Recent Trends in Water Abstraction and Usage in the Former Soviet Union and Eastern Europe

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Abstract
Water abstraction and usage statistics were conscientiously reported to Soviet Union's central authorities, and this practice has continued in post-Soviet times in the newly independent states. These statistics show that water usage and abstraction have declined in many former Warsaw bloc nations and in all except five of the former Soviet republics. Total water abstraction has decreased in the Soviet Union from 334 km³ in 1988 to some 278 km³ by 1996. This is believed to be due to declining industrial and public water consumption caused by economic slowdown and, to some extent, by campaigns to increase efficiency of water usage. Of the five states not exhibiting this trend, four are semi-arid, highly agriculturalised nations (Turkmenistan, Azerbaijan, Tajikistan and Kyrgyzstan), where consumption of water by grossly inefficient irrigation systems is seen as a national priority to maintain crop production. In the fifth nation, Lithuania, the bulk of water abstracted is accounted for by the Ignalina nuclear power station.

Introduction
Water, in the former Soviet Union, was regarded as being so fundamental to our daily existence that authorities, mindful of public opinion, accorded it, at least in theory, great importance. In fact, water quality was arguably one of the most important issues: in 1988, expenditure on water use and protection accounted for 60 percent of the total sum allocated to environmental security in the Soviet Union (GOSKOMSTAT, 1989).

Visitors to the former Soviet Union will have been impressed by the capital expenditure allocated to harnessing hydroelectric power and to the use of water as a resource. For example, in the not atypical Siberian city of Tomsk, a 50-60 km line of around 200 wells along the banks of the Rivers Tom' and Ob' supplies the city with drinking water (Lgotin & Makushin, 1998). An entirely separate distribution system supplies hot water to the city's residents, partially (30–40% – Economist, 2000) heated by the nuclear reactors of the nearby atomic research centre of Seversk. Nevertheless, despite these engineering feats, maintenance of this infrastructure has proved a mammoth task and the system is prone to leaks and failures. For long periods during recent summers, residents of Tomsk have been deprived of hot water during repair works. On occasions, even drinking water supplies fail and those living in tower blocks must carry water up in buckets from standpipes in the street. Apart from the obvious inconvenience to citizens, it must be suspected that the poor state of repair of the distribution network leads to large water losses and inefficient use of water. In addition, the centralised distribution of hot water, so common in many large Soviet cities, not only renders the population vulnerable to failure of central heating, but also leads to high water usage as consumers draw off large quantities of water to get the tap to "run hot".

This paper examines trends in water consumption in the newly independent states (NIS) of Eastern Europe and the former Soviet Union. It attempts to ascertain how the efficiency of water consumption compares with that in "the West", and how the situation has changed since the fission of the Soviet Union.

Trends in Water Abstraction and Usage

The sources of the data presented in this paper are statistical reports provided by industries and manufacturers that consume or supply water to other consumers. In the communist states within the Soviet sphere[1], the form of the reports by which these organisations supplied data to state authorities on their water abstractions, use and discharges was rather uniform. The so-called "*2-TP-vodkhoz*" forms provided by enterprises were in turn summarised by regional authorities and then passed on to state water authorities who prepared national statistics. Fortunately, many of NIS inherited this mechanism for collating statistics, a fact that still allows comparison of statistics from the NIS nations with a high degree of confidence. The downside of the current situation is the ubiquitous bureaucratic chaos caused by social upheaval and, due to which, some NIS states do not report statistics or only incompletely report them.

Finally, it is worth noting the existence of two subtly different water consumption statistics for surface and ground water. It is common to find figures both for *total water abstraction and for total water usage* in the statistical reports. The main difference between these measures is that due to losses in transportation (e.g. leakage in distribution systems). It is not uncommon for commentators on

[1] *i.e. the COMECON nations (Council for Mutual Economic Aid - an organization established to facilitate and coordinate the economic and other development of the eastern European countries belonging to the Soviet bloc)*

water issues to confuse these, and mistakenly report water usage as water abstraction (Moldova SoE, 1999; FAO, 1999). These figures do not include recycled water or water taken for hydroelectric power, fisheries, navigation or large canals. An overview of these statistics for various former communist states is provided in Table 1.

A straightforward comparison of water abstractions in the pre- and post-Soviet periods reveals that most NIS nations abstracted less water in the 1990s than the 1980s. To this observation, there are five exceptions (highlighted in Table 1): Turkmenistan, Azerbaijan, Tajikistan, Kyrgyzstan and Lithuania. We will return to these exceptions later, but let us first examine those nations exhibiting declines. In 1988, the total amount of water abstracted in the former Soviet Union was 334 km^3. Peterson (1993) considered this figure as essentially comparable with the abstraction figure for the USA of 551 km^3. By 1996, the sum for fifteen ex-Soviet republics was 278 km^3 (of which 92 km^3 was abstracted in the Russian Federation), although this figure is based on usage rather than abstraction for a few republics where abstraction figures are not available. This is only 83 % of the 1988 abstraction. Continuous decreases in water abstraction from the end of the 1980s have been reported for Belarus and the Ukraine. In Kazakhstan, the water abstraction declined from 39 km^3 in 1988 to 25 km^3 in 1996 (Figure 1).

