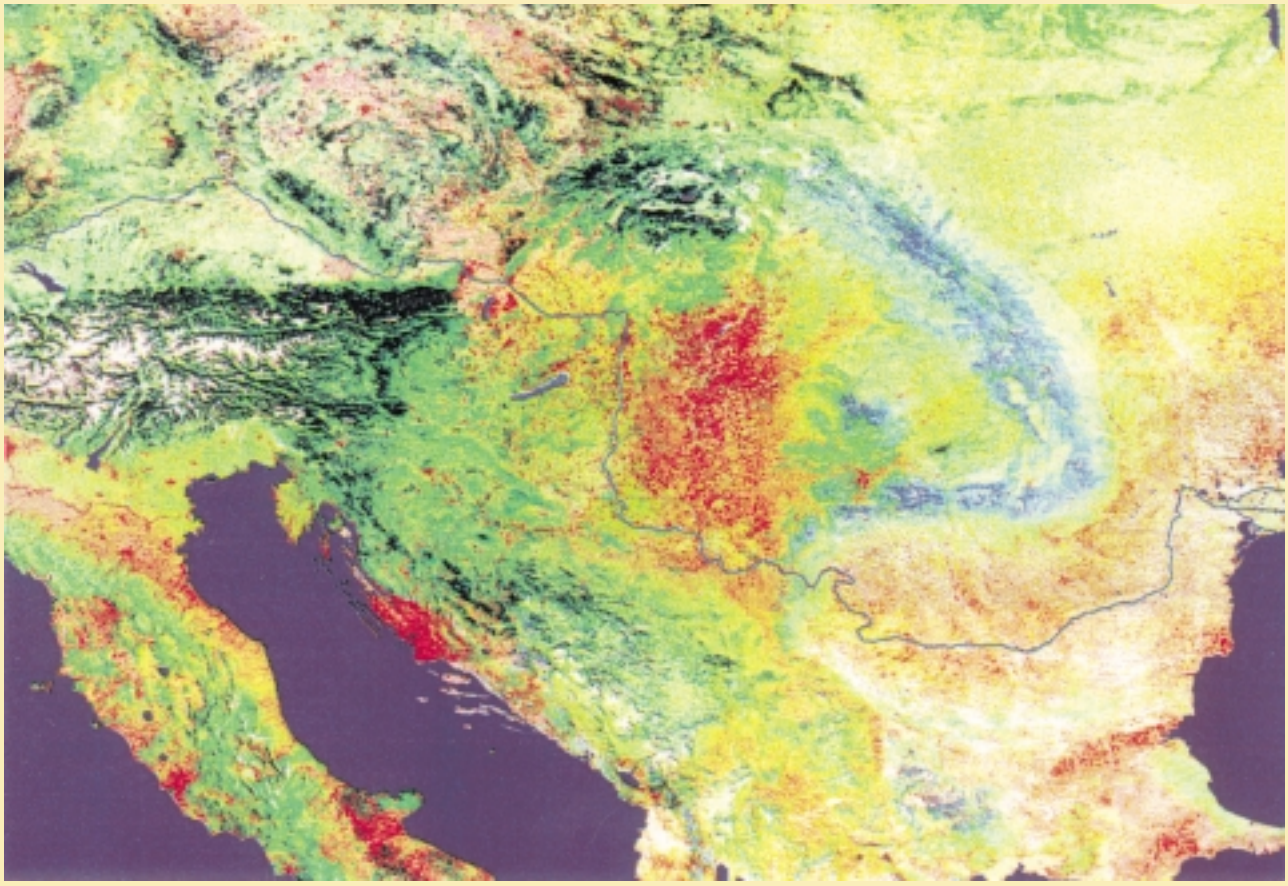
DANUBE POLLUTION REDUCTION PROGRAMME

SOCIO-ECONOMIC EFFECTS OF WATER POLLUTION IN THE DANUBE RIVER BASIN

SUMMARY REPORT

JUNE 1999



Programme Coordination Unit
UNDP/GEF Assistance

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Preface

The Report on the Socio- Economic Effects of Water Pollution in the Danube River Basin was prepared in the frame of the Danube Pollution Reduction Programme (PRP). The study has been carried out to analyse the impacts of water pollution on human populations as well on social and economic development in the Danube River Basin.

The socio-economic impacts of water pollution in the Danube River Basin are an important factor in determining the priorities for investments in pollution reduction projects, While much is known about the sources of pollution, there is still insufficient information concerning the impacts on human health and on ecosystems. By reviewing economic activities such as fishing, tourism, shipping, hydro-power etc. as well as the economic dependence on access to reliable water resources, the value of pollution reduction can be more adequately assessed.

This report evaluates current supply and demand for water supply, waste water collection and treatment services. It also reviews projections for a planning horizon of the next 10 to 20 years in order to support the planning of future infrastructure investments. Finally the report looks at the existing legal and regulatory frameworks and its relationship to the socio-economic effects of water pollution.

The results of this report will facilitate efficient planning at a national as well as a regional level to mitigate the negative impacts of water pollution as well as to maximize the economic benefits in the Danube River Basin.

The current report was prepared by Reinhard Wanninger, international financial consultant who guided a team of socio-economic experts that were selected in each participating Danube country for the preparation of updated National Reviews. This approach ensured full participation at the national level. The socio-economic aspects of water pollution were discussed in the frame of each of the National Planning Workshops. Further, the results of the present study have been utilized in the preparation of the Transboundary Analysis Report and the Pollution Reduction Report.

The conceptual preparation as well as the organization of activities was carried out by Joachim Bendow, UNDP/GEF Project Manager with the assistance of Andy Garner, UNDP/GEF Environmental Specialist. The report was edited by Michael Sokolnikov.

The findings, interpretation and conclusions expressed in this publication are entirely those of the authors and should not be attributed to any manner to the UNDP/GEF and its affiliated organizations.

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List of Abbreviations

A	Austria
BAT	Best available technology
BEP	Best environmental practice
BiH	Bosnia & Herzegovina
BUL	Bulgaria
CRO	Croatia
CSS	Central sewerage system
CWSS	Central water supply system
CZ	Czech Republic
DRB	Danube River Basin
DRBPRP	Danube River Basin Pollution Reduction Program
DRS	Danube River System
EC	European Community
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GER	Germany
HUN	Hungary
MOL	Moldova
NC	National Currencies
RO	Romania
SK	Slovak Republic
SLO	Slovenia
UA	Ukraine
USD	US Dollar
WWTP	Wastewater treatment plant

List of Dimensions and Conversion Factors

1 billion	=	1000 million
1 GW	=	1000 MW
1 MW	=	1000 kW
ha	=	hectare (100 ha is 1 km^2)
m^3	=	cubic meter
km^2	=	square kilometer
l/c/d	=	liter/capita/day
l/s	=	liter/second
p-km	=	passenger-kilometer
ton-km	=	ton-kilometer

1. Introduction

This Summary Report is based on the National Review Reports prepared by national experts and the Executive Summaries prepared by the National Country Co-ordinators for each of the Danube River Basin countries. The main tasks of this report are:

- to summarize the findings of the National Review Reports for a general overview of the environmental, social and economic background in the countries of the DRB;
- to identify common features and problems in the DRB countries; and
- to figure out country specific particularities with relevance to the DRPRP.

The majority of the National Review Reports provide a lot of data and information as well as a relatively profound problem characterization on a country basis. The reports indicate on the other side that the quality, reliability, completeness and international comparability of the presented data and information is strongly determined by the country specific history and the actual development status, and thus rather different from country to country.

In this context it has to be taken into account that, apart from Germany and Austria, all other DRB countries are at the time being in a more or less critical process of fundamental transformation of their political, legal, administrative, economic and social systems. For this reason the majority of the countries are presently not in the position to provide completely comparable socio-economic data and reliable projections, especially not for those features which are closely related to the long term economic development of the particular countries.

Altogether there are seventeen DRB countries which are located in the heartland of central, respectively Eastern Europe. Some basic indictors for the 13 countries which are included in the DRPRP are compiled in the following Table 1.

Table 1. Main Indicators for the Thirteen DRB countries

Country	Population of the Country	Population in the DRB		Country Specific DRB Area	Annual GDP per Capita -1997
	Million	Million	(%)	(1000 km2)	(USD/Capita)
BiH	3.8	2.9	76%	37.3	1087
Bulgaria	8.3	3.9	47%	47.0	1227
Croatia	4.8	3.2	67%	34.4	4267
Czech Republic	10.3	2.8	27%	21.1	5050
Hungary	10.2	10.2	100%	93.0	4462
Moldova	4.3	1.1	26%	12.0	504
Romania	22.6	21.2	94%	237.4	1549
Slovakia	5.4	5.2	96%	44.3	3624
Slovenia	2.0	1.7	85%	17.5	9101
Ukraine	50.9	3.1	6%	32.4	976
Yugoslavia	10.4	9.0	87%	88.9	1462
Germany	82.1	9.1	11%	56.2	25606
Austria	8.1	7.7	95%	80.5	24691
Total	223.2	81.2	36%	802.3	
Total DRB*				817.0	
(*) Including insignificantly small parts of Italy, Switzerland, Poland and Albania.					

For the purpose of a better understanding and assessment of the country specific data and information provided within this Summary Report the thirteen DRB countries can be categorized as follows:

(i) Germany and Austria

These two countries are located at the upper end of the DRB and have compared to all other DRB countries significantly higher development levels, represented by as high per capita income as about 25000 USD per annum. They have achieved high standards of emission reduction and water pollution control and have therefor an exceptional status within the DRPRP. Due to this, and to the fact that they are certainly not candidates for international financial assistance, these two countries have not elaborated complete National Review Reports and are therefore not explicitly considered within this Summary Report.

(ii) Hungary, Czech Republic, Slovakia, Slovenia and Croatia

These countries are located in the middle Danube River Basin. They have in the mean time overcome the former central state planning systems and have reached medium economic development levels, represented by annual per capita incomes between USD 4000 and USD 9000. The economic transformation process has caused significant reduction of industrial and agricultural production, thus temporally reducing production related pollution loads. This has created the opportunity to establish and integrate environmental objectives into industrial and agricultural policies before economic activities are going to recover again. All of these countries are interested to join the EU in the following decade; Hungary, Czech Republic and Slovenia are obviously the priority candidates. Within the process to fulfil the basic accession criteria some benefits will result for the water quality in the Danube River Basin, but that is not a central point of their efforts. All countries of this group and especially the main candidate countries are currently going to establish funding policies, legislation and mechanisms which are more or less in compliance with international standards and the requirements of modern market economies.

(iii) Yugoslavia and Bosnia & Herzegovina (BiH)

These two countries, also located in the middle Danube River Basin, are still in the critical phase to overcome the war aftermath. In the forthcoming period their main task will be to reorganize their political, legal, administrative and socio-economic structures in order to comply with the requirements of the commencing process of economic liberalization and privatization as well as international normalization. With annual per capita incomes of USD 1100 (BiH) and USD 1500 (Yugoslavia) both countries are at the time being clearly below their pre-war levels.

(iv) Romania, Bulgaria, Moldova and Ukraine

These countries located in the lower Danube River Basin are essential polluters, with a lot of damage in each country. At the time being they face serious social problems and are in such a difficult economic transition phase that environmental protection and pollution control investments are not the priority tasks in the near future. Particularly critical is the fact, that their legal and administrative framework is at least to a certain extent still determined by former structures and therefor not really in compliance with the requirements of the commencing process of economic liberalization and privatization. The inferior economic status of these countries is clearly documented by per capita incomes between USD 500 and USD 1500 per annum.

From this basic characterization of the DRB countries it turns out that there is a clear gradient in terms of administrative and economic capability from the "wealthy countries" in the upper DRB, over the "medium countries" in the middle DRB, down to the "poorer countries" in the lower part of the DRB.

On the other side shows the pollution load in the Danube River system a continuously cumulating tendency from the sources towards the delta.

These contrary facts have to be considered as an substantial problem for the implementation of a balanced and utmost cost-effective water pollution reduction programme for the Danube River system.

The location of the DRB countries and the delineation of the DRB are illustrated in Figure 1.

Danube Basin Map

- Catchment boundary
- State boundary
- City
- River
- Water level measuring station
- Hydropower dams

0 100 200 km

Date: January 1996

Prepared by: delft hydraulics

2. State of the Danube Environment

2.1. Water Resources

(a) Basic Characteristics of the DRB

The Danube River has a length of 2857 km and drains a basin area of about 817000 km^2.

The waters of the Danube River and its tributaries make up an aquatic system of high economic, social and environmental value. It includes numerous important or even unique natural areas and supports drinking water supply, agriculture, industry, fishing, tourism and recreation, power generation, river shipping and the final disposal of wastewaters for a densely populated region of Europe.

A large number of dams, dikes, navigation locks and other hydraulic structures have been built along the Danube River and its tributaries to serve these human activities, including over 40 major reservoirs on the Danube River itself. Some of these structures have caused unfavorable changes in flow pattern and damage to the functions and biodiversity of the river system, such as reduced sediment transport, increased erosion, and reduced self-purification capacity.

The character of the Danube River varies from mountain stream to lowland river. At the entrance of the Danube Delta the mean flow of the river is about 6550 m^3/s, with extreme values ranging from 15540 m^3/s for peak discharge to 1610 m^3/s for low flow.

The DRB can be divided into four parts: the upper region, the middle region, the lower region and the Danube Delta. The main characteristics of the regions are compiled in Table 2.1 and described in the following paragraphs.

Table 2.1. Characteristics of the Main Regions of the DRB

Region	Gauging Station	Stream Location (km)	Catchment Area (km^2)	Mean Discharge (m^3/s)
Upper Basin	Bratislava	1869	131338	2020
Middle Basin	Orsova	955	576232	5699
Lower Basin	Ceatal Ismail	72	807000	6550

The Upper Region extends from the source of the Danube River to Bratislava. After the confluence of the two source rivers Brigach and Breg the Danube River follows the fault gap of the German Alb. Major tributaries from the south, including the rivers Iller, Lech, Isar, Inn, Salzach, Traun and Enns, drain the alpine sub-basin and augment the discharge in the Danube substantially. The Morava River is in this region the most important river from the north, draining the Czech part of the DRB and smaller areas of Slovakia and Austria.

The Middle Region is the largest of the three regions, extending from the confluence with the river Morava at Bratislava to the Iron Gate dams. Here the river enters a flatland region.

The major tributaries in this region are:

- from the left the rivers Vah and Hron in Slovakia and Tisa, the largest tributary in the DRS;

- from the right bank side the rivers Leitha, Raab, Drava, Sava and Moldova Veche.

From Moldova Veche the river flows through a 117 km long gorge between the Carpathiens and the Balkan mountains, which has been filled up by large reservoirs for the purpose of hydro-power utilization and navigation.

The Lower Region is formed by the Romanian-Bulgarian lowlands and their surrounding upland plateaus and mountains. From the mouth of the river Timok to Silistra the Danube forms the Romanian-Bulgarian border, flowing mostly east. In this region the Danube is a wide, slow-moving river with extensive, well developed alluvial plains especially on the left- bank Romanian side; the right-bank Bulgarian side is a narrow riverine plain flanked by a steep bank.

Few of the tributaries in the lower region influence the hydrology of the Danube River. Although many of them have large catchment areas, their flow is small in comparison to that of the main river. The last two large left-bank tributaries are the Siret and Prut rivers.

The Danube Delta covers an area of 600000 ha. It was created by the division of the main river into three branches, forming a triangle with about 70 km long sides. Almost two-thirds of the delta area is seasonally submerged due to the low absolute altitude. The whole of the Romanian part was declared a Biosphere Reserve in 1990, and registered under the Ramsar Convention. Over half of its area is listed under the World Heritage Convention. Some 15000 ha or about 10% of the total area of about 150000 ha of the Ukrainian part of the delta is protected, the rest being used for agriculture. The population in the Romanian part is only 15000, while the Ukrainian part has about 68000 inhabitants.

The water resources of the DRB consist of the various types of surface waters, such as:

- watercourses which come from abroad or have their source in the territory of a particular country and flow into the Danube River either inside the country territory or beyond the country border;
- man-made reservoirs and ponds along watercourses;
- natural water bodies feed either by surface water or by ground water;

and the different categories of ground water, such as subsoil water, stratum water, bank (filtration) water, karst water; etc.

(b) Country Specific Characteristics

The main country specific characteristics regarding water resources in the DRB are summarized in Annex 2.1.

2.2. Biological Resources and Ecosystems

(a) Overall Significance of the Danube River Basin as Ecosystem

The Danube River system constitutes a large and unique ecosystem in central Europe which is characterized by an extremely wide spectrum of variations in such different features as:

- topography, landscape;
- climate, precipitation;
- geology, hydrogeology;
- settlement patterns;
- landuse patterns;
- fauna and flora;
- particular ecologically valuable terrestrial and aquatic habitats.

At the same time the watercourses and habitats of the river basin are essential elements of a single ecological network system with strong interdependencies, so that harmful activities or changes in one part of the system can directly or indirectly affect other parts of the system.

Thus, for example, the degradation of the delta or the shelf region of the Black Sea is to a great extent caused by eutrophication from the cumulative inflow of nutrients from the Danube River and its tributaries. That means that nutrients and pollution loads coming from the rivers must be reduced if the health of the whole system, including that of the delta and the Black Sea, are to be restored. This can be supported by appropriate maintaining and managing of natural buffer systems such as wetlands and floodplains, which on the other side also contribute to biological diversity.

(b) Wetland Ecosystems

In the DRB wetlands play a crucial role in sustaining biodiversity; their diverse habitats support a wide variety of species. They act as natural filters for nutrients and toxic substances, support sediment and erosion control, and provide flood protection as well as maintenance of surface and ground water resources.

Wetland habitats in the DRB have been drastically altered over many centuries, but the process has accelerated over the last decades. In that period the main cause of wetland destruction seems to have been the extension and intensification of agricultural activities. This has involved drainage and irrigation, which are partly responsible for the drop in water levels and the removal of wetlands and floodplain forests. Industrial development and pollution, mining, transport and energy production play also an essential role in the destruction or degradation of wetlands in the DRB. Forests with wet meadows and fish ponds appear to have been the most severely affected wetland habitats. The few remaining natural forests are of outstanding importance and careful management is vital.

Wetlands that have gained special international recognition include:

- The Danube Delta in Romania and Ukraine;
- The wetlands along the Drava and Sava rivers in Croatia; these ecosystems include floodplains, flooded forests, reed-patch forests, marshes, lakes, reservoirs and fish ponds; the most important sites are Kopacki Rit, Lonjsko Polje and Plitvice lakes;
- Forests along the Danube River downstream from Vienna in Austria;
- Regental Aue and floodplain forests at the confluence of the Isar and the Danube rivers in Germany.

Unique ecosystems are the karstic underground waterways which are found in many places in the DRB and which support unique aquatic and terrestrial fauna. Many of the species are endemic and in danger of extinction, since the karstic systems are very sensitive to pollution. Slovenia is the country most rich in karstic features.

(c) Biodiversity

As the DRB has a broad variety of landscapes, it is outstandingly rich in biodiversity and a valuable pool of genetic resources. There are about:

- 100 species of fish (compared to about 227 in Europe as a whole);
- 180 species of birds;
- 2000 species of higher plants.

The variety increases from the source of the rivers to the delta. Although many habitats are protected and several approved by the Ramsar Convention, many species are endangered or are already threatened with extinction.

(d) Environmental Protection Areas

Depending on the natural conditions, ecological particularities, public awareness and economic affordability the DRB countries have developed country specific environmental protection strategies. Common features of these strategies are to provide for the protection of particular species, natural entities, ecosystems and other natural resources, and especially for the preservation of biodiversity of genes, species and ecosystems.

In this context all DRB countries adopt rather similar systems of differently restricted protection and reservation areas which usually consist of the following categories:

- national parks;
- nature parks;
- nature reserves;
- nature protection areas;
- landscape protection areas;
- particular protected habitats (CORINE habitats, wetlands and other ecologically sensitive areas along watercourses, bird protection areas, etc.);
- natural monuments;
- historical monuments.

From the data provided by the National Review Reports it turns out that the share of the officially declared nature protection areas in the country territory as well as the composition of the protection areas by the various protection categories are very different from country to country.

Table 2.2 shows the number and total area of the registered protection areas (either for the DRB part of a particular country or for the whole country), and the corresponding share of registered protection areas in the DRB area, respectively the country territory.

