Chapter 6

MANAGEMENT OF FRESHWATER RESOURCES AND QUALITY

6.1 Quantity and quality of freshwater resources

Determinants of the water balance

Croatia lies on the edge of two major climatic regions: the Mediterranean and the Central-European Continental region. The Mediterranean climate of the Adriatic coast is characterized by mild, rainy winters and dry summers. It is more humid in the north-west (1 500 mm precipitation per year) than in the south (500 mm at Hvar). Northern and eastern Croatia have colder winters and more precipitation.

The Croatian territory can be divided into four geomorphological units (see Figure 6.1). The Pannonian area comprises the lowland and hilly part of northwestern Croatia (average altitude less than 500 metres). It is bounded by the rivers Drava, Danube, Mura, Sava (with its tributaries, the Kupa, Korana, Glina and Una). The Croatian highland area, with peaks at about 1750 metres, separates the Pannonian from the coastal zone. This is a karst area, with temporary springs, sink rivers, deeply incised river courses such as the Dobra and the upper Kupa rivers and deep canyons. The Croatian Adriatic area includes the narrow coastal belt separated from hinterland by high mountains (Dinara 1821 metres). This coastal area can be further divided into Istria in the north and Dalmatia in the south. These areas are also of karst nature, with some surface streams, strong karst springs and abundant underground rivers and pools draining from the hinterland's mountains.

Croatia is endowed with abundant water resources. Renewable resources amount to some 45 billion cubic metres a year or 9 500 m^3/cap/year, which places Croatia amongst the best endowed countries in Europe, on a par with its neighbour Slovenia. Available surface water stands at 39 billion cubic metres a year. The surface hydrographic network and flow-rate characteristics are shown in Table 6.1. 60 per cent of these water resources are generated within Croatia, while 40 per cent are external contributions from upstream neighbouring countries (mostly Slovenia, Austria, Bosnia and Herzegovina and Hungary). Most of the river basins, including their underlying groundwater resources, have to a large extent a transboundary character. Therefore all actions for the management of these waters, regarding the regulation of their water regime, the protection of their quality, their regime of use, are tightly interconnected and have consequences in the other neighbouring countries.

Croatia is also rich in groundwater of various kinds, as shown in Table 6.2. About 6 billion cubic metres are available a year, though they are unevenly distributed. A slight decrease in the water table has occurred in the aquifer below Zagreb and a more important one in the Drava river aquifer (a 4-metre drop in the level over the past 20 years). This could become a source of concern unless its users set up a concerted plan.

In spite of this general abundance of water, problems do occur locally. For instance, the Adriatic islands (1 185 islands, 66 of them uninhabited) have poor surface water resources and not enough wells. As a result, they suffer water shortages in the summer.

Groundwater and springs

There are essentially two geologically different zones, with very different groundwater resources and regimes:

- the Pannonian plain with underground aquifers under the main rivers. Most of the groundwater is stored in the alluvial aquifers of the Drava and Sava valleys, in a zone of tectonic depressions where thick quaternary deposits have sedimented. These aquifers, from 10 to 100 metres deep, are covered with poorly permeable clayey-silty deposits of several tens of metres. They replenish with rainfall infiltrating through these layers, which cover almost the entire surface area. An estimated 8 to 30 per cent of precipitation infiltrates the aquifers.