TABLE 1. Water abstraction/usage by year in the NIS republics in the pre- and post-Soviet periods. Source: calculated from SoE (1999), GOSKOMSTAT (1989), Gosudarstvennii Doklad (1998), FAO (1999) GEO2000 (2000). NA = not available. Note: by 1999, the abstraction/usage figures for Russia were 77.9/67.7* km^3 (Gosudarstvennii Doklad, 2001).*

	Republic	**Water abstraction, 1980s (km^3)**				**Water abstraction/usage in the 1990s (km^3)**	
		1985	1986	1987	1988		Year of reference
1	Russia	106.5	113.0	112.1	105.8	87.3/66.2* (Gosudarstvennii Doklad)	1998
2	Uzbekistan	70.6	63.3	73.3	73.9	NA/62-65* (SoE)	1993
3	Ukraine	30.7	34.5	32.5	30.6	19.0/13.0* (SoE)	1998
4	Kazakhstan	39.0	35.3	37.4	39.4	25.3/20.5* (SoE)	1996
5	Turkmenistan	24.2	17.2	21.5	22.5	NA/25.0* (SoE)	1997
6	Azerbaijan	15.2	15.3	15.0	14.9	16.0 /11-13* (SoE)	1996
7	Tajikistan	12.9	13.4	12.9	12.8	NA/13.1*(SoE)	1995
8	Kyrgyzstan	9.3	11.8	12.3	12.1	NA/12.7*(SoE)	1995
9	Lithuania	2.8	3.1	3.2	3.6	4.4/NA* (FAO)	1995
10	Georgia	4.6	4.6	4.4	3.8	3.3 /2.9*(SoE)	1991
11	Moldova	3.7	4.1	3.9	3.7	NA/1.8* (GEO2000)	1996
12	Belarus	2.8	2.9	2.8	2.8	1.907/1.716* (SoE)	1998
13	Armenia	4.1	3.9	4.1	4.2	NA/1.5* (SoE)	1995
14	Estonia	2.6	3.3	3.3	3.0	1.358/NA* (FAO)	1995
15	Latvia	0.665	0.690	0.682	0.671	0.403/NA* (SoE)	1996
	Total	**330**	**326**	**339**	**334**	**278.0**	

The same trend can be revealed for other East European nations. The Czech Republic "State of the Environment" (SoE, 1997, 1999) report concludes that a decrease in water abstraction / usage was evident for all categories of consumers during the 1990s. For example, the water usage for public supply was 1.021 million m^3 in 1994 and 0.80 million m^3 in 1999. In Poland, the total water usage dropped from 15.5 km^3 in 1985 to 12.1 km^3 in 1996 (SoE, 1999), while reductions in water usage are observed for all sectors including public supply.

Of course, one might argue that the statistics do not reveal a real decline in water usage, but a decline in the diligence of reporting. Nevertheless, where specific data can be examined in detail, the hypothesis of a genuine decline in water usage is supported. Indeed, it even seems that there is, if anything, an increase in the number of enterprises reporting water statistics. Specific data for the Siberian city of Tomsk are shown in Figure 2.

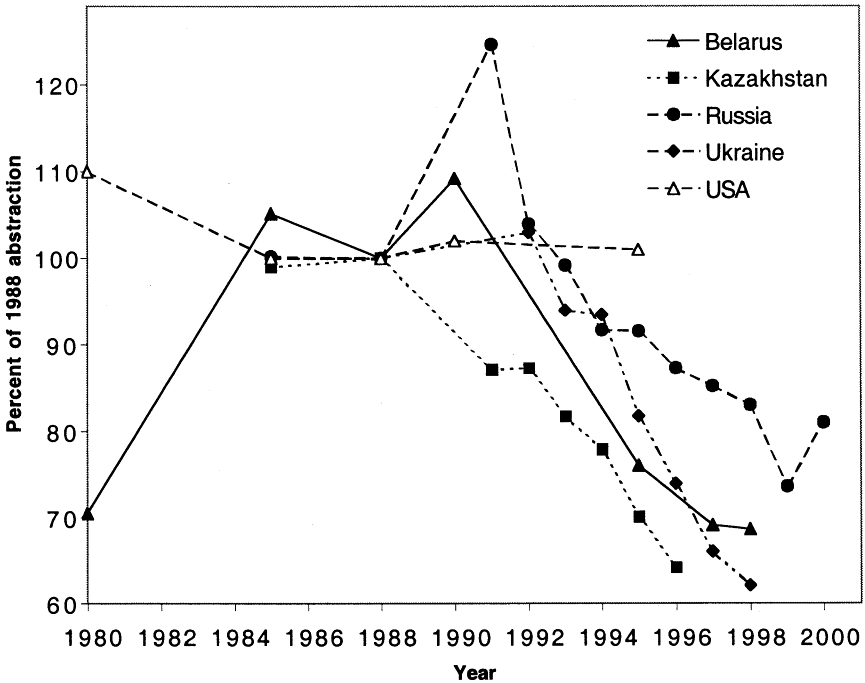

Figure 1. Trends in water abstraction in Belarus, Kazakhstan, Ukraine and Russia, compared with the USA, as a percentage of 1988 abstraction. (GEO-2000 (2000); Gosudarstvennii Doklad (1998, 1999, 2000); SoE (1999); Solley et al., (1993).