Table 2.2. Environmental Protection Areas in the DRB Countries

Country	Environmental Protection Areas			Remarks:
	Total Area	Number of Areas/ Monuments	Share of Territory	
	(ha)	(no)	(%)	
BiH (1)	28000	250	0.5	Target: 16-24% protection areas by the year 2025
Bulgaria (2)	138000		3.0	
Croatia	--	--	--	High number of national parks and nature reserves
Czech Rep.(2)	300000	530	14.0	
Hungary	804000	1250	8.6	
Moldova (2)	49000	793	2.2	
Romania (2)	85000	170	0.4	
Slovakia (1)	1080000	1032	22.0	Including landscape prot. areas and buffer zones
Slovenia (1)	140000	710	8.0	60000 ha of protected areas in the DRB
Ukraine	--	--	--	No data
Yugoslavia (2)	635000	390	7.0	Target: 15% protection areas by the year 2020
Germany (2)	128000	23	2.3	23 major protection area
Austria	--	--	--	No data
(1) Figures for total country, (2) Figures for the DRB part of the country.				

Apart from Slovakia, where the major portion of registered protection areas are "landscape protection areas and buffer zones", the share of the registered protection areas varies between 0.5% (BiH) and 14% (Czech Republic) of the corresponding territories.

In the majority of the countries it is well recognized that due to the lack of funds not all of the ecologically sensitive areas worth to be protected, are actually declared as protection areas, and that the officially declared protection areas are often not properly managed, respectively controlled.

(e) Country Specific Particularities

The country specific characteristics and particularities regarding environmental protection areas are compiled in Annex 2.2.

2.3. Key Issues of Environmental Degradation

The usually wide valley of the Danube River and the valleys of most of the major tributaries are for thousands of years favorable human settlement areas. Nowadays they constitute in nearly all countries of the DRB "settlement development axes of regional or national significance" characterized by high settlement densities and concentration of the different modes of transport infrastructure.

In particular countries there are very special issues of environmental degradation. But the key issues are rather similar for all countries (apart from Germany and Austria). In very general terms the key issues of environmental degradation can be summarized as follows:

(i) Urban and rural settlement

- Contamination of ground and surface water through lack of municipal sewerage systems and efficient wastewater treatment;
- Contamination of soil and groundwater through inadequately operated and controlled individual wastewater facilities (such as septic tanks, etc.) in rural areas;
- Contamination of soil, ground water and surface water through inadequately designed, managed and controlled municipal solid waste dump sites;
- Impairment of ecologically sensitive areas through extensive, respectively uncontrolled recreation activities.

(ii) Industry and mining

- Contamination of soil, ground and surface water through lack of efficient industrial and mining wastewater treatment;
- Contamination of soil, ground and surface water through inadequately designed, managed and controlled dump sites for industrial, mining and especially hazardous solid wastes;
- Contamination of soil, ground and surface water through occasional accidental spillage.

(iii) Agriculture

- Contamination of soil, ground and surface water through punctual direct discharge of liquid manure to lagoons and surface waters;
- Contamination of surface waters and soil through surface runoff of usually overdosed agrochemicals;
- Contamination of agricultural areas through usage of polluted irrigation water.

(iv) Traffic and transport infrastructure

- Pollution of waterways through untreated discharge of wastewater and oil substances from river shipping (inadequate control);
- Pollution of waterways through untreated discharge of wastewater and oil substances from river ports, not equipped with adequate collection, storage and treatment facilities;
- Contamination of soil and surface waters through precipitation of toxic substances from the air.

(v) Protection areas

- Insufficient reservation of ecologically sensitive areas as official protection areas (due to lack of funding sources);
- Insufficient management and control of officially declared protection areas;
- Insufficient reservation and control of ground water protection zones.

3. Population and Water Sector Relevant Characteristics

3.1. Population

Country specific population data are compiled in Table 3.1 and illustrated in Fig. 3.1.

(a) Present Population of the DRB Countries

According to officially published or reasonably up-dated figures the present population of the 13 DRB countries is about 223 million.

For the particular countries the number of population varies between 2.0 million (Slovenia) and 82 million (Germany). Only three countries (Germany, Ukraine and Romania) have a population of more than 22 million, the other ten countries have a population between 2.0 and 11 million.

The average share of urban population in the DRB countries (excluding Germany and Austria) is about 63%.

For the particular countries the share of urban population varies between 46% (Moldova) and 70% (Croatia) and is at the time being atypically high in BiH (80%).

The average population density of all thirteen DRB countries is 119 people/km^2.

For the majority of the countries the population density is between 82 people/km^2 (Bulgaria) and 131 people/km^2 (Czech Republic). Significantly higher is the population density in Germany (230 people/km^2), significantly lower in Bosnia & Herzegovina (46 people/km^2).

(b) Present Population Living in the Danube River Basin

According to the provided estimates the aggregated population of the DRB is about 81 million or 36% of the total population of the 13 DRB countries.

There are two countries, Hungary and Romania, which are completely, respectively with 99% of their territory, located within the DRB. On the other side there are two large countries, Ukraine and Germany, with a share of not more than 6%, respectively 11% of their population living in the Danube River Basin.

The average share of urban population in the DRB (excluding Germany and Austria) is about 57%, and thus about 6% lower than the average share in the 13 DRB countries.

For the majority of the countries the share of urban population in the Danube River Basin is more or less in the same range as for the whole county; only in Croatia and Ukraine the share of urban population in the Danube River Basin is significantly below the country wide average.

The average population density in the Danube River Basin is 101 people/km^2 and thus about 15% lower than the average population density of the 13 DRB countries.

TABLE 3.1

PRESENT AND PROJECTED POPULATION IN THE COUNTRIES OF THE DANUBE RIVER BASIN

	Population Characteristics	Unit	BiH	Bulgaria	Croatia	Czech Republic	Hungary	Moldova	Romania	Slovakia	Slovenia	Ukraine	Yugos-lavia	Germany	Austria	All Countries
A	**Present Population of the Country (1996/97)**	**Million**	**3,8**	**8,3**	**4,8**	**10,3**	**10,2**	**4,3**	**22,6**	**5,4**	**2,0**	**50,9**	**10,4**	**82,1**	**8,1**	**223,2**
	- Urban Population	(%)	80%	68%	70%	60%	63%	46%	55%	57%	53%	68%	52%			63%
	- Rural Population	(%)	20%	32%	30%	40%	37%	54%	45%	43%	47%	32%	48%			37%
	- Population Density	Pop/km2	74	82	85	131	109	128	95	110	98	84	102	230	96	119
B	**Present Population in the DRB (1996/97)**	**Million**	**2,9**	**3,9**	**3,2**	**2,8**	**10,2**	**1,1**	**21,2**	**5,2**	**1,7**	**3,1**	**9,0**	**9,1**	**7,7**	**81,2**
	- Urban Population (%)	(%)	80%	70%	55%	60%	63%	27%	55%	50%	54%	45%	52%			58%
	- Rural Population (%)	(%)	20%	30%	45%	40%	37%	73%	45%	50%	46%	55%	48%			43%
	- Population Density (Population / Km2)	Pop/km2	79	84	94	131	109	91	89	116	99	95	101	162	96	101
C	**Projected Population of the Country (2020)**	**Million**	**5,2**	**8,3**	**4,5**	**9,5**	**9,5**	**4,1**	**22,8**	**5,5**	**2,2**	**52,4**	**10,8**	**82,9**	**8,3**	**225,9**
	- Urban Population	(%)	65%	68%				51%	55%			69%	66%			
	- Rural Population	(%)	35%	32%				49%	45%			31%	34%			
	- Population Density	Pop/km2	102	82	79	121	102	121	96	111	108	87	106	232	99	121
D	**Projected Population in the DRB (2020)**	**Million**	**3,7**	**3,9**	**3,0**	**2,6**	**9,5**	**1,0**	**21,4**	**5,2**	**1,9**	**3,2**	**8,8**	**9,2**	**8,0**	**81,3**
	- Urban Population	(%)	65%	70%				34%	55%			46%	67%			
	- Rural Population	(%)	35%	30%				66%	45%			54%	33%			
	- Population Density	Pop/km2	99	84	88	121	102	83	90	118	111	98	99	164	99	101
	Remarks:	Slovakia: projection figures for year 2010 Bulgaria: No projections available; it is schematically assumed that the population will remain at the present level														

FIG 3.1-1: PRESENT AND PROJECTED POPULATION IN THE COUNTRIES OF THE DANUBE RIVER BASIN

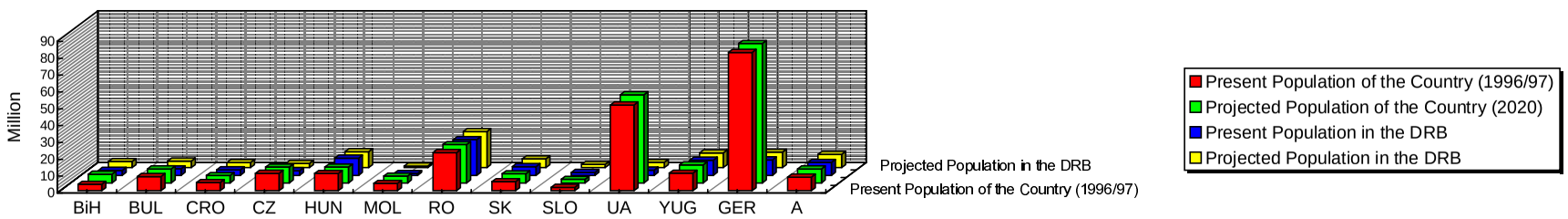
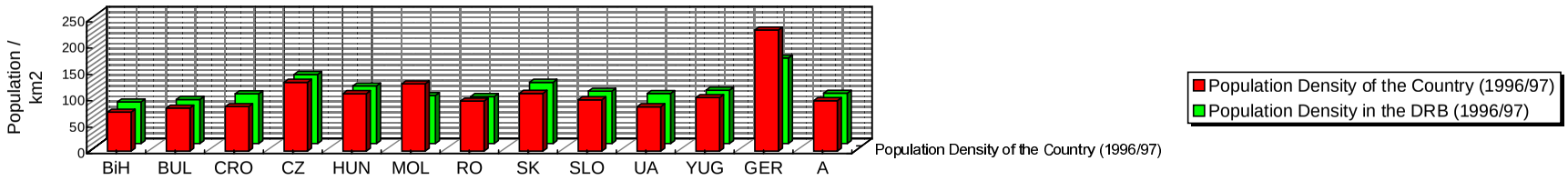


FIG 3.1-2: POPULATION DENSITY IN THE COUNTRIES OF THE DANUBE RIVER BASIN



(c) Projection of Population in the DRB Countries

For the majority of the 13 DRB countries it is in the prevailing phase of economic transition and social uncertainty difficult to obtain reliable projections for the planning horizons 2010, respectively 2020.

Either there are no officially published projections or the projections give a broad range of possible developments. The lower edge of this range is usually defined by "status-quo projections", which are based on the relatively unfavorable trends of the previous years, the upper edge by "target projections" which are usually based on optimistic, partly unrealistic, recovery of the economic and social systems.

The population projections compiled in Table 3.1 represent rather moderate expectations for the following two decades.

According to the projections favored by the national experts it can be expected that the aggregated number of population of the 13 DRB countries will be about 226 million by the year 2020 and thus actually remain at the present level.

According to the country specific projections there is no country (with the exemption of BiH) for which the projected population by the year 2020 is expected to differ more than plus or minus 5% from the number of the present population. For this reason the demographic development cannot be considered a decisive factor for population related demand projections, at least not on national level.

(d) Projection of Population Living in the Danube River Basin

Bearing in mind the difficulties to obtain at the time being reliable projections on national level, it is even more complicated to obtain projections on regional level.

For this reason the country specific projections for the population living in the Danube River Basin are usually directly derived from the nation-wide projections.

From the provided projection figures it can be concluded that the population living in the Danube River Basin by the year 2020 will be of the order of 81 million and thus also remain actually at the present level.

3.2. Country Territories and River Catchment Areas

Data on country territories and details on specific river catchment areas are compiled in Table 3.2 and illustrated in Fig 3.2.

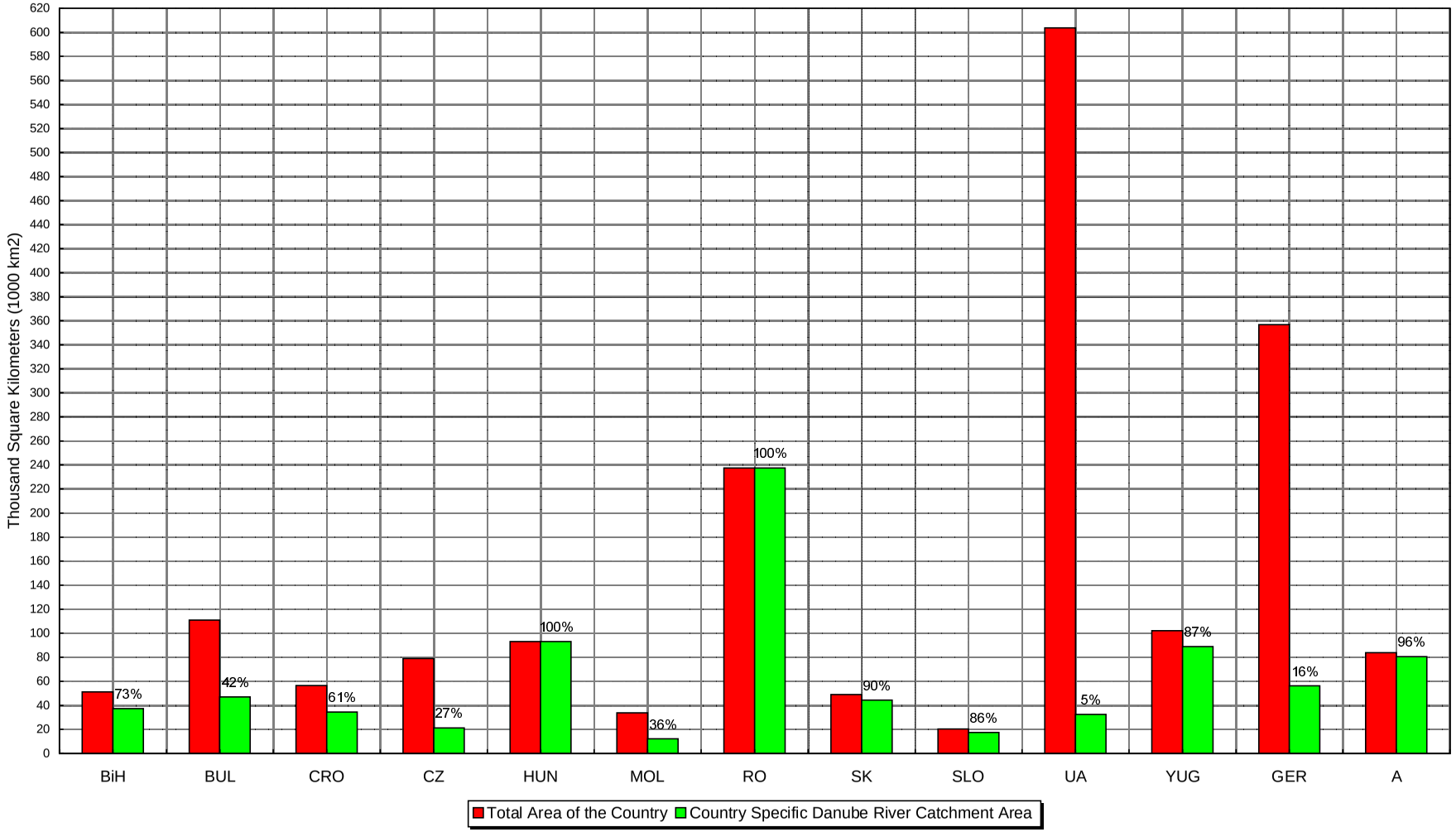
According to the provided figures the aggregated territory of the 13 DRB countries is about 1877 million square kilometers.

The aggregated area of the Danube River Basin is about 817 million square kilometers, or 43 % of the total territory of the 13 DRB countries.

TABLE 3.2
TERRITORIES AND RIVER CATCHMENT AREAS OF THE DRB COUNTRIES

Country		Country Territory	Catchment Areas of the Danube River System by main Rivers											Area of the Country in the DRB	
		1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	1000 km2	**1000 km2**	**%**
BiH	Rivers		Una	Vrbas	Bosna	Drina	Sava								
	Area	**51,182**	8,554	5,806	14,641	5,215	3,100							**37,316**	**73%**
Bulgaria	Rivers		Danube	Ogosta	Iskar	Vit / Osram	Yantra	Rous. Lom	Others						
	Area	**111,000**	2,480	3,117	8,366	4,390	6,860	2,869	17,884					**46,953**	**42%**
Croatia	Rivers		Danube	Drava	Sava										
	Area	**56,542**	2,416	6,888	25,100									**34,404**	**61%**
Czech Republic	Rivers		Morava	Vlara											
	Area	**78,866**	20,681	0,464										**21,145**	**27%**
Hungary	Rivers		Danube	Tisa											
	Area	**93,030**	50,547	42,483										**93,030**	**100%**
Moldova	Rivers		Prut	Yalpugh	Cahul										
	Area	**33,840**	8,240	3,180	0,605									**12,025**	**36%**
Romania	Rivers		Som./Tisa	Crisuri	Mures	Bega/etc	Jiu-Cerna	Olt	Arges-V.	Ialomita-B.	Siret	Prut-B.	Others		
	Area	**237,500**	22,300	14,860	29,390	14,440	11,440	24,010	17,980	15,654	30,406	18,210	38,730	**237,420**	**100%**
Slovakia	Rivers		Morava	Danube	Vah-Nitra	Hron	Ipel	Bodrog-T.	Slana	Bodva	Hornad				
	Area	**49,014**	2,257	1,138	16,005	5,465	3,647	7,329	3,191	0,893	4,427			**44,352**	**90%**
Slovenia	Rivers		Drava	Mura	Sava	Kolpa									
	Area	**20,253**	2,806	1,625	12,120	0,958								**17,509**	**86%**
Ukraine	Rivers		Danube	Tisa	Prut	Siret	Latoritsa	Uzh							
	Area	**603,700**	7,850	7,900	9,630	2,070	2,890	2,010						**32,350**	**5%**
Yugoslavia	Rivers		Danube	Tisa	Tamis	Sava	Morava	Mlava	Pek	Timok					
	Area	**102,173**	3,169	8,994	1,107	31,046	37,269	1,886	1,233	4,215				**88,919**	**87%**
Germany	Rivers														
	Area	**356,778**												**56,240**	**16%**
Austria	Rivers		Danube	Inn/Salz.	Traun	Enns	Moldau	March	Leitha	Rabnitz/R.	Mur	Drau			
	Area	**83,850**	12,353	15,911	4,274	6,075	7,359	3,670	2,145	6,649	10,313	11,815		**80,564**	**96%**
Total	**Area**	**1877,728**												**802,227**	**43%**
Total including small areas located in Italy, Switzerland, Albania and Poland														**817,000**	

FIG 3.2: TERRITORIES AND RIVER CATCHMENT AREAS OF THE DRB COUNTRIES



Two countries, Hungary and Romania, are completely, respectively with 99% of their territory, located within the Danube River Basin. On the other side only 5% of the territory of Ukraine and 16% of the territory of Germany are located within the DRB. For the other countries the share of territory located within the DRB varies between 27% (Czech Republic) and 96% (Austria).

3.3. Economic Indicators for the DRB Countries

The main economic indicators for each of the DRB countries are compiled in Table 3.3 and illustrated in Fig. 3.3-1 and 3.3-2.

The figures of Table 3.3 are based on data published in the EIU Country Reports for 1997/1998, respectively by EBRD, and on data provided by the National Review Reports. The figures for the different countries have to be considered as approximate and are not exactly compatible, as they represent either average, mid-year or end-year values; and in some cases preliminary values.

(a) Gross Domestic Product (GDP)

In 1997 the GDP of the DRB countries (expressed for the purpose of comparison in USD) varied from USD 1.9 billion in Moldova to USD 2034 billion in Germany, that means by a factor of more than 1000.

Apart from Germany and Austria, the countries with the highest total GDP (between USD 45 and USD 50 billion) are Czech Republic, Hungary and Ukraine.

In this context it has to be noted that the GDP figures expressed in USD are calculated on the basis of the official USD exchange rates and do not really reflect the country specific "purchasing power parity". For this reason especially in the countries Ukraine, Moldova, Bulgaria and Romania the GDP figures expressed in USD do not fully represent the real value for the population in the countries.

(b) Composition of Gross Domestic Product (GDP) by Main Economic Sectors

In 1996, the most recent year for which a complete set of data is available, the composition of GDP by main economic sectors is extremely different from country to country and can be summarized as follows:

- The share of the agricultural sector (usually including forestry and fishery) varies between 1% in Germany and 34% in Romania.
- The share of the industrial sector (usually including mining and in some countries construction) varies between 19% in Romania and 45% in Ukraine.
- The share of the "tertiary sector" (including all residual sub-sectors) varies between 37% in Ukraine and 70% in Austria.

(c) GDP per Capita

In 1997 the GDP per capita (expressed in USD and therefore, as outlined above, not really reflecting the country specific "purchasing power parity") varied in the 13 DRB countries between USD 512 per annum (Moldova) and USD 25600 (Germany), that means by a factor of about 50.

