Chapter 11

Wastewater Treatment in the Postcommunist Danube River Basin

Igor Bodík

Introduction

In the aftermath of historical developments during World War II, the majority of the European communist countries were formed in the Danube River basin. The environment of the Danube basin has been under significant pollution stress for several years. Industrial wastes were, and still are, often disposed of or emitted without due consideration to the environment. Many of the municipal wastewater discharges that often contain a high industrial portion continue to flow without treatment to reduce polluting loads.

After more than forty years of economic mismanagement and environmental neglect, these countries have started to correct the effects of the previous rulers' policy in this field. As far as environment and water pollution are concerned, the legacy from the past regime is serious. It is characterized by a high level of water contamination, and the coexistence of problems caused by traditional pollutants as well as point and nonpoint sources. The additional difficulties caused by the past contamination of soil, sediment, and groundwater present the issue of a costly and slow rehabilitation.

In spite of the features mentioned above, the water pollution problems of the postcommunist Danube countries should not be considered unique in a technical sense. Similar situations existed in industrialized regions of the West (e.g., the Ruhr and Rhine rivers in Germany) about thirty years ago, and there is evidence that tools and technologies are available for the cleanup. The uniqueness stems from the coincidence of the need to handle these weighty environmental issues

along with the very specific political, economic, and social conditions of postcommunist development.

The main objective of this study is to analyze the recent status of water management in the Danubian countries with a focus on sewage and municipal wastewater treatment in postcommunist countries in this region. Some detailed information about wastewater collection and treatment will be presented for the Slovak Republic.

Basic Characteristics of the Danube River Basin

Altogether, there are seventeen European countries occupying part of the Danube River basin (DRB)(see map, Figure 11.1). Because the part of the territory of the DRB (1.8 percent) that belongs to Italy, Switzerland, Poland, and Albania is insignificantly small, these countries will not be included in this study. Some basic geographical and economical indicators for the thirteen Danube countries are compiled in Table 11.1.

Table 11.1 indicates that significant portions of the territory and population of the DRB are formed by former "communist bloc" countries. The socioeconomic differences among the Danube countries are evident from the Gross Domestic Product (GDP) values. These discrepancies have to be considered as a substantial hindrance to implementing a balanced and optimally cost-effective water pollution reduction program for the Danube River system.

Figure 11.1 Location of Danube River Basin Countries

Table 11.1 Basic Geographical and Economic Parameters of the Danube Countries

Country		Present population	Present population in the DRB		Country territory	Country territory in the DRB		GDP in 1997	Inflation rates in 1997
		Mil.	Mil.	%	1,000 km^2	1,000 km^2	%	USD/cap.	%
Bosnia	BiH	3.8	2.9	76	51.2	37.3	73	1,087	3.0
Bulgaria	BUL	8.3	3.9	47	111.0	47.0	42	1,227	1082.0
Croatia	CRO	4.8	3.2	67	56.5	34.4	61	4,267	3.6
Czech Rep.	CZE	10.3	2.8	27	78.9	21.1	27	5,050	8.5
Hungary	HUN	10.2	10.2	100	93.0	93.0	100	4,462	18.3
Moldavia	MOL	4.3	1.1	26	33.8	12.0	36	504	11.8
Romania	ROM	22.6	21.2	94	237.5	237.4	100	1,549	154.8
Slovakia	SVK	5.4	5.2	96	49.0	44.3	90	3,624	6.1
Slovenia	SLO	2.0	1.7	85	20.3	17.5	86	9,101	8.3
Ukraine	UKR	50.9	3.1	6	603.7	32.4	5	976	16.0
Yugoslavia	YUG	10.4	9.0	87	102.2	88.9	87	1,462	18.5
Germany	GER	82.1	9.1	11	356.8	56.2	16	25,606	1.8
Austria	AUT	8.1	7.7	95	83.9	80.5	96	24,691	1.3
Total/avg.		**223.2**	**81.2**	**36**	**1,878**	**802.3**	**43**	**11,532**	

Source: R. Wanninger, *Socio-economic effects of water pollution in the Danube River Basin: Summary Report, June 1999,* Danube Pollution Reduction Programmme, UNDP/GEF (United Nations Development Program/Global Environmental Facility); International Commission for the Protection of the Danube River, *Joint Action Programme for the Danube River Basin.* URL: www.icpdr.org

According to the data in Table 11.1, the DRB countries can be divided into three groups: from the "wealthy countries" (GER, AUT) in the upper Danube, through the "medium countries" (CZE, SVK, HUN, SLO, CRO) in the middle Danube, down to the "poorer countries" (BiH, YUG, BUL, ROM, MOL, UKR) in the lower part of the river Danube.