Figure 6.1: Hydrographic network and water basin boundaries

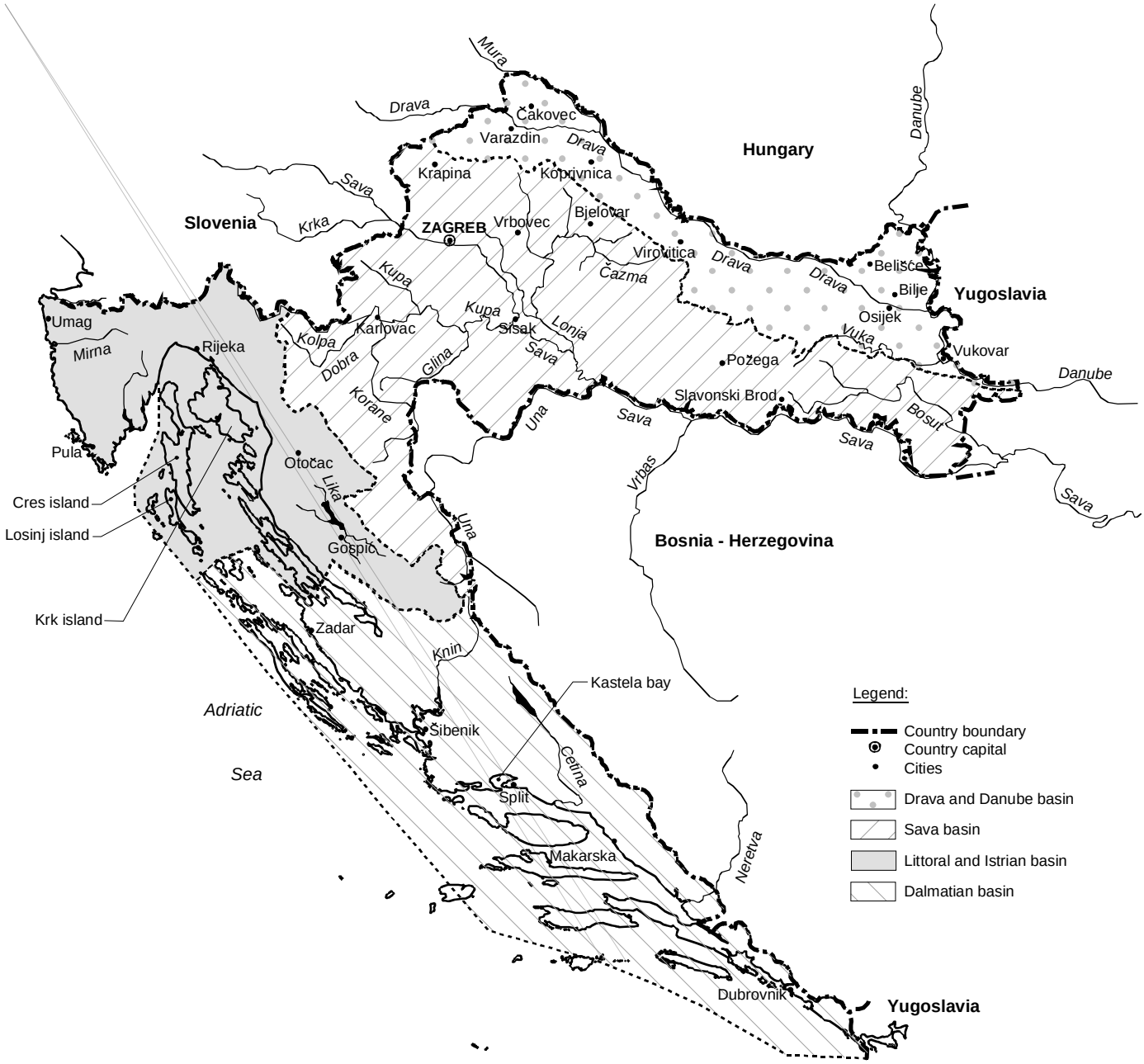


Table 6.1: Characteristics of Croatia's largest rivers

Basins and rivers	Length		Catchment area		Average annual discharge a/		
	Total	In Croatia	Total	In Croatia	Minimum value b/	Mean value	Maximum value c/
	(km)		*(km^2)*			*(m^3/s)*	
Black Sea and Danube basin							
Danube	2 857	188	817 000	1 872	…	6 430	…
Drava	707	505	40 150	6 038	…	625	…
Mura	438	…	13 800	…	…	210	…
Sava	945	562	96 328	23 243	…	1 209	…
Sutla	92	89	582	343	…	…	…
Krapina	75	75	1 123	1 123	…	…	…
Trebez, Lonja, Ilova	218	218	6 993	6 993	…	…	…
Orljava	89	89	1 494	1 494	…	…	…
Bosut	186	151	3 097	2 572	…	…	…
Kupa	296	296	10 032	10 032	…	103	…
Sunja	69	69	462	462	…	…	…
Una	212	120	9 368	636	…	243	…
Adriatic Sea							
Cetina	101	101	1 463	1 463	8	36	146
Lika	…	78	…	…	…	…	…
Gacka	…	22	…	…	…	13	…
Krka	73	73	2 088	2 088	23	55	84
Mirna	53	53	458	458	4	8	14
Neretva	225	20	11 798	430	…	378	…
Zrmanja	69	69	907	907	17	38	52

Sources: Hrvatske Vode, 1997,
Statistical yearbook, 1998.

Notes:
a/ Average calculated over 30 years (1960-90).
b/ Mainly summer period.
c/ Mainly from December to March-April.

- the karst area, which comprises the major part of the mountainous zone and the coast including the islands (Dinaric region). A particular danger in the karst region (carbonates rocks) is the vulnerability of groundwater to pollution from the surface through fissures, conduits and caves enlarged by dissolution processes. The high quantity of rainfall sinks into the underground, where it constitutes large flows which surge out in littoral fresh springs, saline littoral springs or submarine springs. But, with the exception of a few large ones, the islands have no external inflow of groundwater.

Specific to Croatia is the abundance of thermal and mineral water springs; some of them are renowned.

Groundwater and springwater quality

The quality of groundwater is considered good throughout the country. The monitoring data from the Institute of Geology and county public health institutes show that there have so far been only few limited cases of pollution. In terms of point sources of pollution, the Zagreb landfill has been identified so far as a potential source of groundwater pollution by chemical substances, although the values still meet the standards. In terms of diffuse pollution by fertilizers or pesticides, the karst area is not under threat as there is no agriculture there. However, in Istria, nitrates have recently appeared sporadically in groundwater during the period of fertilizer spreading, although the standards were

met (10 to 12 mg NO_3/l). In the upper-Drava aquifer, the situation is more serious, with nitrate concentrations regularly higher than the Croatian standards for drinking water allow (44 mg NO3/l), but still below the EU standards (50 mg/l). The high iron content of the Sava aquifer is due to the geological layer's components. There, the water must be treated to reduce the iron content and chlorinated before human consumption.

Table 6.2 : Surface and underground water resources in Croatia

	Runoff (Billion m^3/year)
Surface water	
Black Sea basin	31
Adriatic Sea area	8
Ground water	
Karst area	4
Continental part	2

Source: Integrated Water Management System, Hrvatske Vode, 3 (1995).

Surface waters

The country is predominantly part of the Black Sea watershed. Most surface waters drain to the Danube or one of its tributaries; the rest (only 20 per cent of Croatia's river basins) go to the Adriatic Sea. The largest rivers are shared watercourses. The Danube flows through Croatia over a length of 188 km and the country's two other major rivers, the Sava and the Drava, flow through Croatia over 562 km and 505 km, respectively (both are tributaries to the Danube). The Kupa (296 km), Korana (134 km), Bednja (133 km), and the Cetina and Glina (100 km each) are entirely Croatian.

