

WATER

Water is the main condition for the existence of life on Earth

Properties

Freezing and boiling temperatures, which are far apart

Maximum density at 4 deg C, therefore, ice floats

Permits layering in ponds

High specific heat, higher than any liquid except ammonia - 5 times of solids

Serves as a ballast to prevent fast temperature changes

High heat of vaporization, among the highest.

Serves as an excellent heat sink

The best solvent

WATER

COMPOSES 75% OF YOUR BRAIN

REGULATES YOUR
BODY TEMPERATURE

HELPS CARRY
NUTRIENTS
AND OXYGEN
TO YOUR
CELLS

MOISTENS
OXYGEN
FOR BREATHING

MAKES UP 83%
OF YOUR BLOOD

HELPS CONVERT
FOOD TO
ENERGY

REMOVES
WASTE

PROTECTS AND
CUSHIONS YOUR
VITAL ORGANS

COMPOSES 22%
OF YOUR BONES

HELPS YOUR BODY
ABSORB NUTRIENTS

CUSHIONS YOUR
JOINTS

MAKES UP 75% OF
YOUR MUSCLES

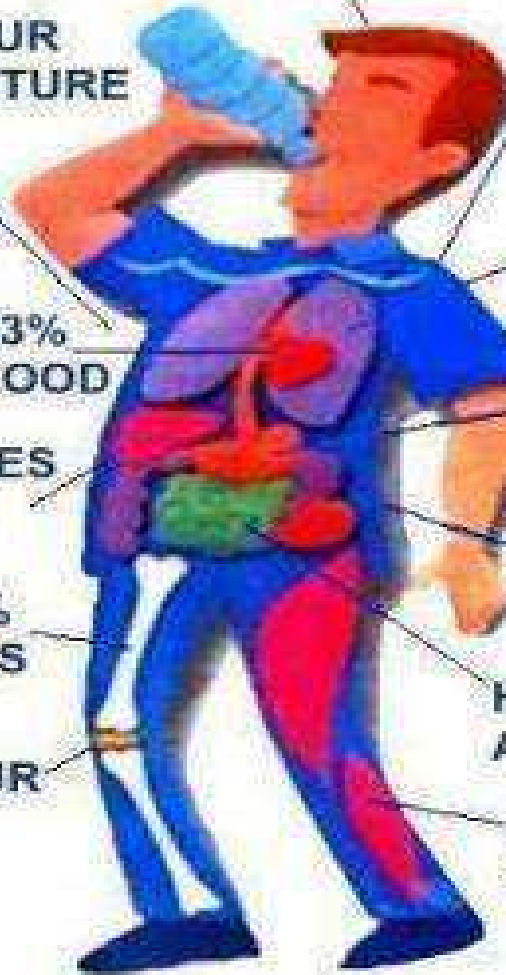


Table 1. Water content %

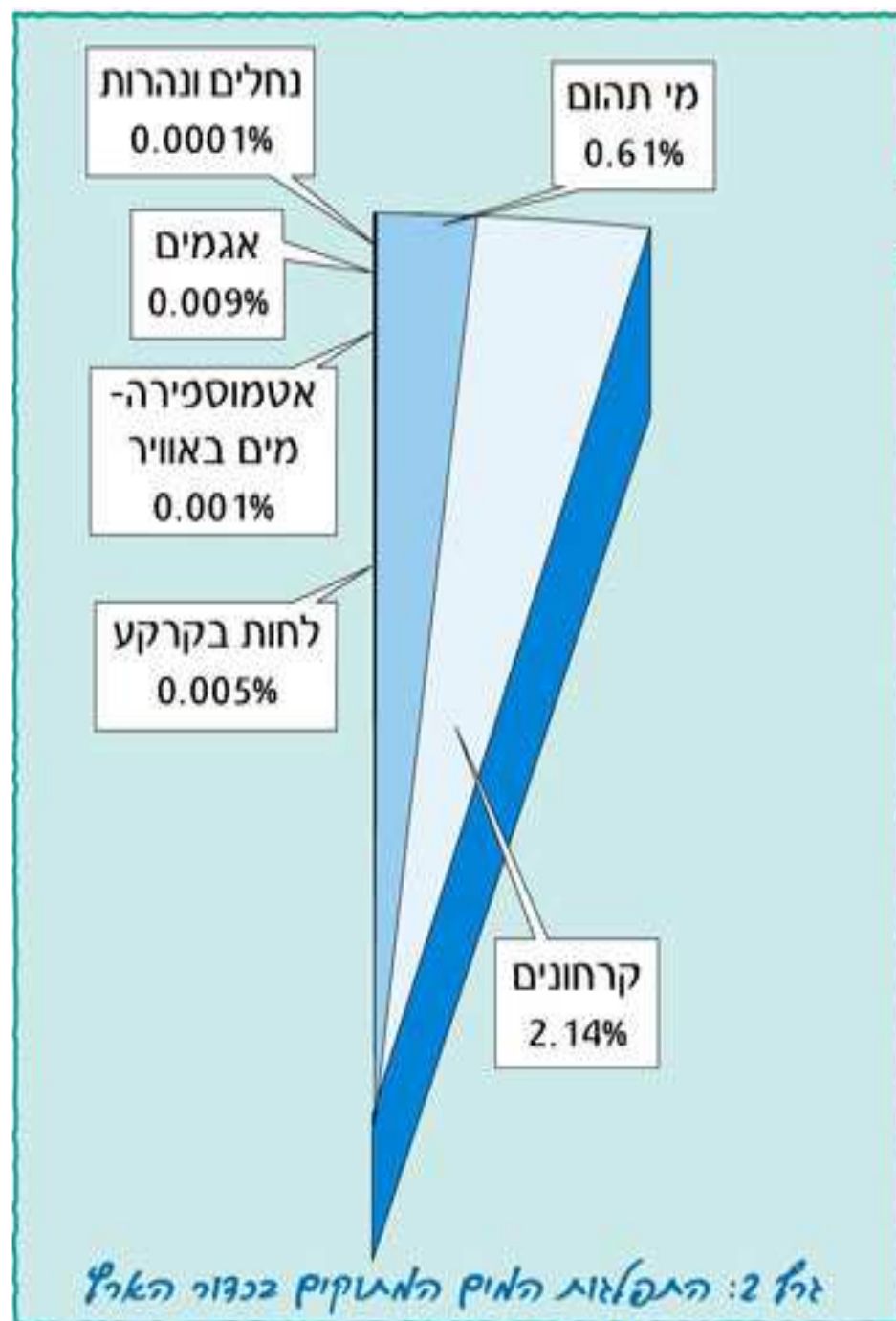
Marine invertebrates	97
Human fetus (1 month)	93
Human (adult)	70
Bacterial spores	50
Body fluids	95
Nerve tissue	84
Muscle	77
Skin	71
Connective tissue	60
Adipose tissue	30
Vegetables	89
Milk	88
Fish	82
Fruit	80
Lean meat	76
Potatoes	75
Cheese	35
Bread	30

