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Water Resources in the EU and in the Candidate Countries

Ulrich Wieland

The countries in Europe are spread over different bio-geographical areas with different characteristics on water issues. Northern countries like Finland, Norway and Iceland have large water resources, whereas Southern countries like Spain or Turkey tend to have shortages at least during the summer period, when the need for water is particularly high.

Differences in water use can also be found between the European Union and the Candidate countries. This is not only due to the geographical location (e.g. Turkey as a large southern country tends to distort the statistics for Candidate countries), but also due to the different historical background and economic development.

Water resources and abstractions in the EU and in Candidate countries are here described using recent statistics to produce an assessment of water resources and water stress. Besides using the Candidate countries aggregate versus the EU-15, data on Member States, Candidate and EFTA countries are included to enable comparisons. This large European area has also been divided into four bio-geographical regions - Nordic, Western, Southern and Eastern countries - to improve several aspects of the analysis.



Lowest water use intensity rates in Candidate Countries

Total fresh water resources are unevenly distributed across Europe. Table 1 shows the main components that are included in this calculation (fresh water resources = precipitation – evapotranspiration + external inflow). All variables included are average figures over 20 years or more and therefore reflect the state of the hydrological features in these countries.

Total fresh water resources amounts are higher in the EU-15 than in Candidate countries. Taking into account the respective areas, the EU-15 has 477 thousand m^3/km^2 while the CC-13 value is 375 thousand m^3/km^2 and the value for EFTA countries is 1 269 thousand m^3/km^2 .

A ratio per km² gives a more detailed picture of the repartition of the water resources. Precipitation and evapotranspiration (the water lost to the atmosphere) show some differences between the CC-13 and EU-15 groups. While precipitation in the EU-15 reaches 851 thousand m³/km² in the CC-13 the value is 651 thousand m³/km² though the fact that Bulgaria is not included in this calculation might significantly influence these results. At country level larger values of precipitation (by km²) occur in the three EFTA countries with values ranking from 1 454 to 1 936 thousand m3/km2. Among the Member States, Austria, Ireland and UK report the largest values: about 1 100 thousand m3/km2. In the CC-13 group only Slovakia shows a similar value. Evapotranspiration in the EU is 465 thousand m3/km2 while in the CC-13 it is 417 thousand m3/km2. Nevertheless, the ratio of evapotranspiration to precipitation represents only 0.54 in the EU-15 and 0.64 in the CC-13 which contributes to the difference in total amounts of fresh water resources. External inflows are higher in the CC-13 group (142 thousand m³/km²) than in the EU-15 (87 thousand m³/km²).

At country level it is clear that many countries are heavily dependent on the external contribution of water from transboundary rivers to meet their demands. For the countries included in Table 1, nine receive more than 40% of their total water resources via rivers flowing in from neighbouring countries. Countries such as Hungary and Slovakia, which are located on the lower reaches of large rivers (Danube) receive more than 80% of their water resources from other countries. For these, the usability of renewable water resources and the quality of water depend mainly on the water management system of upstream countries.

The ratio of total yearly fresh water abstraction to total fresh renewable water resources (calculated as an average over 20 years or more), provides a good indication of water quantity potential problems. The map on the first page illustrates these results.

Europe (Member States, Candidate and EFTA countries) as a whole abstracts annually a relatively small portion (10%) of its renewable water resources. With such a low rate, it seems that potentially Europe has sufficient resources to meet its demand. The situation is nevertheless quite worrying when observed at country or country grouping level. About 40% of Europe's population lives in countries which use more than 20% of their annual water resources; this indicates, according to expert opinions, water stress, particularly during drought or low river flow periods (the seasonal effect). In addition, about 77% of the population live in countries where annual water abstraction is more than 10% of the renewable freshwater resources. As shown in the map, in the Candidate countries, the water use intensity rates are lower compared to Member States. Only Cyprus and Malta have an intensity rate over 20%. The Czech Republic, Lithuania, Poland, Romania and Turkey have intensity rates above 15% while all other countries fall below 5%.