Per capita GDP in the thirteen DRB countries varies between USD 512 (MOL) and USD 25,600 (GER), or by a factor of about 50. The economic status of all the Danube countries taken together is documented by average GDP of USD 11,532 per annum. Yet among the formerly communist countries in the DRB (all except GER and AUT) average economic power is extraordinarily low—USD 2,046 per capita per annum, which classifies these Danubian countries as developing countries.

The composition of GDP by main economic sectors differs broadly from country to country (see Table 11.2). In the countries with the higher development levels (GER, AUT, CZE, HUN, SVK, SLO), the share held by the agricultural sector (usually including forestry and fishery) varies between 1 and 5.3 percent. As the economic power parity of the country decreases, the share of the agricultural sector in the GDP increases. The share of GDP generated by the industrial and tertiary sectors of the Danube countries is relatively comparable. With the exceptions of Bosnia and Herzegovina and Moldova, similar proportions of inhabitants reside in urban or rural areas of the DRB countries (Table 11.2). Also roughly equal are the population densities of these countries.

All of these geographic, demographic, and economic parameters are keys to understanding the problem of water management in the individual Danube countries. The demand for and quality of drinking water, the status of sewage systems, and the quality and quantity of wastewater must be considered the prime determinants of correct measures in water management in the DRB countries.

Drinking Water Supply

Numerous criteria are used to describe the current situation of the drinking water supply in the DRB countries. Table 11.3 presents some of the more important water supply parameters from the countries studied. "Water consumption" is restrictively defined as the quantity of water that is actually used by private households, which is metered and has to be paid for. "Water demand" is defined in this context as the quantity of water that has to be supplied to cover domestic demand, thus usually including consumption by private households; commercial, institutional, and tourism consumption; and losses in water production and distribution.

Domestic water consumption ranges from 98 l/cap/d (in CZE at the far low end of consumption) to 244 l/cap/d (extremely high consumption in ROM, probably due to agriculture). The rest of the countries have relatively comparable values. The cost of water plays a very important role in household water con-

Table 11.2 Population and GDP in the DRB Countries

	BiH	BUL	CRO	CZE	HUN	MOL	ROM	SVK	SLO	UKR	YUG	GER	AUT	Total
						Present population of DRB countries								
Urban (%)	80	70	55	60	63	27	55	50	54	45	52	—	—	58
Rural (%)	20	30	45	40	37	73	45	50	46	55	48	—	—	42
Density (cap/km^2)	79	84	94	131	109	91	89	116	99	95	101	162	96	101
						% of GDP produced by sector								
Agriculture	—	11.7	10.3	5.0	3.0	30.0	34.2	5.3	5.2	17.8	19.9	1.1	2.1	
Industry, mining	—	28.3	20.3	33.8	30.3	25.0	19.1	27.0	36.1	44.8	37.8	31.9	27.6	
Services, other	—	60.0	69.4	61.2	66.7	45.0	46.7	67.7	58.8	37.4	42.3	67.0	70.3	

Source: R. Wanninger, *Socio-economic effects of water pollution in the Danube River Basin: Summary Report, June 1999,* Danube Pollution Reduction Programmme, UNDP/GEF; International Commission for the Protection of the Danube River, *Joint Action Programme for the Danube River Basin.* URL: www.icpdr.org

Table 11.3 Basic Characteristics of the Drinking Water Supply in DRB Countries

	BiH	BUL	CRO	CZE	HUN	MOL	ROM	SVK	SLO	UKR	YUG	GER	AUT
Domestic water consumption (l/cap/d)	150	190	170	98	107	143	244	131	141	144	179	146	145
Total water demand (l/cap/d)	250	439	254	265	147	177	409	245	196	172	255	230	242
Population connected to central water supply systems (%)	57	98	62	86	96	29	61	82	81	70	45	98	86
Range of losses in the water supply system (%)	40	43	35	28	27	20	22	23	28	17	30	12	13

Source: International Commission for the Protection of the Danube River, *Joint Action Programme for the Danube River Basin.* URL: www.icpdr.org.