Chun T. Ch Feb 1982

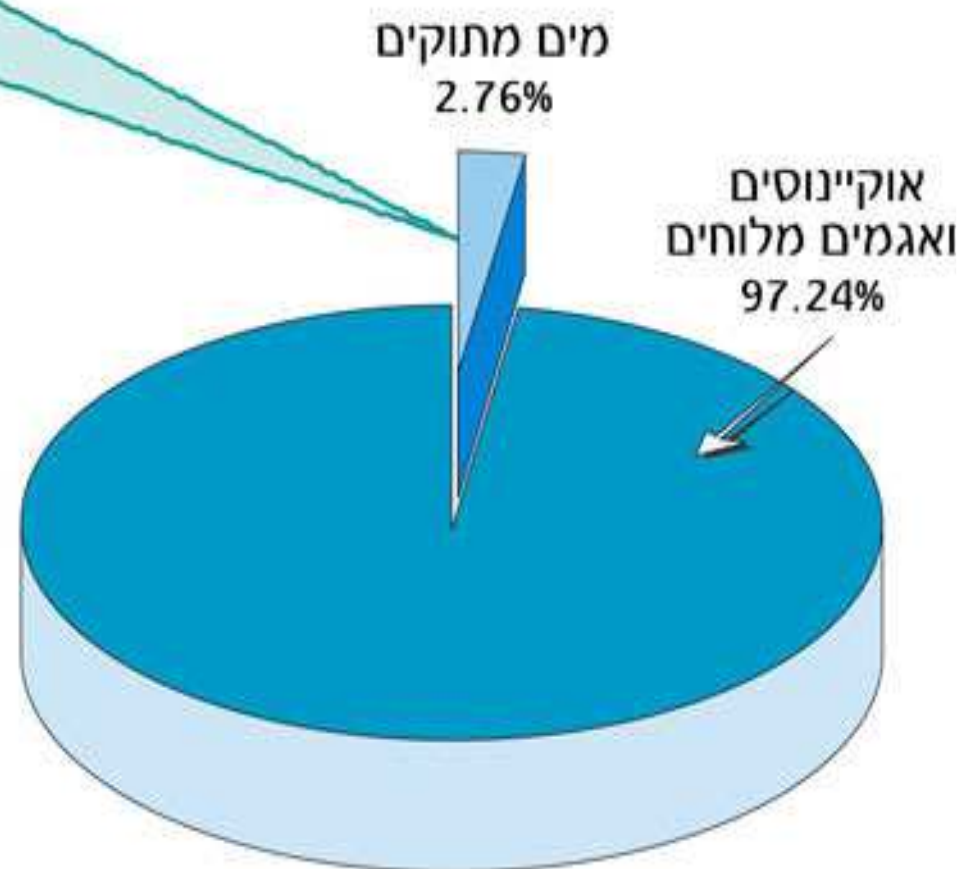
TABLE 4.1 STOCKS OF WATER ON EARTH

Location	Amount (10^{15} m ³)	Percentage of world supply
Oceans	1350	97.2
Icecaps and glaciers	29	2.09
Groundwater within 1 km	4.2	0.30
Groundwater below 1 km	4.2	0.30
Freshwater lakes	0.125	0.009
Saline lakes and inland seas	0.104	0.007
Soil water	0.067	0.005
Atmosphere	0.013	0.0009
Water in living biomass	0.003	0.0002
Average in stream channels	0.001	0.00007

Source: Harte (1985).



(על פי נתוני המכון הגיאולוגי האמריקני)



The salinity of a water source is measured in terms of the “total dissolved solids” (TDS) content, which is commonly reported in milligrams per liter (mg/l). Based on its salinity, water sources may be classified as follows:

Fresh water	less than 1,000 mg/l TDS
Slightly saline	1,000 to 3,000 mg/l TDS
Moderately saline	3,000 to 10,000 mg/l TDS
Highly saline	Over 10,000 mg/l TDS

Brackish water normally refers to water with salinities between 1,000 to 10,000 mg/l. Seawater salinity is on the order of 35,000 mg/l TDS.

In terms of salinity alone, the U.S. Environmental Protection Agency established a TDS guideline of 500mg/l for drinking water. Water desalination technologies are the means to reduce the TDS concentration to drinking water standards. Commonly, in brackish

The WHO standards for drinking water are [1]:

Substance	Desired maximum concentration in mg/l	Permitted maximum concentration in mg/l	Isotonic solution in mg/l .[2]
total dissolved solids	500	1500	9000
Mg	30	150	-
Ca	75	200	-
Chloride	20	60	3550-3800
Sulfate	200	400	-
Sodium	-	-	3050-3400
Potassium	-	-	150-210
total content in mmol/l	approx. 10	approx. 30	approx. 150

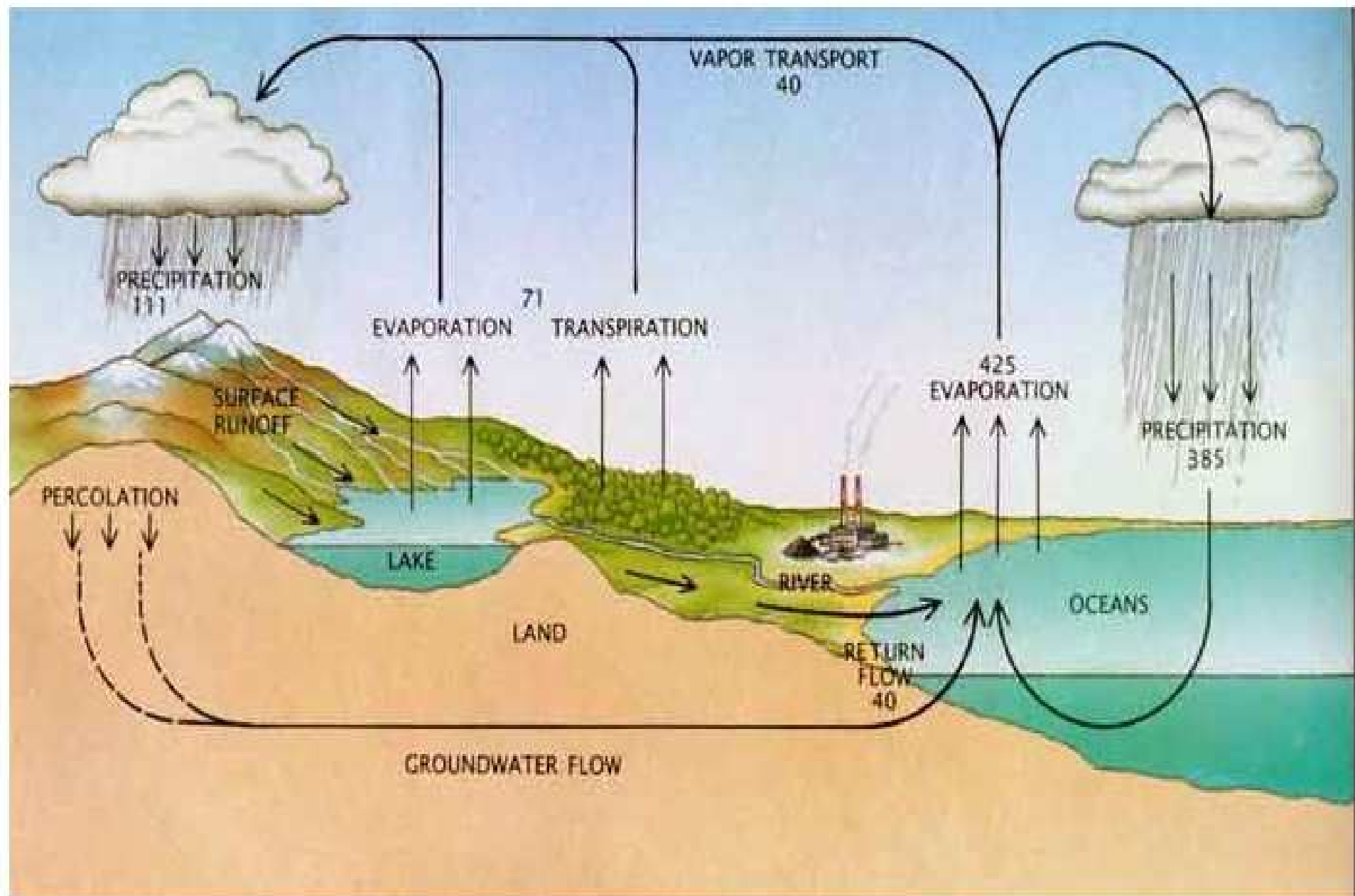
PRINCIPAL CONSTITUENTS OF SEAWATER

<u>Chemical Constituent</u>	<u>Content (parts per thousand)</u>
Calcium (Ca)	0.419
Magnesium (Mg)	1.304
Sodium (Na)	10.710
Potassium (K)	0.390
Bicarbonate (HCO_3)	0.146
Sulfate (SO_4)	2.690
Chloride (Cl)	19.350
Bromide (Br)	0.070
Total dissolved solids (salinity)	35.079