In the European Union, Belgium and Italy have the highest intensity rates. For Belgium this includes about 60% of water abstracted for electricity cooling purposes. Germany, Spain and the United Kingdom form a second group with rates of around 20%. The third group of countries is made up of Denmark, Greece, France and Portugal (with rates of circa 10%). Water use intensity in the remaining countries is 5 % or less.

Table 1: Fresh water resources (LTAA)

(mio m^3)

	Total fresh		Evapo-	Internal	External	
	water	Precipitation	transpiration	Flow	inflow	Outflow
LTAA	resources	es				
	1-2+3	1	2	1-2	3	
EU-15	1 504 493	2 683 894	1 466 503	1 234 941	272 983	:
В	16 500	27 100	14 700	12 400	4 100	8 400
DK	6 115	28 761	22 646	6 115	-	6 000
D	182 000	278 000	167 000	111 000	74 000	182 000
EL	72 000	115 000	55 000	60 000	12 000	:
Е	111 133	346 527	235 394	111 133	-	111 133
F	191 000	476 594	296 363	180 231	11 000	168 000
IRL	52 198	80 825	31 627	49 198	3 000	40 000
Ι	175 000	296 000	129 000	167 000	8 000	155 000
L	1 644	2 030	1 125	905	739	1 600
NL	89 680	29 770	21 290	8 480	81 200	86 300
А	84 000	98 000	43 000	55 000	29 000	84 000
Р	73 593	82 164	43 571	38 593	35 000	34 000
FIN	110 000	222 000	115 000	107 000	3 200	110 000
S	179 000	335 600	165 600	170 000	9 000	179 000
UK	160 630	265 523	125 187	157 886	2 744	160 630
CC-13	659 552	1 143 104	732 926	410 178	249 374	583 860
BG	:	:	:	:	:	:
CY	781	4 420	3 639	781	-	113
CZ	15 977	54 653	39 416	15 237	740	15 977
EE	21 114	30 647	18 603	12 044	9 070	11 920
HU	120 000	58 000	52 000	6 000	114 000	120 400
LV	36 192	43 443	24 999	18 444	17 748	36 192
LT	24 500	44 010	28 500	15 510	8 990	25 897
MT	67	181	114	67	-	:
PL	63 100	193 100	138 300	54 800	8 300	63 100
RO	42 293	154 000	114 585	39 415	2 878	17 930
SK	80 326	37 352	24 278	13 074	67 252	81 680
SI	20 902	22 298	14 892	7 406	13 496	32 651
TR	234 300	501 000	273 600	227 400	6 900	178 000
IS	170 000	200 000	30 000	170 000	:	170 000
NO	369 000	470 671	112 000	358 671	10 329	369 000
СН	53 250	60 100	19 950	40 150	13 100	53 500

Notes: NL, LV: excludes underground flows

FIN: includes only inflow from Russia.

D, FIN, UK: total fresh water resources are national estimates.

CH: excludes inflow from Liechtenstein (about 1%).

CC-13: excludes BG, total actual outflow excludes BG and MT.



Large differences in available resources per capita in Candidate Countries

To allow comparison between countries, the amount of fresh water resources and freshwater abstraction are reported per capita.

Table 2: Freshwater abstraction per capita

Both the EU and the Candidate countries have approximately 4 000 m³/capita of water at its disposal (based on the Long Term Annual Average), with large differences among countries: from 176 m³/capita in Malta to 21 319 m³/capita in Finland.

Malta has the lowest amount of fresh water available per capita, followed by Cyprus, Denmark, Czech Republic, Belgium, Poland and Romania which have less than 2 000 m³ of fresh water available per capita. Finland, Sweden, Estonia, Latvia, Slovak Republic, Ireland, Hungary, Slovenia and Austria register the highest values of resources per capita (over 10 000 m³/capita).