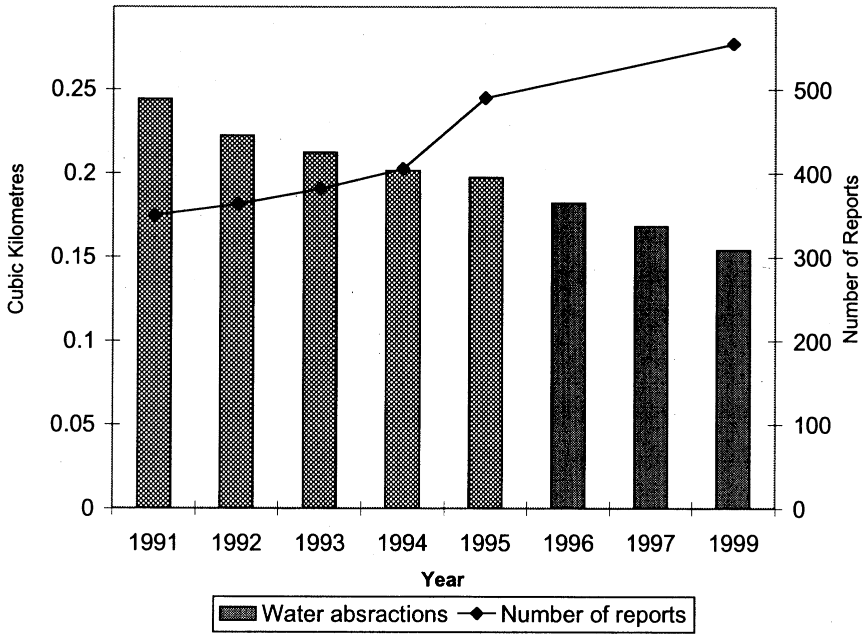

Figure 2. Trends in water abstraction and reporting of data in the Tomsk Region; 1991-99. (Tomsk Region State of the Environment (1996, 1999)

Reasons for Declining Water Consumption

The most obvious reason for the decline in water abstraction and usage is a decrease in industrial output and economic recession, which all NIS states underwent after the Soviet Union disintegrated. For example, the decline in Latvian GDP by 1995 to only 49% of the 1990 level, was paralleled by a decline in water abstraction. This was 66% of the 1990 level in 1996, while primary energy consumption was only 50% of the 1990 level.

Of course, we cannot exclude other reasons than industrial decline for the observed decrease in water abstraction in transition economies. In Poland, a constant reduction in water use is observed despite a growth in GDP during recent years (SoE, 1999). According to the Estonian SoE report (SoE, 1999), water-conservation measures are claimed to be effective, providing a partial explanation for declining consumption. It is also should be noted that the Baltic States have regarded themselves as politically and economically close to the "West" and have been highly motivated to introduce approaches (such as water conservation) common, at least in theory, in the liberal democracies of Europe. Sustainable water pricing is one tool used to attain such policy goals. Lithuanian authorities have adopted this approach and have gradually, but continuously, raised water prices for consumers. As a result, many consumers installed water meters and, having realised the marginal costs associated with water consumption, are reported to have become more conservative in their usage (FAO, 1999), although this is not reflected in the figures reported in Table 1, for other reasons, discussed below. In Latvia, reduction in water usage was achieved via a new law providing for a Natural Resources Tax (SoE, 1999). A similar situation prevails in the Ukraine.

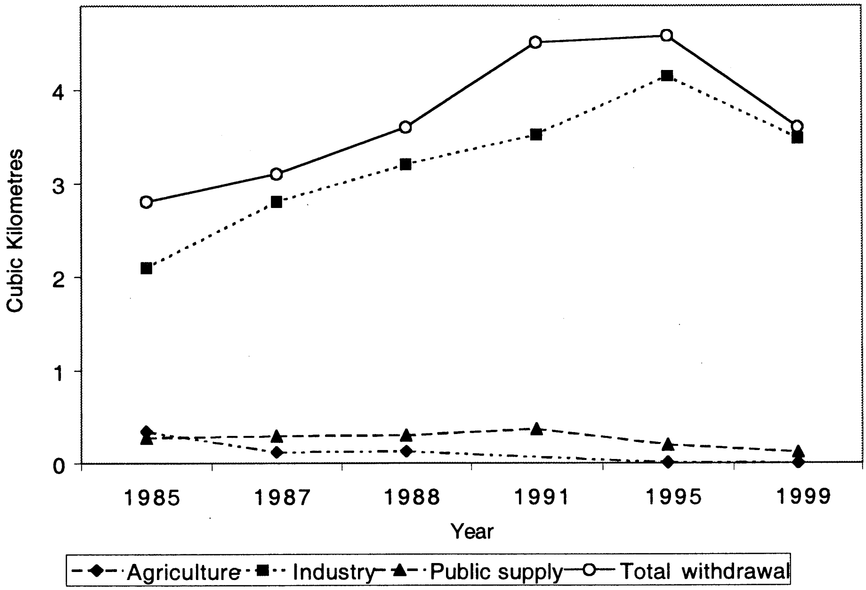

Figure 3. Water abstraction in Lithuania from 1985 to 1999. Data from Lithuanian State of the Environment (SoE) report.