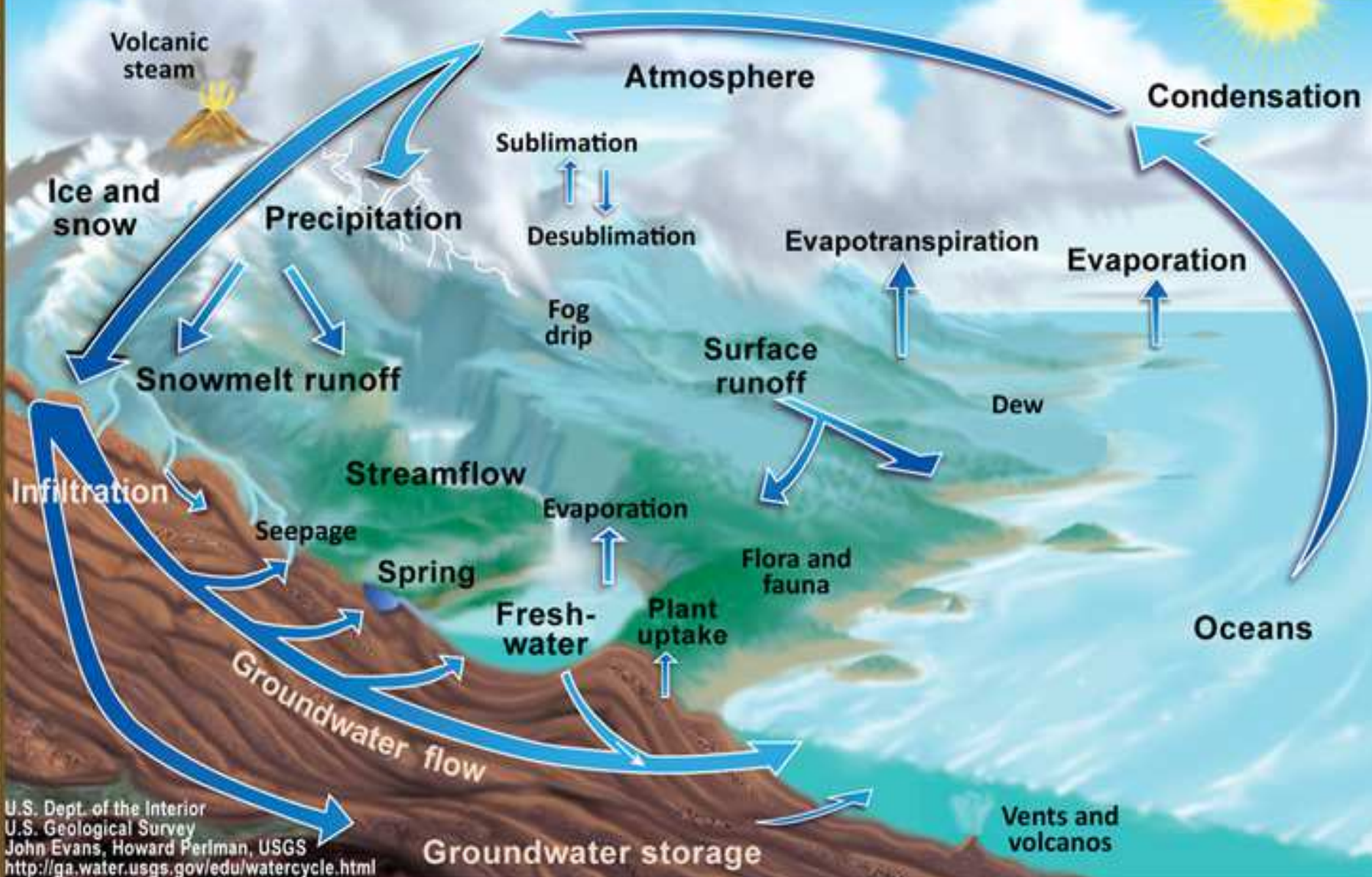
COMPARISON BETWEEN OCEAN WATER AND RIVER WATER

<u>Chemical Constituent</u>	<u>Percentage of Total Salt Content</u>	
	<u>Ocean Water</u>	<u>River Water</u>
Silica (SiO_2)	—	14.51
Iron (Fe)	—	0.74
Calcium (Ca)	1.19	16.62
Magnesium (Mg)	3.72	4.54
Sodium (Na)	30.53	6.98
Potassium (K)	1.11	2.55
Bicarbonate (HCO_3)	0.42	31.90
Sulfate (SO_4)	7.67	12.41
Chloride (Cl)	55.16	8.64
Nitrate (NO_3)	—	1.11
Bromide (Br)	0.20	—
TOTAL	100.00	100.00