Most large rivers in terms of water flow drain to the Black Sea (Table 6.1). For instance, after its confluence with the Mura, the Drava's average flow is 587 m^3/s and at the point where it joins the Danube it is 620 m^3/s. The Sava's average flow rate is 340 m^3/s at the Slovenian border, the Kupa's is 283 m^3/s at Sisak. In the Adriatic catchment area, the Mirna's average flow rate is 16 m^3/s , the Rasa's is 12 m^3/s, the Rjecina's is 24 m^3/s, the Zrmanja's 23 m^3/s, the Krka's 50 m^3/s, the Cetina's 127 m^3/s and the Neretva's 378 m^3/s. Most of Croatia's watercourses reach a peak in spring and autumn, while the summer minimum is more pronounced in the Adriatic region than in the Black Sea catchment area. In Zagreb, the Sava flow rate peaks at 400 m^3/s in November, but drops to 180 m^3/s in August; in Slavonski Brod, it peaks at 1 400 m^3/s in March and falls back to 400 m^3/s in August and September. Because the rivers swell so much, floods have always been a serious threat, requiring the building of strong protection along watercourses.

There are not many lakes in Croatia: 26 natural and artificial lakes, totalling 105 km^2. The largest natural lake is Lake Vrana (30.2 km^2), followed by Lake Prokljansko (11.5 km^2), Lake Vransko (5.8 km^2), Kopacevsko (3.5 km^2) and the sixteen famous Plitvice Lakes (1.9 km^2) classified as World Natural Heritage Sites by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Croatia also has artificial lakes and reservoirs which have been created to produce hydroelectric energy: Kruscica (20 km^2) on the Lika river and Peruca (13 km^2) on the Cetina river are the biggest. These lakes have brought great changes to the naturally arid karst relief.

River quality

A regulation defines four river quality categories (from I, fairly good, to IV, bad - see Table 6.3). Quality objectives have been defined for all the country's water streams. The severe crisis in industry (operating at only 40 per cent of capacity) and the drastic reduction of inputs in agriculture (pesticides and fertilizers) have considerably eased the pollution pressure on waters (see Chapters 10 and 11).

Table 6.3: River quality classification

Parameters	Units	Classes	
		I and II	III and IV
NH_4^+	*mgN/l*	0.08	0.4
NO_2^-	*mgN/l*	0.01	0.5
NO_3^-	*mgN/l*	10	15
PO_4^{-3}	*mgPO_4/l*	0.1	0.1
Phenols	*mg/l*	1	50

Source: Report on the Quality of Surface Water, 1998, State Water Directorate.

In the Pannonian watershed, the rivers are frequently one quality level below the objective, in general due to bacterial pollution (from domestic wastewater direct discharges and agriculture breeding units). The worst conditions are found in the Sava river basin, which downstream is categorized as III or IV (downstream from Zagreb, in Obrovo region) because of bacterial pollution.

The left tributaries to the Sava have high BOD[5], nitrogen, phosphorus and bacterial contamination levels. Occasional river blossoming occurs. The water quality is so bad in some locations that mass fish kills occur sometimes in summer when oxygen deficiency is severe. The Drava and Mura rivers are quality III when they enter Croatia, where they tend to improve. Downstream from Terezino Polje they comply with category II conditions. Danube waters are category II throughout Croatia.

In the Istrian and Dalmatian Littoral basin, the watercourses are very clean upstream, but their quality deteriorates downstream in part due to untreated waste-water discharges from households, industry and agriculture. The quality of the Rjecina, the lower Gacka and Lika rivers, and the Cetina meets the objectives. In the Primorje-Istria catchment basin, the lower streams of watercourses are significantly polluted. In the Dalmatian catchment area, watercourses comply in general with category I or II, clean upstream, more polluted downstream. Along the coast, the water is mostly category II, with higher pollution levels in the vicinity of seaports and industrial towns, where the quality can drop to category III or IV.

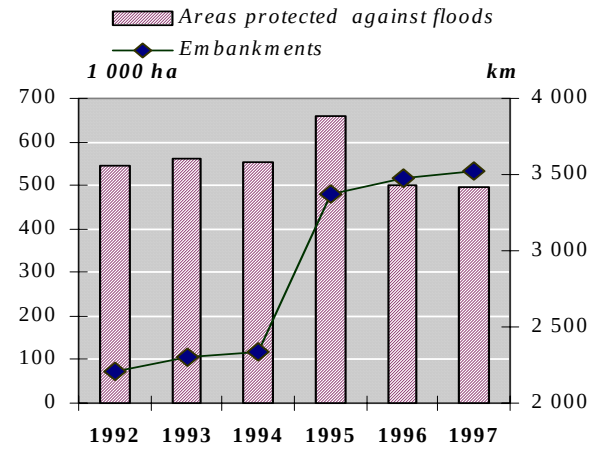
6.2 Water protection and use

Water protection and floods

Due to its geomorphology and its climate, Croatia is very prone to water damage. In the Danube basin, the Drava, the Sava and the Kupa have large flood plains. Protective measures include deliberate flooding, drainage of excess water and protection against erosion and torrents. A total of 1 500 km of protective dykes has been built since the early 90s (Figure 6.2).

In the Sava river basin, 285 000 hectares of fertile flatland are regularly exposed to floods, which cause damage to agriculture, industry and settlements. The protection plan of the Sava is 60 per cent complete. In 1997, in the central Sava basin system, 535 of the planned flood storage reservoirs were completed. Large flood storage and dykes along the river make it possible to store 30 per cent of the flood water and drain the remaining safely. The city of Zagreb is now well protected against floods. Protective measures are still needed 100 km downstream from Zagreb, near and downstream from Sisak.

Figure 6.2 : Protection from floods of external water, 1992-1997



Source: Statistical yearbook, 1998.

In the Drava basin, in addition to dykes, the flow is regulated by hydropower plants situated upstream in Austria and Slovenia, and another three in Croatia. There is a joint Croatian-Hungarian Water Management Commission, which is working to solve common problems regarding the regulation and use of the Drava. The situation of the basin is now satisfactory.