In the case of Lithuania's increased water abstraction in recent years, one should bear in mind that the majority (up to c. 4.1 km^3) of the reported water abstraction of 4.4 km^3 can be ascribed to water used, largely for cooling, at the Ignalina nuclear power plant. Annual water abstraction and use in Lithuania is illustrated in Figure 3. Unlike many other ex-Soviet nations, water use for industrial purposes steadily increased in Lithuania throughout the last fifteen years. Lithuania is also the only republic that exhibited a significant increase in *per capita* water use (Table 4). Nevertheless, a decrease in industrial output has been reported for Lithuania, commencing at the end of the 1980s. Unfortunately, data on water usage at Ignalina are not available for this period, preventing us from drawing any conclusions as to Ignalina's impact on total water abstraction in the Republic, although according to the BEF (2000) water usage (excluding cooling water) in industry dropped by 73% from 1991 through 1999. Water usage in agriculture and for public supply showed the same declining trend as in the other ex-Soviet republics.

Irrigation - a Drain on Resources ?

The over-use, or, more correctly, the inefficient use of irrigation water is largely due to artificially low pricing, a (perhaps understandable) example of governments' interference in market equilibria to achieve social goals (Turner et al. 1994). Soviet governments' subsidies of the production of irrigation and potable water have ensured the provision of cheap food and water to households with low income, but it can also be argued that this practice has resulted in water resource wastage, over-watering, waterlogging and salinization of arable areas.

If we turn to the few republics (Table 1) which do not exhibit any decline in water usage, we may note that three of them are Central Asian (Turkmenistan, Kyrgyzstan) or Caucasian (Azerbaijan) republics where a large proportion of the GDP is derived from agriculture (Table 2). These three republics, and a fourth Asian nation, Tajikistan, engage heavily in irrigated crop production. In fact, the majority (up to 90 % in some cases, Figure 4) of abstracted water is used for irrigation of cotton, wheat, barley, vegetables and fodder. In most cases, irrigation use is highly inefficient, often involving field flooding from surface canals, with inherent water wastage due to leaking canals, losses to evaporation and improper levelling and terracing of irrigated land.

In fact, very few Soviet republics enjoyed progressive or efficient methods of irrigation. In Turkmenistan until 1992, for example, all irrigation was by simple surface water methods and, even by 1994 (FAO, 1999), only a small percentage (0.05 %) of the total irrigated area was under micro-irrigation. The Soviet system encouraged major, large-scale irrigation and inter-basin water transfer schemes, which were generally susceptible to huge losses. For, example, one of the world's longest canals, the Kara Kum, was constructed in Turkmenistan in the 1950s in order to divert the waters of the Amu Darya River to irrigate the desert via a network of smaller canals. These smaller canals are usually inadequately lined and huge losses occur in the labyrinthine network. Peterson (1993) describes the inundation of Ashkabad (the Turkmen capital) by water leaked from the Kara Kum Canal. To prevent flooding, the authorities have had to drill some 150 wells to dewater areas of the city. The Kyrgyz authorities report a steady trend towards increasing losses in irrigation water distribution systems, with losses of up to 90 % being recorded (SoE, 1999).

TABLE 2. Share of agriculture in the GDP of ex-Soviet republics (Source: FAO 1999).

Republic	Share of agriculture in GDP, %	Year of reference
Turkmenistan	50	1995
Armenia	41	1994
Georgia	38	1995
Uzbekistan	36	1994
Kyrgyzstan	33	1994
Azerbaijan	31	1995
Moldova	25	1992
Belarus	22	1996
Kazakhstan	19	1993
Tajikistan	17	1992
Russia	16	1993
Ukraine	14	1993-1995
Estonia	10	1993
Latvia	8	1995
Lithuania	7	1994

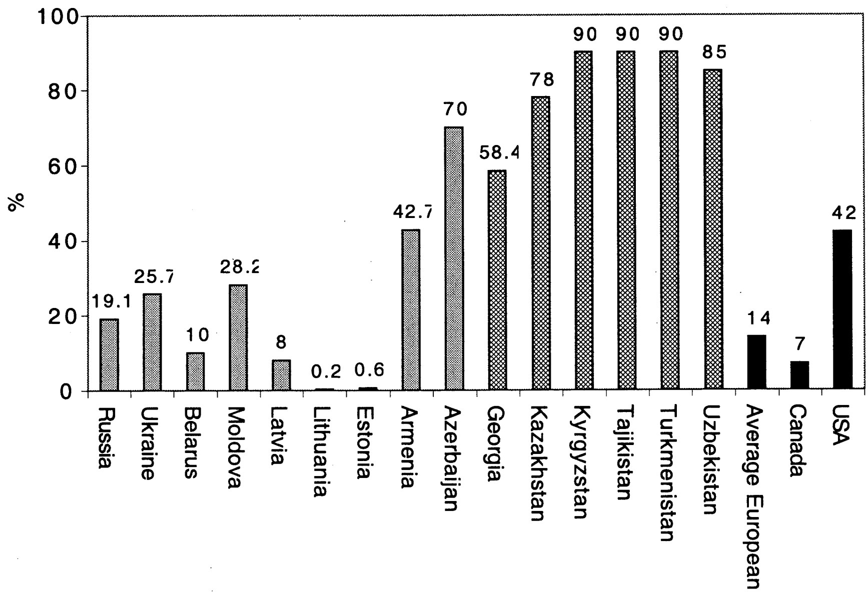

Figure 4. Percentage of water used in agriculture in various post-Soviet republics. (GEO-2000 (2000); Gosudarstvennii doklad (1998); SoE (1999); Solley et al., (1993); StatCanada (1999)