א. שטפים בהידרוספירה



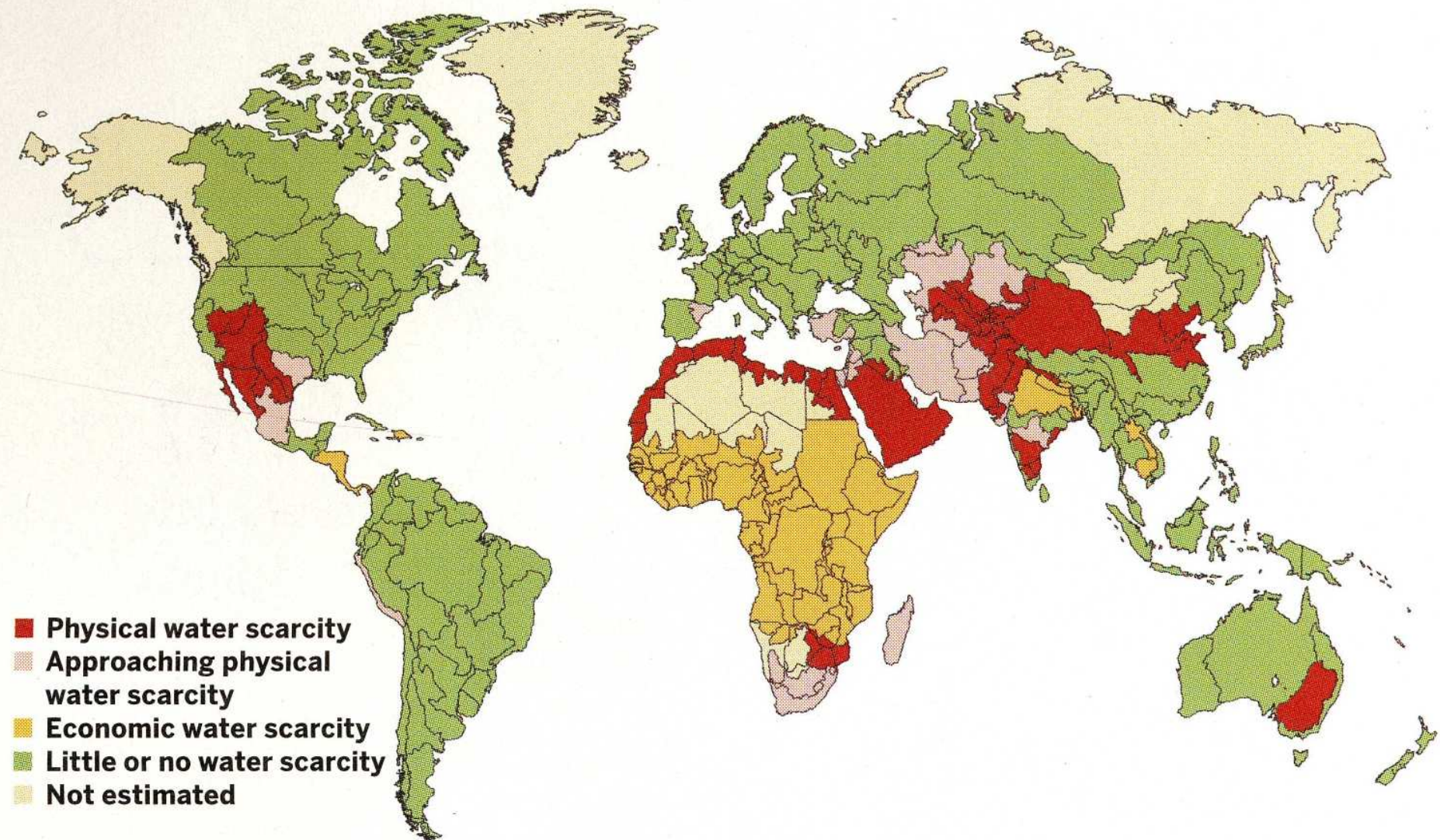
The Water Cycle



Water is not distributed evenly



WATERWORLD Areas of physical and economic water scarcity.



NOTE: When more than 75% of a region's river flows are withdrawn for agriculture, industry, and domestic purposes, it suffers from physical water scarcity. Economic water scarcity is when human, institutional, and financial capital limit access to water, even where water is available locally. **SOURCE:** Comprehensive Assessment of Water Management in Agriculture, 2007

Fresh Water Is Drying Up

Colors map the ratio of how much fresh water people withdraw to how much is available.

Ratios of 0.4 or higher reflect high water stress imposed by the local population.



Multi-year droughts in U.S. and southern Canada

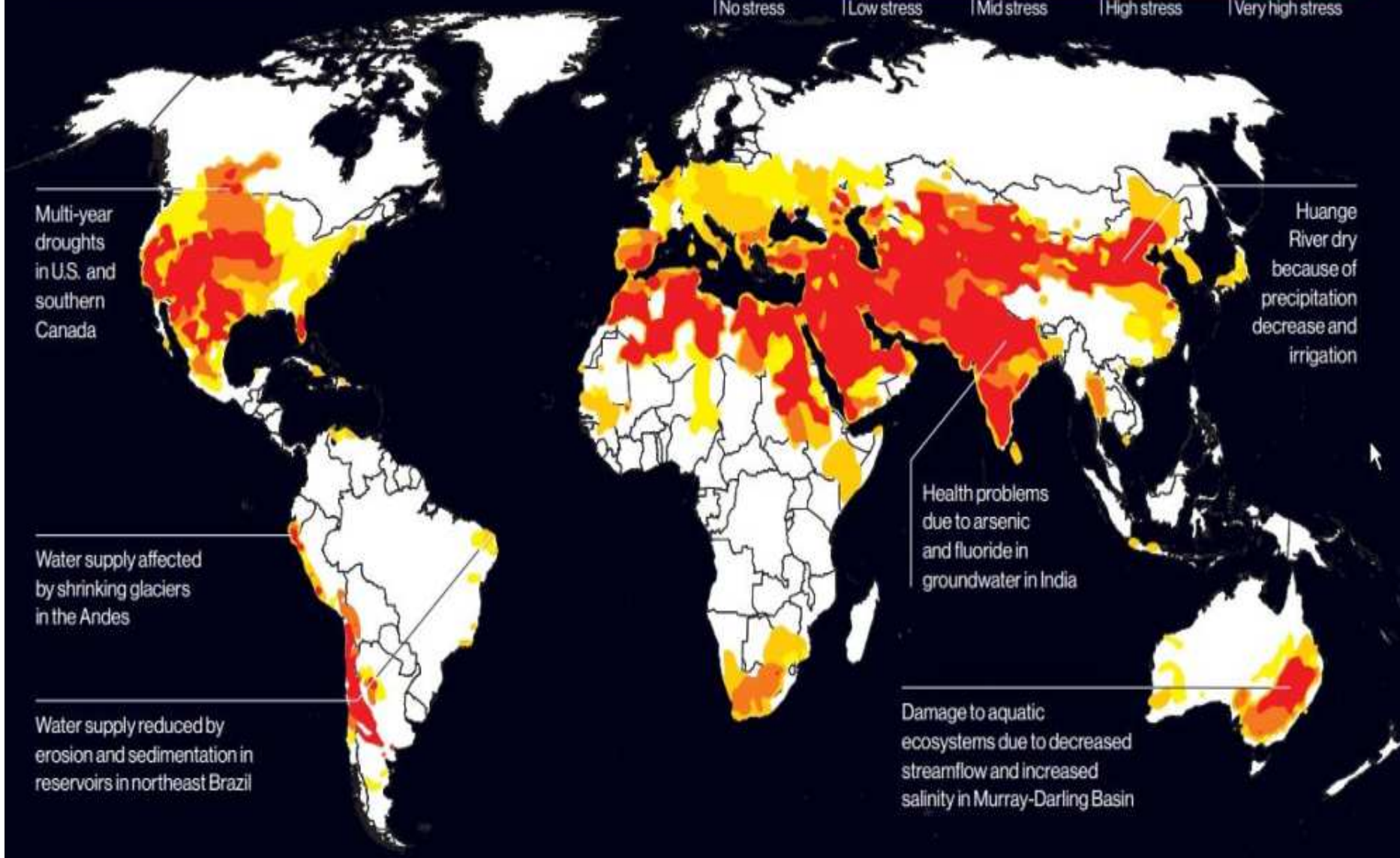
Water supply affected by shrinking glaciers in the Andes

Water supply reduced by erosion and sedimentation in reservoirs in northeast Brazil