The development of the country specific "GDP per capita in USD" between 1996 and 1997 (reflecting both the economic development in the country and the variation in the exchange rate between the national currency and the USD) can be summarized as follows:

- 3 countries with significantly increasing GDP/capita (between 10% and 40%):
  BiH, Moldova, Ukraine
- 8 countries with approximately stagnating GDP/capita (between -1.0% and +3.5%):
  Bulgaria, Croatia, Czech Republic, Hungary, Romania, Slovakia, Slovenia, Yugoslavia;
- 2 countries with decreasing GDP/capita of about 11% (mainly resulting from variation in exchange rates):
  Germany and Austria.

(d) Inflation Rates

Regarding the development of the annual "consumer price inflation rates" for the period 1995 to 1997 the 13 DRB countries can be categorized as follows:

- Two countries with extremely high inflation rates:
  - Bulgaria, with an increase from 62% to 1083%; (followed by a significant recovery with an expected rate of 30% in 1998);
  - Romania, with an increase from 32% to 155%;
- Four countries (BiH, Croatia, Czech Republic and Germany) with approximately stagnating inflation rates; varying actually between 2% and 9%;
- Seven countries with decreasing inflation rates; varying actually between 1.3% and 18.5%.

Regarding the actual inflation rates in 1997 the countries can be categorized as follows:

- Four countries with actually low inflation rates of less than about 4%:
  BiH, Croatia, Germany and Austria;
- Three countries with medium inflation rates between 6% and 8.5%:
  Czech Republic, Slovakia and Slovenia;
- Six countries with unacceptably high inflation rates of more than 11%:
  Bulgaria, Hungary, Moldova, Romania, Ukraine and Yugoslavia.

(e) Exchange Rates between National Currencies and USD

During the period 1995 -1997 all DRB countries experienced a devaluation of their national currencies against the USD. For seven countries (Croatia, Czech Republic, Moldova, Slovakia, Yugoslavia, Germany and Austria) this devaluation was less than 25%.

For the other countries the devaluation was partly significantly higher, for Bulgaria and Romania extremely high.

(f) Minimum Wages

The available data on "minimum wages" indicate that they are very different from country to country (e.g. USD 4.0 per month in Moldova and about USD 200 in Croatia).

In some countries the minimum wages (usually determined by law or government degree) really reflect the "existence minimum", and can therefor be considered as a criterion for the assessment of what the lowest income segment of the population can afford to pay for public services.

TABLE 3.3
MAIN ECONOMIC INDICATORS FOR THE DRB COUNTRIES

Country	Gross Domestic Product 1997	GDP by Main Sectors 1996			GDP/Capita (*)		Annual Inflation Rates			Exchange Rates: National Currencies to US$					Minimum Wage
					1996	1997	1995	1996	1997	Name of National Currency	1995	1996	1997	1998 January/ May	1996/ 1997
	Billion USD (*)	Agri-culture %	Industry Mining %	Services Others %	(**) USD/ Capita	(***) USD/ Capita	%	%	%	(NC)	NC/USD	NC/USD	NC/USD	NC/USD	USD/ Month
BiH (****)	4,1	--	--	--	776	1087	-12,0	3,0	3,0	KM	--	--	1,8	--	40-85
Bulgaria	9,9	11,7	28,3	60,0	1114	1227	62,0	123,0	1082,6	BGL	67,1	177,9	1717,7	--	77
Croatia	18,8	10,3	20,3	69,4	4243	4267	2,0	3,5	3,6	HRK	6,0	5,4	6,4	6,5	200
Czech Republic	48,9	5,0	33,8	61,2	5063	5050	9,1	8,8	8,5	CZK	26,5	27,0	31,7	--	76
Hungary	44,5	3,0	30,3	66,7	4308	4462	28,2	23,6	18,3	HUF	125,7	152,6	186,8	205,2	91
Moldova (****)	1,9	30,0	25,0	45,0	455	504	29,9	23,5	11,8	MDL	4,5	4,6	4,6	--	4
Romania	34,6	34,2	19,1	46,7	1569	1549	32,2	38,8	154,8	LEI	2600,0	3800,0	7200,0	8478,0	--
Slovakia	19,5	5,3	27,0	67,7	3531	3624	9,9	5,8	6,1	SK	29,7	30,7	33,7	34,4	87
Slovenia	17,4	5,2	36,1	58,7	9254	9101	13,4	9,9	8,3	SIT	118,5	135,4	159,7	--	--
Ukraine (****)	49,7	17,8	44,8	37,4	880	976	377,0	80,0	16,0	HRN	1,5	1,8	1,9	2,1	27
Yugoslavia	15,5	19,9	37,8	42,3	1477	1462	74,1	93,1	18,5	YUD	4,7	5,1	5,9	10,6	36
Germany	2034,1	1,1	31,9	67,0	28790	25606	1,8	1,5	1,8	DM	1,4	1,5	1,7	1,8	--
Austria	195,7	2,1	27,6	70,3	27950	24691	2,2	1,9	1,3	ATS	10,1	10,6	12,2	12,4	--

Remarks:

al currencies

Intelligence Unit Limited, 1997/1998)

(***) Source: EBRD

ied by number of domestic population;

FIG 3.3-1: Gross Domestic Product per Capita in the DRB Countries

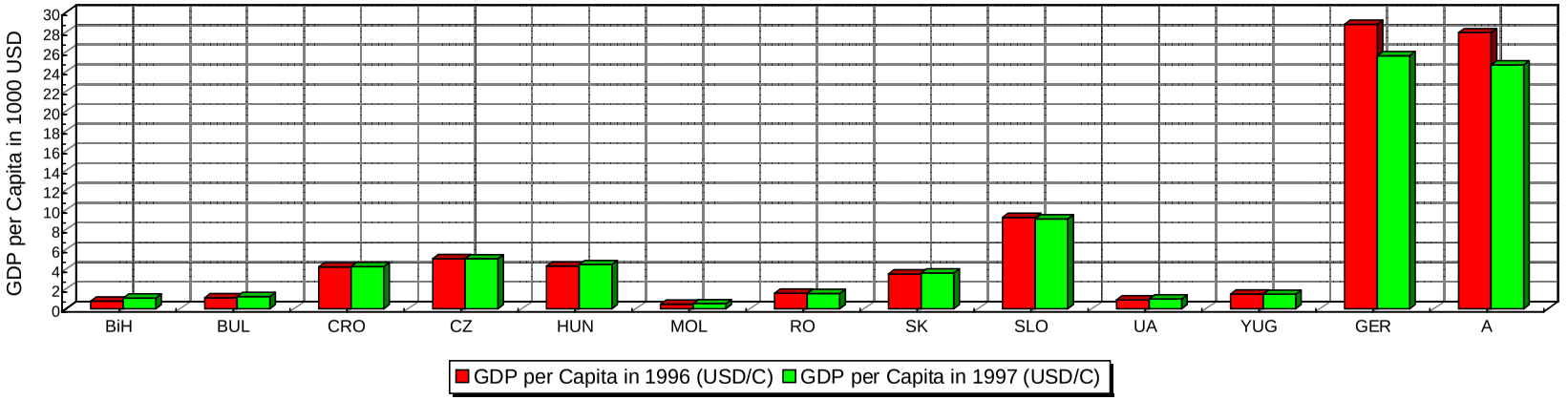
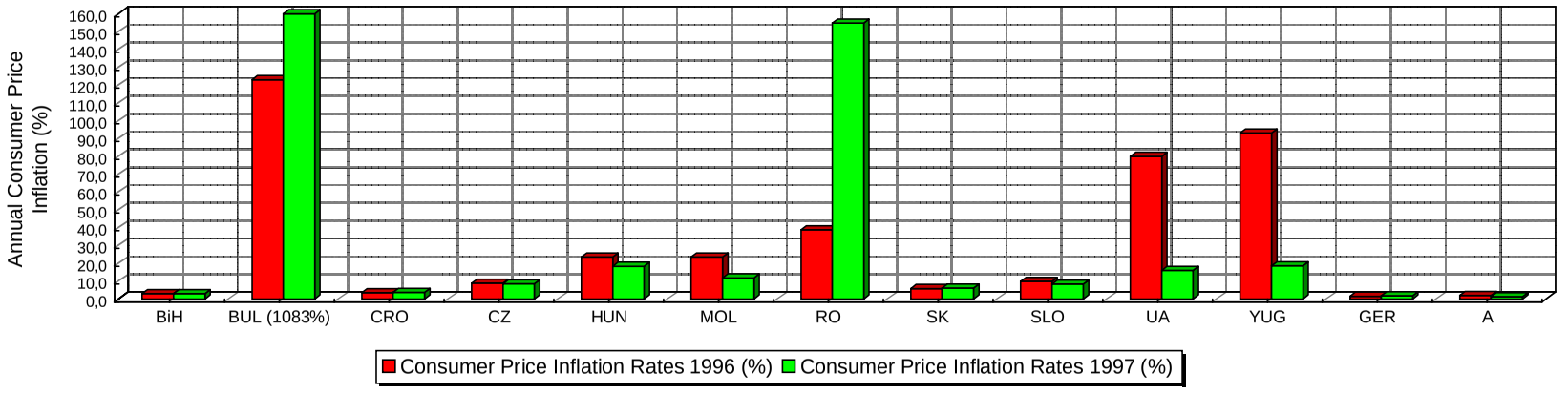


FIG 3.3-2: Annual Inflation Rates in the DRB Countries



3.4. Domestic Water Demand

From the National Review Reports it turns out, that some countries have problems to provide adequate and fully comparable figures regarding domestic water demand.

First of all there is a principal differentiation between population supplied by individual sources and population connected to central water supply systems.

(a) Water Demand of Population Supplied by Individual Water Sources

For most of the countries there are no reliable data on the overall water demand of the segment of the population supplied by individual water sources. As this demand category is of minor interest in the long term the main characteristics can shortly be summarized as follows:

- The share of population in the DRB supplied by individual water sources varies between 2% (Germany and Bulgaria) and 61% (Moldova); for the majority of the countries it is between 11% and 43%.
- The average "water demand per capita" is somewhere between 30 l/c/day and 100 l/c/day, depending on water availability and comfort of water supply (tap in the house or on the yard, etc.). The provided figures are usually estimated or "normative" figures.
- The main problems regarding individual water supply sources are seasonal variation in water availability and insufficient control of water quality.

(b) Present Water Demand of the Population in the DRB Connected to CWSS

The main characteristics of the water demand, respectively water consumption, of the population in the DRB connected to central water supply systems are compiled in Table 3.4 and illustrated in Fig. 3.4-1 and 3.4-2.

"Water demand" is in this context defined as the quantity of water which has to be supplied to cover the domestic demand (thus usually including consumption of private households and commercial, institutional and tourism consumption, as well as losses of water production and distribution). "Water consumption" is restrictively defined as the quantity of water which is actually used by the private households and which is usually metered and has to be paid for. For the purpose of comparability it is normally stated "per capita".

For the following reasons it is obvious that the figures provided for the particular countries cannot be fully comparable:

- Definitions for officially published water demand data are slightly different from country to country.
- In most of the countries, apart from Germany and Austria, neither the primary water production and network losses, nor the final consumption of the population are reasonably metered. Usually only the industrial consumption and the consumption of larger public institutions (budget organizations) are to different extent metered.
- The domestic water demand and consumption is thus often a residual value and a composite of overestimated water production, underestimated network losses, not fully known number of connected households and people and "normatively" defined consumption figures per capita, per household or per flat.

Bearing in mind these basic problems of data reliability the aggregated annual water demand of the population in the DRB connected to centralized water supply systems is of the order of 6100 million m^3.

The "average water demand per capita" varies between 147 l/c/day (Hungary) and as much as 409 l/c/day in Romania and 435 l/c/day in Bulgaria. Without Bulgaria and Romania (two countries with low degree of consumption metering and insignificantly low water prices until 1996) the "water demand per capita" varies between 147 l/c/day and 255 l/c/day, which is a reasonable range, taking into account the above stated problems.

The share of population connected to central water supply systems varies between 29% (Moldova) and 98% (Bulgaria and Germany).

Excluding Germany and Austria (with losses of less than 15%), the losses stated for the particular countries vary between 17% (Ukraine) and 43% (Bulgaria).

From water utility studies in the concerned countries (as for example Ukraine) it is recognized that the actual water losses are not really known, but should be significantly higher than the stated figures (in out-dated supply systems up to 50%).

Not taking into account the extremely high "per capita consumption" of 244 l/c/day in Romania and the extremely low consumption of 98 l/c/day in Czech Republic (a figure which is derived from the "actually billed consumption") the "average consumption per capita" varies between 107 l/c/day (Hungary) and 190 l/c/day (Bulgaria).

(c) Projection of Water Demand of the Population in the DRB Connected CWSS

The country specific projections of the domestic water demand for the planning horizon 2020, respectively for the years 2015/2010 in countries for which projections up to 2020 are not available, have to be considered as very tentative. From Table 3.4 can be seen that the projections are usually based on the assumption of

- either increasing or decreasing water demand per capita;
- usually increasing share of population connected to central water supply systems; and
- usually decreasing water production and network losses.

Following the projections provided by the National Review Reports the aggregated water demand of the population in the DRB connected to central water supply systems is anticipated to increase to about 7400 million m^3, which is about 20 % higher than the present water demand of about 6100 million m^3 per year.

TABLE 3.4
DOMESTIC WATER DEMAND IN THE DANUBE RIVER BASIN

Country	Water Demand Characteristics of Present Population Connected to Central Water Supply Systems							Water Demand Characteristics of Projected Population Connected to Central Water Supply Systems						
	Year	Present Population in the DRB	Total Demand per Year	Water Demand per Capita	Portion of Population Connect. to Cent. Syst.	Range of Losses	Per Capita Consump-tion	Year	Projected Population in the DRB	Total Demand per Year	Water Demand per Capita	Portion of Population Connect. to Cent. Syst.	Range of Losses	Per Capita Consump-tion
		Million	Mln m3/a	l/c/d	%	%	l/c/d		Million	Mln m3/a	l/c/d	%	%	l/c/d
Bosnia & Herzeg. (2)	1997	2,9	153	250	57%	40%	150		3,7	404	305	98%	20%	
Bulgaria (1)	1996	3,9	622	439	98%	43%	190	2010	3,9	369	260	99%		
Croatia (3)	1997	3,2	184	254	62%	35%	170	2015	3,0	184				
Czech Republic (1)	1995	2,8	201	248	80%	26%	98	2015	2,6	230	282	86%		150
Hungary	1996	10,2	546	147	96%	27%	107	2020	9,5	744	217	99%		
Moldova	1995	1,1	21	177	29%	20%	143	2020	1,0	59	241	67%	10%	217
Romania (1)	1996	22,6	2062	409	61%	22%	244	2020	22,8	2928			20%	
Slovakia	1997	5,2	361	245	78%	23%	177	2010	5,2	340	226	79%		178
Slovenia	1995	1,7	100	196	81%	28%	141	2020	1,9	101	158	90%	20%	126
Ukraine	1997	3,1	136	172	70%	17%	144	2020	3,2	140	172	70%		
Yugoslavia (4)	1991	9,0	372	255	45%	30%	179	2020	8,8	598	293	64%	18%	240
Germany (1)	1997	9,1	750	230	98%		146	2020	9,2	667	200	99%		135
Austria (1)	1997	7,7	586	242	86%		145	2020	8,0	604	237	86%		145
Total		**82,6**	**6093**						**82,8**	**7368**				

Remarks:

(1) "Specific water demand": including water losses and other population related demand (such as administrative, commercial, touristic demand, etc)

(2) Water demand figures for Bosnia & Herzegovina are "normative figures" (disregarding actual war demages)

(3) No projection figures available: it is schematically assumed that the domestic water demand will approximately remain constant

(4) Data for urban population connected to large CWSS;

FIG 3.4-1: Annual Water Demand of the Population in the DRB Connected to Central Water Supply Systems

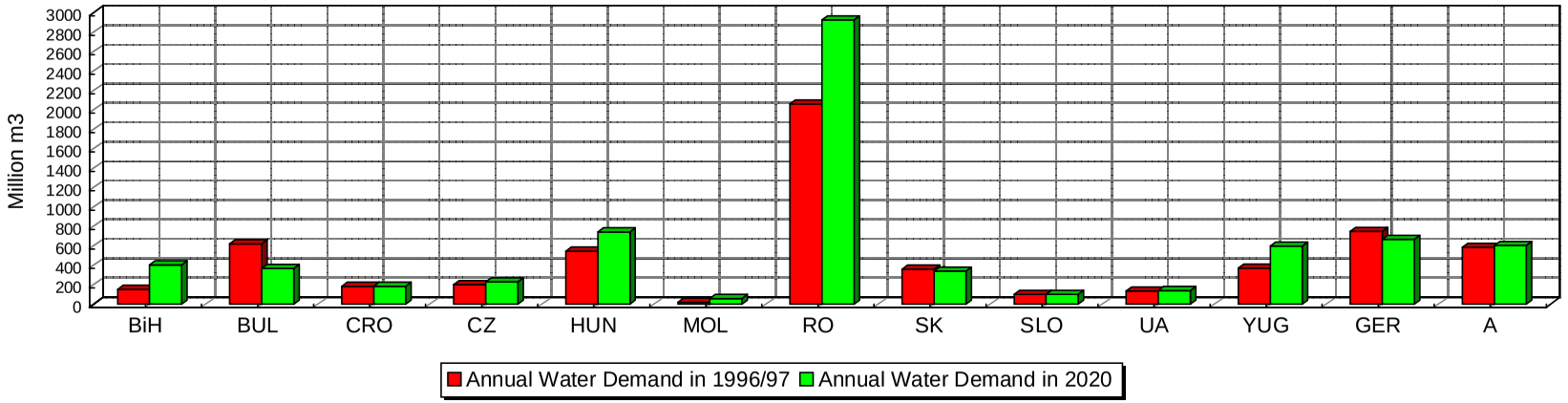
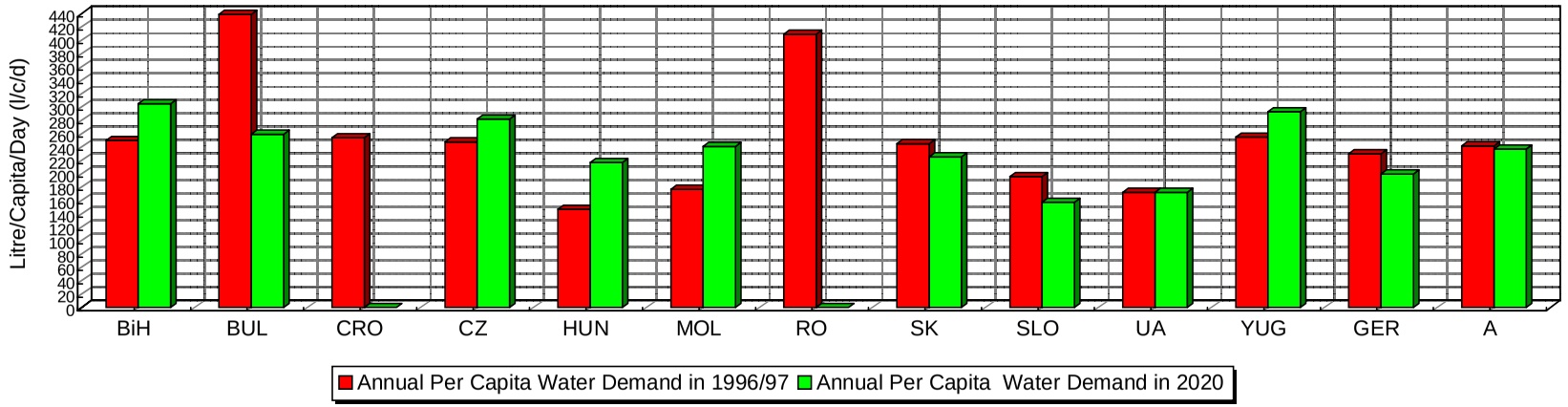


FIG 3.4-2: Annual Per Capita Water Demand of the Population in the DRB Connected to Central Water Supply Systems



3.5. Domestic Wastewater Generation

Regarding domestic wastewater generation there is a principal differentiation between population using individual wastewater solutions (e.g. septic tanks, etc.) and population connected to central sewerage systems.

(a) Wastewater Generation of Population Using Individual Solutions

For most of the DRB countries there are no reliable data on the wastewater generation by population using individual solutions. The main characteristics of the individual solutions can shortly be summarized as follows:

- The share of population in the DRB using individual systems for wastewater collection, treatment and discharging varies between 11% (Germany) and 86% (Moldova). In 6 countries more than 50% of the population use some kind of individual solution; in the rural areas of some countries this share is higher than 95%.
- The average "wastewater generation per capita" is usually not known. If figures are stated they are derived from the corresponding water consumption (usually between 30 l/c/day and 100 l/c/day) and based on the assumption that portions between 20% (in urban areas) and up to 80% (in rural areas) are directly discharged into the ground or used for agricultural or gardening purposes.
- The main problem of the individual wastewater solutions is that the privately owned facilities are often not properly maintained and operated and constitute therefor a permanent or periodically relevant hazard of soil and ground water contamination. Another general problem is that there are usually no appropriate methods and facilities for adequate disposal of sludge from septic tanks.