In the Caucasus, Armenia, which derived 41% of its GDP from agriculture (FAO, 1999), mainly implemented surface irrigation. 10 % of irrigated land was under sprinkler irrigation (which can also be very inefficient due to evaporation losses), while only a very small part (0.07%) was under micro irrigation. In neighbouring Azerbaijan, almost 90% of the irrigation is surface irrigation, using mainly furrow and border-strip techniques. Here, only 4.1% of the 38,900 km permanently active canal length is adequately lined with artificial coatings, while 95.9 % are merely excavated straight into natural soils, resulting in huge losses of water, the rise of ground water levels, and secondary salinisation and swamping (SoE, 1999). The European republics showed a tendency towards more modern (though not necessarily more water-efficient) techniques, with sprinkler irrigation being almost exclusively used in Belarus, Ukraine, Lithuania, Latvia and Estonia (FAO, 1999).

Central Asia and the Aral Sea

The former Soviet Republics of Central Asia can be regarded as rather special in terms of water issues for a range of reasons. Firstly, the arid climate results in scarce and unevenly distributed water resources. Secondly, while water demand in these republics has increased, its availability (per capita) has sharply decreased, largely due to population growth (Klötzli, 1994). Thirdly, the area contains the Aral Sea, a key hydrological feature of Central Asia, and rightly regarded as an area of environmental catastrophe. Finally, as seen above, the region wastes huge quantities of water through poorly constructed irrigation systems.

The former Soviet republics of the region include (populations in parentheses): Uzbekistan (23.2 million), Kazakhstan (16.7 million), Tajikistan (6.0 million), Kyrgyzstan (4.6 million) and Turkmenistan (4.6 million). All these republics depend heavily on surface water resources, as groundwater is regarded as scarce in the region (although it may, in some cases, merely be under-exploited – see Table 3, and Banks & Soldal [2002] on the situation in Afghanistan). In fact, the main sources of surface water for at least four of Central Asian Republics are the Syr Darya and Amu Darya Rivers, which feed the Aral Sea. The fifth, Kazakhstan, exploits watercourses flowing towards the Arctic and the Caspian Sea, in addition to those of the Aral catchment.

The Aral Sea is a saline lake with no surface water outlets. The riparian nations of the sea are Kazakhstan and Uzbekistan. The only major inflows to the sea are the Syr Darya and Amu Darya rivers systems. The Syr Darya is formed by the confluence of tributaries derived from the Tien Shan mountain system in the Fergana Valley of Kyrgyzstan. It flows northwest, through Tajikistan, Uzbekistan and Kazakhstan before discharging into the Aral Sea. The source of the Amu Darya is in the Pamir / Hindu Kush / Koh-e-Baba mountains of

Tajikistan and Afghanistan (Banks & Soldal, 2002). It also flows through Uzbekistan and Turkmenistan to the Aral Sea.

Tajikistan and Kyrgyzstan, located upstream on these watercourses, are in a powerful position, being able to regulate flows by means of reservoirs (for example, the Toktogul reservoir on the Naryn tributary of the Syr Darya in Kyrgyzstan's Tien Shan mountains and reservoirs on the Vaksh tributary of the Amu Darya in Tajikistan). In contrast, Uzbekistan controls 42% of the storage capacity of the Amu Darya, while Turkmenistan has no control over its storage capacity (Klötzli, 1994).

Central Asia has the highest percentage of water withdrawal for agriculture (95%) in the Near East. It is also the region where the largest proportion of cultivated land is under irrigation (80% according to FAO, 1999). Central Asia has historically been an agricultural region, but under the Soviet regime cotton production expanded immensely at the expense of other crops. Cotton was recognised by the communist authorities as a strategic crop for military purposes as well as a source of hard currency. Soviet managers created extensive large-scale irrigation systems that linked different catchments, as well as upstream- and downstream users, through canals and collectors. The most famous is the Kara Kum canal of Turkmenistan that runs 1,400 km (870 miles) from the Amu Darya River to the Caspian Sea coast (see above). Water from the canal is used mostly for irrigation purposes.