Total fresh water abstraction includes fresh water collected by water companies (public water supply) and fresh water abstracted directly by water consumers (the main consumers are agriculture, industry, and production of electricity). The total annual abstraction of water of the European Union and the Candidate countries amounts to approximately 530 m³/capita/year, ranging from 45 m³/capita/year in Malta to over 1 000 m³/capita/year in Portugal and Estonia. On average, Candidate countries abstract less fresh water per capita (452 m³/capita) compared to abstraction by Member States (580 m³/capita). This difference can be explained by the different level of economic development.

The public water supply abstracts water to supply other users (mainly domestic sector). In general, abstractions for public water supply are a small percentage of the total abstraction (less than 20% for 6 Candidate countries and 9 Member States).

In Candidate countries, it is possible that the public water supply distributes large amounts of water to other users besides the domestic sector.

Water resources LTAAYearTotal fresh water abstractionof which for : public water supply $(m^3/capita)$ (m^3/capita)(m^3/capita)%EU-154 011(m3/capita)(m3/capita)%EU-154 011(m3/capita)(m3/capita)%B1 6191998730729.81DK1 16519961839853.49D2 218199849566813.69EL6 8661997829829.91E2 797200065569714.74F3 265199955310118.25IRL14 568199432813139.97I3 040199897617618.00L3 83119991428862.07NL5 78819963008227.22A10 40219984417516.97P7 28119981 102756.82FIN21 31919994517817.35S200 200200030310434.34UK2 694200030310434.34UK2 694200030310434.34UK2 69420030310434.34UK2 69420030310434.34UK2 69420030310434.34UK2 6942						
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	NO	11 979	1999	:	173	:

Notes: average CC-13 for water resources excludes BG.

data on population refer to the year mentioned in the column 'year' of the table.

Abstraction from fresh surface water still predominant

The fresh water sources in a territory include: abstraction in natural waterbodies (fresh surface water and fresh ground water), production of fresh water (desalinated water, reuse of treated waste water) and imports of freshwater from neighbouring territories. Furthermore, non-fresh water sources (marine and brackish water) can also be used for certain purposes.

The economic situation greatly influences the type of water sources abstracted. The aggregate figures for Member States (EU-15) and Candidate countries (CC-13) are therefore relevant for this analysis.

In the EU and in Candidate countries, surface water is the predominant source of freshwater, typically accounting for 70 to 90 % of total fresh water abstraction. The predominance of surface

water can be explained by the fact that it requires less expensive technology to be extracted. Nevertheless, it requires the use of more intensive purifying treatments. On the other hand, groundwater, which is initially more expensive to abstract, has better quality and is usually preferred for domestic use.

Only 3 countries (Denmark, Malta and Iceland) extract mainly ground water, accounting for more than 95% of the total fresh water abstraction.

In Luxembourg, Portugal, Cyprus, Latvia and Slovenia, abstraction from both sources are roughly on the same level.





Notes: Members states (MS) exclude I, candidate countries (CC) exclude MT.

Common features found in Candidate countries and Member States are the following:

- The public water supply abstracts a large part of ground water (a little more than half of its abstraction).
- Manufacturing industry abstracts about 20% of groundwater.
- Production of electricity (for cooling purposes) abstracts exclusively surface water.

Regarding agriculture, surface water is the predominant source. Nevertheless Member States extract 24% of ground water while Candidate countries extract only 6%. The technical use of water by agriculture (mainly for irrigation) does not necessarily require "pure" water. Abstraction from groundwater may be considered as a waste of resources where demand can easily be supplied by surface water.

Other water sources: a sustainable alternative

Non-fresh water sources include the sea, swamps, lagoons and estuaries from which marine and brackish water (containing salts at a concentration significantly less than that of seawater) can be abstracted. These types of water sources can be used as such for cooling purposes in the manufacturing industry and in electricity production.