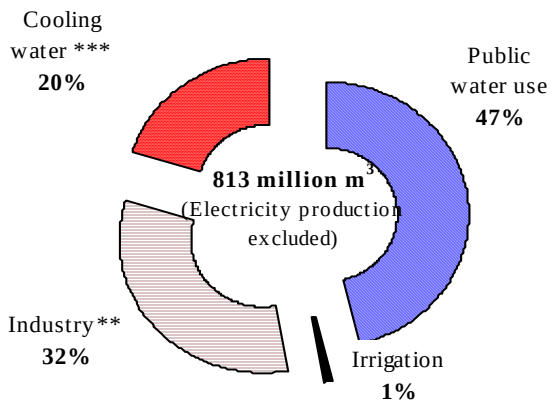
The karstic Dalmatian basin is also subject to severe floods in the rainy period. The entire flood area covers 34 000 ha, of which about 20 000 ha of agricultural land are still under threat. Erosion by torrents (339 torrents are recorded in this zone) also affects about 190 000 ha. The protective measures are based on building dykes along the banks, as well as tunnels and canals.

In the Istrian and Croatian littoral basin, 225 000 ha are threatened by floods and 456 200 ha affected by erosion. Measures are similar to those in the Dalmatian region: building dykes and canals, and flood storage reservoirs.

As they are vital, all protection installations are State property and are financed directly from the State budget. Their maintenance is the responsibility of the State Water Directorate (SWD), which can subcontract these tasks. Each year DM 70 million is spent on maintaining flood protection installations.

However, only an estimated 60 per cent of the necessary flood defence works have been built so

Figure 6.3 : Water abstracted* by activity, 1996



Source: Statistical yearbook, 1998.

* Excluding water losses.
** Industry (ISIC 10-37,402-403).
*** Cooling water for thermal power plants.

far. Funds raised to maintain and develop this system are just enough to maintain what is already built and to maintain the hydrometeorological water management system for warning and forecasting basin water regimes, and to coordinate national strategies. Too little money is left for new infrastructure.

Protection works are generally built with a view to combining the multipurpose uses of river streams with flood protection objectives. The Sava, the Drava and the Kupa rivers are of particular importance because they are to a large extent navigable. In Dalmatia, the Krka and Cetina rivers stand out because of their hydroelectric potential.

In 1997 the Government adopted a project to build a 61-km long, multipurpose Danube-Sava canal connecting the Danube basin to the Adriatic. The Sava would be channelled to Zagreb and used for navigation and hydropower production. The Sava floods would be controlled, some territories drained, and Sava's water used for industrial and agricultural purposes. The project's environmental impact is currently being assessed, with a public hearing planned before summer 1999.

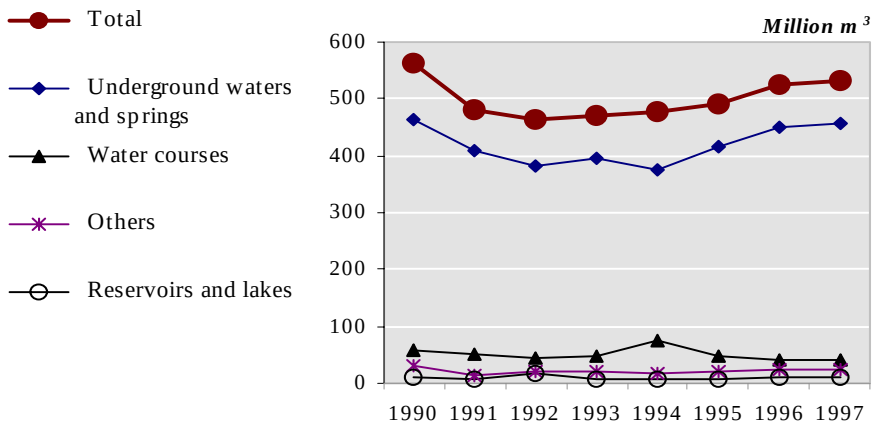
Water abstraction, supply and use

The direct abstraction of water for *hydroelectricity production* is huge (more than 35 billion cubic metres in 1997- Figure 6.3). Hydroenergy has been used for electricity production since the end of the 19th century. There are 20 hydropower plants; they have a total capacity of 2 076 MW and an average output of 11 700 GWh. In 1997, hydroelectricity production represented about 47 per cent of total electricity output and 26.1 per cent of total power output. Only 55 per cent of the potential of rivers is used today. There are projects to further develop 62 small and medium-size plants, half of which would be multipurpose facilities, providing also water supply and flood control (see above).

The *uptake for public water supply*, which had slowed down slightly in 1991-1993, is now again reaching its 1990 level, i.e. 530 million cubic metres in 1997 (Figure 6.4). Most comes from groundwaters: 51 per cent from aquifers and 35 per cent from springs. Surface waters (from watercourses, reservoirs and lakes) represent only about 10 per cent (Figure 6.5). In 1997 and based on these figures, with 63 per cent of the population connected to the public water supply network, water abstraction would amount to 190 m^3/cap or 519 l/cap/day all supplies combined (household, municipal and industrial users).

Water is also abstracted for *industrial use* (264 million cubic metres/year), but far less than in the early 1990s. Today, industry runs at only 40 per cent of its capacity and has drastically reduced its water use (down three quarters in 1996 compared to 1991). 80 per cent of the water used by industry is directly abstracted from surface watercourses, the rest comes from the public supply network.