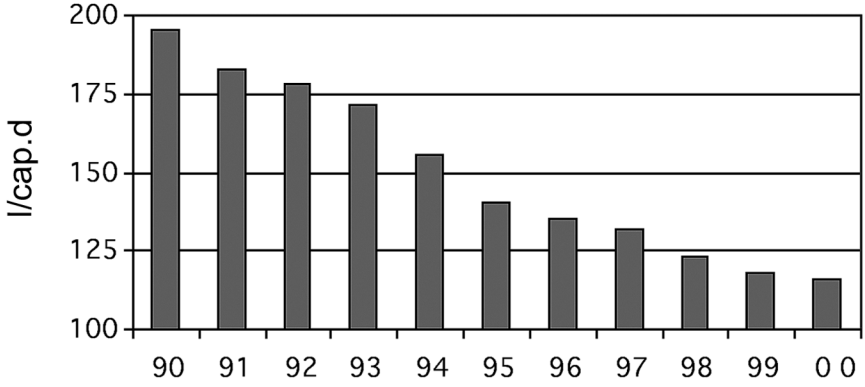
sumption. Excluding Germany and Austria, water prices are still significantly lower (0.1–0.3 USD/m^3) than in Western countries although they have been rising. A decrease in total water demand and domestic water consumption has been observed over the last ten years in all postcommunist countries, mainly as the result of increasing water costs. This fact is documented in the example of the Slovak Republic in Figure 11.2.

The share of the national population connected to central water supply systems ranges from 29 percent (MOL) to 98 percent (GER). A connection value in the 60th percentile indicates the developing infrastructure of the country. Values above 80 percent are comparable with those of developed Western countries (the reported value of 98 percent in BUL seems to be a fabrication). Accurate data on water losses in the water supply systems are difficult to obtain; adjusted values are likely to be significantly higher in some DRB countries (UKR, MOL).

Wastewater Production and Sewerage

The basic characteristics of the production and treatment of municipal wastewater are presented in Table 11.4. From this point of view there are significant differences between individual countries. Regarding domestic wastewater production, there are no reliable data on the wastewater generation by population using individual water supply sources. The average wastewater production per capita is usually unknown (estimates range from 30 to 100 l/cap/day). The striking differences are in the figures reported for municipal wastewater that is channeled into central sewage systems in the DRB countries—from 80 l/cap/day (CZE) to 202 l/cap/day (SVK). These differences probably are the result of diverse calculation of production (inclusion or exclusion of infiltration to sewers,

Figure 11.2 Development of Domestic Water Consumption in the Slovak Republic (l/cap/d, 1990–2000)



Source: Ministry of Agriculture of the Slovak Republic, *Report on Water Management in the Slovak Republic 2002* (Bratislava, November 2002).

rainwater, industrial wastewater, etc.). The next problem is the sewage quality. A high level of groundwater infiltration dilutes wastewater and lowers its temperature, causing problems in wastewater treatment. This circumstance is typical for all postcommunist DRB countries.

The fraction of the population connected to central sewage systems is relatively similar (40–60 percent) for the majority of DRB countries. The only exceptions are Moldova (14 percent) and Yugoslavia (33 percent), whose figures correspond to the level of economic development in these countries. A high degree of connection to sewage systems is characteristic of the Western countries Germany (89 percent) and Austria (75 percent), followed by Czech Republik (71 percent) and Bulgaria (65 percent). To provide a wider perspective of DRB countries with regard to connection to central sewage systems, the data of other countries in the world are presented in Table 11.5.

The economic problems following the downfall of communism slowed the development and construction of treatment systems in comparison with the previous era. Especially crippling were the financial problems of the new economies and the obscurity of the economic relations (e.g., privatization of utilities) they maintained. A typical example is the Slovak Republic (see Figure 11.3).