Desalinated water obtained after established processes by which the salt content is reduced sufficiently to make it fit for human, animal, industrial, or other specified uses is important in Spain mainly for irrigation and in Malta where it constitutes an important source for the public water supply. Due to the fact that such processes involve higher costs than the abstraction of fresh water, they have been developed only where fresh water resources are very scarce.

Reused water is water that has undergone wastewater treatment and that is delivered to a user as reclaimed wastewater. Bulgaria and Estonia are the only countries that report on the use of smaller amounts for manufacturing industry and the production of electricity.

It should be noted that these statistics are more difficult to collect and figures only exist for the countries included in Table 3.

	E	NL	FIN	S	IS	BG	CZ	EE	MT	TR
(mio m³/year)	2000	1996	2001	2000	2001	2001	2001	2000	2000	1998
Non fresh water sources	:	5353	:	9204	-	418	-	16	:	:
used for manufacturing industry	:	1568	1170	500	-	:	-	:	:	:
used for production of electricity	:	3784	4220	8704	-	418	-	:	:	2586
Desalinated water	1234	-	:	:	-	-	-	-	17	-
used by public water supply	174	-	:	:	-	-	-	-	:	-
Reused w ater	:	-	:	:	-	402	-	5	:	:
used for manufacturing industry	:	-	:	:	-	40	-	5	:	:
used for production of electricity	:	-	:	:	-	311	-	:	:	:
Imports of water	:	14	:	:	-	-	-	-	:	-

Turkey alone changes the profile

Water abstraction by the main sectors, i.e. public water supply, agriculture, industry and production of electricity, shows a largely uneven pattern (Table 4 and Figure 2). A better analysis results when countries are grouped into bio-geographical regions.

In Southern countries, the largest abstractions of water are for agricultural purposes, specifically irrigation.

Western and Eastern countries show a similar picture: the abstraction of water for production of electricity (for cooling purposes) is predominant. Excluding Turkey, Candidate countries follow the same pattern as the previous group.

In Nordic countries, the largest abstractions of fresh water are for both public water supply and manufacturing industry.

For Candidate countries, the largest abstractions of water are for agricultural purposes (as for Southern countries). This is due to the inclusion of Turkey, which abstracts a huge amount of water for irrigation.



Notes: Candidate and Southern countries exclude MT.





Box 1: A decrease of fresh water abstraction

2) BG, CZ, EE, LV, HU, PL, RO, SK, SI

These graphs present the amount of water abstracted per capita by public water supply, agriculture and manufacturing industry.

Although limited by the number of countries for which time series are available, the trends over the last five years show a decrease in total freshwater abstraction for all the sectors both in the EU and in Candidate countries.

Efforts have been made to encourage a more sustainable use of abstraction of groundwater in Candidate countries, which is currently abstracted predominantly for public water supply.

In Member States, the year 1997 seems to show a turning point: after an increase of abstraction of ground water by agriculture in the early 90s (see Statistics in Focus 06/2001, Water resources, abstraction and use in European countries), a significant decrease occurred though the per capita levels of consumption are still quite high.



(mio m ³)