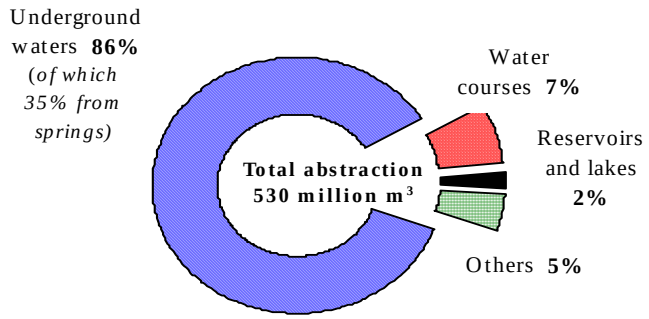
Figure 6. 4: Water abstraction* for public supply, 1990-1997



Source: Statistical yearbook, 1998.

* Data refer to public water supply system.

Figure 6.5 : Breakdown of water abstraction* by sources, 1997



Source: Statistical yearbook, 1998.

* Data refer to public water supply system.

Cooling water (over 700 million cubic metres/year) goes mostly to electricity production, the chemical industry and the refining industry.

Irrigation is negligible (less than 15 000 hectares of land is irrigated) and uses 9.5 million cubic metres/year. Only 0.8 per cent of the surface which would need to be irrigated is equipped with modern irrigation systems. About 80 per cent of this land is located in Dalmatia. There is no full-fledged irrigation system. Yet the need exists. A research project has therefore been undertaken and plans are being prepared; charges will be worked out accordingly.

Fish-farming and fish breeding in fish ponds of freshwater are well developed in Croatia. The related water use is estimated at about 280 million cubic metres a year. Water for all those uses is mostly taken from rivers and reservoirs in the Danube, Drava and Sava basins.

Public water supply

The public water supply is predominantly drawn from groundwater (above 85 per cent), although surface water is also used for drinking water in some places, such as the Pannonian plain. The use of groundwater for drinking is more common, as its

quality is generally good, necessitating only disinfection but no other treatment. Individual wells, however, do not seem free from bacterial contamination. From 1992 to 1996, an important proportion of the voluntarily checked samples proved to be contaminated and 12 epidemiological outbreaks occurred due to poor water quality (see Chapter 13).

Much of the water infrastructure was built in the 1980s, at a time of fast economic growth and tourism development. The most striking problem is the high water losses along the pipe network, which represent between 25 to 30 per cent of abstracted water.

In 1997, only 63 per cent of the population was publicly supplied with water. However, this figure conceals huge discrepancies. In the Sava basin, the situation is uneven, with a 51 per cent average supply rate, ranging from 10 per cent to 85 per cent (Zagreb). A large portion of the population still has individual supplies (tanks, shallow wells, etc). The supply rate is 53 per cent in the Drava and Danube basins, where surface water from watercourses may be used to supply the population. There, hydrogeological water research has been carried out to encourage the use of groundwater as drinking water and keep surface water for industrial use. In the Istrian and Dalmatian littoral basin, the development of tourism has rapidly increased the use of water (see Chapter 9). At the same time, even though the water infrastructure has been improved along the coast, the situation remains far from satisfactory. The drastic temporary increase in the population in summer coincides with the dry season and a low water resource level. In the Dalmatian basin, the supply rate is 73 per cent, but in general the situation is still difficult on the islands, as they do not have enough wells. Their water has to be brought in from the mainland by underwater pipelines or transported by special tank ships, which is common for the smaller islands. Cres and Losinj are the only islands able to meet as much as 90 per cent of their own water needs. Where underwater pipelines supply drinking water, the consumption tends to increase, resulting in more waste water. Moreover, small industry is increasing (fish processing, vineyards, small shipyards, etc.) as well as tourism. Expanding the transport of water by underwater pipelines would require a considerable financial effort.

In short, more than 2 000 small water supply systems meet local requirements. Some supply a few households, others supply groups of settlements. About 90 per cent of these facilities do not meet the required sanitary conditions. Domestic supply has been fairly stable over the years, while the water quantities supplied to businesses have decreased by about one quarter since 1990. In 1996, half the water publicly supplied was for domestic users (Table 6.4). The rapid growth in the urban population (e.g. the population of Zagreb has much increased since the war) often stretches facilities beyond capacity. Chlorination is not systematically performed in the countryside. The final development stage of the water supply strategy foresees a reduction in the number of water supply networks to 56, which will supply 90 per cent of the population.

Waste-water discharge and treatment

The total waste-water volume discharged in surface and coastal waters is equivalent to that of about 10.5 million inhabitants (including domestic and industry discharges). The typical sewage system is mixed. Only a few smaller cities and residential districts of bigger towns have separate systems.

Table 6.4: Public water supply by type of users, 1990-1997

	1990	1991	1992	1993	1994	1995	1996	1997
Total supplied* *(Million m^3)*	**429**	**357**	**339**	**357**	**359**	**362**	**374**	**372**
Water supplied to: *(as % of total)*								
- Households	*40*	*42*	*44*	*45*	*47*	*48*	*49*	*49*
- Sectoral activities	*52*	*47*	*51*	*48*	*47*	*44*	*43*	*43*
- Other water supplied	*8*	*11*	*4*	*6*	*6*	*8*	*7*	*8*
Water loss along pipe network *(as % of total abstraction)*	*24*	*26*	*27*	*24*	*25*	*26*	*29*	*30*

Source: Statistical yearbook, 1997 and 1998.

Table 6.5: Public waste-water sewage and treatment by technology, 1990-1997

	1990	1991	1992	1993	1994	1995	1996	1997
Public sewage *(Million m^3)*								
Total	**315**	**277**	**274**	**273**	**270**	**268**	**271**	**289**
Domestic sewage	112	109	117	115	116	122	127	134
Sectoral activities	204	168	156	158	154	146	144	155
Treated as % of total	*15*	*14*	*15*	*17*	*22*	*20*	*21*	*21*
Treatment by technology *(as % of treated discharge)*								
Mechanical	*83*	*76*	*77*	*85*	*81*	*84*	*76*	*81*
Biological	*10*	*11*	*10*	*11*	*9*	*9*	*10*	*6*
Combined	*7*	*12*	*13*	*4*	*11*	*7*	*14*	*13*

Source: Statistical yearbook, 1997 and 1998.

