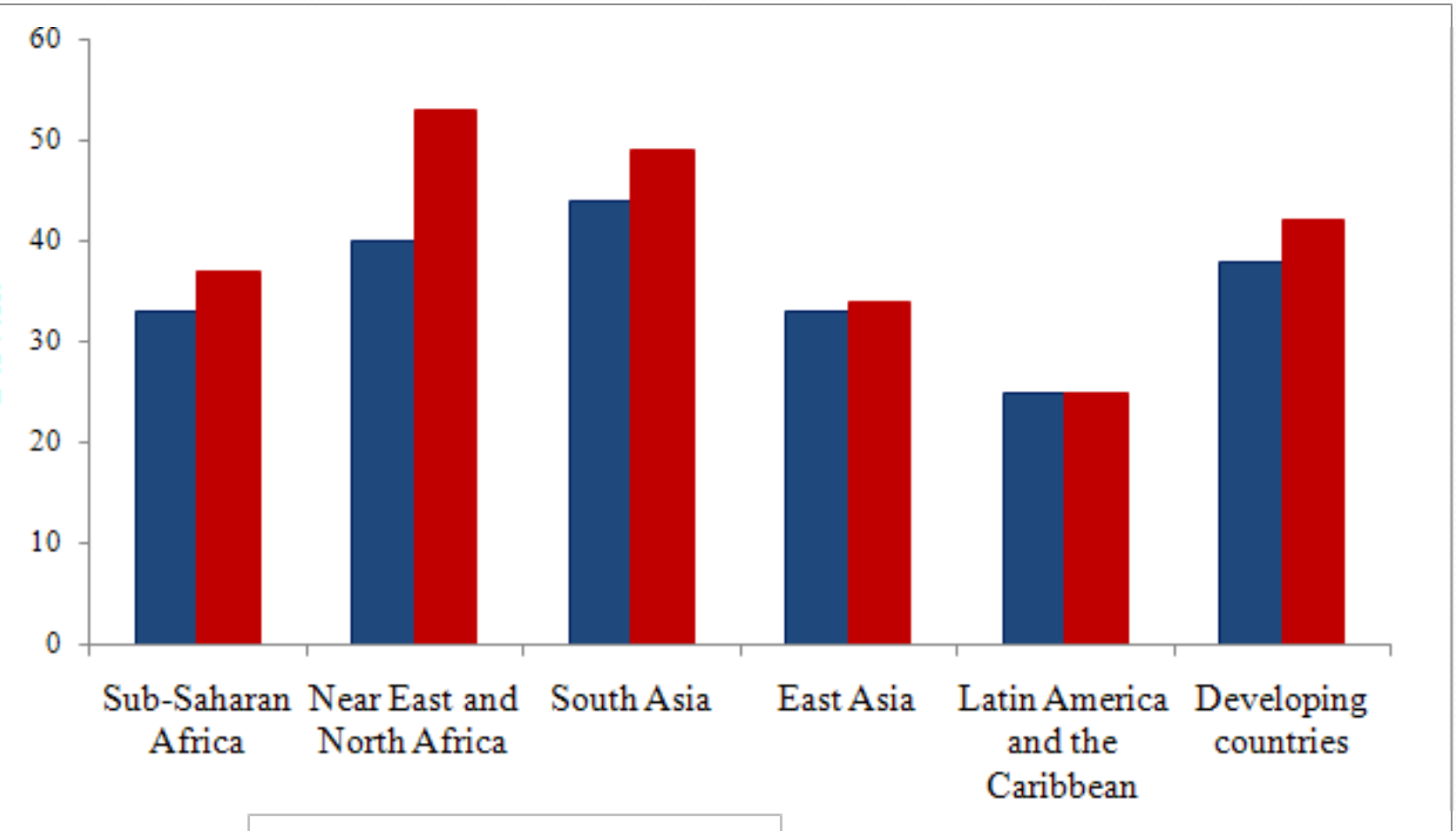


ore from Less : Water Productivity Gains from Shifting to Drip from Conventional Surface Irrigation in India