Municipal Wastewater Treatment

The different status of wastewater treatment in each of the DRB countries is the result of such factors as diverse historical and economic development, wastewater management traditions, and access to the sea. One of the relevant comparable indicators is the portion of untreated wastewater (directly discharged into the river system) in the total collected wastewater production for each country. From this point of view only the postcommunist countries Czech Republik and Slovak Republic achieve the best values (of course, GER and AUT do, also). In the countries recently stricken by the Balkan War (BiH, YUG and CRO), the fraction of untreated wastewater, shockingly, exceeds 80 percent. Meanwhile, despite their relatively strong economies, surprisingly high portions of wastewater go untreated in Slovenia (77 percent) and Hungary (58 percent). In Slovenia, of the total wastewater produced only 46 percent is collected and only 23 percent of collected wastewater is biologically treated; i.e., only about 10 percent of produced municipal wastewater is biologically treated (for HUN this figure is 23 percent).

The values presented above amount to a daily flow of about 6.5 million m^3 of untreated wastewater into the Danube River system. Assuming an average municipal wastewater concentration of 200 mg BOD_5/l, they represent a BOD-load (Biological Oxygen Demand) of about 1.3 million kg BOD_5/d and about 21.7 million PE (population equivalent).[1] The prevailing part of this pollution is produced and discharged into the Danube in the territory of Romania.

In all DRB countries there is a strong tradition of using the activated sludge process in secondary wastewater treatment. The age of wastewater treatment plants

Table 11.4 Production and Treatment of Wastewater in the DRB Countries

	BiH	BUL	CRO	CZE	HUN	MOL	ROM	SVK	SLO	UKR	YUG	GER	AUT
Municipal wastewater production (l/cap/d)	125	161	178	80	139	152	197	202	108	157	140	155	145
Population connected to central sewage system (%)	52	65	41	71	45	14	41	50	46	51	33	89	75
Type of wastewater treatment (%)													
mechanical	0	—	13	3	44	0	43	5	37	0	8	0	0
biological/other	15	—	6	88	42	87	15	89	24	40	6	100	100
without treatment	85	—	81	9	14	13	31	6	40	60	86	0	0

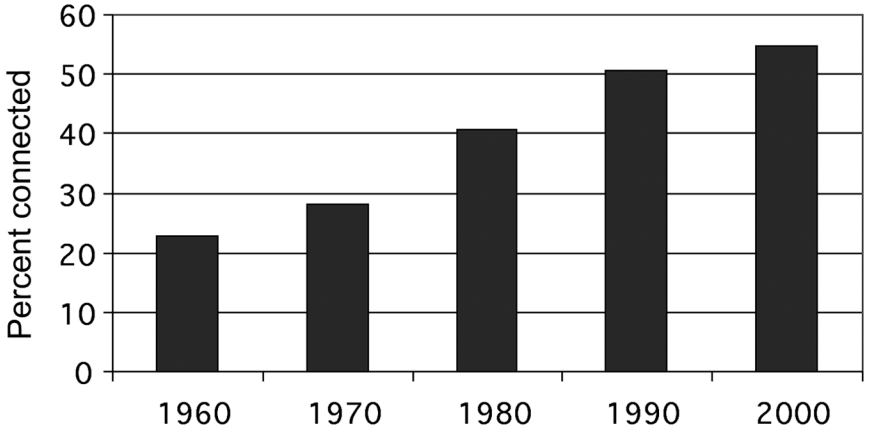
Source: R. Wanninger, *Socio-economic effects of water pollution in the Danube River Basin: Summary Report, June 1999,* Danube Pollution Reduction Programmme, UNDP/GEF; International Commission for the Protection of the Danube River, *Joint Action Programme for the Danube River Basin.* URL: www.icpdr.org

Table 11.5 Connection to Sewage System in Selected OECD Countries (year 2000)

Country	CAN	MEX	USA	JPN	KOR	NZL	BEL	TUR	DNK	GRC	POL	NOR	ESP	UK	ITA
Population connected to central sewage systems (%)	78	22	71	62	53	80	27	12	87	45	47	73	48	88	61

Source: OECD: Environmental Data Compendium. URL: www.oecd.org

Figure 11.3 Development of Inhabitants' Connection to Sewage Systems in the Slovak Republic



Source: Ministry of Agriculture of the Slovak Republic, *Report on Water Management in the Slovak Republic 2002* (Bratislava, November 2002).

is relatively high; more than half of them were constructed in the 1970s. There are practically no plants providing nitrogen and phosphorus removal. The lack of adequate industrial pretreatment is a problem in all of the countries. In some cases, industrial wastes cause BOD and COD (Chemical Oxygen Demand) influent concentrations that are much higher than in typical municipal wastewater. Industrial wastewater often contains toxic or other undesirable components: heavy metals, oils, toxic organic compounds, wastes, and so on. There are many wastewater treatment plants that are overloaded by 100 percent or more. Upgrading these facilities is an important strategic consideration for the short term.[2]