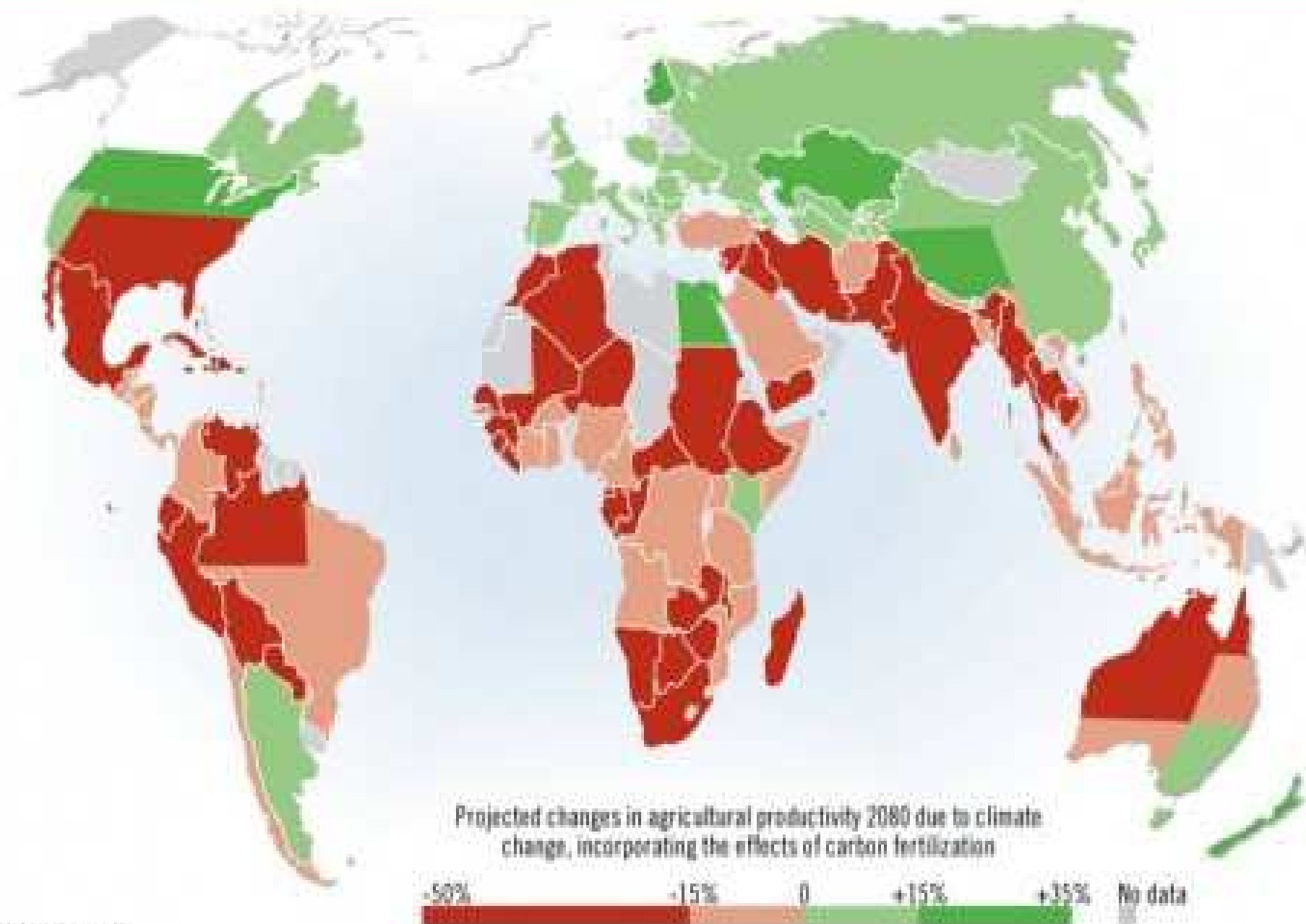
Huanghe River dry because of precipitation decrease and irrigation

Health problems due to arsenic and fluoride in groundwater in India

Damage to aquatic ecosystems due to decreased streamflow and increased salinity in Murray-Darling Basin