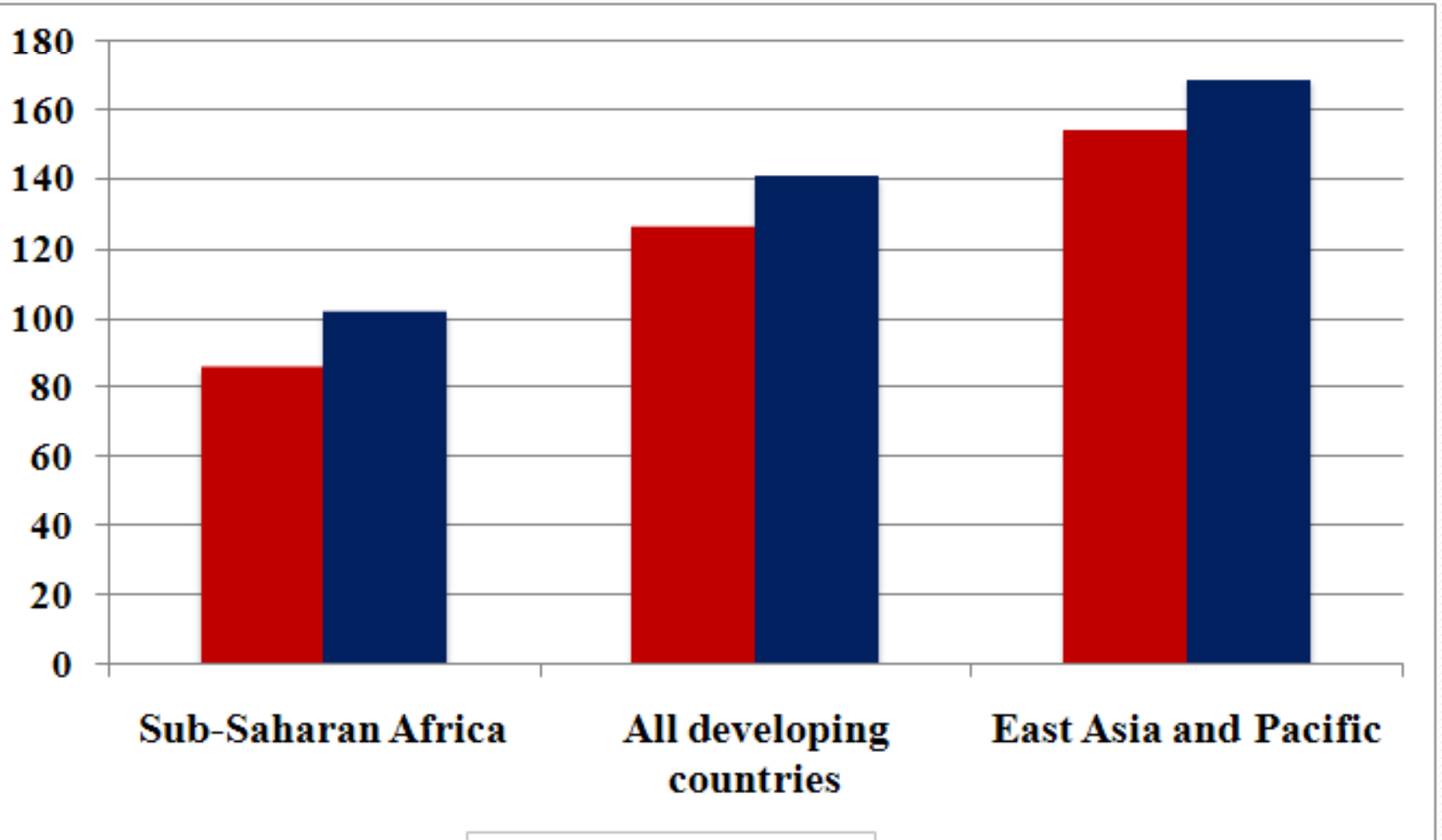
	Change in yield/ha (percent)	*Change in water use/ha (percent)*	*Change in water productivity (percent)*
as	+52	–45	+173
n	+27	–53	+169
s	+23	–48	+134
potatoes	+39	–60	+243
oes	+50	–39	+145