(b) Present Wastewater Generation of the Population in the DRB Connected to CSS

The main characteristics of the wastewater generation of the population in the DRB connected to central sewerage systems are compiled in Table 3.5 and illustrated in Fig. 3.5-1 and 3.5-2.

According to the figures provided by the particular National Review Reports the aggregated wastewater generation of the population in the DRB connected to central sewerage systems is of the order of 2500 million m^3. The high difference to the aggregated water demand of about 6100 million m^3 can be explained by the following two facts:

- The "wastewater generation per capita" is significantly lower than the "water demand per capita", (due to the exclusion of water losses which are usually between 17% and 43% and portions of 10% to 20% of the supplied water which are not discharged to the sewerage systems but used otherwise).
- The country specific connection rates to central sewerage systems are in all countries significantly lower than the connection rates to central water supply systems.

The wastewater generation per capita varies between 80 l/c/day (Czech Republic; a figure which is derived from the "billed" quantities of water supply) and 202 l/c/day (Slovakia).

The share of population connected to central sewerage systems varies between 14% (Moldova) and 89% (Germany).

As data on wastewater treatment and "infiltration water" are usually not separately available for the category of domestic wastewater, but usually only for total municipal sewerage systems and wastewater treatment plants these aspects are dealt with in Chapter 5.

(c) Projection of Wastewater Generation of the Population in the DRB Connected to Central Sewerage Systems

The country specific projections of the domestic wastewater generation for the planning horizon 2020, respectively for the years 2015/2010 in countries for which projections up to 2020 are not available, have to be considered as very tentative. From Table 3.5 can be seen that the projections are usually based on the assumption of

- either decreasing, approximately stagnating or increasing wastewater generation per capita; and
- increasing share of population connected to central water supply systems.

Following the projections provided by the National Review Reports the aggregated wastewater generation of the population in the DRB connected to central sewerage systems is anticipated to increase to about 3900 million m^3 per year, which is about 56% higher than the present wastewater generation of 2500 million m^3 per year.

TABLE 3.5
DOMESTIC WASTE WATER GENERATION IN THE DANUBE RIVER BASIN

Country	Present Waste Water Generation in the Danube River Basin of Population Connected to Central Sewerage Systems							Projected Waste Water Generation in the Danube River Basin of Population Connected to Central Sewerage Systems						
	Year	Present Population in the DRB	Total Waste Water Generation	Waste Water Generation per Capita	Percentage of Population Connected to Central Sewerage Systems			Year	Projected Population in the DRB	Total Waste Water Generation	Waste Water Generation per Capita	Percentage of Population Connected to Central Sewerage Systems		
					Total	Urban	Rural					Total	Urban	Rural
		Million	Mln m3/a	l/c/d	%	%	%		Million	Mln m3/a	l/c/d	%	%	%
Bosnia - Herceg. (1)	1997	2,9	70	125	52%				3,7	316	234			
Bulgaria	1996	3,9	149	161	65%	91%	5%	2010	3,9	332				
Croatia (2) (3)	1996	3,2	87	178	41%			2015	3,0	81				
Czech Republic (2)	1995	2,8	57	80	71%			2015	2,6	96	128	80%		
Hungary	1996	10,2	231	139	45%	67%	6%	2020	9,5	639	205	90%		
Moldova	1996	1,1	9	152	14%	48%	1%	2020	1,0	46	260	49%	95%	25%
Romania	1996	22,6	665	197	41%			2020	22,8	960				
Slovakia (2)	1997	5,2	189	202	50%			2010	5,2	187	142	69%		
Slovenia	1995	1,7	32	108	46%			2020	1,9	57	108	75%		
Ukraine (3)	1997	3,1	90	157	51%	75%	3%	2020	3,2	93				
Yugoslavia	1997	9,0	152	140	33%	63%		2020	8,8	306	192	50%	74%	
Germany	1997	9,1	460	155	89%			2020	9,2	447	146	95%		
Austria	1997	7,7	306	145	75%			2020	8,0	358	145	85%		
Total		**82,6**	**2496**						**82,8**	**3917**				

Remarks:

(1) Waste water figures for Bosnia & Hercegovina are "normative figures" (disregarding war demages)

(2) Waste water projection for Croatia and Czech Republic for year 2015, for Slovakia for year 2010;

(3) Projection of waste water generation proportionally to development of population

FIG 3.5-1: Annual Waste Water Generation of the Population in the DRB Connected to Central Sewerage Systems

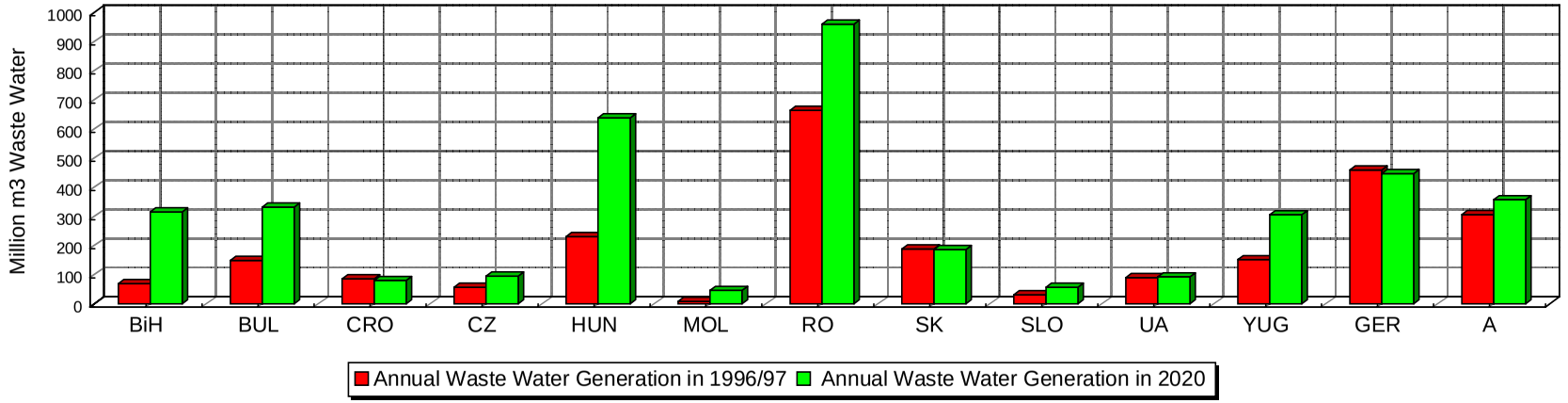
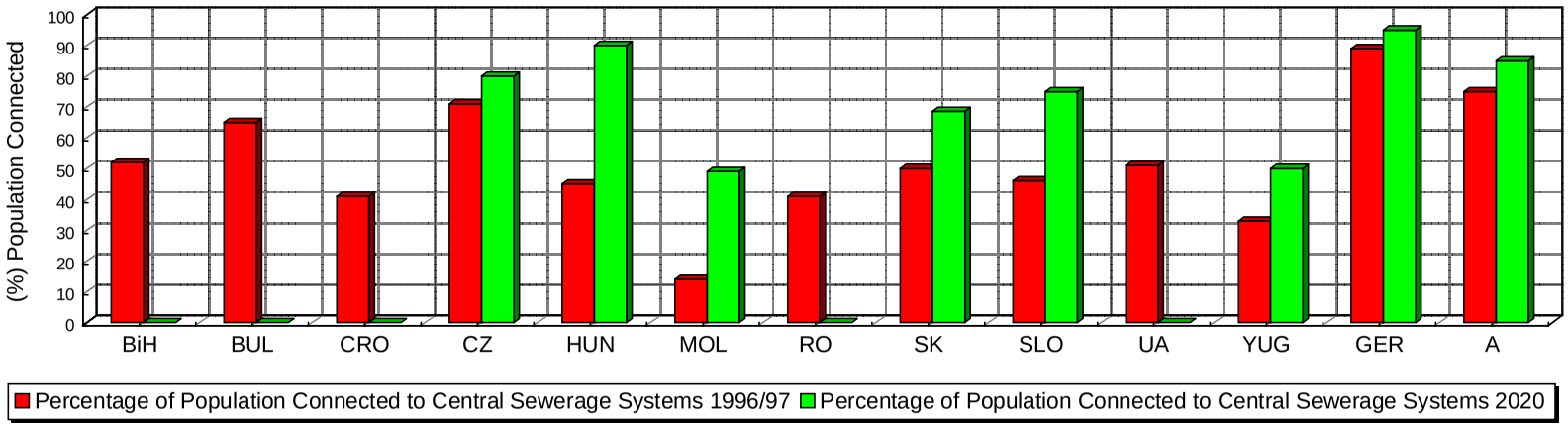


FIG 3.5-2: Percentage of Population in the DRB Connected to Central Sewerage Systems



4. Population Potentially Affected by Water Pollution

4.1. Population Potentially Affected by Unsanitary Conditions in the DRB

The National Review Reports for the eleven DRB countries (without Germany and Austria) provide a lot of detailed information and data on the population potentially affected by unsanitary conditions in the Danube River system.

Table 4.1 at the end of this chapter contains two compilations which indicate for each country two levels of affection through unsanitary conditions in the Danube River system: the lower level is characterized by the number of population living along river stretches exceeding "water quality standards for bathing water", the higher level by the number of population living along river stretches exceeding "raw water quality standards for drinking water".

(a) Population Living along River Stretches Exceeding "Water Quality Standards for Bathing Water"

The basis for the determination of the portion of concerned population are usually river stretches of "water quality classes IV and V", respectively river stretches of comparable national classification. The number of population living along these river stretches have been obtained by aggregating the population of all communities and municipalities directly located at these river stretches. It is obvious that the number of concerned population is not more than a general indicator, because the relation between the number of people living in a certain distance of a watercourse and the function of the watercourse (in this case the "bathing function") can sometimes be relatively loose due to particular settlement or topographic issues, etc.

Nevertheless it is interesting that in the eight countries for which data are available a total number of about 16.5 million people, or 33% of the corresponding population living in the DRB, live along or in close vicinity to watercourses in which the water quality is below a defined "water quality standard for bathing water".

In the particular countries the share of population living along river stretches exceeding "water quality standards for bathing water" varies between 12% (Moldova) and 82% (Slovakia) of the total population living in the country specific part of the DRB.

In this context it has to be stated that for most of the countries the number of concerned population seems to be underestimated, because population living along small or "unclassified" watercourses have usually not been taken into account.

(b) Population Living along River Stretches Exceeding" Raw Water Quality Standards for Drinking Water"

The basis for the determination of the portion of concerned population are usually river stretches of "water quality classes III, IV and V", respectively river stretches of comparable national classification.

In this context it is essential to recognize that the population living along such river stretches is not actually affected by insufficient quality of drinking water supply.

The number of concerned population is just a further indicator, because there is usually no direct relation between the number of people living in a certain distance of a watercourse of certain water quality and the actual quality of drinking water supply, which is particularly in the case of insufficient surface water quality based on ground water sources.

In the eight countries for which data are available a total number of about 18.6 million people, or 38% of the corresponding population living in the DRB, live along or in close vicinity to watercourses in which the water quality is below defined "raw water quality standards for drinking water".

In the particular countries the share of population living along river stretches exceeding "raw water quality standards for drinking water" varies between 16% (Moldova) and 98% (Slovakia) of the total population living in the country specific part of the DRB.

In this case the number of concerned population is obviously underestimated, because for three countries for which adequate data are not available the lower number of population living along river stretches exceeding "water quality standards for bathing water" has been adopted. From a plausible adjustment of the available figures can be concluded that at least 50% of the total population in the DRB live along or in close vicinity to watercourses in which the water quality is below defined "raw water quality standards for drinking water".

4.2 Health Hazards through Water Pollution in the Danube River System

In general terms the main health hazards mediated by water from the Danube River system can be summarized as outlined in Table 4.2.

Table 4.2. Water Mediated Health Hazards in the DRB

Health Hazards	Water Related Causes	Sources of Problems
Communicable diseases	Pathogens in:	Insufficient water supply
- dysentery	- drinking water	Sewage contamination
- hepatitis	- recreational water	Manure
- salmonellosis	- irrigation water	
- cholera; etc.	- fish consumption	
Acute intoxications	Toxic substances in:	Inadequate water treatment
And	- drinking water	Sewage contamination
Chronic diseases	- irrigation water	Manure
	- fish	Agrochemicals
	- recreation water	Industry, hazardous wastes
		River / road traffic
Allergies and skin	Proliferation of toxic	Nutrient overloading from:
Irritations (from bathing)	cyanobacteria	- sewage contamination
		- manure
		- agrochemicals
Skin and eye infections	Insufficient household	Insufficient water supply
And infestations	hygiene	

The occurrence and significance of health hazards mediated by water in the particular DRB countries depends actually on the following features:

- Raw water quality of the river stretches from which drinking and irrigation water is abstracted;
- Share and efficiency of water treatment of public water supply;

- Share of population not connected to public water supply systems and control of the individual water sources;
- Share and efficiency of municipal and industrial wastewater treatment;
- Share of population not connected to public sewerage systems and control of the individual wastewater facilities;
- Water quality of the river stretches which are used for water related recreation (such as bathing, swimming, etc.);
- Control of fish catch and fish products for consumption;
- Efficiency of water quality monitoring and control mechanisms, particularly regarding occasional accidents and spillages.

The most essential sources of water mediated health hazards recognized to different extent in all DRB countries (excluding Germany and Austria) are:

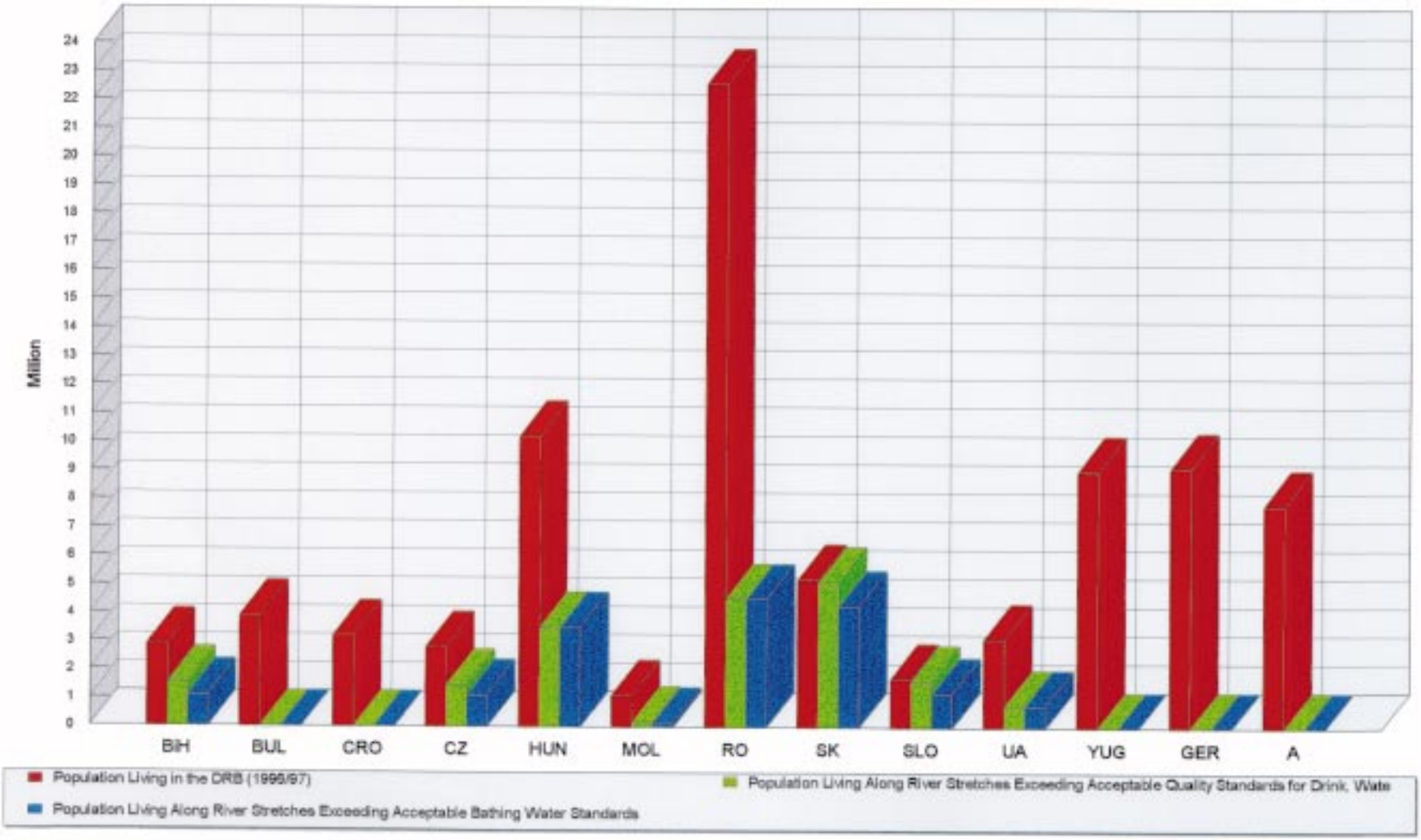
- Untreated or not properly treated municipal and industrial wastewater discharge;
- Untreated discharge of manure into lagoons, soil or surface waters;
- Pollution of surface and ground water through dump sites for all types of solid wastes (industrial and mining wastes, slag, ashes mud, etc.) located directly at watercourses or in areas dangerously close to groundwater aquifers or watercourses;
- Occasional accidents and spillages of toxic industrial and mining substances;
- Agrochemical runoff.

The main water mediated health hazards, respectively diseases, in the particular countries of the DRB are shortly described in Annex 4.2.

TABLE 4.1
POPULATION IN THE DANUBE RIVER BASIN POTENTIALLY AFFECTED BY UNSANITARY CONDITIONS IN THE DANUBE RIVER SYSTEM

Country	Population Living in the DRB	Population Living Along River Stretches Exceeding Raw Water Quality Standards for Drinking Water			Population Living Along River Strechtes Exceeding Water Quality Standards for Bathing Water		
		Number of Population	Portion of Population	Remarks	Number of Population	Portion of Population	Remarks
	Million	Million	%		Million	%	
BiH	2.9	1.531	53%		1.103	38%	
Bulgaria	3.9		0%			0%	
Croatia	3.2		0%			0%	
Czech Republic	2.8	1.470	53%	Strechtes of water quality classes III, IV, V	1.110	40%	Streches of water quality classes IV, V
Hungary	10.2	3.478	34%	Streches "unaccepably and seriously polluted" (1)	3.478	34%	Streches "unaccepably and seriously polluted"
Moldova	1.1	0.175	16%		0.136	12%	
Romania	22.6	4.499	20%	Strechtes exceeding "acceptable standards" (1)	4.499	20%	Strechtes exceeding "acceptable standards"
Slovakia	5.2	5.096	98%	Strechtes exceeding "acceptable standards"	4.254	82%	Strechtes exceeding "acceptable standards"
Slovenia	1.7	1.625	96%		1.192	70%	
Ukraine	3.1	0.767	25%	Strechtes exceeding "acceptable standards" (1)	0.767	25%	Strechtes exceeding "acceptable standards"
Yugoslavia	9.0		0%			0%	
Germany	9.1		0%			0%	
Austria	7.8		0%			0%	
Total	82.6	18.6	38%		16.539	33%	
Remarks:	(1) Under-estimation by adopting the same population figures as estimated for the river stretches exceeding "water quality standards for bathing water"						

FIG 4.1: POPULATION IN THE DANUBE RIVER BASIN POTENTIALLY AFFECTED BY UNSANITARY CONDITIONS IN THE DANUBE RIVER SYSTEM



5. Economic Significance of the Danube River System and Environmental Impacts of Economic Activities

5.1. Abstraction of Raw Water from the Danube River System

The water demand for domestic purposes and economic activities is in all DRB countries ensured by the utilization of both ground water and surface water (rivers, reservoirs, lakes, etc.). Surface water from the Danube River system is one more or less essential water resource for the following user categories:

- public water supply systems (usually supplying various consumer categories);
- industrial and mining enterprises (usually covering own raw water requirements);
- agricultural enterprises / co-operatives (agricultural and irrigation requirements);
- energy sector (mainly cooling water requirements).