Industrial waste water is often discharged into the sewage system, in many cases without adequate pretreatment. In 1997, just over 20 per cent of all waste water was treated (Table 6.5), with big regional disparities. For instance, efforts to improve bathing water quality concern the beaches, where 60.5 per cent of the 1.74 million inhabitants are connected to sewage networks (1995 data). In general, it is difficult to get an accurate picture of the scale of the pollution discharged in Croatia's water bodies, as the only data available to the public (Statistical yearbook) are based on total volumes discharged, and not on pollution load or specific polluting components.

Within the framework of the Danube Convention, pollution hot spots on the Danube's tributary rivers have been identified in each country that participates in the Danube Strategic Action Plan. In Croatia this has happened along the Sava, Drava, Kupa and Danube rivers. In 1995, 22 hot spots were listed, 18 due to municipal waste-water discharges of large towns (Belisce, Belje, Cakovec, Karlovac, Koprivnica, Osijek, Sisak, Slavonski Brod, Varazdin, Vrbovec, Vukovar, Zagreb) and 4 due to discharges from industrial plants (iron works, chemical and food industries). The destruction of numerous water and waste-water networks by the war has caused additional environmental pollution. Waste-water treatment plants of several municipalities have been destroyed and not yet rebuilt, for instance in Gospic and Otocac. As the first priority was to rebuild the public supply system, there is currently a gap between the share of the population that is connected to the supply system (62 per cent) and the share that is connected to the sewage system (35 per cent). This means that 65 per cent discharge their waste water in individual treatment systems or directly into nature, which explains the bacterial contamination of surface waters in the watershed (see above). In general, the collective sewage system, where it exists, is obsolete.

On the Adriatic coast, waste-water treatment plants have been upgraded considerably in the resorts to improve the quality of bathing water. For instance, sea outfall pipes have been built in Pula, Porec, Umag and Dubrovnik. In 1994, a new municipal waste-water treatment plant was built in Rijeka. Other waste-water treatment projects are being constructed in Split and Kastela Bay. The Bay of Split is the most polluted area. Households, resorts and industries (cement works, chemical industries and shipyards) are concentrated there. The future waste-water treatment project will be based on mechanical treatment as a first step. The situation on the southern coast is worse, for instance around Makarksa and Dubrovnik, where the installations are ageing.

In general, along the coast, efforts focus on building sewage networks to further reduce individual discharges and develop collective sewage systems, primary waste-water treatment and deep injection into the sea (see Chapter 9). This is what has happened in Istria, which is now sufficiently equipped with mechanical treatment plants (flotation and settling). This is acceptable in times of hardship. The sharp increase (5 to 30-fold) of the population size in summer would make it difficult to start up and run biological units satisfactorily. Biological units pick up slowly and reach their full performance regime only after several weeks. In addition, they are badly affected by any variation in flow rate and load. Therefore, they are not well adapted to tourist areas. Nevertheless, many places have old sewage

systems that still do not have treatment facilities. Croatia is lucky in that coastal streams and deep sea water are close enough to wash pollution far away. But this solution might not be acceptable in the future (see Chapter 4, the Barcelona Convention).

On the islands the situation is not good. Few have sewage systems. This results in waste water still being disposed of in the same way as in the past, i.e. discharged into the sea through the sewage system after simple preliminary settling. Biological facilities are rare, and the quality of their operations questionable. Settlements along the coast have direct individual discharges. The increase in tourists and tourism activities and settlements adds to the problem. The case of the Krk Island is described in Chapter 12. Overall, there is a serious lack of water infrastructure.

In terms of treatment facilities, Croatia is under-equipped (Table 6.5). The bulk of its waste waters (81 per cent in 1997) is treated only mechanically, which means poor performance yields, except for suspended solids, and a poor effect on dissolved pollution. About 6 per cent of waste waters are biologically treated and 13 per cent are subjected to combined treatment. Because the only data available are expressed in volumes (no data are available for COD, BOD, SS, N, P or other specific elements in spite of existing monitoring and reporting), it is difficult to calculate the eliminated pollution load. The reduction in pollution load is estimated at around 25 per cent of what is treated. Sludge production by waste-water treatment plant is not recorded.

Since waste-water treatment was made a priority a few years ago, many municipal installations have been or are being built, but their operation is fraught with difficulty. In many cases, municipalities that have invested and borne 50 per cent of the cost of the plants do not have enough money to cover the loans, and operate and maintain the equipment. So, they bypass their empty facilities and discharge their polluted effluents untreated. At the same time, new projects are being designed and partly financed by the water agency (Hrvaske Vode) to equip other towns.

It is difficult to describe the situation in industry. There again, no data on pollution load from industry, or at least from the most polluting industrial sites, are published even though industry reports annually to the authorities (the SDW and recently the SDEP) on the pollution it generates. A peculiarity of Croatian practices is the fact that part of the waste water from industry (30 per cent in 1996) is discharged together with domestic sewage into municipal waste-treatment plants, as industry is obliged to use and contribute to the plants where they exist. Another part is discharged directly or after preliminary treatment (for instance in Pliva Company, the Zagreb production unit reduces COD and toxicity, the Petrochemia/Kutina Company recovers and recycles part of the nitrate and ammonium) into watercourses or the sea.

6.3 Water policy objectives and management practices

Priorities for water policy and management programmes

The Strategy for Water Protection was adopted in 1992. There are three basic objectives:

- To extend public water supply to 90 per cent of the population; the remaining 10 per cent would continue to rely on individual facilities;
- To repair, construct and reconstruct sewage and waste-water treatment facilities for a total capacity of 10.5 million population equivalent;
- To achieve protection against flood (including reservoirs, canals, etc.) and build multipurpose projects involving river water use.