Postel 1999

Irrigation Efficiencies, 1997-99 and 2030



Irrigated Cropping Intensities, 1997-99 and 2030



rigation Productivity Enhancement

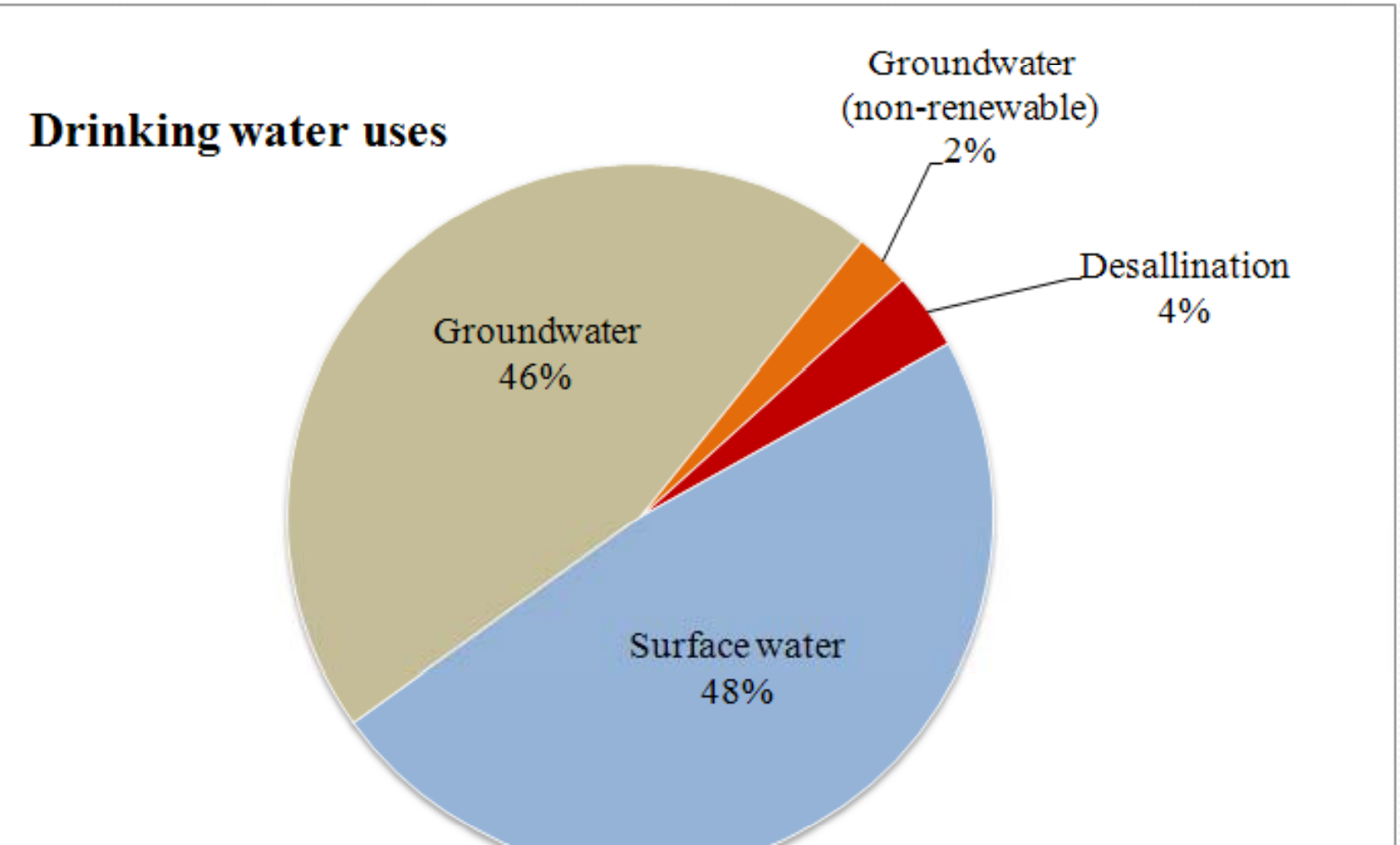
- **Physical**
  - ✓ **Irrigation system modernization**
  - ✓ **Land leveling**
  - ✓ **Canal lining**
  - ✓ **Pressurized irrigation**
- **Practical and institutional**
  - ✓ **Improved management**
  - ✓ **Farmers participation**