The utilization of surface water in relation to ground water is very different from country to country and depends on:

- the quantity and quality of ground water resources, which constitute in all countries of the DRB considered the highest priority resource for public water supply systems and are usually negligible for cooling water requirements;
- the quality and seasonal reliability of surface water in acceptable distance;
- the raw water quality requirements of the particular user categories (e.g. potable, industrial, irrigation water);
- the cost of ground water production (pumping and transmission) in relation to the incremental cost of surface water treatment.

(a) Present Situation

Data on the actual abstraction of surface water from the Danube River system are compiled in Table 5.1 and illustrated in Figure 5.1. The country specific figures are stated for the most recent year for which data are available.

According to the figures provided the total aggregated volume of water abstracted from the Danube River System is currently about 12.7 billion m^3 per year (without cooling water). More than half of this volume is abstracted on the territory of Romania.

The additional volume of cooling water abstracted from the Danube River system is about 15.7 billion m^3 per annum and thus significantly higher than the volume of all other user categories together.

The figures of Table 5.1 indicate that the absolute and relative utilization of surface water from the Danube River system is very different from county to country as well as for the particular user categories.

Currently the total volume of surface water abstracted from the Danube River system is utilized as follows:

- 62 % for industrial and mining purposes (not including cooling water for power plants);
- 24 % for agricultural and irrigation purposes;
- 14 % for public/municipal water supply systems.

TABLE 5.1
ABSTRACTION OF RAW WATER FROM THE DANUBE RIVER SYSTEM

Country	Present Raw Water Abstraction from the Danube River System							Projected Raw Water Abstraction from the Danube River System						
	Year	Total Without Cooling Water	Public Water Supply Systems	Industry, Mining	Agri-culture, Irrigation	Other Purposes	Cooling Water	Year	Total Without Cooling Water	Public Water Supply Systems	Industry, Mining	Agri-culture, Irrigation	Other Purposes	Cooling Water
		Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a		Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a	Mln m3/a
BiH (1)	1997	57	7	49	--	--	--	2020	678	165	473	40	0	--
Bulgaria (3)	1996	234	--	211	17	6	176		--	--	--	--	--	--
Croatia (3)	1994	104	16	79	9	0	242		--	--	--	--	--	--
Czech Republic	1995	162	54	97	11	0	67	2015	270	54	189	28	0	--
Hungary (3)	1996	1148	41	171	935	0	4417		1217	49	205	963	0	--
Moldova	1996	114	17	7	79	11	0	2020	285	59	21	155	50	--
Romania (2) (3)	1996	7388	1237	4647	1504	--	2600		--	--	--	--	--	--
Slovakia	1997	879	49	747	83	0	0	2010	1481	113	1352	16	0	--
Slovenia (3)	1995	14	8	1	4	0	51		--	--	--	--	--	--
Ukraine (2) (3)		--	--	--	--	--	--		--	--	--	--	--	--
Yugoslavia (4)	1997	1152	271	457	424	--	5300	2020	4821	435	2362	2024	--	--
Germany	1997	164	34	130	0	0	1512	2020	172	42	130	0	0	--
Austria	1997	1300	0	1300	0	0	1300	2020	1300	0	1300	0	0	--
Total (Mln m3)		**12714**	**1734**	**7896**	**3067**	**17**	**15665**		**10226**	**917**	**6032**	**3227**	**50**	**--**
Total (%)		**100%**	**14%**	**62%**	**24%**	**0%**	**123%**		**100%**	**9%**	**59%**	**32%**	**0%**	

Remarks:

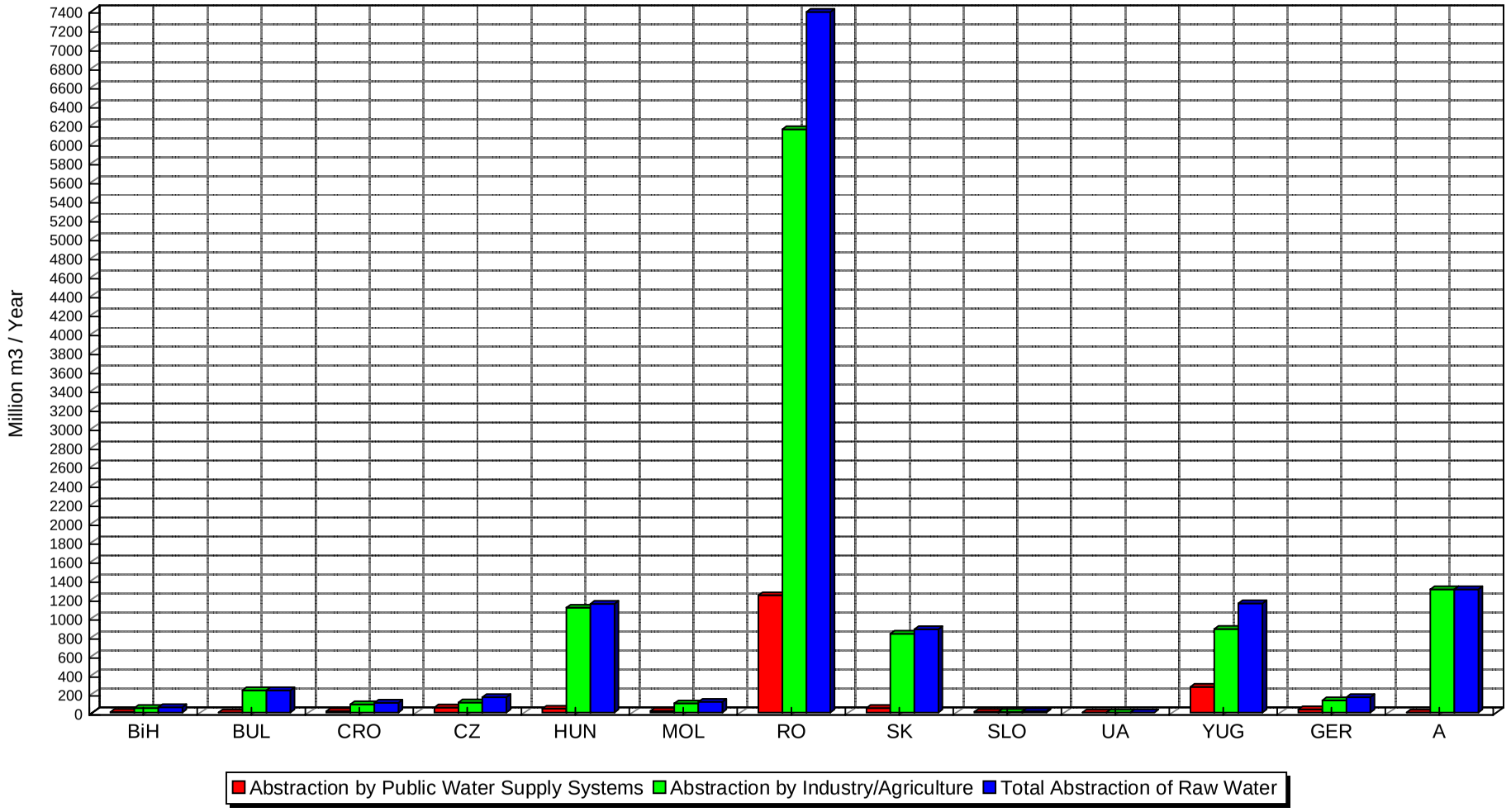
(1) Industrial water abstraction presently about 10% of pre-war volume;

(2) Schematic assumption: 60% of municipal water demand and 75% of industrial water demand abstracted from surface waters;

(3) No projection figures available

(4) Schematically assumed that 75% of water for irregation is abstracted from surface water;

FIG 5.1: Annual Abstraction of Raw Water from the Danube River System



The utilization of surface water from the Danube River system for industrial purposes is extremely different from country to country; according to the figures provided the utilization varies between 1% (Slovenia), 70% (Bulgaria) and 85% (Czech Republic).

For agricultural and irrigation purposes the utilization of surface water from the Danube River system varies between 56% (Bulgaria) and 94% (Slovenia).

(b) Projection of Water Abstraction from the Danube River System

The country specific projections for water abstraction from the Danube River system by the year 2020 are relatively fragmentary and very tentative.

Projections for the year 2020, respectively 2015, are available for eight countries. For these countries it is anticipated that the volume of water abstraction from the Danube River system will increase from presently 5.0 billion m^3 per year to 10.2 billion m^3 by the year 2020.

If the projection figures for these 8 countries are representative, it can be anticipated that the overall volume of surface water abstracted from the Danube River system could increase by about 100% between 1997 and the planning horizon 2020.

The actual utilization of raw water from the Danube River system will, however, depend on the actually quality and availability of surface water at the river stretches and locations where the water is needed.

5.2. Wastewater Discharge to the Danube River System

Data on the present and projected discharge of wastewater to the Danube River system are compiled in Table 5.2 and illustrated in Figure 5.2.

Table 5.2 contains aggregated figures on wastewater discharge from public sewerage systems and from industrial and agricultural enterprises directly discharging to the river system, as well as data on the standard of wastewater treatment. The country specific figures are stated for the most recent year for which data are available. In this context it has to be mentioned that the data on public/municipal sewerage systems seem to be relatively reliable; the data on industrial discharge do in some countries not include all enterprises (e.g. not the smaller ones) or all types of enterprises; agricultural discharge is obviously under-estimated, because in some countries data are not available or fragmentary. Not included are in any case volumes and treatment of wastewater, respectively sludge, from individual facilities (such as septic tanks, etc.).

(a) Present Volumes of Wastewater Discharge

According to the available data, the total volume of wastewater discharge to the Danube River system is presently about 12.6 billion m^3 per year. This total wastewater volume is composed of 7.4 billion m^3 (59%) wastewater from public sewerage systems and 5.2 billion m^3 (41%) industrial and agricultural wastewater directly discharged to the river system. The ratio between these two categories can be very different from country to country, depending on the fact, how much of the industrial and agricultural wastewater is in a particular country collected and discharged via public sewerage systems or directly discharged to the river system.

The high difference between the annual volume of 7.4 billion m^3 wastewater discharge from public sewerage systems and the annual domestic wastewater generation of not more than 2.5 billion m^3 per year, can be explained by the fact, that the volume of public wastewater discharge includes "infiltration water" (which can be as high as 20 to 30%) and additional portions of industrial and agricultural wastewater collected and discharged via public sewerage systems.

(b) Present Standard of Wastewater Treatment

Extent and standard of wastewater treatment is very different from country to country. Country specific data are either available for "overall wastewater discharge" or in some countries at least for "municipal wastewater discharge".

According to the provided data the share of wastewater discharged without any treatment varies between 0% (Germany) and 86% (Yugoslavia). From this point of view the DRB countries can be categorized as follows:

- Germany, Austria, Slovakia and Czech Republic;
  (share of "non-treated" wastewater discharge less than 10%);
- Hungary, Moldova;
  (share of "non-treated" wastewater discharge between 10 and 20%);
- Romania, Ukraine, Bulgaria, Slovenia;
  (share of "non-treated" wastewater discharge between 30 and 40%);
- Croatia, BiH, Yugoslavia;
  (share of "non-treated" wastewater discharge more than 80%);

The figures on the different type of wastewater treatment, as compiled in Table 5.2, can be used for a first assessment of the country specific treatment standard, but the figures have to be considered as relatively tentative. They partly reflect country specific classifications (e.g. categories such as "insufficient" or "sufficient" wastewater treatment) and do not reflect the actual efficiency of the treatment plants in operation.

(c) Projection of Wastewater Discharge

The country specific projections for wastewater discharge to the Danube River system by the year 2020 are relatively fragmentary and very tentative.

Projections for the year 2020, respectively 2015, are available for nine countries. For these countries it is anticipated that the wastewater discharge will increase from presently 8.0 billion m^3 per year to 11.9 billion m^3 by the year 2020.

If the figures of these countries should be representative it can be anticipated that the total volume of wastewater discharge to the Danube River system could increase by about 50% between 1997 and the planning horizon 2020.

TABLE 5.2
WASTE WATER DISCHARGE TO THE DANUBE RIVER SYSTEM

Country	Present Waste Water Discharge to the Danube River System												Projected Waste Water Discharge			
	Year	Total Waste Water Discharge					Municipal Waste Water Discharge					Industrial, Agricult., Other Discharge	Year	Total Waste Water Discharge	Municipal Discharge	Industrial, Agricult., Other Discharge
		Volume/ Year (1)	Type of Treatment				Volume per Year	Type of Treatment								
			Non-treated	Mech.-treated	Biolog.-treated	Others		Non-treated	Mech.-treated	Biolog.-treated	Others					
		Mln m3	%	%	%	%	Mln m3	%	%	%	%	Mln m3		Mln m3	Mln m3	Mln m3
BiH	1997	878	85%	0%	15%	0%	166	85%	0%	15%	0%	712	2020	985	425	560
Bulgaria	1996	0	0%	0%	0%	0%	314	-	-	-	-	0	2010	332	332	-
Croatia (3)	1990	253	81%	13%	6%	0%	127	-	-	-	-	127	2020	-	-	-
Czech Republic	1995	256	-	-	-	-	151	6%	7%	87%	0%	106	2015	289	192	97
Hungary	1996	749	13%	43%	42%	2%	608	14%	44%	39%	3%	140	2020	1285	825	460
Moldova	1996	36	13%	0%	87%	0%	9	-	-	-	-	27	2020	134	63	71
Romania	1996	3227	31%	52%	17%	0%	1870	42%	43%	15%	0%	1357	2020	-	-	-
Slovakia	1997	699	-	-	-	-	428	6%	5%	89%	0%	270	2010	656	656	-
Slovenia	1995	182	-	-	-	-	119	40%	37%	22%	2%	63	2020	-	-	-
Ukraine (2)	1997	295	32%	0%	14%	54%	90	60%	0%	38%	2%	205	2020	-	-	-
Yugoslavia	1997	1564	-	-	-	-	833	86%	8%	6%	-	731	2020	4288	1336	2952
Germany	1997	2096	0%	0%	43%	57%	1976	0%	0%	45%	55%	120	2020	2065	1957	108
Austria	1997	1800	-	-	-	-	670	-	-	-	-	1130	2020	1867	737	1130
Total		**0**					**7361**					**0**		**11902**	**6524**	**5379**

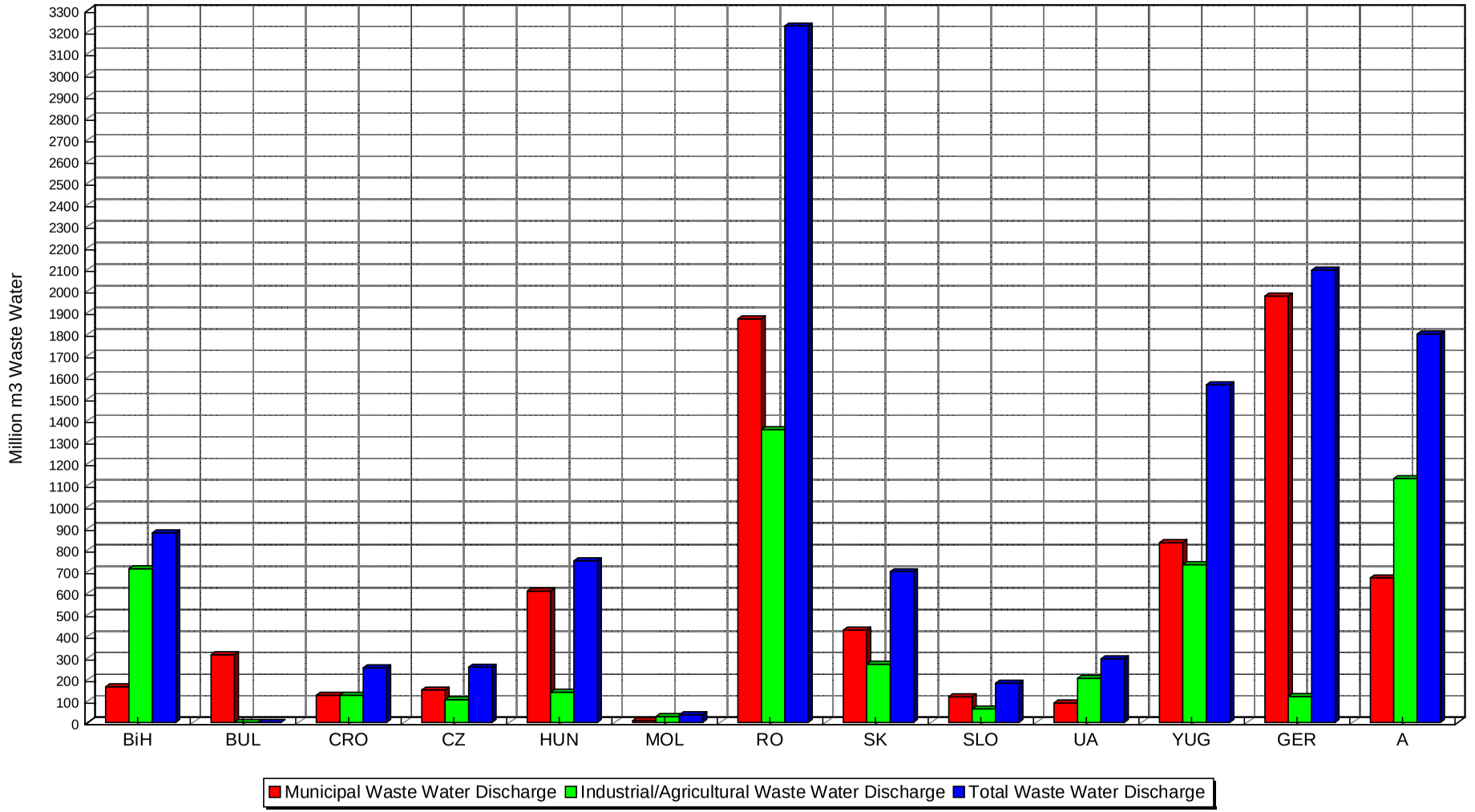
Remarks:

(1) Total annual discharge excluding "cooling water"

(2) "Others" is volume of "normatively clean water"

(3) Total volume schematically split in equal portions to "municipal" and "Industrial" discharge

FIG 5.2: Annual Waste Water Discharge to the Danube River System



5.3. Potential Pollution of Aquatic Systems through Soil and Ground Water Contamination from Solid Wastes

The most important soil and related ground water contamination include industrial and municipal waste dumps and landfill sites, mining residues, industrial plants, railway yards, military bases and sites of surface oil piping and storage.

The diffuse sources of soil pollution are mainly agricultural activities and atmospheric deposition. In most of the DRB countries fertilizers with a high content of cadmium have been extensively used; in some cases together with overdoses of pesticides resulting in a soil quality practically unsuited for agricultural and especially food production. Cadmium, copper, lead and zinc are threatening the quality of surface soil through atmospheric deposition.

The following sections deal with potential pollution of aquatic systems through soil and ground water contamination from point sources.

5.3.1. Municipal Solid Waste

(a) Generation and Disposal of Municipal Solid Waste

Figures on generation and disposal of municipal solid waste in the countries of the DRB are compiled in Table 5.3.

The figures available for 7 countries indicate that the average annual domestic solid waste generation per capita ranges between 280 kg (Croatia) and 400 kg (Slovenia).

Municipal waste is usually disposed, either on registered municipal or "mixed" dump sites (between 80 and 90%, at least in countries with higher development standard), or on not-licensed dump sites, often uncontrolled and not complying with actual legal and regulatory requirements.

Solid waste recycling is in comparison to Western European countries in most of the DRB countries negligibly low.

A particular problem constitutes in all DRB countries the high number of abandoned and sometimes even unknown dump sites for which often only fragmentary data on waste volume and composition are available.

(b) Critical Features of Municipal Solid Waste Disposal

The most critical features and methods of municipal solid waste disposal with relevance to potential pollution of aquatic systems can be summarized as follows:

- In the past municipal solid waste has not always been dumped separately, but usually together with industrial and even hazardous waste.
- Major portions of municipal waste have been dumped in unauthorized and uncontrolled dump sites or in dump sites which are not conform with the present protection regulations.
- Location of dump sites were often not properly planned (taking adequately into account hydro-geological aspects and environmental risks), but were often ad-hoc determined by topographic issues or the availability of any kind of pits.
- A significant number of municipal dump sites are located directly at river banks or in areas dangerously close to watercourses or ground water aquifers.
- Significant portions of municipal solid waste have been dumped individually and unorganized (unknown sites, unknown volumes, unknown content).

- There is usually no systematic periodical coverage of dump sites in operation and no recultivation of abandoned land fills.
- Most of the municipal dump sites are not enclosed by a fence system or do not have permanent attendance or watch service, and are thus more or less uncontrolled accessible.
- The majority of the existing dump sites for municipal waste do not dispose of adequate technical standards and equipment, such as
  - adequate technical protection, respectively isolation methods (folio, clay, etc.);
  - adequate drainage systems and drainage water collection facilities;
  - periodical coverage of sites in operation;
  - waste testing equipment;
  - weighing bridges;
  - bio gas utilization;
  - adequate control and recording of waste volumes, contents, etc.;
  - adequate management of operation and observance of regulatory requirements.