Total gross abstraction		Public water supply		Agric	Agriculture		Manufacturing industry		Production of electricity		
	Year	Groundw ater	Surfacew ater	Groundw ater	Surfacew ater	Groundw ater	Surfacew ater	Groundw ater	Surfacew ater	Groundw ater	Surfacew ater
В	1998	641	6 802	472	258	14	4	100	1 303	3	4 242
DK	2000	:	17	417	:	190	:	99	:	:	:
D	1998	6 710	33 880	4 103	1 455	120	43	888	4 934	40	26 332
EL	1997	:	:	445	417	3 100	4 500	:	:	18	106
Е	2000	2 105	23 948	928	2 911	965	20 373	183	560	:	:
F	1999	6 149	26 174	3 631	2 267	891	2 290	1 552	2 164	45	19 453
IRL	1994	225	951	118	352	45	134	62	188	:	277
I I		:	:	:	:	:	:	:	:	:	:
L	1999	32	29	23	14	0	-	3	11	-	-
NL	1996	1 153	3 502	814	453	155	75	183	557	1	2 410
А	1997	1 065	2 496	599	6	100	:	363	923	3	1 568
Р	1998	6 290	4 800	471	401	4 193	2 358	179	206	:	:
FIN	1999	285	2 043	239	165	10	40	6	1 563	-	274
S	2000	635	2 053	452	471	70	80	11	1 395	1	96
UK	2000	2 351	13 543	1 776	4 212	209	1 671	313	1 307	10	2 616
BG	2001	525	5 308	380	696	10	855	105	195	8	3 506
CY	2000	87	88	3	36	83	39	1	3	:	:
CZ	2001	529	1 310	382	395	5	7	30	319	1	501
EE	2000	255	1 216	27	44	4	33	9	18	0	1 116
HU	2000	871	4 720	687	60	49	453	76	152	11	4 017
LV	2001	116	141	17	0	4	43	15	28	:	:
LT	2001	157	2 611	127	:	5	48	7	50	:	2 486
MT	2001	17	-	17	:	:	:	:	:	:	:
PL	2001	2 700	8 899	1 422	796	:	1 033	182	464	18	6 570
RO	2001	990	6 353	762	1 700	33	985	162	754	7	2 911
SK	2001	423	716	331	64	14	56	46	596	:	:
SI	2000	136	168	114	106	:	:	23	62	:	:
TR	2001	6 000	33 780	:	:	3 400	27 600	:	:	:	:
IS	2001	152	4	71	3	69	1	10	:	-	-
СН	2000	886	:	886	175	:	:	:	:	:	1 503
NO	1999	:	:	96	672	:	:	:	:	:	:

Notes: D, EL, E, P, TR: Agriculture refers only to irrigation

IS: public water supply includes the domestic use of geothermal water

Major pressures in the most sensitive areas

As a conclusion the profile of the four bio-geographical areas is delineated as a snapshot of water resources and water use. It illustrates that critical limits can be roughly quantified and sustainable options in relation to demographic and economic development must be sought.

Comparing bio-geographical regions shows that the major pressures on water are found in Southern countries (which includes 8 countries and 30% of the population) while the lowest pressures remain in the Nordic countries (4 countries and 3% of the population). Except Nordic countries, all the regions have approximately the same amount of water resources per capita, the highest water use intensity rates are found in regions where agriculture represents the major water abstractor.

In a next *Statistic in Focus* issue on Water Statistics, statistical data on water use and waste water generation and treatment in the European Union and in Candidate countries will be presented to complement this analysis.

Table 5: Profile of biogeographical regions

		Nordic	Southern	Western	Eastern	Candidate	E11.15
		countries	countries	countries	countries	countries	20-13
Water use intensity	%	1.01	20.70	9.48	9.45	11.89	14.21
Fresh water resources	m ³ /capita/year	27 320	3 638	4 604	3 940	3 988	4011
Freshwater abstraction	m ³ /capita/year	276	753	436	372	452	570
Main uaa	0/	Manufacturing industry (39%)	Agriculture	Production of	Production of	Agriculture	Agriculture (33%)
	%	Public water supply (30%)	(67%)	electricity (54%)	electricity (56%)	(45%)	Production of electricity (32%)

Notes: Nordic countries: abstraction by capita excludes Norway

Southern countries: type of use excludes Italy

Candidat countries: resources by capita excludes Bulgaria



> ESSENTIAL INFORMATION - METHODOLOGICAL NOTES

The data used in this Statistics in Focus is from the Joint OECD/Eurostat Questionnaire 2002, Section on Inland Waters. For all the data (except data on water resources) of this publication, UK refers to England and Wales.

When interpreting these data, it should be borne in mind that definitions and estimations methods employed by countries may vary considerably.

The definitions of the parameters used in this Statistics in focus are given below:

Precipitation is the total volume of atmospheric wet precipitation (rain, snow, hail,...).