rigation Productivity Enhancement

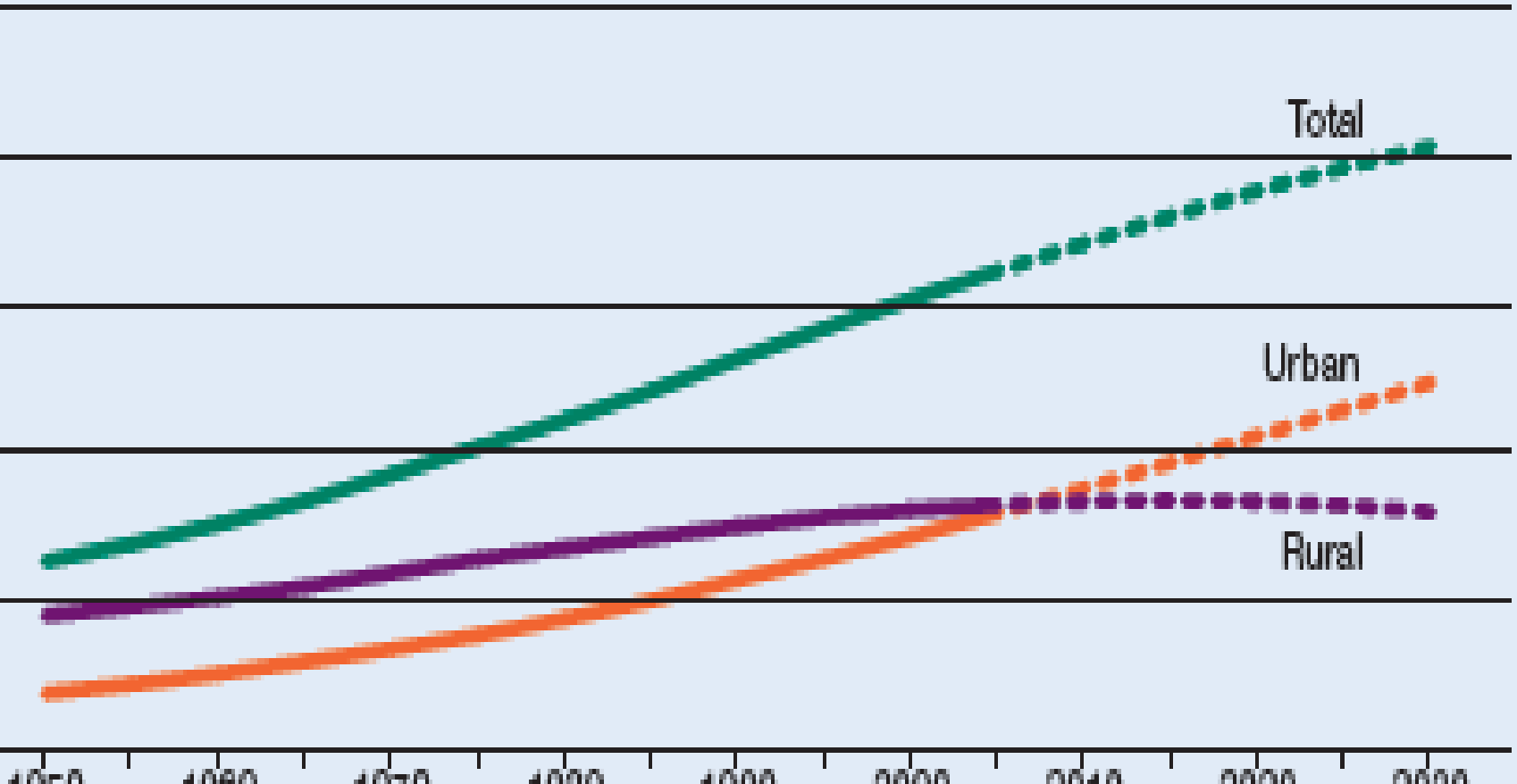
- **Demand management**
  - ✓ **Pricing**
  - ✓ **deficit irrigation**
- **Crops characteristics improvement**
  - ✓ **Salt tolerant crop**
  - ✓ **Increasing the harvest index**
  - ✓ **Bioengineering**
  - ✓ **Genetic engineering**

Urban Water Productivity

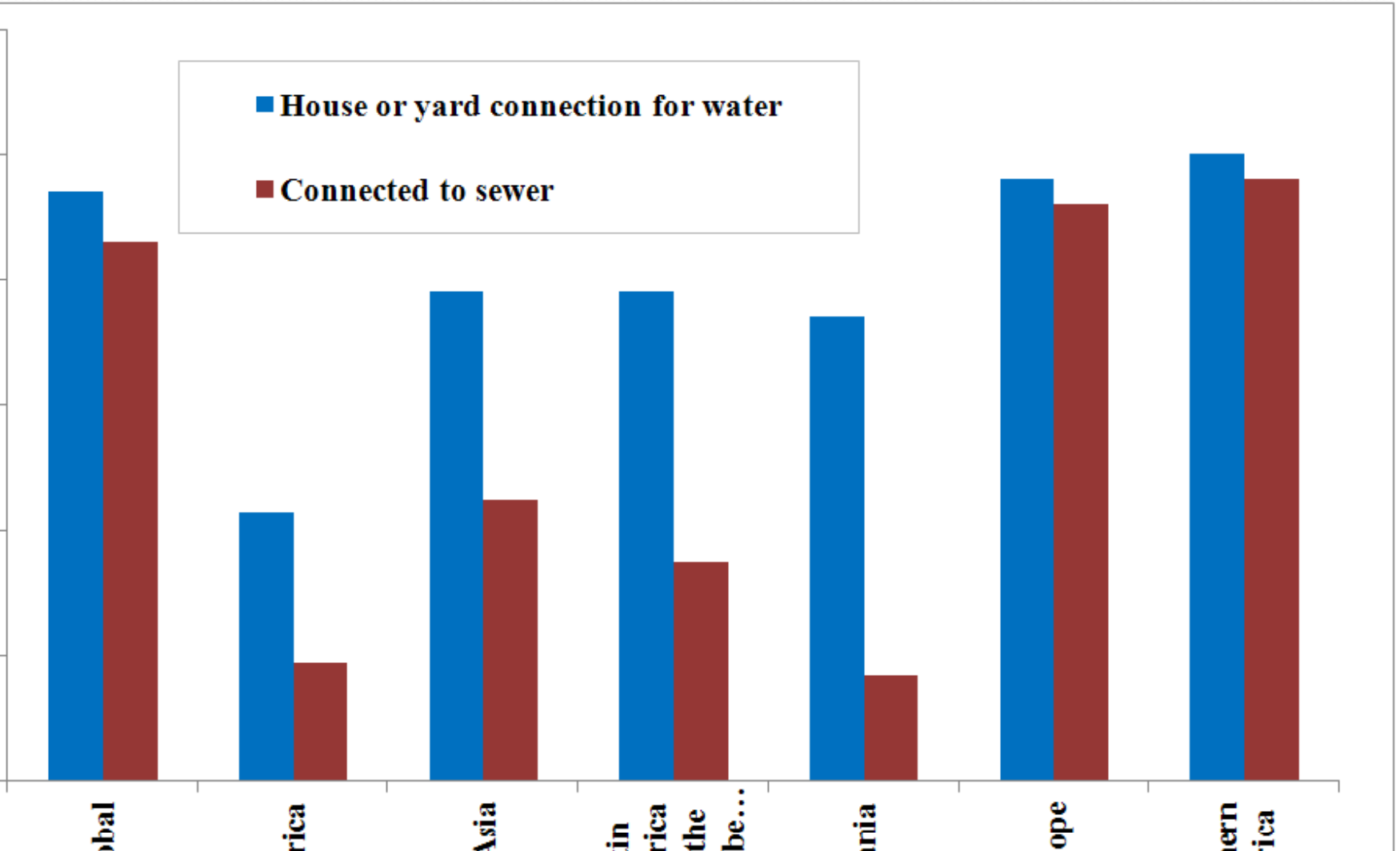
Sources of Water use Globally and for major Sectors , 2000