(c) Hazards for Aquatic Systems from Municipal Solid Waste Disposal

The particular hazards for the aquatic systems in the DRB from municipal solid waste disposal are directly related to the above listed inappropriate technical standards and methods of dumping prevailing in the particular countries.

The most critical problem constitute the municipal dump sites which are located directly at river banks or in areas dangerously close to watercourses or ground water aquifers.

In Hungary, for example, 20-30% of the 2700 municipal dump sites are located in such areas and constitute a partial explanation for the fact that about 60% of drinking water resources have been polluted over the past decades.

The country specific problems and hazards are described in rather detail in the National Review Reports.

5.3.2. Non-municipal and Hazardous Solid Waste

(a) Generation and Disposal of Non-municipal and Hazardous Solid Waste

Figures on generation and disposal of all categories of non-municipal solid wastes in the countries of the DRB are compiled in Table 5.3. The available figures indicate that the volume of non-municipal solid wastes (comprising all categories of industrial, construction, agricultural and mining wastes, slag and ashes from power plants, as well as special and hazardous wastes) is in the particular countries between 5 and 20 times higher than the volume of municipal solid waste.

Non-domestic solid waste is disposed on municipal and "mixed" dump sites as well as on special dump sites for industrial and other wastes.

The share of waste recycling is in comparison to Western European countries very low; in Romania, however 34% of industrial waste (excluding mining wastes).

Hazardous wastes constitute usually a portion between 5% and 6% of all non-domestic wastes; in Slovakia it is in the range of 10%.

Only in few cases hazardous waste is properly disposed on special dump sites or by means of waste incinerators; significant portions are disposed on industrial dump sites and even on municipal dump sites.

(b) Critical Features of Non-municipal and Hazardous Solid Waste Disposal

The most critical features and methods of non-municipal solid waste disposal with relevance to potential pollution of aquatic systems can be summarized as follows:

- Disposal of industrial and hazardous waste on authorized, respectively not-authorized industrial waste dump sites with inadequate technical standards and equipment (as listed above for municipal dump sites);
- Disposal of industrial and even hazardous solid waste on municipal dump sites;
- Disposal of industrial and hazardous waste on dump sites located directly at river banks or in areas dangerously close to watercourses or ground water aquifers;
- Stockpiling of industrial and hazardous waste on backyards of factories, without technical protection and control;
- Illegal, respectively uncontrolled disposal of industrial and hazardous waste on "wild sites";
- Uncontrolled or inadequate disposal of slag, ash and mud in areas with unfavorable hydro-geological conditions (e.g. high ground water levels) or in dump sites dangerously close to water courses.

(c) Hazards for Aquatic Systems from Non-municipal and Hazardous Solid Waste

The most serious hazards from inappropriate industrial and hazardous solid waste disposal for the aquatic systems in the DRB can be summarized as follows:

- Contamination of drinking water resources (through pollution of surface or ground water where dump sites are located directly at river banks or in areas dangerously close to watercourses and ground water aquifers used for potable water abstraction).
- Contamination of agricultural areas, respectively agricultural products (either by pollution of ground water or irrigation water, or by toxic substances moved by wind).
- Fish killing by contamination of surface waters (either by discharge of toxic drainage water or by surface runoff).
- Contamination of air, water and soil by toxic emissions from uncontrolled burning of industrial or hazardous waste on dump sites.

The country specific problems and hazards are described in rather detail in the National Review Reports.

TABLE 5.3
MUNICIPAL AND INDUSTRIAL/MINING/HAZARDOUS SOLID WASTE IN THE DRB COUNTRIES

Country	Characteristics of Municipal Solid Waste Generation and Disposal						Characteristics of Industrial, Mining, Hazardous Solid waste Generation and Disposal				
	Year	Total per Year	Per Capita	Share of Solid Waste Properly Dumped	No of Regis-tered Dump Sites	No of Critical/ Wild Dump Sites	Annual Volume of Waste			No of Regis-tered Dump Sites	Remarks
							Total per Year	Indus-trial / Mining/ Others	Hazar-dous Waste		
		Mln t/a	kg/c/a	%	No	No	Mln t/a	Mln t/a	Mln t/a	No	
BiH	1997	1,500	395	--	--	--	--	--	--	--	--
Bulgaria		--	--	--	--	--	--	--	--	--	--
Croatia	1996	1,350	281		700	1300	6,370	6,039	0,331		--
Czech Republic	1996	--	--	--	380	10000	--	--	--	--	--
Hungary	1997	4,000	392	88%	2682	--	80,000	75,800	4,200		Incineration plant Dorog
Moldova	1997	--	--	--	583	--	--	--	--	--	--
Romania	1996	6,696	296	--	--	--	107,200	107,200	--	893	33% of waste recycled
Slovakia	1995/97	1,600	296	85%	--	--	24,100	21,600	2,500	--	
Slovenia	1997	0,800	400	86%	53	10000	7,800	7,355	0,445	13	
Ukraine		--	--	--	--	--	--	--	--	--	
Yugoslavia	1997	3,450	332	55%	174	--	10,050	9,800	0,250	115	
Germany		--	--	--	--	--	--	--	--	--	--
Austria		--	--	--	--	--	--	--	--	--	--
Total		**19,396**			4572	21300	**235,520**	**227,794**	**7,726**	**1021**	

5.4 Economic Importance and Environmental Impacts of Hydro-Electric Power

The main characteristics of hydro-electric power utilization in the Danube River Basin are compiled in Table 5.4. From the figures of this table it is obvious that hydro-power utilization in the DRB is very different from country to country. It is of significant importance in Romania, Yugoslavia, Slovakia, Bosnia & Herzegovina and Slovenia.

According to the provided figures the installed hydro-electric capacity in the DRB is of the order of 12000 MW (excluding the capacity of Germany and Austria), with a broad variation between 28 MW (Hungary) and 5200 MW (Romania).

The corresponding annual hydro-electric power generation is 41000 GWh, varying between 87 GWh (Moldova) and 15500 GWh (Romania). The ratio of electricity generation to installed capacity indicates an average annual running time of about 3500 hours over all hydro-electric power plants in operation.

The country specific share of hydro-electric power generation in the total country electricity generation varies between 0.6% in Hungary and about 30% in Romania and Yugoslavia.

The annual hydro-electric power generation per capita of population living in the DRB varies between negligible 20 kWh (Hungary) and 1500 kWh in Slovenia.

Assuming an average value of USD 0.05 per kWh, the value of the overall annual hydro-electric power generation in the DRB would amount to about USD 2000 million, or to about USD 32 per capita of the corresponding population (64.6 million, excluding population of Germany and Austria) living in the DRB.

Countries with relative high additional hydro-electric power potentials are:

- Bosnia & Herzegovina (additional annual potential of about 19000 GWh hydro-electric power generation);
- Croatia (additional annual potential of about 6000 GWh hydro-electric power generation).

The most essential problems and negative effects of hydro-power plants (mainly relevant in the case of inappropriate plant design, plant operation and water management) can be summarized as follows:

- flooding of environmentally valuable areas or natural phenomena;
- changes in water regime;
- sub-optimal flood control and protection;
- oscillation of water levels in reservoirs and downstream river stretches;
- oscillation in water temperature and impacts on micro-climate conditions;
- impact on river shipping (in case of missing locks or ship-lifting facilities);
- impact on fish migration (in case of missing or inadequate fish-ladders / passages).

TABLE 5.4
HYDRO-ELECTRIC POWER UTILISATION IN THE DANUBE RIVER BASIN

Country	Overall Electric Generation in the Country			Hydro-Electric Power Utilisation in the Danube River System							Remarks
	Year	Capacity	Annual Electricity Generation	Year	No of Hydro Power Plants	Installed Capacity	Share of Electric Capacity in the Country	Annual Electricity Generation	Share of Electricity Generation in the Country	Annual Electricity Generation per Capita	
		MW	GWh			MW	%	GWh	%	kWh/c	
Bosnia & Hercegovina		--	--	1991	37	815	--	3426	--	1181	
Bulgaria		--	--		44	130	--	334	9,0%	86	No hydro-power plants on Danube River
Croatia		--	--	1996	6	289	--	1502	25,0%	462	No hydro-power plants on Danube River, (share of 25% in 1990!)
Czech Republic		--	--	1995	27	494	--	408	0,7%	147	+ 650 MW pumped-storage hydro-power plant Dlouhe Strane (1996)
Hungary	1996	7280	36989	1996	--	28	0,4%	207	0,6%	20	High number of small hydro-power plants
Moldova	1997	--	1355	1997	1	--	--	87	6,4%	79	Electricity generation of Costesti-Stanca plant shared with Romania
Romania	1995	--	57800	1996	291	5223	--	15524	29,0%	687	Hydro-power plants of Portile de Fier I+II on Danube River
Slovakia	1995	--	27324	1995	--	1542	--	6831	25,0%	1322	All hydro-power plants are equipped with locks and fish passes
Slovenia	1996	--	11510	1996	--	655	--	2639	22,9%	1515	New hydro-power plants on Sava river under construction
Ukraine		--	--	1997	1	27	--	133	--	43	Only one hydro-power station: Tereble Rikska
Yugoslavia		--	--	1997	15	2680	--	10149	30,0%	1126	Hydro-power plants Djerdap I+II on Danube river
Germany		--	--		--	--	--	--	--	--	No data
Austria		--	--		--	--	--	--	--	--	No data
Total		**7280**	**134978**			**11883**		**41240**			

5.5. Economic Importance of Fishery

The main characteristics of "fishery" in the Danube River Basin are compiled in Table 5.5. In this context the term "fishery" comprises the following two categories:

- fishing in natural surface waters (rivers, reservoirs feed by rivers, lakes);
- fish farming in natural or artificial ponds (feed by river water or other sources).

Both categories are to a large extent dependent on the water availability and quality of the river systems. For the majority of the DRB countries there is not a clear differentiation between these two categories in the official statistics. Generally there are relatively reliable figures available for large scale fish farming, not, however, for intrinsic river fishing, mainly performed as individual game or sport fishing. For this reason the figures presented in Table 5.5 include both categories.

From the figures of this table it turns out that from the economic point of view river fishing in the DRB is not relevant in Bosnia & Herzegovina, Czech Republic, Slovakia and Ukraine.

In the residual countries (excluding Germany and Austria, for which data are not provided) the annual quantity of fish production/catch is of the order of 73000 tons. At least three quarters of this quantity is estimated to come from fish farming.

The market prices of one kg of fish range from USD 1.0 to USD 4.5, depending on species, season, religious holidays and local customs. Assuming an average market price of USD 2.0 per kg of fish the annual production of 73000 tons represents an overall market value of about USD 146 million per annum.

In this context it is, however, necessary to point out, that in the ongoing period of privatization, the officially published figures obviously underestimate the real production of fish farming, and in particular the quantities of individual catch (professional as well as sport river fishing). Not included in the above stated figure is further the value of caviar production in the DRB. This is presumable a multiple of the market value of the fish production/catch.

The intrinsic value of river fishing is, however, not the market value of the catch, but the leisure and recreational value of fishing; and this value is not so much dependent on the quantity of catch, but primarily on the variety of species in the rivers. From this point of view river fishing is also a significant activity in the countries in which it is not significant from the economic point of view.

The main problems regarding river fishery can be summarized as follows:

- continuously degradation of water quality, especially in smaller water courses;
- occasional accidents (discharge of toxic or hazardous matters into surface waters);
- blocking of traditional fish migration by dams and hydro-power plants (not equipped with functioning fish-ladders or passages);
- decline of particularly high-quality fish species.

From Yugoslavia, for example, it is reported that after the construction of Djerdap I+II hydro-electric power plant the catch of the Acipenseridae dropped from more than 12 tons per year to less than 5.5 tons per year. The corresponding decline of caviar production is assumed to result in losses of about USD 200000 each year.

TABLE 5.5
MAIN CHARACTERISTICS OF FISHERY IN THE DANUBE RIVER BASIN

Country	**Overall River, Lake, Pond Fishery in the Country**			**River and Related Pond Fishery in the Danube River Basin**			Remarks
	Year	Quantity per Year	Market Value of Catch	Year	Quantity per Year	Market Value of Catch	
		Tons/a	Mln US$		Tons/a	Mln US$	
Bosnia & Hercegovina	--	--	--	--	--	--	Actually not relevant, potentials in hydro-power reservoirs and lakes
Bulgaria	--	--	--	1997	449	--	Registered catch only, 2238 licences for commercial fishing
Croatia	1996	2996	4,511	1996	17996	4,511	2996 tons from river fishery, about 15000 tons from fish farming in ponds; 434 registered fishermen
Czech Republic	--	--	--	--	--	--	River fishery not relevant
Hungary	1996	21124	22,400	1996	13518	22,400	13518 tons from fish farming, 7606 tons from rivers, reservoirs; 2910 people employed in fishery
Moldova	--	--	--	1996	806	0,806	Including fish production from fish farming in ponds
Romania	1996	24781	--		24781	--	Including production from fish farming, not including catch of sport fishing (200000 licences)
Slovakia	1997	2840	--		--	--	River fishery in Danube River Basin not relevant
Slovenia	1996	298	--	1996	267	--	Insignificant from commercial point of view, relevant only from the view of sport fishing
Ukraine	--	--	--	1996	1490	--	Communal fish production in lakes and ponds
Yugoslavia	--	--	--	1997	13375	30,000	12695 tons from fish farming; 680 tons commercial river catch; 3400 persons in commercial fishery
Germany		--	--		--	--	No data
Austria		--	--		--	--	No data
Total		**52039**			**72682**		

5.6. Economic Importance and Environmental Impacts of River Shipping

The Danube countries cooperate on navigation under several agreements dating back to 1856. The Danube, especially the middle and lower reaches has been an important natural waterway for centuries. The idea of constructing a navigable waterway connecting the rivers Main and Danube, and thus the North Sea and the Black Sea, dates back to ancient times. It was realized after the opening of the Rhine-Main-Danube canal in 1992. A Danube-Black Sea canal between Cernavoda and Constanza shortens the route by about 370 km.

The main characteristics of river shipping in the DRB - excluding again data of Germany and Austria - are compiled in Table 5.6. This table contains data, according to availability either for the years 1995, 1996 or 1997, on the following aspects:

- freight transport;
- throughput of riverine ports;
- passenger transport.

(a) Freight Transport

Due to restricted navigability of potential river stretches freight transport on rivers of the DRB is not relevant, respectively insignificant, in the following countries:

Bosnia & Herzegovina, Czech Republic, Moldova, Slovenia.

In the countries, for which data are available, the aggregated volume of freight transport on rivers of the DRB is about of 43 million tons per year.

The corresponding transport performance is about 19400 million ton-km per year.

The resulting overall average transport distance is about 451 km, with strong variation between an average distance of 19 km for Croatia and 884 km for Slovakia.

Assuming that the average value of one ton-km is USD 0.02, the overall value of the freight transport performed on the rivers of the DRB is of the order of USD 388 million per year.

In this context it is necessary to mention that the above stated transport volume of 43 million tons per year is the composite of the volumes transported by the national vessel fleets of the particular countries on the rivers of the DRB. It does therefor not include international transport (mainly transit transport). In Hungary, for example, the overall transport volume including goods transported by international vessel fleet, is estimated at 8.3 million tons per year, compared to only 1.9 million tons, performed by the Hungarian vessel fleet per year. This means that the economic importance of freight transport (especially on the Danube River) is significantly higher, than represented by the figures compiled in Table 5.6.

(b) Throughput of Riverine Ports

Taking into account that data on port throughput are not relevant for the four countries listed above, data on riverine ports in the DRB are available for the following five countries:

Croatia, Hungary, Romania, Ukraine, Yugoslavia.

Also for these countries the provided data are not complete, but state

- only domestic throughput (Croatia, Yugoslavia);
- "port capacity", which is usually higher than the actual throughput (Romania).

According to the provided figures the aggregated annual throughput of ports (quantity of "loaded" plus quantity of "unloaded" goods) is 82 million tons per year in the DRB.

The most essential problems regarding riverine ports can be summarized as follows:

- out-dated structure of port terminals (inadequate terminal length);
- out-dated handling/loading equipment;
- inadequate water depth, not complying with Western European standards;
- insufficient road and railway connection;
- inadequate port management and organization;
- inadequate environmental protection facilities (as listed below).

(c) Passenger Transport

Passenger transport is at the time being not relevant (or insignificant) in the countries:

Bosnia & Herzegovina, Croatia, Czech Republic, Moldova, Slovenia, Yugoslavia.

Data on passenger transport are available for the following countries:

Bulgaria, Hungary, Romania, and Slovakia.

The aggregated number of passengers for the four countries for which data are available is about 5.8 million per year.

The corresponding annual performance is 131 million passenger-km, the average travel distance about 23 km.

(d) Main Environmental Problems Regarding River Shipping

The main environmental problems regarding river shipping and especially riverine ports can be summarized as follows:

- inadequate equipment of river vessels with storage tanks or treatment facilities for wastewater, solid waste and oil products;
- uncontrolled direct discharge of wastewater, solid waste and oil products from river vessels into water courses;
- unprotected storage areas for hazardous goods in ports;
- unprotected or not appropriate liquid storage facilities in ports;
- lacking or not appropriate service facilities, especially wastewater, solid waste and oil disposal facilities in ports (occasional spill of larger quantities of oil products).

TABLE 5.6

MAIN CHARACTERISTICS OF RIVER SHIPPING IN THE DANUBE RIVER BASIN

Country	Year	Main Characteristics of River Shipping on the Rivers of the Danube River System									
		Freight Transport				Throughput of Riverine Ports		Passenger Transport			
		Volume of Freight Transport	Average Transport Distance	Annual Per-formance	Remarks	Annual Through-put	Remarks	No of Passen-gers	Average Transport Distance	Annual Per-formance	Remarks
		Mln tons/a	km	Mln ton-km		Mln tons/a		Mln P/a	km	Mln P-km	
Bosnia & Herzeg.		–	--	--	Not relevant; mainly Sava river navigable	–	No relevant ports	–	--	–	Not relevant
Bulgaria	1997	24,010	536	12870	In 1996,162 tons of sanitary/ballast ,waste water	--		1,946	39	75	Decreasing tendency
Croatia	1996	1,150	19	22		1,071	Only domestic freight transport	--	–	–	Presently not relevant
Czech Republic		–	--	–	Not relevant, only Morava and Becva navigable	--	Not relevant	--	--	–	Not relevant
Hungary	1996	1,911	672	1284	Incl. international transport: 8.3 mln tons	7,616	Throughput in 1995	1,303	24	32	Without Lake Balaton
Moldova	1996	0,150	–	--	Insignificant	–	Not relevant	--	–	--	Not relevant
Romania	1996	14,142	267	3774	Increasing tendency	36,465	"Capacity" of the riverine ports	2,399	7	17	
Slovakia	1995	1,661	884	1468	Decreasing tendency	–	Data not available	0,138	51	7	
Slovenia		–	--	–	Not relevant, no navigable rivers	–	Not relevant	--	–	–	Not relevant
Ukraine	1996	–	--	–	Data not available	21,408	Incl. international transport	--	–	–	Data not available
Yugoslavia	1997	–	--	--	Data not available	15,309	Incl. international transport	--	–	–	Presently not relevant
Germany		–	--	–	No data	–	--	–	–	--	No data
Austria		–	--	–	No data	–	--	–	–	--	No data
Total		43,024	451	19418	Aggregated national river transport, only!	**81,869**		**5,786**	**23**	**131**	

5.7. Significance and Environmental Impacts of River and Water Related Tourism and Recreation

The assessment of the significance of the Danube River System for water related tourism and recreation has to differentiate between international tourism and domestic tourism and recreation.

(a) International River and Water Related Tourism

One essential river related feature of international tourism is river cruising, either in form of local short distance travel (usually in the vicinity of cities and particular scenic river sections) or in form of transboundary long distance travel (e.g. "from the Alps to the Black Sea").

Other river related international tourism activities are usually concentrated on especially attractive riverside locations and can be summarized as follows:

- Hiking and bicycling in scenic river areas (e.g. Wachau) ;
- Hiking and nature observation in "natural parks", equipped with appropriate tourist facilities, and in other environmentally attractive riverside areas (e.g. Danube Delta);
- River fishing in form of sport and game fishing (especially for rare species);
- River rafting and white water canoeing in few especially attractive river stretches.

Directly water related recreation activities, such as bathing, swimming, motor boating, water skiing, rowing, etc. in or on the rivers of the Danube River system are at the time being not so relevant for international tourism. Thus an at least visually acceptable water quality in the rivers of the DRB is from this point of view rather a basic prerequisite and "image factor" for the overall attractiveness of the particular DRB countries for international tourism.

For most of the countries it has to be stated that the river related potentials for international tourism are at the time being not at all fully developed. The main reasons are the lack of appropriate priority setting, inappropriate administrative planning tools and lack of public and private funds.