The total investment for all these works has been estimated at DM 6 billion, equally shared between the three above-mentioned objectives. Additional objectives relate to river regulation, development of irrigation and a comprehensive information system on water resources and water quality.

According to the Water Law (1995), water management planning is to be based on the Water Management Master Plan drawn up at the State level (i.e. the Long-term Plan for the Development of Water Management 1986-2005), and water management plans and schemes drawn up at the catchment area level. The Long-term Plan specifically deals with watercourse regulation, protection from floods and other natural water catastrophes. It also covers the use of water resources and supply; and the management of water pollution. The Long-term Plan is a document that ought to be regularly revised and adjusted to changes and to other policy documents such as the National Development Plan of Croatia, the Strategy for Physical Development, the Strategy for Environmental Protection, forest management plans and the navigation plan of the inland navigation

system. The Water Management Master Plan is not yet finalized.

Geographical areas with complex water management problems should have a water management plan along the same lines as the Master Plan but restricted to a smaller area; other catchment areas only need water management schemes. These schemes and plans essentially deal with the distribution and supply of water and improvement of water quality. According to the law, they should be developed by the SWD (HV), in coordination with the SDEP, local authorities and planning authorities; public and scientific institutes should be involved. The plans are then submitted to the basin level. According to the law, water management plans must be drawn up in every river basin and in Zagreb. Today few of these local plans are ready. The plan for the complex use of the Drava has been adopted (1998). The plan for the Sava and Zagreb's plan have not yet been adopted. The Littoral and Istrian catchment area and the Dalmatian catchment area have no plan yet.

The Long-term Plan has a series of sub-components, each of them dealing with one of the strategic objectives mentioned above:

- The National Plan against Floods, 1997;
- The Water Use Plan;
- The Long-term Water Supply Programme;
- The Water Pollution Control Plan;
- The State Water Protection Plan, adopted in January 1999.

The State Water Protection Plan defines the basic guidelines, tasks, activities and measures to reduce the pollution burden on water. The Plan's objectives regarding freshwaters are:

- To preserve the water which is still clean; water monitoring and quality objectives of the rivers are prescribed. Watercourses should meet the prescribed water quality and other water properties.
- To stop water quality deteriorating further by implementing protective measures. Measures are classified into several categories according to their urgency. The Plan includes emergency measures and contingency plans. Objectives for completing the protection infrastructure are set, in particular for municipalities. Deadlines are set for the different steps, starting with equipping first the most populated municipalities. Settlements below 50 000 population equivalent will be dealt with at the local level, while the State Plan includes waste-water treatment plants for settlements with a population equivalent of more than 50 000. The investments that should be made in such facilities for settlements with a population equivalent of 50 000 and above (in total 5.5 million population equivalent) are estimated at 7 600 million kunas. The deadline for implementation is 2005.

Legal framework

The 1994 Environmental Protection Law sets goals and principles which are important for managing water (see Chapter 1). The Water Law was issued at the end of 1995. It is subdivided into 9 parts and contains 219 articles. This umbrella law regroups and integrates various acts and regulations that were inherited from the previous regime. It regulates the legal status of water and its ownership, the manner and conditions in which it is managed (water extraction and use, water protection, regulation of watercourses and other bodies of water, and protection against harmful impacts of water). It defines the responsible bodies, the sharing of responsibilities and water policing. It establishes a water agency: *Hrvatske Vode* (Croatian waters). It does not deal with the financing of water management.

A major feature of the Law is that it divides Croatia's territory into four water basins, plus Zagreb city:

- Water basin of the Sava river catchment area;
- Water basin of the Drava and Danube catchment areas;
- Water basin of the Littoral and Istrian catchment areas.
- Water basin of the Dalmatian catchment area.

A water basin contains one or more catchment areas of minor watercourses, and includes surface and groundwaters. The catchment area constitutes a territorial unit for water management purposes. Surface waters are divided into waters of State importance and of local importance. Basin and catchment areas have been defined by ordinances. The Law also provides for the regulation of watercourses and in particular the protection against the adverse effects of floods.

The Law states that the use of water for supplying tap water to the population has absolute priority over other uses. It regulates the protection of water

aquifers, wells and well-inflow areas. Under the responsibility of municipalities, sanitary protection zones should be set up around sources of water used for public supply. It seems that this measure is generally implemented, except in the Karst region, where the topography makes it difficult to put into practice.

There is a separate Law on Water Management Financing (1996). It regulates the sources of funding for activities and uses within the water management system, the manner of determining individual responsibility and collection of charges, and other issues concerning the allocation and use of funds. There is a series of public revenues from waters, i.e. water management contribution, charge on water use, charge for water protection, charge for sand and gravel extraction, basin water management charge, and a special charge for investing in land improvement and drainage systems (to local authorities). All water charges are collected by the water agency, Hrvatske Vode.

In 1997, the national regulatory framework for protecting water was completed. The local regulatory framework is not yet complete. There are no water protection plans. Environmental polluters need to be identified and systematic water monitoring needs to be established for all national and international watercourses. Activities which could potentially threaten water quality are occasionally surveyed (monitored); only four spot checks a year are required.