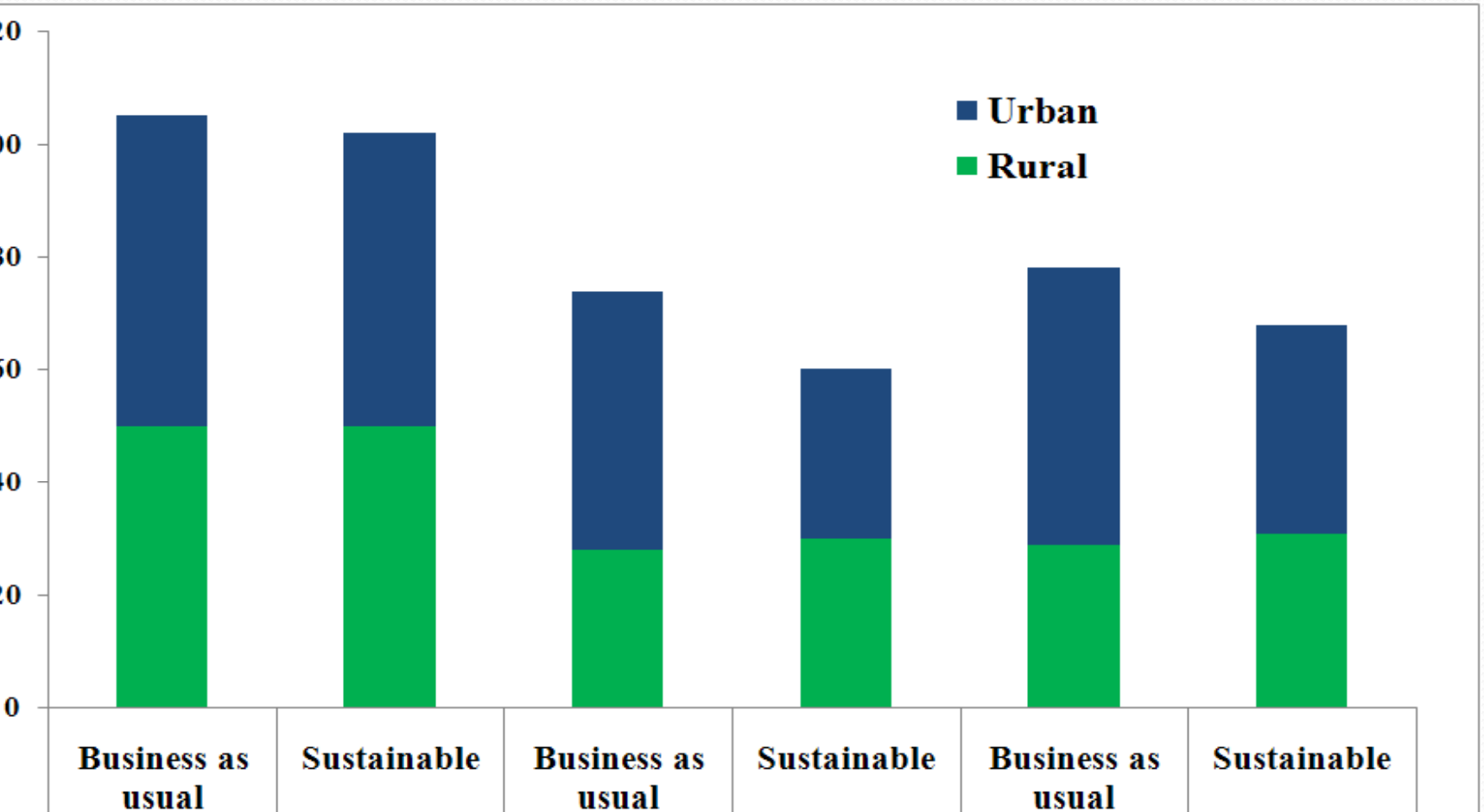
The world's Population is Shafting to the Cities