(b) National Water Relevant Recreation

The significance of the Danube River system for recreation purposes of the domestic population is very different from country to country, but usually much higher than for international tourism.

The main features of water related domestic recreation can be summarized as follows:

- bathing and swimming of riparian population;
- sport and game fishing on suited river stretches;
- motor boating, water skiing, rowing, canoeing, etc.;
- timber rafting and white water rafting in few especially suited river stretches;
- camping sites and weekend-house settlements located on river banks;
- organized boat trips in the vicinity of cities or on scenic river stretches.

The main problems regarding water related recreation can be summarized as follows:

- Most of the recreation areas are not authorized and reasonably controlled;
- Most of the recreational activities are at the time being performed in relatively unorganized way;
- Even basic recreational infrastructure is either not available or inadequate (e.g. parking lots, public toilets, garbage tons, etc.);

- Recreation areas are often not properly maintained and therefore often dirty and sometimes in unsanitary condition;
- Recreation visitors often mass in particularly famous riverside areas and reservoirs; with left rubbish of about 1.0 to 1.5 kg per visitor and day.

In most of the DRB countries river and water related recreation cannot be considered as a relevant economic factor on country level, but can be of same relevance on local level. In Romania the Danube Delta is because of its unique feature in Europe considered as an essential potential for eco-tourism.

(c) Main Environmental Impacts

Compared to other human and economic activities international and national river and water related tourism and recreation is generally not a major issue from the view of water pollution. More relevant are usually the impacts on fauna and flora of particularly sensitive areas, such as wetlands, along particular river stretches.

Major environmental impacts can arise from:

- oil and oil products from motor boating;
- effluent of larger camping sites directly located on river banks;
- effluent of larger weekend-house settlements on river banks:
- rubbish left by recreation visitors in ecologically sensitive riverside areas;
- unauthorized utilization of protected areas for hiking, camping, fishing, hunting, boating, etc.

6. Adequacy of the Legal and Institutional Framework for Sound Environmental Management of Water Resources and Ecosystems

6.1. Relevant Legal Framework

Apart from Germany and Austria, the adequacy of the legal framework for sound environmental management of water resources has to be discussed under the aspect of the political, economic, administrative and social changes which have taken place in the particular DRB countries during the previous years of transition.

In all DRB countries the legal framework for environmental management of water resources and ecosystems consists of a hierarchic system of decrees, laws and regulations on the different administrative levels:

(i) International level

The international agreements and conventions signed or ratified by the particular countries constitute a kind of orientation framework for the national environmental policies and legislation of the member countries.

The most relevant international agreements, conventions and protocols with environmental / water sector relevance can be summarized as follows:

World Wide Conventions, Protocols:

1970 RAMSAR Convention on Wetlands of International Importance;
1972 PARIS Convention on the Protection of the World Cultural and Natural Heritage;
1972 LONDON Convention on the Prevention of Marine Pollution by Dumping of Wastes;
1973 WASHINGTON Convention on International Trade of Endangered Species;
1973 LONDON International Convention for Prevention of Pollution from Ships (MARPOL);
1979 BONN Convention on Conservation of Migratory Species of Wild Animals;
1998 BASEL Convention on the Control of Transboundary Movements of Hazardous Wastes;
1992 RIO Convention on Biological Diversity;
1992 NEW YORK Framework Convention on Climate Change;
1997 KYOTO Protocol to Framework Convention on Climate Change;
1998 UN Convention on Non-navigational Uses of International Waterways.

Regional and Subregional Conventions, Protocols:

1950 PARIS International Convention for the Protection of Birds;
1976 BARCELONA Convention - Protocol against Pollution of Mediterranean Sea;
- 1976 BARCELONA Protocol on Dumping;
- 1980 ATHENS Protocol on Land Based Sources of Pollution;
- 1982 GENEVA Protocol on Special Protected Species;
- 1994 MADRID Protocol against Pollution from Exploration /Exploitation;

1979 BERN Convention on the Conservation of European Wildlife and Natural Habitats;
1991 ESPOO Convention on Environmental Impact Assessment in Transboundary Context;
1991 SALZBURG Convention on the Protection of the Alps;

1992 HELSINKI Convention - Protocol on Use of Transboundary Waters and International Lakes;
1992 HELSINKI Convention on Transboundary Effects of Industrial Accidents;
1992 BUCHAREST Convention - Protocol against Black Sea Pollution;
1994 SOFIA Convention on Cooperation for the Protection and Sustainable Use of the Danube River;
1998 AARHUS Convention on Access to Information and Public Participation;
1998 AARHUS Protocol on Transboundary Air Pollution with Heavy Metals;
1998 AARHUS Protocol on Transboundary Air Pollution with Organic Compounds.

A particular feature for all DRB countries is the harmonization of the national environmental legislation with EC regulations and standards. Hungary, Czech Republic and Slovenia which are the priority candidates to join the EU before the year 2005, are expected to successfully achieve this process of harmonization in time. In the other countries the time frame for the envisaged harmonization is determined by the actual status of environmental and water management legislation and the economic capability and affordability of the particular country.

(ii) Federal ministerial level

In all DRB countries the primary competence for the environmental and water related legislation is with the national government, respectively the relevant federal ministries. These are usually the ministry of environment and, if separated, the ministry responsible for water management.

(iii) State / district level

The allocation of legal competence between state / district level and municipal / community level is very different in the various DRB countries. It usually depends on historical features and especially on the federal structure of the particular country according to which the competencies of the ministries and authorities on state / district level are in general terms defined.

(iv) Municipal / community level

The administrative and legal competence of the local governments is in this context usually restricted to:

- local land use and settlement policy;
- local environmentally relevant infrastructure;
- public utilities and services on municipal level;
- regulation of locally relevant environment and water protection areas.

On this rather common basis the completeness and adequacy of the environmental and water related legislation, the special allocation of responsibilities and the practice of handling and enforcement are very different from country to country.

In a number of countries the basic structure of the legal system is still to some extent determined by the structures of the former state planning systems. That means, numerous laws and regulations were adopted long time ago, have been frequently amended during the previous years of transition and need basic revision.

Thus in most of the DRB countries the relevant legislation is currently in the phase of substantial reform and modernization. Due to the complexity of this task it can be anticipated that the completion of the ongoing reform process will take several years until the relevant legislation will have reached an acceptable level of compliance with international requirements.

Countries in which the legal framework for environmental management of water resources and ecosystems has to be considered as adequate and in consistence with international requirements are Germany and Austria, and with some reservations Hungary and Czech Republic.

In the other countries there are still essential deficits and problems, which mainly result from the fact, that

- in some countries the environmental and water related legislation is still based to a certain extent on historical structures, with the consequence that the various changes, adjustments and modifications have led to critical inconsistencies;
- some countries are currently in the process of establishing new environmental and water related legislation, for which the practical applicability and effectiveness has not yet been proven;
- some countries have developed relatively sophisticated systems of environmental and water related legislation, which can at the time being not really enforced due to critical social and economic issues in the country.

That means that in these countries the actual environmental and water related legislation cannot be considered as fully adequate regarding sound and sustainable environmental management of water resources and ecosystems from the international point of view.

Common deficiencies and needs for improvement regarding water sector related legislation in the DRB countries can be summarized as follows:

- Restructuring and adjustment of relevant legislation to the requirements of modern environment oriented market economy;
- Streamlining, simplification and elimination of inconsistent components, basically resulting from ad-hoc changes during the previous transition period;
- Ensurance of utmost compatibility of interacting legislation on the various administrative levels;
- Specification of efficient implementing regulations and elimination of all kinds of non-justified exemptions.
- Further harmonization of national legislation with EU regulations and standards.

The country specific characteristics and particularities regarding the relevant legal framework in the particular DRB countries are compiled in Annex 6.1.

6.2. Relevant Institutional Framework

In most of the DRB countries there is a rather clear hierarchy and allocation of responsibilities and tasks regarding environmental management of water resources and ecosystems.

In the majority of the DRB countries the leading responsibility for water management is not with the Ministry of Environment, but with an own ministry, sometimes together with construction, transport, communication, industry, etc. This is mainly caused by the fact that the ministries responsible for water management are usually "old" ministries and the ministries of environment have in most of the countries been established rather recently.

In all DRB countries special subjects which are from their nature closely related to the management of water resources and ecosystems are invested to other ministries or sub-bodies of ministries. These subjects are usually:

- waterway infrastructure and water transport;
- hydro-electric power utilization;
- water related recreation and tourism;
- river fishery;
- agriculture and forestry.

Thus there is sometimes a kind of competition between a number of ministries, usually not regarding the general policies and strategies, but actually as regards the allocation of funds and budgets as well as the responsibility for subordinated institutions and organizations.

In most of the DRB countries, independent on the fact whether the responsibility for the management of water resources and ecosystems is with one or more ministries, there are Environmental and Water Inspectorates which usually act as sub-bodies of the ministries on regional level, respectively on the level of river catchment areas.

In all countries there are in addition various authority departments, institutes and organizations dealing with special administrative, fiscal, scientific, statistical, nuclear, medical, health and similar features. Some of them had essential importance in the former systems and are now in the position that their tasks have been streamlined or allocated to other administrative units or that there is not enough money to maintain their scientific standards or even existence.

Especially in countries which are currently in the critical phase of transition responsibilities and tasks are not always reasonably defined and sometimes overlapping allocated to different ministerial or sub-ministerial authorities as well as to state, semi-state or in meantime privatized institutes and organizations. A particular problem in this context is that also mechanisms of coordination and cooperation are not always appropriately defined or standardized, occasionally resulting in overlapping activities on the one side and critical gaps on the other side.

Country specific characteristics and particularities in the DRB countries are compiled in Annex 6.2.

7. Actual Policies and Strategies

7.1. Actual Policies and Strategies

Each of the DRB countries has actually a more or less comprehensive system of environmental and water sector related policies and strategies which usually reflects:

- the capability of the country to contribute to the solution of transboundary problems;
- the significance and evidence of the country specific environmental problems;
- the significance and evidence of environmentally related health hazards;
- the economic development and affordability of the country.

In this context all countries have developed a hierarchic system of medium and long term objectives and principles which usually reflect the key environmental problems and the sector priorities on national and regional level.

(i) Objectives

The long term objectives are usually very general and often not related to any definite time frame for implementation or solution. Usually there are also no estimates of the overall long term funding requirements. In the DRB countries the long term objectives of environmental policy mainly focus on:

- Protection of climate and ozone layers;
- Preservation of a sound environment for the future generation;
- Protection of biological diversity;
- Protection of drinking water resources.

(ii) Principles

Despite the diversity of problems, interests and priorities across the DRB, the Danube countries share certain values and principles relating to the environment and the conservation of natural resources. The most essential principles in this context are:

- **The precautionary principle:**
  This means that planning and measures have to take into account the possibility that adverse effects might occur, even when at the time being firm evidence is lacking. In other words, under certain circumstances it is better to be on the safe side than to be actually wrong.
- **Best available technology / best environmental practice (BAT / BEP):**
  BAT means in this context the latest state of the art of processes, of facilities or of methods of operation which indicate the practical sustainability of a particular measure for limiting discharges, emissions, wastes and minimizing the utilization of resources.
  EP means the application of the most appropriate combination of sectoral environmental control strategies and measures.
- **Control of pollution at the source:**
  This means that it is generally less expensive to prevent the creation of harmful wastes or pollution through cleaner technologies and processes than to cure and repair the damage to the environment afterwards.

- **The polluter pays principle:**
  The "polluter pays" principle and the related "user pays" principle mean that the polluter or user of natural resources should pay for the cost of maintaining the resources or repairing the damages, usually through a fee or levy.
- **The integrated approach:**
  This means the utmost utilization of regional mechanisms and structures for transboundary coordination and cooperation on environmental policy on the one side and the incorporation of all environment related sectors on the other side.

(iii) Short and Medium Term Targets

The short and medium term targets of the subordinate level are much more specific formulated and laid down in form of strategies, programmes and plans, which usually cover the following features:

- **Legal features:**
  - Definition of time frames for harmonization of national and international legislation and standards:
  - Identification of laws, regulations and discrepancies which need improvement;
  - Improvement of standards and mechanisms for handling and application of existing laws, regulations and standards.
- **Institutional features:**
  - Definition of principles for international cooperation and coordination;
  - Definition of appropriate institutional hierarchies and determination of leading and subordinate responsibilities;
  - Definition of appropriate mechanisms for institutional coordination and cooperation;
  - Improvement of institutional capabilities;
  - Improvement of human resources capabilities.
- **Environmental features:**
  - Protection and improvement of water quality (surface water and ground water);
  - Protection and improvement of soil quality;
  - Protection and improvement of aquatic ecosystems;
  - Protection and improvement of water related terrestrial ecosystems;
  - Protection of biological diversity;
  - Protection of drinking water resources.
- **Technical features:**
  - Definition of priority solutions in the environmental and water management sectors;
  - Definition of adequate technologies;
  - Definition of appropriate technical standards;
  - Improvement of technical and scientific capabilities;
- **Economic and financial features:**
  - Investment portfolio for environmental investments and programmes;
  - Allocation of public budget funds on the different administrative levels;
  - Establishing or reorganization of environmental and water management funds;
  - Application of effective economic and financial incentives;
  - Application of appropriate charges for utilization of natural resources;
  - Application of appropriate penalties for miss-utilization of natural resources (i.e. discharging of wastewater exceeding determined standards, etc.);
  - Application of appropriate tariffs for water supply and wastewater services.

(iv) Programmes and Plans

The most essential environmental and water related programmes and plans in the particular DRB countries are:

Bulgaria:	National Action Plan on Environment and Health;
Croatia:	Basis for a Strategy for Water and Sea Protection from Environmental Pollution in the Republic of Croatia, (in preparation)
	Plan for Water Protection Against Pollution from City's Wastewater;
Hungary:	National Environmental Programme 1997-2002, (13 sub-programmes);
Moldova:	National Environmental Action Plan of the Republic of Moldova,(1995);
Romania:	Environmental Protection Strategy of Romania;
	Environmental Action Programme;
Slovakia:	Strategy, Principles and Priorities of the State Environmental Policy, 1993;
	Concept of Territorial Development of the Slovak Republic;
Slovenia:	The National Programme for Environment Protection, (draft);
Yugoslavia:	Environmental Protection Policy, 1993;
	Resolution on the Policy of Biodiversity Protection in the FRY, 1996;
	Draft of the Water Economics Plan of Serbia, 1996;
	Draft of the Water Economics Plan of Montenegro, 1998;
Germany:	National Danube River Action Plan, Germany;
	Various programmes and plans on federal and state level;
Austria:	National Danube River Action Plan, Austria;
	Various programmes and plans on federal and state level.

7.2. Sector Policies

All countries have on principle recognized the necessity to harmonize and coordinate the policies of the following environment related sectors:

- Water sector (water resources, waterway infrastructure);
- Industry, mining (technologies, wastewater, solid wastes);
- Agriculture, forestry (technologies, agrochemicals, wastewater, runoff);
- Transport sector (road, rail, water traffic and transport infrastructure).

In practice the inter-sectoral coordination and the application of an integrated approach is by far not yet realized, partly due to the critical economic status of particular countries, partly due to historical features and competing responsibilities.

Annexes

Annex 2.1.

Country Specific Characteristics Regarding Water Resources in the DRB Countries

The main country specific characteristics regarding water resources in the DRB can be summarized as follows:

Bosnia & Herzegovina:

- All rivers in BiH beside the river Neretva belong to the DRB; their joint characteristics are the relatively high flow velocity in the upper courses and the relatively high flow volumes;
- Significant water resources are also lakes with usually good water quality to be used for all purposes of water utilization;
- A different water resource is the 24 km long coast line which recently has become a significant tourist's resource.

(ii) Bulgaria:

- The overall annual water resources in Bulgaria are about 19.5 billion m^3 or 2350 m^3 per capita; data for the Bulgarian part of the DRB are not explicitly available.

(iii) Croatia:

- The length of the Danube River within the boundaries of Croatia is about 188 km; the more important surface water resources are the rivers Drava and Sava with their tributaries;
- Danube River and river Drava are not considered as acceptable raw water sources for public water supply, but raw water from river Sava is actually used for this purpose;
- Monitoring shows gradually improvement of water quality in all three rivers and their tributaries for the past 15 years;
- It is estimated that ground water reserves make up 12% of overall water reserves in Croatia; compared to other countries of the DRB the quality of ground water is relatively good and therefor more than 90% of public water supply is ensured by ground water.

(iv) Czech Republic:

- Total annual run-off of watercourses within the Czech part of the DRB is about 3.4 billion m^3 or 1200 m^3 per capita;
- There are 34 water reservoirs with a total volume of 569 million m^3 and 2900 ponds with a total volume of 90 million m^3;
- Total annual water abstraction from surface water resources is about 210 million m^3;
- Exploitable capacity of ground water is 8.5 m^3/s, of which about 65% (or 167 million m^3 per year) is actually used.

(v) Hungary:

- The total surface water resources in Hungary, which is completely located within the DRB, is about 1.25 billion m^3 in a typical year, or not more than 123 m^3 per capita;
- 95% of the surface water originate from abroad; the not used volumes leave the country concentrated to three rivers, namely Danube, Tisa and Drava;
- Ground water is of basic importance for public water supply; the utilizable ground water resources are estimated in the order of 1.8 billion m^3; about 1.1 billion m^3 is actually made use of;
- The composition of ground water resources is as follows: 10% subsoil water, 30% bank water, 20% karst water, 40% stratum water.

(vi) Moldova:

- The total surface water resources in the Moldovian part of the DRB is about 500 million m^3 in a typical year, or 460 m^3 per capita;
- The Prut river is the last major tributary of the Danube River, with a total length of 967 km and a length of 595 km within the boundaries of Moldova; the water availability in a typical year is about 2.9 million m^3;
- There are about 40 main surface water bodies with a volume of more than one million m^3 each; all of them are directly connected to watercourses;
- The exploitable ground water resources within the Danube River catchment area are 140 million m^3, of which about 50% are actually used;
- Presently about 2100 artesian wells, 62000 shallow wells and 250 springs are exploited within the Danube River catchment area.

(vii) Romania:

- The surface water resources in Romania are relatively poor in quality and rather unequally distributed;
- The theoretical annual surface water resources are 125 billion m^3 (40 billion from inland rivers and 85 billion from the Danube River which constitutes the southern border of the country); the potentially utilizable resources are 35 billion m^3 and the actually utilizable resources 23 billion m^3;
- There are about 3450 natural lakes with a water capacity of 2.0 billion m^3;
- Due to strong seasonal and annual variations and the unequal spatial distribution of water resources a lot of reservoirs as well as territorial reallocation systems had to be developed;
- The storage capacity of the existing reservoirs is of the order of 14.3 billion m^3, of which about 5.5 billion can be considered as the utilizable volume;
- The annual ground water resources are about 9 billion m^3 of which about 3 billion can be used under the existing technical and economical conditions.

(viii) Slovakia:

- The territory of Slovakia is drained by eleven major rivers out of which nine belong to the DRB;
- In total the average annual flow in the Slovakian part of the DRB is 3300 m^3/s, out of which 370 m^3/s have their source in the territory of Slovakia;
- In the majority of the DRB rivers there is natural unregulated flow regime going along with strong restrictions in surface water utilization, especially in summer time and draught periods;
- Only by means of a high reservoir capacity it is possible to achieve a surface water utilization of 54 m^3/s or 1.7 billion m^3 per year;
- Ground water is the basic source of public water supply, where it is available in sufficient quantity and quality;
- The utilizable annual ground water resources in the Slovakian part of the DRB are about 2.3 billion m^3, of which about 0.7 billion m^3 are actually used.

(ix) Slovenia:

- Slovenia has seven major transboundary rivers;
- The average annual run-off in the Slovenian part of the DRB is about 13.1 billion m^3 per annum or 6550 m^3 per capita;
- In Slovenia there are 1271 registered surface water bodies; seven of them have a volume of more than ten million m^3; out of the 15 major ones 14 belong to the DRB;
- There are 16 karst water sources with an abundance of more than 350 l/s;
- Dynamic ground water resources amount to 50 m^3/s or 1.6 billion m3 per year.

(x) Ukraine:

- In the Ukrainian part of the DRB there are seven major rivers with a length of about 1100 km altogether;
- There are many natural lakes, of which the five biggest ones have a volume between about 50 and 380 million m^3;
- In addition there are about 600 ponds with an aggregated volume of about 57 million m^3 and 33 reservoirs with an aggregated capacity of 1.3 billion m^3, of which about 0.6 billion m3 can be used for run-off control;
- A particular kind of water resource are the different types of mineral waters in the Transcarpathien Water Management Region; they are characterized by a wide range of minerals, temperatures between 7° and 89° and an average discharge of about 13000 m^3 per 24 h.