There is a lack of comparable data on types of wastewater treatment plants (WWTPs), the efficiency of WWTPs, and effluent parameters in individual DRB countries. At the highest level of the wastewater treatment, in Germany and Austria, WWTPs achieve high removal efficiency, including the processes for nitrogen and phosphorus removal. All the WWTPs above 100,000 PE fulfill the highest effluent criteria. The Vienna WWTP is currently being rebuilt and upgraded to the state of the art. Among the DRB countries, relatively high wastewater treatment status is attained in the Czech Republic. Having started on a relatively good level after the communist regime's downfall in 1989 thanks to its historic wastewater treatment traditions, research, and education in this field, the Czech Republic rose to first place in wastewater treatment development among all the postcommunist countries. Czech cooperation with Germany in recent years in the revitalization of the river Elbe has allowed the expansion and reconstruction of many large WWTPs in the Czech Republic. The Prague WWTP has waited for its upgrading for some years.

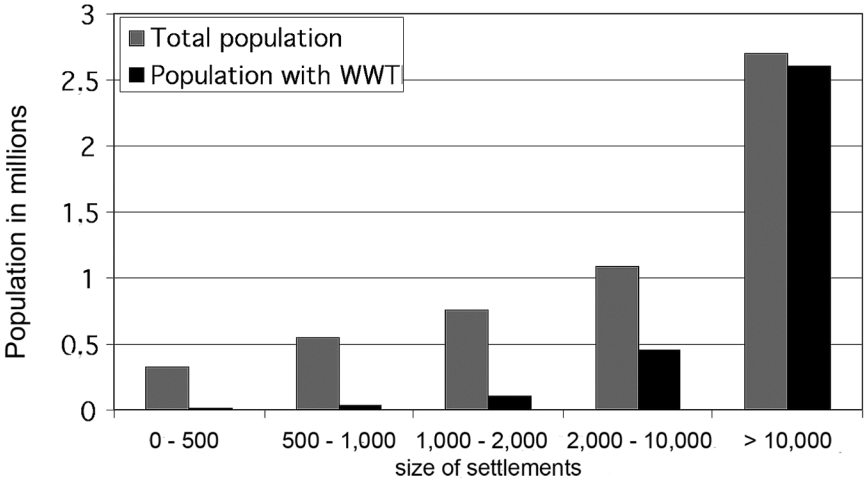
Of the total 2,883 Slovak settlements, only 471 have a sewage system; 363 have their own WWTP. The structure of WWTP distribution in Slovak settle-

ments is demonstrated in Figure 11.4. It shows that a significant part (96 percent) of the population living in settlements with more than 10,000 inhabitants (72 in all) is connected to a WWTP. Many of the existing larger WWTPs need to be upgraded for higher organic removal efficiency and for nutrient removal. The situation is worse in the smaller settlements, where the connection to WWTP is low. Given the demographic situation of the Slovak population (see Figure 11.4), along with more realistic local investment possibilities, it is expected that small WWTPs will be most frequently designed and constructed in the near future. Despite its problems, the Slovak Republic is one of the best-developed DRB countries in the field of wastewater treatment.

Wastewater Treatment Financing and Policy

The dominant problem of wastewater treatment in all postcommunist countries is the investment costs. The lack of their own investment sources negatively influences these countries' development of water and wastewater management. Many world and European programs have been started (under UNDP, PHARE, ISPA, EBRD, the World Bank, etc.) with the aim of providing financial support for postcommunist countries in the field of water and wastewater management. The Environmental Program for the Danube River Basin (EPDRB) is one of them. Within the framework of the EPDRB, the costs of achieving the priorities of the individual Danubian countries for municipal wastewater treatment strategies were estimated. The expected reduction of pollution from municipal WWTPs is presented in Table 11.6. Expected total financial outlays for solving only the

Figure 11.4 Distribution of WWTPs among Slovak Settlements



Source: I. Bodík and E. Rajczyková, "Basic Wastewater Treatments Problems in the Slovak Republic," *XXI. storočie* 4, no. 1 (2001): 30–32.