The Proportion of Households in Major Cities Connected to Piped Water and Sewers



Potential per capita Domestic Water Consumption by Connected Rural and Urban Households, Business as Usual and Sustainable Scenarios, 2025



emand Management Benefit in Urban Water Supply

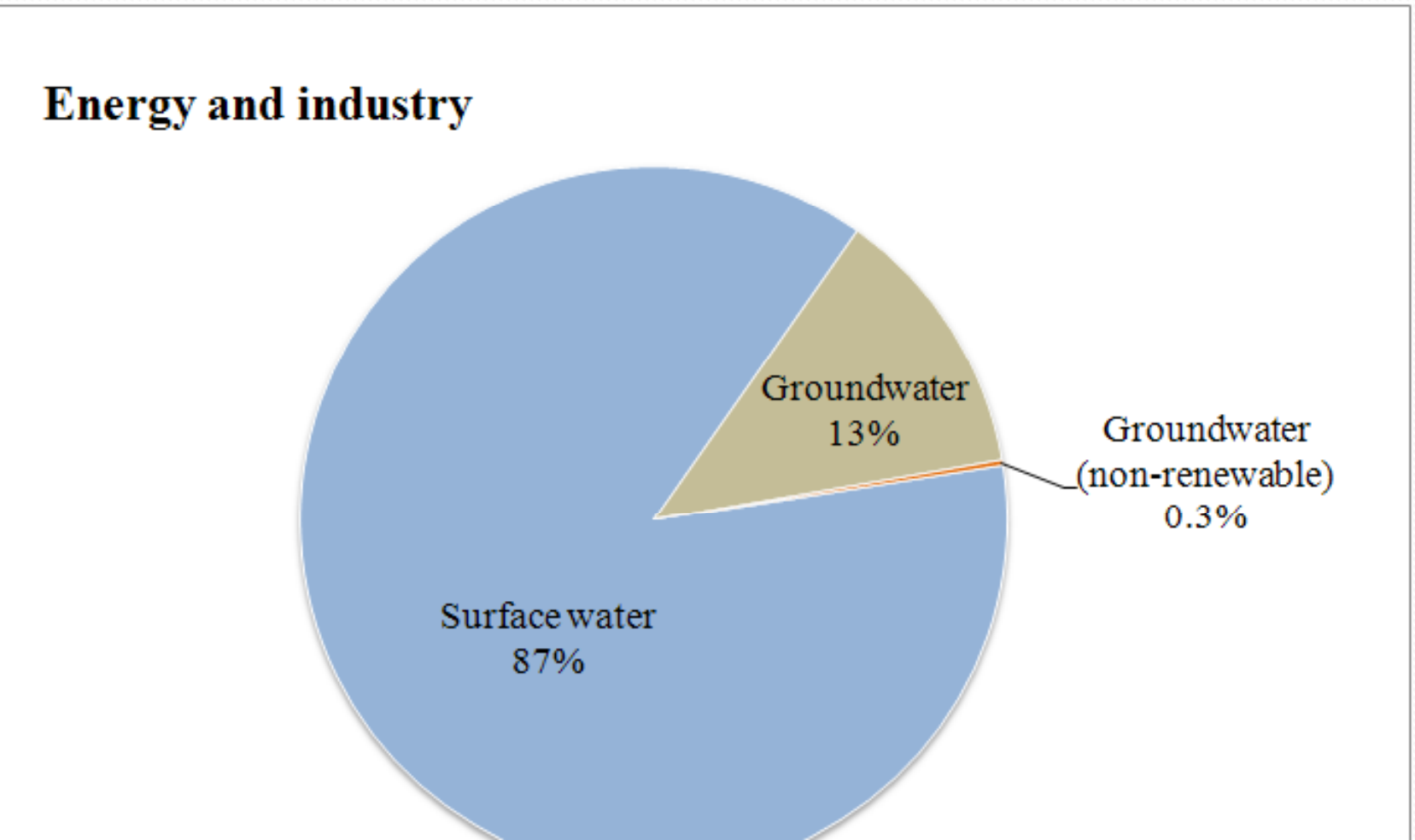
- **Reduce water consumption**
- **Most effective means of meeting demand**
- **Protection of the environment by making the best use of existing water resources**
- **The shared responsibility between the utility and its users**