Evapotranspiration (Actual evapotranspiration) is the total volume of evaporation from the ground, wetlands and natural water bodies and transpiration of plants. According to the definition of this concept in hydrology, the evapotranspiration generated by all human interventions is excluded, except unirrigated agriculture and forestry. The 'actual evapotranspiration' is calculated using different types of mathematical models, ranging from very simple algorithms (Budyko, Turn Pyke, etc) to schemes that represent the hydrological cycle in detail.

Internal flow is the total volume of river run-off and groundwater generated, in natural conditions, exclusively by precipitation into a territory. It is equal to precipitation less actual evapotranspiration.

External inflow (Actual external inflow) is the total volume of actual flow of rivers and groundwater, coming from neighbouring territories.

Outflow (Total actual outflow) is the actual outflow of rivers and groundwater into the sea plus actual outflow into neighbouring territories.

Fresh water resources is the quantity of water available for abstraction each year as a result of the movement of water in the hydrological cycle during the year. It is calculated as the net result of precipitation minus actual evapotranspiration plus actual external inflow.

LTAA (Long Term Annual Average) represents the average over a long period, normally 20 consecutive years or more and illustrates the estimated resources of water within each country.

Fresh surface water is the water which flows over, or rests on the surface of a land mass, natural watercourses such as rivers, streams, brooks, lakes, etc., as well as artificial watercourses such as irrigation, industrial and navigation canals, drainage systems and artificial reservoirs. Bank filtration is also included under (fresh) surface water.

Fresh ground water is the water which is being held in an underground formation. It includes all permanent and temporary deposits of water, both artificially charged and naturally, in the subsoil, of sufficient quality for at least seasonal use. This category includes phreatic water-bearing strata, as well as deep strata under pressure or not, contained in porous or fracture soils. Ground water includes springs, both concentrated and diffused, which may be subaqueous.

Non-fresh water sources includes sea water and transitional water, such as brackish swamps, lagoons and estuarine areas.

Desalinated water is water obtained from desalinated processes.

Reused water is the waste water that has undergone wastewater treatment to be delivered to a user. This means the direct supply of treated effluent to the user. Recycling within industrial sites is excluded.

Imports of water is traded bulk water from another territory (bottled water is not included).

Water abstraction is the water removed from any source, either permanently or temporarily. Mine water and drainage water are included. Water abstractions from groundwater resources in any given time period are defined as the difference between the total amount of water withdrawn from aquifers and the total amount charged artificially or injected into aquifers. The amounts of water artificially charged or injected are attributed to abstractions from that water resource from which they were originally withdrawn.

Public water supply (PWS) refers to water supplied by economic units engaged in collection, purification and distribution of water (including desalting of sea water to produce water as the principal product of interest, and excluding system operation for agricultural purposes and treatment of waste water solely in order to prevent pollution). It corresponds to division 41 (NACE/ISIC). Deliveries of water from one public supply undertaking to another are excluded.

Agriculture corresponds to NACE divisions 01 to 05.

Manufacturing industry corresponds to NACE divisions 15 to 37.

Electricity corresponds to NACE divisions 40.1

For the purpose of this publication, some groupings have been made as follows:

Member States: Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden and the United Kingdom.

Candidate Countries: Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Malta, Poland, Romania, the Slovak Republic, Slovenia, Latvia, Lithuania and Turkey.

EFTA (European Free Trade Association) countries: Iceland, Switzerland and Norway.

Nordic countries: Finland, Sweden, Iceland and Norway.

Southern countries: Cyprus, Greece, Italy, Malta, Portugal, Spain, Slovenia and Turkey.

Western countries: Belgium, Germany, Denmark, France, Ireland, Luxembourg, Austria, the Netherlands, Switzerland, and the United Kingdom.

Eastern countries: Bulgaria, the Czech Republic, Estonia, Hungary, Poland, Romania, the Slovak Republic, Latvia and Lithuania.



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