Table 11.6 Expected Reduction of Pollution from (tons/year) and Expected Investment Cost in Municipal WWTPs in the DRB for Years 2000–2005.

DRB country	BOD_5	COD	N_{total}	Investment costs (in millions USD)	The most important country investment action (in millions USD)
BiH	>7,690	>14,800	>3,000	147	WWTP Tuzla – 58
BUL	>19,448	>34,718	>2,308	>112	WWTP Sofia – 26
CRO	>15,310	>34,426	>1,509	434	WWTP Zagreb – 256
CZE	1,394	>597	1,306	208	WWTP Brno – 50
HUN	—	—	3,282	655	WWTP Budapest – 407
MOL	249	459	785	297	
ROM	24,121	27,274	5,167	597	WWTP Bucharest – 492
SVK	12,968	25,459	2,001	103	WWTP Kosice – 20
SLO	27,836	45,440	5,053	383	WWTP Ljublana – 110
UKR	>678	>621	>486	>55	WWTP Uzghorod – 25
YUG	—	—	—	—	
AUT	14,000	30,000	9,500	730	WWTP Vienna – 200
GER	1	9	1,700	110	WWTP Munich – 85
Total	**>124,000**	**>214,000**	**>36,100**	**>3,850**	

Source: International Commission for the Protection of the Danube River, *Joint Action Programme for the Danube River Basin.* URL: www.icpdr.org.

most critical national municipal wastewater problems are about USD 4 billion. But, on the other hand, the total outlays in the DRB countries for municipal WWTPs are much higher. For example, to meet all the requirements of European wastewater legislation just in the Slovak municipal WWTPs, about USD 2–2.5 billion is needed.

In principle, countries in the Danube region could borrow money for water pollution control. However, such a policy would not be wise, as the national debt is already high (between 30 and 80 percent of GDP). Some of the Western countries spent about 1 percent of their GDP on developing sewerage and wastewater treatment over the past twenty years and achieved remarkable results. To realize a similar development path, postcommunist countries would have to utilize at least 5 percent of GDP for the same purpose—an unlikely option.

One of the most important steps for the future development of water management (and the whole environment, too) is to develop a new long-term control policy. In the majority of the DRB countries the leading water management authority has not been the Ministry of Environment but other ministries: of construction, transport, industry, forest, etc. The allocation of legal competence among the state, district or municipal, and community levels varies dramatically

from one DRB country to another. It usually depends on historical features and especially on the federal structure of the particular country. Responsibility for water supply and treatment and ownership of the infrastructure is being transferred to municipalities. Decision making has been largely decentralized. Imposed in the absence of experience or adequate institutional structures, decentralization can lead to rather peculiar schemes, particularly if financing issues also are involved. For example, the planned construction of a wastewater treatment plant may now involve decision making by the state and local governments, several ministries, their inspectorates and regional authorities, water works, and so on.[3]

European Legislation

The EU Urban Wastewater Treatment Directive (91/271/EEC), which was adopted in 1991, provides the main legislation for the control of urban pollution. The aim of the directive is to avoid pollution of fresh and marine waters by urban sewerage systems. The directive requires that:

- All agglomerations above 2000 PE should be provided with collection systems for urban wastewater;
- The effluent from sewage treatment plants must meet certain minimum effluent standards as laid down in the directive (the standards depend on the degree of sensitivity of the receiving body of water);
- Sewage discharges into "less sensitive" waters, which are defined as estuarine and coastal waters with high dispersion capacity, may receive only primary treatment;
- Sewage discharges into a body of water with "normal" sensitivity must receive at least biological treatment;
- Sewage discharges of > 10,000 PE into "sensitive" waters must be subjected to nutrient removal in addition to biological treatment; "sensitive areas" are to be identified based mainly on the risk of eutrophication.[4]

In 2000, the European Commission published a landmark document in the field of water policy, the Water Framework Directive (WFD). The overall purpose of the WFD is to establish a framework for the protection of fresh water, estuaries, coastal waters and ground water in the EU. It requires member states to identify the individual river basins lying within their territories and to assign competent responsible authorities.[5]

DRB countries in which the legal framework for environmental management is regarded as adequate and consistent with international requirements include Germany and Austria and, with some reservations, Hungary, the Czech Republic, and the Slovak Republic. In the other countries essential deficits and problems persist, mainly because in some countries the environmental and water-related legislation is based to a certain extent on historical structures and now suffers

from critical inconsistencies brought on by the various changes, adjustments, and modifications. The majority of the DRB countries are currently in the process of establishing new environmental and water-related laws whose practical applicability and effectiveness have not yet been proven.