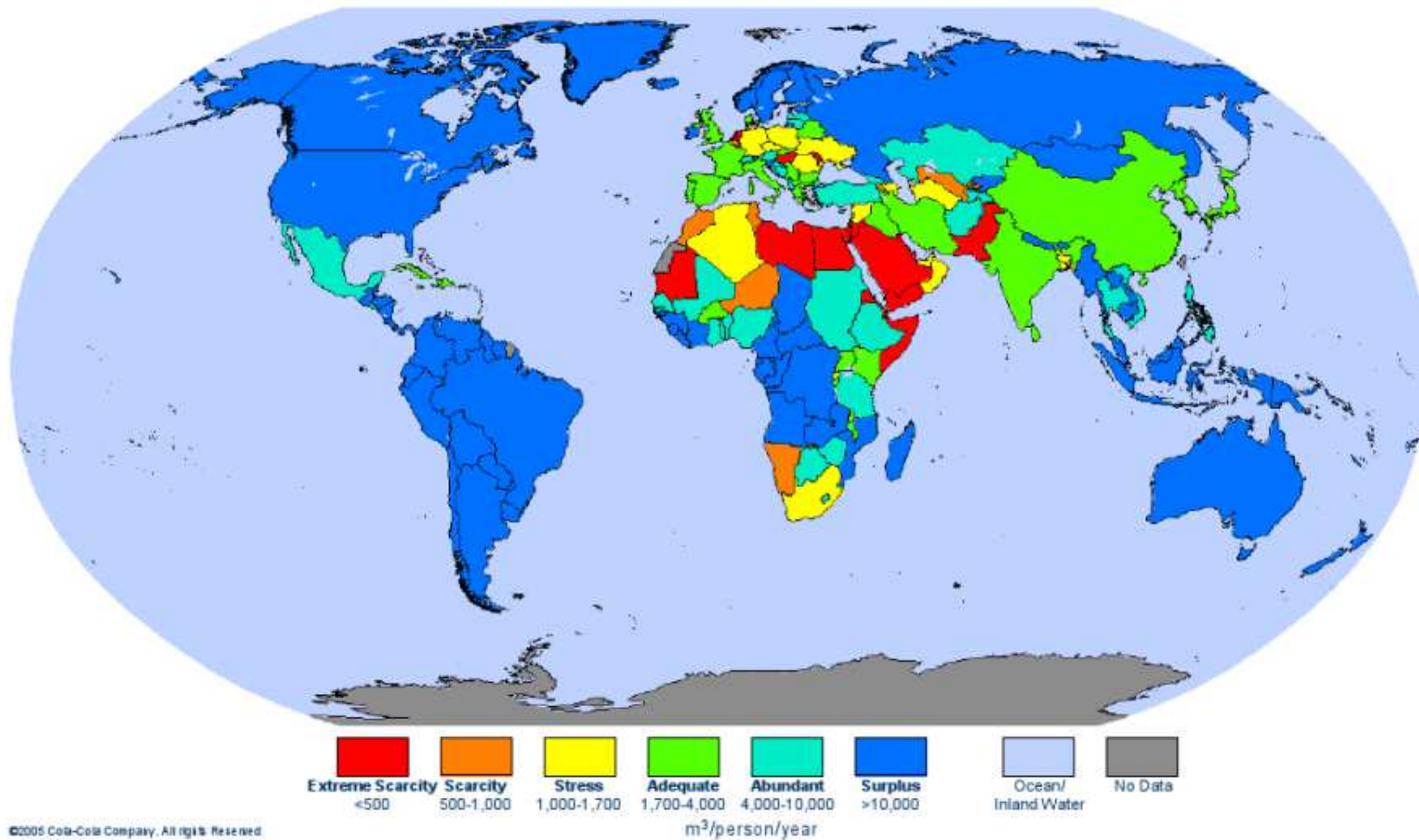


PROJECTED CHANGES IN AGRICULTURE IN 2080 DUE TO CLIMATE CHANGE

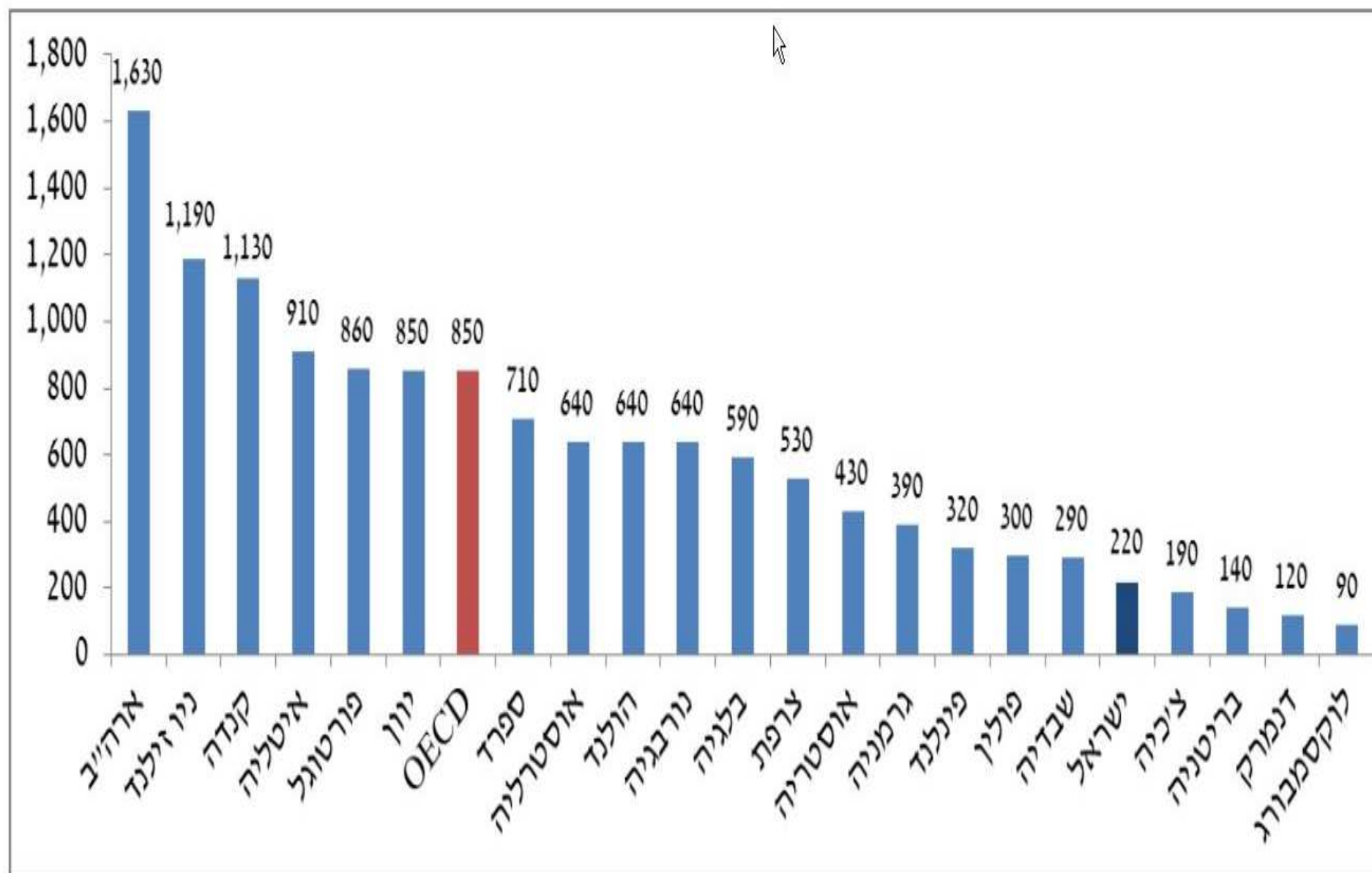


Source: Cline 2007

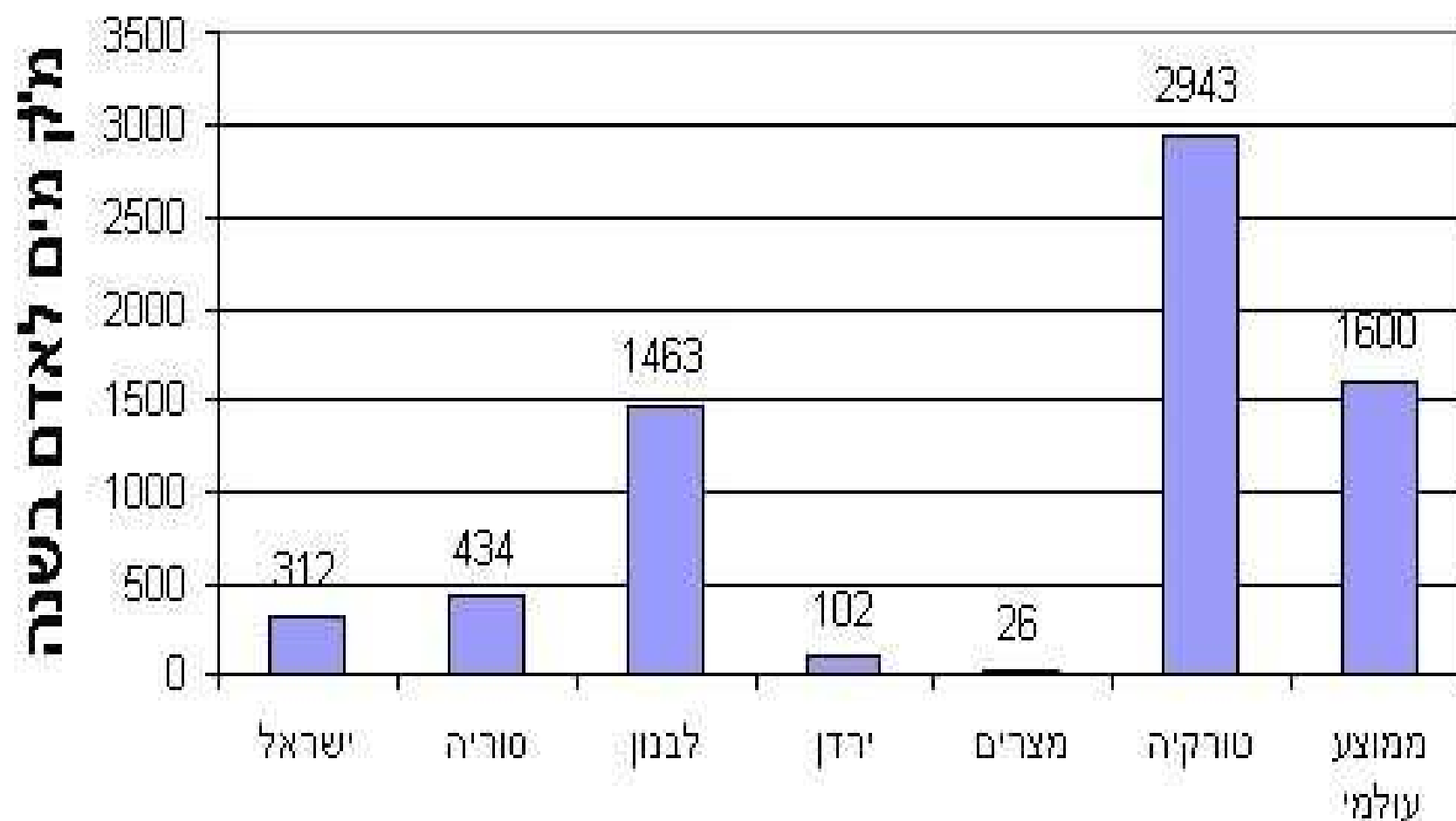
Water Availability: 2025



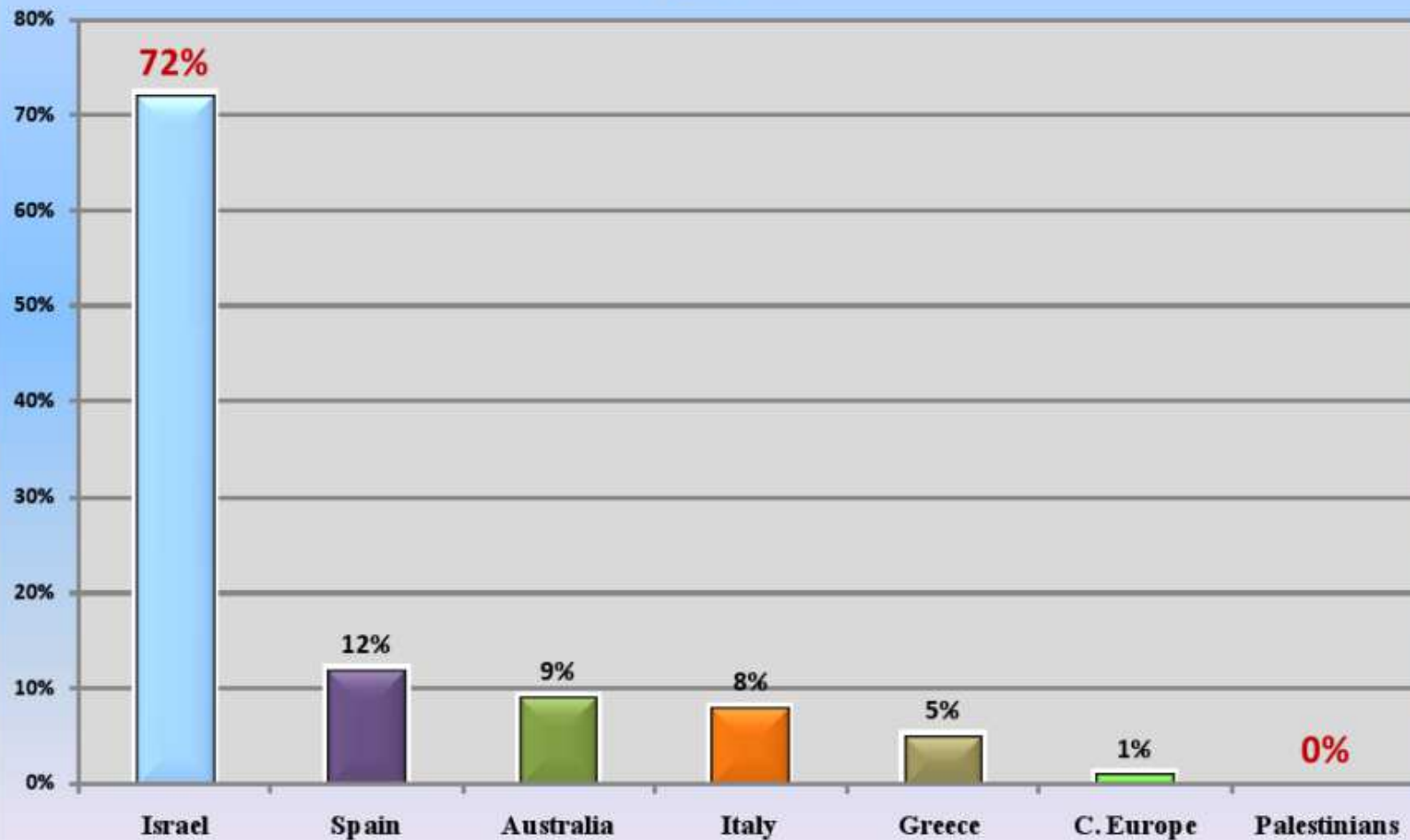
תרשים 6 – הפקת מים שפירים לנפש בשנה במדינות OECD (2010 או שנה אחרונה ידועה, במ"ק)⁵⁹



גרף 2 - כמות המים הזמינים בממוצע לאדם בשנה במדינות שונות (על
פי נתוני 2000)



International Comparison of Wastewater Reuse Policy - 2007 ☐



* In 2010 Israel's activities to alleviate the water shortage include reuse of 80% of its wastewater, whereas the Palestinians' activities remain 0.