emand Management Options

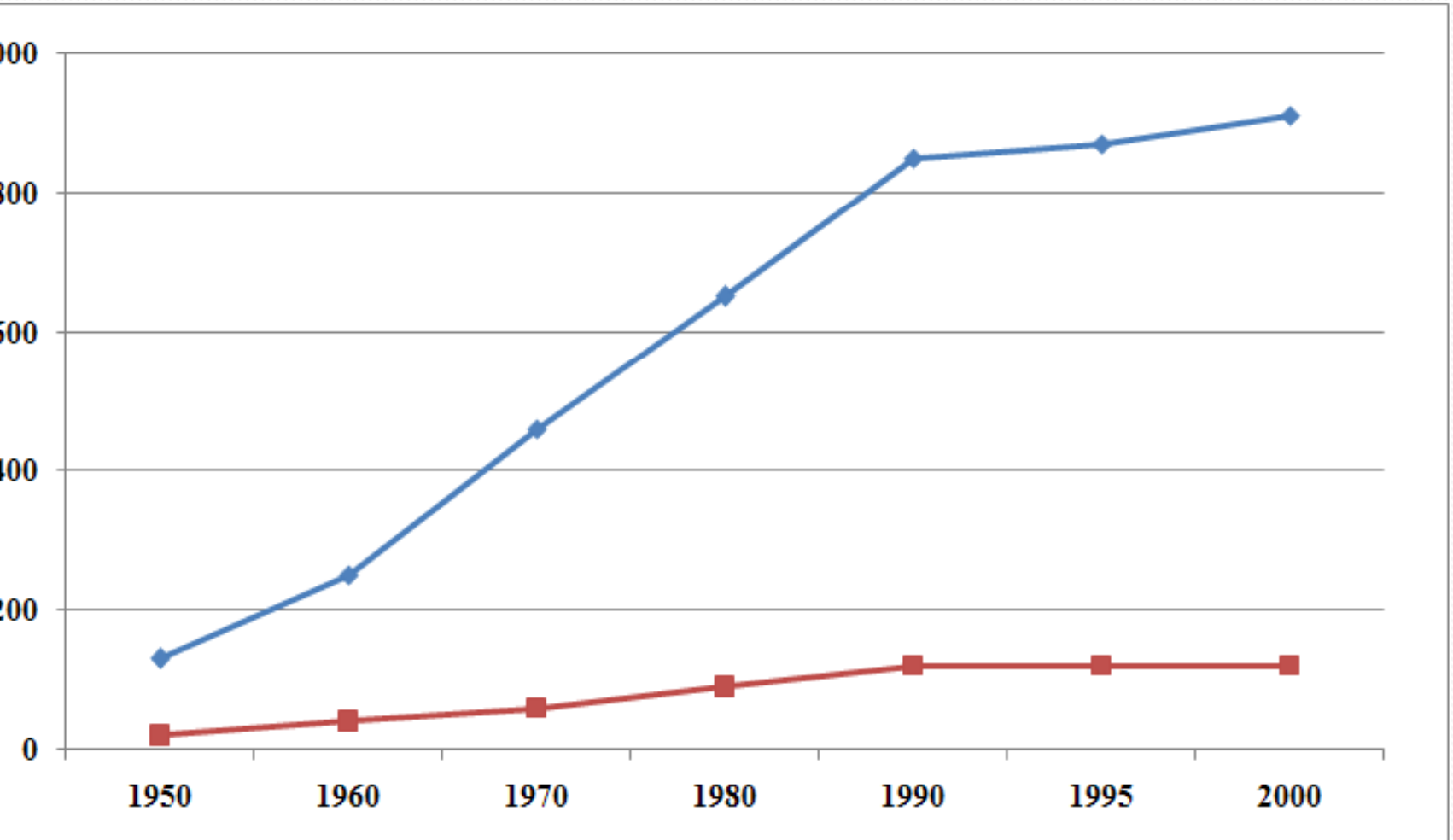
- Reducing and controlling leakage
- Encouraging industrial and commercial users for recycling
- Encouraging domestic users to reduce their usage
- Reuse of rainwater and wastewater by users
- Volumetric charging by revenue metering
- Pressure regulating in the network