Thus, in most of the DRB countries the relevant legislation is currently in a phase of substantial reform and modernization. Due to the complexity of this task, it can be anticipated that the ongoing reform process and relevant legislation will take several years to complete, i.e., to reach an acceptable level of compliance with international requirements. In the context of this long-term accession process many postcommunist countries have adopted the provisions of "Chapter 22—the Environment" (within the framework of the EU accession process) but have negotiated transitional periods for urban wastewater treatment until 2010 (CZE) or 2015 (HUN, SVK, SLO). Bulgaria and Romania have not yet adopted the environment chapter of the *Acquis communautaire.*

Conclusion

This chapter has addressed the actual status of water and wastewater management in the postcommunist European countries lying in the Danube River basin. From the viewpoint of economics and development, these countries are quite differently positioned, but all of them have the same aim—the improvement of water quality in the Danube River basin. The DRB postcommunist countries are going through unique political, economic, and social changes associated with the heritage of serious pollution problems from the past. The solution of these problems requires tremendous outlays that are not in harmony with the resources available.

The overall level of water supply is quite high, and sewage collection is, on average, adequately developed in DRB municipalities. However, the quality of municipal wastewater treatment is poor. The choice of an optimal wastewater management strategy is very important. Could the historical development of wastewater treatment in Western Europe during last twenty years serve as the optimal model for Central and Eastern Europe?

The future of wastewater collection, treatment, and sludge disposal in the DRB countries ought to be focused on these main developments:

1. **Adopting legislation in the DRB countries** comparable to EU legislation in the field of sewerage systems, wastewater treatment, and sludge processing. It should focus on improved requirements for the quality of effluents from WWTPs in all monitored parameters, above all in nutrient concentrations. Standards in the DRB countries are currently under revision, and the application of a flexible system is being considered in order to set realistic limit values with respect to the recent economic and aquatic environmental situations.

2. **Implementing modern wastewater treatment technologies.** In the context of the need for WWTP reconstruction, it is necessary to utilize modern, low-cost technologies (e.g., use of biofilms), regulation systems of the WWTPs, etc.
3. **Monitoring and controlling** the flow rate and quantity of industrial wastewater discharged into municipal sewer systems.
4. **Building small WWTPs of under 10,000 PE.** In the DRB countries a relatively high amount of the population lives in settlements smaller than 10,000 inhabitants, where the shortcomings of the sewage systems and WWTPs are evident. For these settlements, low-cost technologies appropriate for small WWTPs must be used.
5. **Reducing the impact of poor design** based on incorrect data and repairing building defects in existing sewerage and wastewater treatment plants. Solution of these problems may help to decrease the inflow to treatment plants, but this requires huge investments.
6. **Addressing the problem of sludge processing and disposal.** The DRB countries will face some problems with sludge disposal. Therefore, all available modern and ecologically friendly methods for sludge processing must be exploited with the aim of minimizing the quantity of produced sludge and maximizing the exploitation of sludge in other industrial fields.
7. **Upgrading the skills of operators and the monitoring of WWTPs.** Many plants have been expanded or upgraded in several steps, resulting in complicated treatment lines, yet the standard of flow measurement and quality have not been changed. Operators' knowledge often is insufficient and behind the times with regard to technological developments.

Notes

1. One population equivalent (PE) means the organic biodegradable load having a five-day biochemical oxygen demand (BOD_5) of 60 grams of oxygen per day. Definition taken from EEA information website.
2. J. Námer, M. Drtil, I. Bodík, and M. Hutňan, "Wastewater treatment in Slovak Republic," *Polish Journal of Environmental Studies* 6, no. 2 (1997): 39–45.
3. L. Somlyódy, "Quo vadis Water Quality Management in Central and Eastern Europe," *Water Science Technology* 30, no. 5 (1994): 1–14.
4. Council Directive 91/271/EEC on Urban Wastewater Treatment.
5. Water Framework Directive, Directive 2000/60/EC of the European Parliament and of the Council, 23 October 2000.