TABLE 3. Water availability and groundwater usage in ex-Soviet republics

Republic	**Water resources**	**Groundwater (% of water abstracted)**	**Estimated renewable groundwater resources**	**Reference**
Armenia	Limited	47	4.3 km^3/yr	SoE (1999)
Azerbaijan	Limited	6.9-7.5		SoE (1999)
Belarus	Sufficient	57	18 km^3/yr	SoE (1999)
Estonia	Sufficient	65	4 km^3/yr (FAO 1999)	SoE (1999)
Georgia	Sufficient	33	17.7km^3/yr	SoE (1999)
Kazakhstan	Limited	17 (FAO)?	41-4 km^3/yr (SoE) 35.9 km^3/yr (FAO)	SoE (1999)/FAO (1999)
Kyrgyzstan	Sufficient	5.9	13.6 km^3/yr	FAO (1999)
Latvia	Sufficient	72.5	2.2 km^3/yr (FAO) 4.7 km^3/yr (SoE)	SoE (1999)/FAO 1999)
Lithuania	Sufficient	c. 100 % (Ref.)	1.2 km^3/yr	FAO (1999) BEF (2000)
Moldova	Limited	40	0.4 km^3/day	SoE (1999)/FAO 1999)
Russia	Sufficient	17.6 (1996)	29.1 km^3/yr(SoE) 788 km^3/yr(FAO)	SoE (1999)/FAO 1999)
Tajikistan	Sufficient	19	6.6 km^3/yr	FAO (1999)
Turkmenistan	Limited	5	3.4 km^3/yr (FAO) 3.1 km^3/yr (SoE)	SoE (1999)/FAO 1999)
Ukraine	Sufficient	15 (SoE 1999)	20 km^3/yr	FAO (1999)
Uzbekistan	Limited	12	19.7 km^3/yr	FAO (1999)

The awkward and complex situation of the Syr Darya and Amu Darya rivers is further complicated by the politics of hydropower production. Hydropower is particularly important in Kyrgyzstan and Tajikistan, whose hydropower accounts for over 50 % of the total energy production. Hydropower is less significant in Kazakhstan and Uzbekistan, with shares of less than 50% of the total production (Klötzli, 1994).

Intense water use for irrigation resulted in the diminishment of the annual mean flow of the Amu Darya and Syr Darya rivers, and from the beginning of the 1960s the Aral Sea started to shrink in area. The Aral used to be the world's fourth largest lake in terms of area (behind the Caspian Sea, Lake Superior and Lake Victoria). By the beginning of 1987, the Aral's water level had dropped by 12.9 m, its area decreased by 40% and its volume declined by 66%. The average depth of the Sea had decreased from 16 to 9 m, and its average salinity risen to from 10 to 27 g/litre (Micklin, 1988). The Soviet political and scientific elite was undoubtedly aware of the problem, but apparently decided to "sacrifice" the lake for the benefit of agricultural output. The profitability of cotton production led to the externalising of its production costs to the local population of the Karakalpak republic of Uzbekistan and the areas of Kazakhstan adjacent to the Aral Sea (i.e. the local inhabitants, who are neither consumers nor producers of cotton, pay part of the "price" of cotton production through damage their environment and livelihood). As a consequence, local populations suffered a number of negative impacts, including alleged tap water pollution by pesticides and other chemicals, dust storms carrying salt and contaminants from the former lake bed and a high rate of unemployment due to lost jobs in fishery and related industries.

It is perhaps interesting to consider the various responses of the Central Asian nations to the Aral Sea issue. Turkmenistan officially considers the Aral Sea as doomed, and does not support regional efforts for its stabilisation. Conflicts of interests have arisen between *Kyrgyzstan* and downstream riparian nations (*Uzbekistan, Tajikistan and Kazakhstan*) regarding the amount of water released to the Syr Darya river from reservoirs. Conflict also exists between *Tajikistan* and downstream riparians *Uzbekistan* and *Turkmenistan* regarding overexploitation of hydropower resources on the Amu Darya river (e.g. the use of its dam on the Vakhsh river - a tributary of Amu Darya). Ill-will also exists between *Uzbekistan* and *Turkmenistan* over the water resources of the Amu Darya. Uzbekistan blames Turkmenistan for wasting excessive water because of poor water administration (water use per capita in Turkmenistan is more than twice that of Uzbekistan and other Central Asian republics, see Table 4). The Kara Kum Canal diverts from the Amu Darya more than double the 6 km^3/year initially agreed under the old Soviet water quota system for Turkmenistan. These withdrawals drastically deplete available water flow to the downstream users in Karakalpakia in the west of Uzbekistan. To make matters worse, Turkmenistan has declared it a national priority to achieve self-sufficiency in grain and other crops without reducing the output of cotton, thereby intending to put an additional 1.6 million hectares under cultivation (Klotzli, 1994). Additionally, Afghanistan makes few secrets of its ambitions to use Amu Darya water for irrigation of its northern provinces, at the expense of downstream users (Banks & Soldal, 2002).

One of the most notorious of the Soviet Unions "mega-projects" was proposed to provide additional water resources for Central Asia. It involved reversing the current northerly course of Siberia's three main rivers, the Ob', the Yenisei and the Lena towards Central Asia, for use as irrigation water (Peterson, 1993). Fortunately, the project has never been implemented and is unlikely to be so in the foreseeable future.