General uses

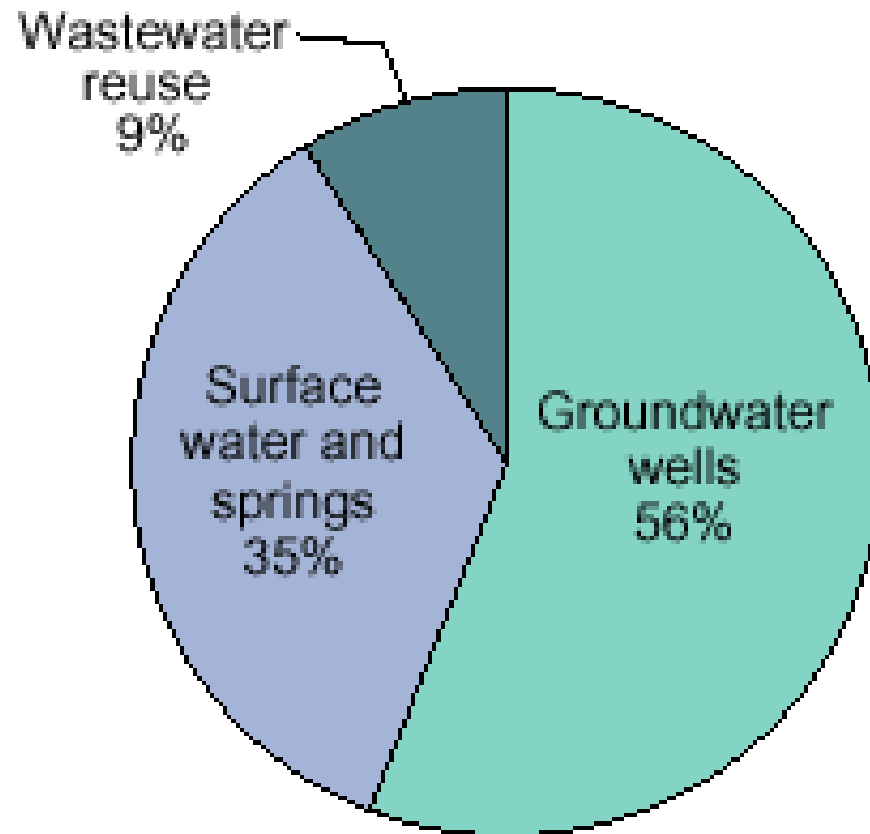
Irrigation

Urban use

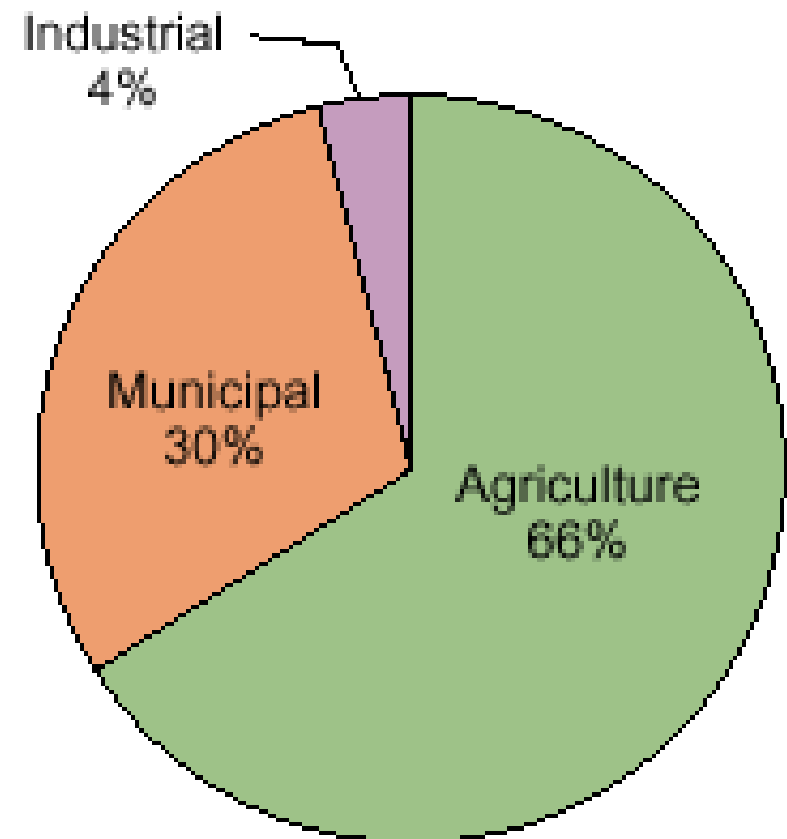
Power stations

Industry

Water use by source



Water use by category



Sources

Ground water

Rivers and lakes

Sea water

Saline water

Recovered waste water

Water for industry

Industries:

Steel

Petroleum

Paper

Power stations

Chemical

Water for industry

Uses:

Cooling

Steam

Solvent

Raw material

Transport of solids

Dilution

Water treatment

Filtration

Chemicals for preventing of corrosion
and growth of plants,.

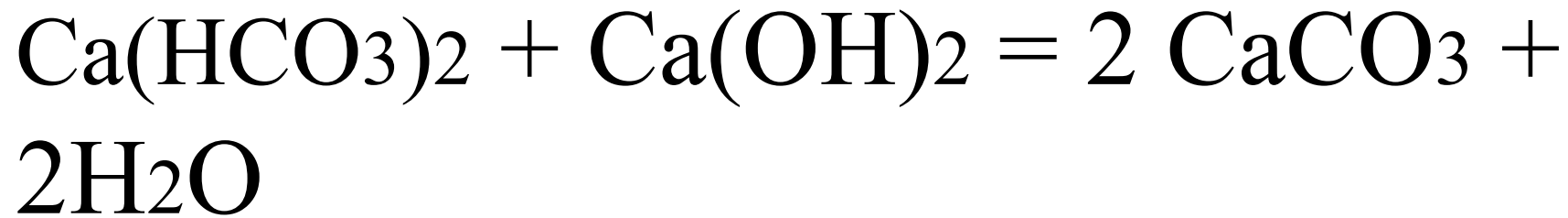
Chemicals for settling of dispersed
solid particles.

Softening

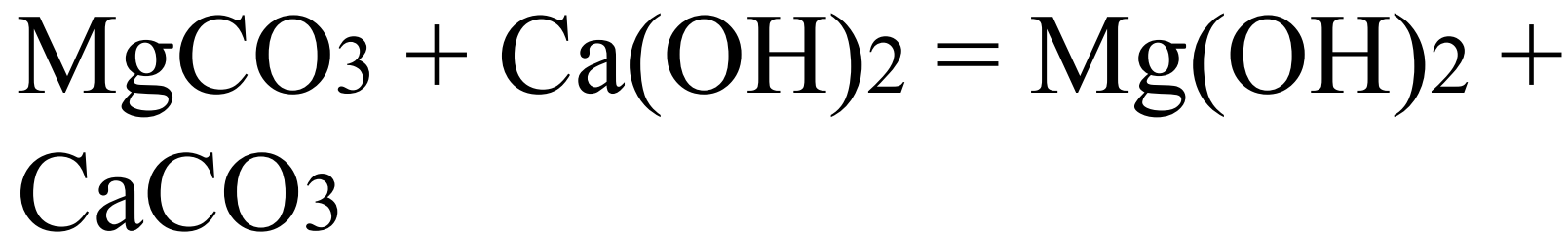
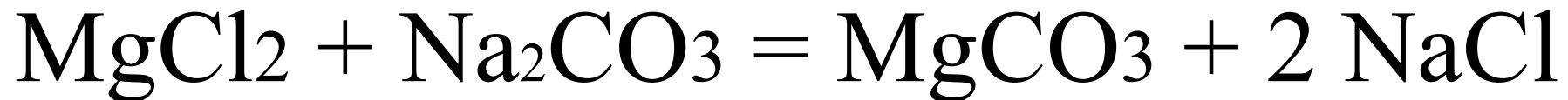
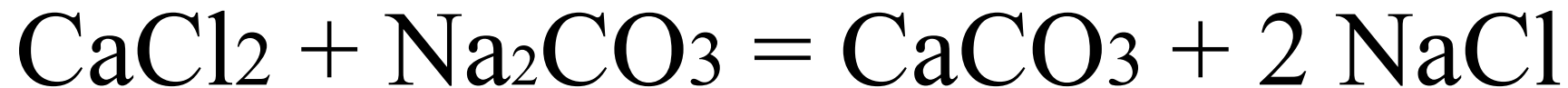
High purification

A. Initial settling of salts

Treatment with lime:



Treatment with lime and soda:



Ion exchange.

Waste water

Problems

1. Organic waste.

2. The saturation concentration of oxygen in the waste water is 8-15 mg/liter, depending on salts concentration and temperature.

The concentration required to maintain live fish is 5-8 mg/liter for very active fish like trout, down to 3 mg/liter for less active fish like carp.

The level of organic waste is measured by B.O.D.
(BIOCHEMICAL OXYGEN DEMAND) in a variety
of units:

lb oxygen per cu m or cu ft

lb oxygen per 100 lb water at 20C for 5 days

lb BOD per population units

The specification of BOD depends on its use:

Drinking water, irrigation, swimming or fish farming.

Another standard is COD (Chemical oxygen demand)

The amount of oxygen required for chemical oxidation
of the waste.

פרמטר	יחידות	תסנין אולטרפילטריציה	תסנין אוסמוזה הפוכה	
			שלב ראשון	שלב שני
pH	-	7.6 ± 0.3	5.9 ± 0.4	5.4 ± 0.7
מוליכות חשמלית	$\mu\text{S/cm}$	1534.2 ± 307.3	29.3 ± 9.7	76.2 ± 19.8
כלורידים	mg/L	328.6 ± 6.7	8.3 ± 1.2	17.5
נתרן		210.7 ± 16.2	3.0 ± 1.7	16.7 ± 5.6
סידן		83.3 ± 10.0	0.1 ± 0.2	0.1 ± 0.1
מגנזיום		29.5 ± 5.2	0.0 ± 0.2	0.1 ± 0.1
פחמן אורגני כללי		12.8 ± 5.4	0.8 ± 0.5	5.4 ± 5.3
חנקן כללי		6.3 ± 7.4	0.3 ± 0.5	0.3 ± 0.1
אלקליניות	mg/L CaCO_3	254.9 ± 23.0	7.9 ± 3.0	24.1 ± 9.2

טבלה 1. איכויות (ממוצע \pm סטיות תקן) של התסנינים השונים בפיילוט ההתפלה הטכניוני במט"ש ניר עציון לאורך תקופת העבודה