(xi) Yugoslavia:

- The average flow of the Danube River is about 2300 m^3/s at the entry to Yugoslavia and about 5500 m^3/s at the cross-section on the border with Romania;
- The average flow of the main tributaries of the Danube River at their mouth varies between not more than 9 m^3/s (river Pek) and 1570 m^3/s (river Sava);
- Since the erection of the Djerdap I+II hydro-electric power plants the flow regime of the Danube river has been significantly changed, in the downstream sections as well as in the upstream sections;
- Potential ground water resources are about 45 m^3/s or about 1.4 billion m^3 per year;
- In addition there are karst water resources of about 25 m^3/s or 0.8 billion m^3 per year, which are highly exposed to the influence of surface waters.

Annex 2.2.

Country Specific Characteristics Regarding Biological Resources and Ecosystems in the DRB Countries

The country specific characteristics and particularities regarding biological resources, ecosystems and environmental protection areas can be summarized as follows..

(i) BiH:

- According to the up-dated "space arrangement plan" of 1980, 16-24% of the total country territory should be put under "some kind of protection" by the year 2025;
- High priority is envisaged for water related ecologically sensitive areas and particularly wetlands.

(ii) Bulgaria:

- Essential elements for the conservation of biological diversity, the self purification of watercourses and the long-term sustainability of water related biological resources are the following ecosystems along the Danube River:
  - the Danube islands (10600 ha);
  - the flood lowlands (47000 ha);
  - riverside lakes and marshes (part of the flood lowlands, 1500 ha);
- The 81 officially declared protection areas in the DRB include:
  - 5 national parks (99000 ha);
  - 7 UNESCO biosphere reserves (16000 ha);
  - 9 nature reserves (16000 ha);
  - 11 protected habitats (2700 ha);
  - 44 nature monuments (3300 ha), and 5 historical places (600 ha).

(iii) Croatia:

- The catchment areas of the Drava, Sava and Danube River are rich in partly "untouched" habitats and ecosystems.

(iv) Czech Republic:

- The floodplain forests and the wetlands in the broad riverine floodplains of the Morava river basin are essential habitats with a high diversity of species and the occurrence of rare and endangered species of flora and fauna;
- The valleys of the Morava and its tributaries are natural migration routes of plants and animals; some of them have been included in the European Ecological Network of the UNESCO.

(v) Hungary:

- The Hungarian rivers and their riparian zones constitute essential parts of the national ecological network;
- Since 1994 the number and area of declared protection areas has been continuously extended;
- In the national nature conservation strategy the water related ecologically sensitive areas and especially wetlands are considered as habitats of high priority;
- Water related habitats such as wetlands, bogs and bogmeadows are presently the mostly endangered habitats, not only due to unfavorable climatic change and natural drying up,

but mainly due to biological degradation caused by human activities and harmful intervention in river regimes.

- In 1997 the total environmental protected areas of about 804000 ha are composed as follows:
  - 423000 ha national parks;
  - 320000 ha protected landscape areas;
  - 25000 ha nature conservation reserves;
  - 36000 ha areas of local importance.
- Number of protected plants: 515;
- Number of protected animal species: 855;
- Number of protected caves: 3263;

(vi) Moldova:

- Along the Prut river there is a distinct gradient in species richness, reaching the maximum in the floodplains of the lower part of the river basin;
- In general the ecosystems of the Prut river are represented by various fish, amphibian, reptilian and bird species, of which a significant number of species is recorded as endangered or threatened with extinct;
- Originally there were important wetlands along the Prut river; but limestone quarries and river bed dredging for sand are significant causes for environmental degradation and destruction of river ecosystems;
- The remaining number of species has been dramatically reduced over the last decade mainly due to intensive agricultural activities and destruction of wetlands.

(vii) Romania:

- The fauna and flora on the territory of Romania is considered a highly valuable regenerative resource of the country;
- The flora includes more than 3500 species of plants, of which about 1500 species are found in the Danube Delta, which is from this point of view unique in Europe;
- The occurrence of about 100 species of mammals is rather typical for central Europe;
- During the last decade Romania's famous hunting fauna has been decreased significantly, as regards the wild boar, the stag, the black chamois, the bear, etc.;
- Of some 8600 species of birds existing in the world, about 300 can be encountered in the Danube Delta; these represent approximately 80% of all bird species in Romania.

(viii) Slovakia:

- Slovakia is a country with high nature diversity, comprising all vegetation zones of the mild climate, apart from the Mediterranean and nival zones;
- The 1032 protection areas in the country include:
  - 7 national parks (240000 ha);
  - 576 nature reserves (96000 ha);
  - 16 landscape protection areas (600000 ha);
  - 433 other preserved areas, including 4 biosphere reserves and 7 Ramsar areas.

(ix) Slovenia:

- The ecosystem characteristics of the river basins of the Sava, Drava and Mura are a reflection of the geographic transit position where alpine, subalpine, dinaric-karstic and subpannonian characteristics interweave;
- There are about 9000 recorded flora species, of which 46 are recorded as endemic, and about 14000 terrestrial fauna species, of which 850 are recorded as endemic.

(x) Ukraine:

- Due to climatic, topographic and geological features the river basins of Tisa, Prut and Siret show a high diversity of flora with more than 1300 species. The most essential habitats are floodplains, marshes, meadows and highland meadows;
- The river basins of Tisa, Prut and Siret have also a unique variety in fauna, and especially in the Carpathien forests a broad spectrum of valuable hunting species, such as brown bear, red deer, wild boar, lynx, otter, badger, forest marten, wolf, etc.;
- The rivers and fresh-water lakes, as well as the delta and the "savant-delta areas" (from the ecological point of view transition zones between fresh water and sea water aquatic systems) are the habitat of a broad variety of 98 species of fish.

(xi) Yugoslavia:

- The Danube River, its islands and the riparian zones are characterized by high biodiversity as regards species and ecosytems;
- The majority of the most valuable habitats is to be found in the Danube River basin, ranging from running and stagnant freshwaters, through pit bogs and marches, grassy and forest habitats, as well as rocky, sandy and glacier habitats to agricultural and absolutely artificial habitats;
- Due to its specific geological structure and refuge features the Djerdap Gorge is an extremely important area of flora diversity, with more than 900 species of vascular flora and over 30 relict forest ecosystems;
- The 390 protection areas in the DRB include:
  - 6 national parks;
  - 64 nature reserves;
  - 19 nature parks;
  - 6 areas with specific features;
  - 294 natural landmarks and 59 protected areas around cultural landmarks.

(xii) Germany:

- There is a high number of "nature protection areas" in the Danube River valley which constitute essential parts of the country ecosystem network;
- The upper Danube valley is declared as "nature park" (85700 ha);
- The national parks "Bayerischer Wald" (13300 ha) and "Berchtesgaden" are declared as "UNESCO biosphere reserves".

Annex 4.2.

Country Specific Health Hazards and Water Mediated Diseases in the DRB Countries

The country specific health hazards and water mediated diseases in the DRB countries can be summarized as follows:

(i) Bosnia & Herzegovina:

- As a consequence of the war public water supply and sewerage systems are to different extent damaged, partly under construction;
- Only one third of population is currently supplied with hygienically correct potable water;
- In 1996 14 infection and parasite epidemics (including 4 epidemics of enterocollitis and 2 epidemics of hepatitis A) have been recorded;
- Presently situation has improved but has still to be considered as unstable.

(ii) Bulgaria:

- Public water supply in the Danube part of the basin is mainly ensured by ground water (65%) and 35% by surface water;
- In the region of Svistov elevated contents of iron and manganese are found in water from the public water supply systems due to worn-out piping systems;(there is a treatment plant to remove the manganese);
- Contamination of water sources with ammonia, petroleum products and chromium-6+(carcinogenic);
- Elevated level of coliform bacteria in most towns of the DRB (increased risk of water related infection diseases);
- Periodically enhanced nitrite levels in different areas of the DRB.

(iii) Croatia:

- Public water supply is mainly ensured by ground water (90%);
- No serious problems with water related diseases;
- Occasional epidemics of enterocollitis and hepatitis A.

(iv) Czech Republic:

- In 1996 no case of water born infection from drinking water abstracted by public water supply systems;
- Occasional cases of water born infections in certain periods from bathing in water-courses and reservoirs);
- Potential hazards may result from accidental pollution of water courses; in 1995, for example, 243 such cases were registered;
- An extreme case was the summer flood in 1997, in which numerous drinking water resources were depreciated, wastewater treatment plants flooded and various industrial chemicals and wastes got under water.

(v) Hungary:

- Public water supply is principally ensures by ground water (95%); only regional or periodic usage of surface water;
- 65% of ground water resources are vulnerable; problems are occasionally iron, manganese, nitrate and arsenic with natural origin;
- The microbiological quality of bathing water is often below the requirements;
- Occasional epidemics due to bacteriological infections in swimming-pools.

(vi) Moldova:

- Public water supply is mainly ensured by ground water (80-85%);
- Elevated contents of hydrocarbons, sodium and fluorides in water from public water supply systems;
- Water from shallow wells is often polluted with nitrogen compounds;
- On average 38% of centralized water supply sources do not meet sanitary-chemical standards and 11% do not correspond to microbiological standards;
- From decentralized water supply sources 70% do not meet sanitary-chemical standards and 12% do not correspond to microbiological standards;
- There are significant incidences of hepatitis A, dysentery and enteritis; exact data on water born diseases are, however, not available.

(vii) Romania:

- In Romania surface water can principally not be used for drinking purposes without proper treatment;
- Water quality of shallow wells and boreholes is considered a serious health problem in rural areas due to high nitrate concentration usually exceeding 50 mg/l;
- Significantly increased occurrence of diseases mediated by water from the Danube River system or groundwater sources is reported for:
  - Infant methemoglobinemia (caused by nitrate intoxication);
  - Communicable diseases such as dysentery, acute diarrhea, cholera, viral hepatitis (due to microbial contamination of surface water and water from shallow aquifers and rural wells);
  - Communicable diseases (due to water shortage, respectively periodic intermittence of tap water supply combined with fecal contamination);
  - Diseases due to intoxication from industrial and agrochemical substances in water used for drinking purposes; either from permanent pollution or from occasional accidents and spillage);
  - Diseases from elevated content of toxic cyanobacteria in surface waters.

(viii) Slovakia:

- About 75% of the population are supplied by ground water sources;
- About 90% of irrigation water is surface water;
- The primary problems regarding both surface and ground water are a high nitrate contamination from agrochemicals and untreated wastewater discharge;
- The main problem regarding the surface waters of the Danube River system are high pollution by nutrients and contamination by different industrial substances, including oil substances;
- At the time being there are no significant health hazards through pollution of water used for drinking purposes;
- Diseases caused by the hygienic quality of drinking water are not frequent and only in exceptional cases it has come to epidemics.

(ix) Slovenia:

- Surface water is a minor source of public water supply;
- No serious health hazards;
- Some cases of pollution used for drinking purposes with organic solvents, pesticides, heavy metals;
- Some problems with chemical pollution through industrial spillages and agricultural runoff.

(x) Ukraine:

- Regarding centralized water supply systems about 18% of water quality tests did not meet sanitary-chemical standards and 15% of the tests did not correspond to bacteriological standards (figures for Odessa Region, 1996);
- At the time being there are no exact data on health hazards mediated by surface or ground water utilization in the DRB part of Ukraine;
- A recognized problem is the use of hypo chlorinated water with high concentration of heavy metals and other toxic substances, which are supposed to lead to endocrine system diseases, metabolism disturbances, nervous system diseases, etc.

(xi) Yugoslavia:

- Inadequate water quality in larger municipal water supply systems from inferior raw water quality, inadequate water treatment and disinfection;
- About 50 municipal water supply systems (for which microbiological inadequacy is higher than 5% and physical and chemical inadequacy higher than 20%) do not use water from watercourses or impounding reservoirs, but ground water from different water bearing strata;.
- In a large number of small settlements the quality of drinking water is not satisfactory due to the absence of water treatment and casual disinfection on one side, and worn-out piping and periodic supply interruptions, on the other side;
- Most frequent causes of inadequate water quality are elevated contents of iron, manganese and organic matters, the absence of residual chlorine, an increase in the total number of bacteria, periodical presence of coliform bacteria, sporadically presence of E.coli;
- The number of epidemics of contagious diseases reached a peak in 1995 (396 epidemics and 6850 diseased persons) and is supposed to have had a decreasing tendency since that time.

Annex 6.1.

Country Specific Characteristics Regarding Water Sector Relevant Legal Framework

The country specific characteristics regarding the relevant legal framework in the particular DRB countries can be summarized as follows:

(i) BiH:

- Since the declaration of the new constitution in 1994, environmental legislation is still in the constitutional phase;
- Allocation of competence and responsibilities between national level (Federation of Bosnia and Herzegovina and Republic Srpska), canton level and municipal level are not adequately and efficiently defined, but just provisional determined;
- General matters are usually regulated by laws; procedures, standards, etc. usually by accompanying "books of rules".

(ii) Bulgaria:

- The harmonization of the national legislation regarding water and solid waste management, ecology, health and the procedures for environmental impact assessment (EIA) with international regulations and standards has been started since 1990;
- Altogether the complex system of environmental and water related legislation seems not to be fully compatible and suited for adequate control and management of the serious environmental problems in the country.

(iii) Croatia:

- Due to the fact that Croatia is an independent state only since 1990, the legal and institutional structures are still in the process of transformation, also in the fields of water management and environmental protection.

(iv) Czech Republic:

- The most urgent task is the preparation of a new "water act" that will replace the outdated one from 1972, amended 1989;
- A general task is further harmonization of national legislation with EU regulations and standards.

(v) Moldova:

- According to the constitution of the Republic of Moldova the President of the Republic is responsible to the world community for the state of environment and he also represents the interests of Moldova on environment protection at the international level;
- Although there is a complex system of environmental legislation (with a high number of decrees, laws and regulations elaborated and amended since 1990), there remains the problem that they cannot be enforced due to the problematic economic situation and the lack of professional capability.

(vi) Romania:

- At the time being the environmental and water related legislation is in a process of transformation. The reorganization of the legislation framework reflects the need to manage all the natural resources as part of an integrated system and strategy, which involves cooperation between all relevant authorities and institutions on the different administrative levels;
- One of the main concerns is the harmonization of the national environmental and water related legislation with international requirements, regulations and standards.

(vii) Slovakia:

- The environmental legislation is mainly formed by the following three main acts:
  - Act on the National Environment, 1991;
  - Act on Nature and Countryside Protection, 1994;
  - Environmental Impact Assessment Act, 1994;
- The Water Act (1973) and the Act on State Administration in Water Management (1974) have been amended in 1993 and have brought significant changes in the responsibilities of various public authorities;
- Today environmental legislation, especially regarding effective public participation, has not yet recognized the principles already incorporated in the legislation of western democracies.

(viii) Slovenia:

- Slovenia has no recent legislation on water; the most urgent task is the preparation of a new "Water Act" that will replace the outdated one from 1981;
- The new Act on Water, at the time being in draft status, will stipulate the institutional structure as well as the basic responsibilities, liabilities and obligations for the implementation of the new national water management programme;
- A general task is future harmonization of national legislation with EU regulations and standards.

(ix) Ukraine:

- The basic principles for the protection of the environment in the Ukraine are regulated by the "Law on protection of the Environment, 1996" and the "Law on Sanitary and Epidemiological Security of the Population, 1994;
- The main water related issues are regulated by "The Water Code of Ukraine, 1995";
- In addition there are a number of regulations, rules norms, etc., regulating in detail particular issues;
- Altogether it is recognized that an improvement of the unsatisfactory environmental situation can only be achieved by more effective control and enforcement of gradually improved environmental legislation.

(x) Yugoslavia:

- The legal framework for environmental protection and the protection of water resources and ecosystems is a composite of federal and republican laws and regulations and consequently characterized by discrepancies;
- The particular administrative structure of the country calls for basic coordination between the legislation of the republics, in each of which the system of environmental protection has been rather well developed and the federation which is authorized to lay down the fundaments of the system of environmental protection;
- In addition, numerous laws and regulations regarding environmental issues were adopted long time ago, have been frequently amended and need revision.

Annex 6.2.

Country Specific Characteristics Regarding Relevant Institutional Framework

Country specific characteristics in the DRB countries can be summarized as follows:

(i) Bulgaria:

- In Bulgaria there is one ministry responsible for environment and water, under this ministry 6 Regional Environment and Water Inspectorates are acting on regional level;
- "Wands" is the umbrella organization for all private, mixed and state water and wastewater utilities in the country;
- A particular institution is the National Center of Environment and Sustainable Development in Sofia.

(ii) Croatia:

- The responsibility for environmental protection is with the Ministry of Construction and Environmental Protection and the subordinated State Directorate for Environmental Protection. The responsibility for water management is with the Ministry of Agriculture and Forestry and the subordinated State Directorate for Water Management;
- A particular institution is the "JVP", an umbrella organization for all water and wastewater utilities in the country.

(iii) Czech Republic:

- The overall responsibility for water management is with the Ministry of Agriculture; the professional management is carried out by privatized joint stock companies (called Povodis) which are acting on river catchment basis;
- The responsibility of environmental aspects of water management and water resources is with the Czech Environmental Inspection a body of the Ministry of Environment.

(iv) Hungary:

- In Hungary the responsibility for the environmental protection has been allocated to the Ministry of Environment, but all ministries should consider the environmental consequences of their activities. The water sector has been divided, so the aspects of water quality belong to the Ministry of Environment, and the aspects of water quantity and so called water management to the Ministry of Transport, Communication and Water management, a traditionally strong ministry;
- On the regional level the responsibilities are allocated to the Environmental Protection Inspectorates and the District Water Authorities;
- Significant strengthening of the environmental institutional system is recognized as a fundamental precondition for the implementation of the National Environmental Plan and the practical enforcement of the principle of sustainable development.

(v) Moldova:

- In Moldova the Ministry of Environmental Protection is the leading authority regarding environmental protection and issues of water related ecosystems;
- "Apele Moldovei", a sub-division of the Ministry of Agriculture and Forestry is responsible for surface water resources and the issues of water balance;
- Jointly with the two ministries and their sub-bodies various institutions are responsible for particular environmental and water related aspects;
- A general matter of concern is that responsibilities and tasks are not definitely defined and partly overlapping allocated to a high number of authorities and institutions.

(vi) Romania:

- In Romania the Ministry of Water, Forests and Environmental Protection is responsible for all environmental and water related issues;
- "Apele Romane", a public utility with branches in each of the country's 12 river basins is responsible for 70000 km of watercourses, 150 multi-purpose lakes and dikes and raw water supply to municipalities, industry and agriculture, whereas the water and wastewater services are under the responsibility of the municipalities, respectively the Ministry of Public Works.

(vii) Slovakia:

- In Slovakia the overall responsibility for water management is shared between the Ministry of Environment which is responsible for the environmental protection of the water medium and the Ministry of Soil Management which is responsible for all water utility functions;
- In 1996 a new territorial-administrative division has been established with consequent transfer of the state competence in water management to regional and district authorities which are also responsible for environmental protection. At the time being the effect of this fundamental transformation is difficult to assess.

(viii) Slovenia:

- The responsibility for water management is with the Ministry of Environment and Physical Planning;
- The professional water management is organized in 8 river catchment areas (Water Act 1981);
- The inspectorates of the Ministry of environment are responsible for the control regarding all aspects of water users;

(ix) Ukraine:

- The overall responsibility and guidance for all environmental and water related issues is with the Ministry of Environmental Protection and Nuclear Safety;
- The management of water resources is on national level carried out by the Cabinet of Ministers, supported by especially authorized bodies such as departments of the Ministry of Environment, the State Committee for Water Resources, the State Committee for Geology and Utilization of Mineral Resources, the Hydrometeorological Committee, as well as sub-bodies of these committees;
- A particular body with regional responsibilities is the Government of the Autonomous Republic of Crimea.

(x) Yugoslavia:

- Due to the complicated political structure of the Federation of Yugoslavia the allocation of responsibilities regarding environmental protection and management of water resources is also relatively complicated;
- For all projects, respectively decisions with possibly negative impact on the environment (including water) or human health, an EIA has to be carried out which has to be approved by the Ministry of Environmental Protection;

- Water management is overlapping since each of the following ministries is responsible for one segment:
  - Ministry of Mining for ground water resources;
  - Ministry of Health for drinking water;
  - Ministry for municipal Services for all aspects related to water supply systems;
  - Federal Ministry of Agriculture;
  - Federal Ministry of Development, Science and Environment;
  - Feral Ministry of Health and Social Affairs;
  - Ministry of Agriculture, Forestry and Water Management of Republic of Serbia and Montenegro;
  - Ministry of Environment of Republic of Serbia and Montenegro;
  - Ministry of Health of Republic of Serbia and Montenegro;
- Quality control of surface waters of inter-state and inter-republican watercourses is performed by the Federal Weather Bureau, while the control of other watercourses is performed by the republican weather bureaus.