Table 4. Water abstraction / usage per person per day* (m^3)*. Calculated from SoE (1999), Gosudarsvennii Doklad (1997), Peterson (1993), GOSKOMSTAT (1989), FAO (1999), Solley, Pierce, and Perlman (1993). Na = data not available.* (This figure is calculated as total abstraction/ usage divided by population and thus includes all industrial abstraction)

State	1980s	Reference	1990s	Reference
Superpowers				
United States	6.4	Peterson	5.7	Solley et al.
Soviet Union	3.3	Peterson	-	-
East and Central Europe				
Average European	-	-	1.7	GEO-2000
Bulgaria	2.3	Peterson	Na	-
Hungary	1.9	Peterson	Na	-
Poland	1.2	SoE	Na/0.9*	SoE
Czechoslovakia	0.9	Peterson	-	SoE
Czech Republic	-	-	0.647	SoE
Slovak Republic	-	-	0.413*	SoE
Ex-Soviet Republics				
Latvia	0.68/0.66*	Goskomstat	0.441/na	SoE
Belarus	0.76/0.75*	Goskomstat	0.5 /0.45*	SoE
Armenia	3.4/2.9*	Goskomstat	Na/1.2*	SoE
Ukraine	1.6/1.5*	Goskomstat	1.0 /0.69*	SoE
Russia	2.0/1.8*	Goskomstat	1.6 /1.2*	Gosudarstvennii Doklad
Georgia	1.9/1.6*	Goskomstat	1.8 /1.4*	SoE
Moldova	2.4/2.3*	Goskomstat	Na/1.128*	SoE
Estonia	5.1/5.1*	Goskomstat	Na/2.5*	FAO
Lithuania	2.7/2.6*	Goskomstat	Na/3.3*	FAO
Kazakhstan	6.6/5.5*	Goskomstat	4.2 /3.4*	SoE
Azerbaijan	5.8/4.9*	Goskomstat	5.8 /4.0-4.7*	SoE
Tajikistan	7.0/6.4*	Goskomstat	Na/6.0*	SoE
Uzbekistan	10.0/7.5*	Goskomstat	Na/7.3*-7.7*	SoE
Kyrgyzstan	7.7/6.4*	Goskomstat	Na/7.6*	SoE
Turkmenistan	17.6/16.0*	Goskomstat	Na/15.0*	SoE

Per Capita Water Abstraction - An Index of Efficiency in Water Consumption?

The *per capita* water abstractions/ usages in the NIS are compiled in Table 4. This figure helps us to gain some impression of the real "water efficiency" performance of each nation. Very high *per capita* abstractions are exhibited (as discussed above) by the Central Asian Republics and Azerbaijan. Those for Lithuania and Estonia are also rather large compared with other European NIS, largely due to the huge water usages in nuclear power production in Lithuania and thermal power production in Estonia (Sæther et al. *in press*). The annual water abstraction of 1.36 km^3 (see Table 1) cited for Estonia includes a 1.2 km^2 intake of cooling water for the oil-shale fired thermal power plants in the Narva area (SoE, 1999). Estonia (like Lithuania) is an exporter of energy that covers much of the power requirements of Latvia and parts of the Russian north.

Those republics reporting the lower *per capita* water abstractions (Table 4) would appear to be using water relatively effectively, although even some of these are reported to suffer significant losses in their distribution systems. For example, the Czech Republic is reported to suffer losses of 34.2%, although several West European nations also report percentage losses in the region 25-30%, in France, UK and Spain (GEO-1, 1999).

Despite a high *per capita* rate of water abstraction, the Central Asian republics and Azerbaijan are still regarded as suffering from water shortages. The water shortages for household use are also consistent with the percentage of water used for public supply (Table 5).

Table 5. Water used for public supply as a percentage of total water usage. Source: calculated from SoE (1999), Gosudarsvennii Doklad (1997), GEO2000 (2000), and FAO (1999). *The GEO2000 document appears to include Russia (also Asian Russia) in the term "Average European" although this is not specifically stated.

State	Water used for public supply, as % of total use	At year	Reference
Latvia	58	1996	SoE
Belarus	46.2	1998	SoE
Czech Republic	39.2	1996	SoE
Armenia	33.0	1996	SoE
Ukraine	26.5	1998	SoE
Poland	20.7	1996	SoE
Russia	20.7	1998	Gosudarstvennii Doklad
Average European*	***14***		***GEO2000***
Moldova	9.9	1994	SoE
Slovak Republic	9.1	1996	SoE
Estonia	6.5	1995	FAO
Kazakhstan	5	1996	SoE
Lithuania	4.7	1995	FAO
Kyrgyzstan	3	1995	SoE
Tajikistan	3	1995	SoE
Uzbekistan	3	1993	SoE
Turkmenistan	1.5	1997	SoE

The *per capita* water indices for NIS states in Table 5 demonstrate that the high *per capita* abstraction of the Soviet Union reflects an "averaging" of moderate water needs in the European republics and the water-hungry Central Asian republics. After the break-up of the Soviet Union, the *per capita* water abstractions of Russia and the other NIS can be seen to be similar to West European nations (with the exception of Lithuania and Estonia, for reasons described above).