Industrial Water Productivity

Sources of Water use Globally and for major Sectors , 2000



Total world industrial water use, 1950-2000



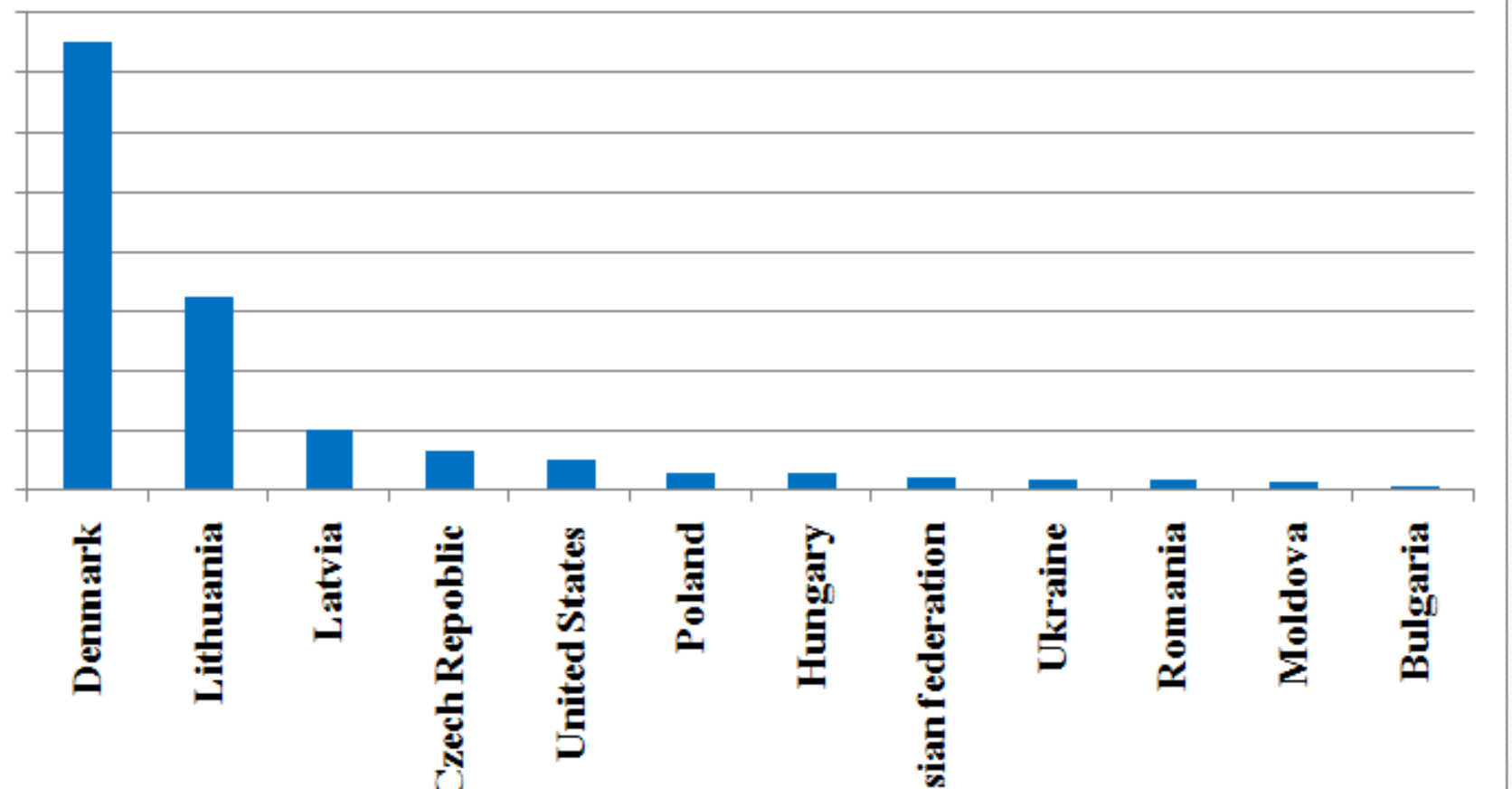
Water use per Tone of Product Produced Selected Industries

(cubic meters per tone)

Product	Water use
Paper	80-2000
Sugar	3-400
Steel	2-350
Petrol	0.1-40
Soap	1-35
Beer	8-25

Industrial water productivity varies greatly across countries

1995 US$ per cubic metre per year, latest year available



Demand Management Approaches for Industry in Water Scarced Regions

- Low water consuming industry
- Up grading the exiting industry to low water consuming technology
- High value industry out put
- Recycling wastewater and drainage reuse
- Reducing losses of energy

MANY THANKS

FOR

YOUR ATTENTION