Table 6 indicates that *per capita* water abstractions in the Soviet Union under communist rule did not equal the very high abstractions reported from the USA and Canada. The high North American *per capita* abstractions are believed to be the result of energy-intensive industrial development and also the dramatic expansion of irrigated agriculture in the USA (GEO-2000, 2000). Within a region, one could maybe argue that *per capita* water abstraction is an indicator of efficiency of water usage and potential for environmental damage, but such a simplistic argument is probably fallacious. The USA indeed had a high *per capita* abstraction that has, in some areas, undoubtedly created environmental problems. However, it could be argued that the USA used its water to create a highly productive economy. The Soviet Union had a lower, though still rather high abstraction. It is improbable that this can be seen as an indicator of more efficient water consumption, as the Soviet Union ultimately failed to transform its consumption of raw materials to a productive economy. Also *per capita* water abstraction must be seen in the light of population density and water resources. Hence a high *per capita* water abstraction (due to hydropower, paper, chemicals and metals industries) in rainy, sparsely populated Scandinavia would have a far lesser environmental impact on the hydrosphere, than a similar *per capita* abstraction in a densely-populated arid land.

TABLE 6. Water abstractions and use in ex-Soviet republics compared to other nations. Sources: calculated from Solley et al., (1993), Peterson (1993), GOSKOMSTAT (1989), Statcanada (1999), GEO-2000 (2000), SoE (1999).

State	Total water abstraction, km^3	Water abstraction per person per day, m^3	Water use in industry including power generation, % of total	Water use in agriculture and irrigation, % of total	Water use for public supply, % of total	Year of reference
USA	551.2	6.2	52.6	34.3	10	1985
USA	555.4	5.7	47	42	11	1995
Canada	45.1	4.4	85	7	8	1991
Average European	-	1.7	55	31	14	1990s
Soviet Union	333.7	3.3	38.4	53.3	6.7	1988
Russia	87.3	1.6	55.9	16.9	20.7	1998
Ukraine	19.0	1.0	45.4	27.5	26.5	1998
Belarus	1.9	0.76	31	10	46	1998
Moldova	2.6	2.4	61.9	28.2	9.9	1994
Estonia	1.3	2.5	92.9	0.6	6.5	1996
Latvia	0.4	0.441	34	8	58	1995
Lithuania	4.4	3.3	94	0.2	4.7	1995
Kazakhstan	25.3	4.2	16	78	5	1996
Kyrgyzstan	12.7	7.6	7	90	3	1995
Tajikistan	13.1	6.0	5	90	3	1995
Turkmenistan	25	15	8	90	1.5	1997
Uzbekistan	62	7.3	12	85	3	1996

Availability of Water

The large *per capita* apparent usage of water, described in these pages, may erroneously give the impression that residents of the former Soviet Union have all the water they can ever need. In reality, nothing could be further than the truth. In rural Siberia, communal pumped village water boreholes are proving extremely difficult to maintain effectively and villagers are reverting to traditional dug wells and springs for their supplies. Residents of larger cities suffer frequent water supply stoppages (often related to failure or necessary repairs to a dilapidated distribution system). Residents of large tower blocks may find themselves walking several flights of stairs to collect water from street standpipes.

Let us take, for example, the republic of Kazakhstan, where the provision of water to its population remains an elusive goal. Only the city of Alm'aty is blessed with a distribution network approaching 100% coverage. In the other main Kazakh cities the coverage does not exceed 70-80%. In many residential districts, citizens collect drinking water from open reservoirs or from external sources. Such water may not be adequately treated and may be unchlorinated (SoE, 1999).

The Ukraine claims that nearly 100% of the population has access to safe water supply, although in rural areas this may mean well supplies that are inadequately protected. Nevertheless, the Ukrainian government heavily emphasises the need for improvements in water provision, largely because existing systems are overexploited. For this reason, and also because of energy shortages, many cities receive water only twice a day for a limited number of hours. Expenditure in this sector has, however, increased substantially: while the five year plans of the 1980s envisaged the laying of around 60 km of water mains for the whole period, there are now some 250 km laid every year. This development should lead to an improved water supply in the near future. (FAO, 1999).

In Armenia (UNSD, 2000; SoE, 1999), some 75% of the population was reported to be served by public waterworks in 1991 but, in practice, the availability of supply fell well short of a basic level. Few parts of Armenia receive 24 hour supplies of drinking water. On average water is supplied for only 2 to 6 hours per day, when pumped. Although around 76% of the population was served by public sewer systems in 1991, sanitary and hygienic standards have declined due to a lack of reliable water supply, as has the general quality of life. Ironically, the intermittent water supply has led to wastage of water, due to taps being left open and water being stored in tubs that are emptied and re-filled whenever "fresh" water becomes available. The provision of a 24 hour potable water supply is now a stated objective of the government in its Public Investment Programme 1996-1998.

Concluding Remarks

Attention has been focussed on several of the problems and controversies surrounding the issue of water resources in the newly independent states of the former Soviet Union. In most NIS republics, there is a trend towards decreasing abstraction of water, reflecting the declining manufacturing economy in many of these nations. Exceptions to this trend include Central Asian states with heavy water abstraction for agricultural needs. In the Central Asian region, agricultural policies have led to overexploitation of resources and the desiccation of surface waters. As in Western Europe, discussions rage over the need for public subsidy of basic commodities such as water and food. Some form of subsidy is often seen as desirable in terms of national security and social policy, yet intensive agriculture and over-abstraction of water have undeniably serious detrimental effects on the environment.

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