Institutional set-up

Water management and water protection are the responsibility of two government agencies: the State Water Directorate (SDW, created in 1994 under the Ministry of Agriculture and Forestry) and the water agency Hrvatske Vode. There is also a parliamentary committee, the National Water Council, which was formed as required by the Water Law to discuss policy, strategies and implementation of laws regarding water management, but is not active. The SDW is represented within the cabinet by the Ministry of Development, Reconstruction and Immigration. Other governmental bodies are also specifically involved in water management. The State Directorate for Environmental Protection, established in 1994, is responsible for water bodies inside protected areas, and deals with environmental protection information. It is responsible for the maintenance of the Environmental Pollution/Emission Cadastre created in 1997, which includes emissions into waters. The Ministry of Health looks at the health impact of water (drinking water) and water uses. There is no formal coordination mechanism between the SWD and the SDEP. The absence of a formal relationship between the two bodies is clearly a problem.

State and local water management takes place under the responsibility of Hrvatske Vode (HV). Its duties are to manage Croatia's waters according to the adopted water management plans and schemes, issue administrative and other orders and make decisions on issues of importance . Its tasks encompass:

- preparing strategies and plans, and investment programmes
- regulating watercourses and water bodies
- managing water use, water protection and water property
- managing the integrated information system and keeping water-related documentation
- disclosing information
- supervising the awarding and implementation of concessions and construction of waterworks, and
- planning and raising funds (collecting fees for water use and fines) for financing water management.

Operative sub-units (i.e. Water Management Departments) are established in each of the four basins. Branch offices responsible for catchment areas are set up in the Departments. Some important specific operations (design, construction, irrigation systems, water supply and waste-water disposal) are entrusted by Hrvatske Vode to other competent legal entities subject to the consent of the State Water Directorate. The Hrvatske Vode governing body is appointed and dismissed by the Government. Hrvatske Vode has a staff of about 700, 60 per cent of them hold university degrees in hydrobiology, hydrochemistry, microbiology, chemistry, economics, etc.

The SDW develops laws and regulations and ensures the administrative supervision of the implementation of the legislation on water. In particular, it exercises control over water quality standards and pollution levels, and is the Principal

International Alert Centre for early warning in the case of accidents on transboundary waters.

The SWD also checks compliance with the water permit. It controls Hrvatske Vode and arbitrates problems between it and county offices in charge of water management. Both the State Water Management Inspectorate (of the SWD) and the county water management inspectors (under the county offices) carry out inspections (1 800 inspections per year). There are 12 inspectors at the State level and 40 at the county level. In some counties, inspectors of the SDW and of the SDEP combine their inspections, on their own initiative.

The State Water Inspectorate supervises international commitments, prepares and implements the National Plan for Defence Against Floods, and other sub-plans under the National Water Management Master Plan. The State Inspectorate is in charge of monitoring water quality. The county water management inspectorate oversees the implementation of the law at local level and the application of measures that are not under the direct competence of the State level. The level of enforcement is still insufficient. The fining system is not adequate to change the behaviour of the polluting industries (see Chapters 1, 2 and 10), especially of the State-owned companies.

Monitoring and cadastres

There is no national integrated monitoring programme in Croatia. Since the 70s, the quality of *water* has been regularly monitored by the SWD. The monitoring programmes are implemented through 270 measuring stations and concern the quality of surface and underground freshwaters, estuaries and sea waters. The number of controls performed and the parameters involved vary according to the importance of the measuring station. They also differ according to watershed. There is no monitoring of non-point (diffuse) sources in Croatia. The quality of watercourses is assessed every five years. So far, samples are still taken haphazardly. They are analysed in 13 certified laboratories which follow international standards and methods. There is no on-line detection of pollution peaks or toxicity, and no ecotoxicological parameter measurements.

In the north, in the Black Sea watershed, the water quality of the international streams (Drava, Sava, Danube) is subject to monitoring programmes under ad hoc joint commissions with Austria and Hungary, as requested under the Danube and Helsinki conventions. The Sava and Drava rivers have been systematically monitored since 1973. The Sava is monitored in 60 stations with a sampling frequency of 5 to 52 samples a year. Since 1993, in line with the requirements of the Danube Convention, Croatia has been actively involved in international monitoring programmes on transboundary waters and participates in the laboratory intercalibration process under UNEP.

In the coastal Adriatic watershed, Croatia is implementing the Land-based Sources of Marine Pollution Programme (LBS) under the Barcelona Convention and carries out tests in about 60 measuring stations on municipal and industrial effluent discharges into the sea. Results are reported annually to the MED unit.

Hrvatske Vode compiles various water documents into a water book, a 'Water Cadastre' and data on concessionaires. The Water Cadastre includes a cadastre of waters, a water building infrastructure cadastre, a cadastre of water abstraction and a cadastre on water protection. The last is an additional tool for water management in Hrvatske Vode and is not transparent for other users.

There is also a register of emissions into waters. All entities which have a water permit must provide Hrvatske Vode via the county offices with recorded information/data on the pollution they discharge into water. However, it seems that the data are not computerized, nor are they made available for statistical use or as a decision-making instrument. They are not disclosed to the public either.

In 1997, the State Directorate for Environmental Protection (SDEP) started implementing an Environmental Pollution/Emission Cadastre (EPC/EEC, see Chapter 1). It includes emissions into waters from municipalities, industry and agriculture. The main parameters are covered, such as flow rates, COD, BOD_5 and suspended solids. Measuring and record keeping are the responsibility of the county offices (including Zagreb Municipal Office) and the municipal administrative environmental authorities. The SWD is involved in the elaboration of the EEC. Priority in the use of the EEC as a decision-making instrument is given to the protection of surface water.

Funding is still required to establish a monitoring system (DM 0.7 million for water monitoring by

the SDEP, cost estimated in early 1999). The quality and monitoring of drinking water is the responsibility of the Ministry of Health.

Regulatory instruments

A water management permit for water use (uptake and discharge) is needed for important water uptakes and discharges. It is a single-medium permit. It is delivered by the State Water Directorate (SWD) for 15 years. The permit is based on EQO (environmental quality objectives), i.e. the impact on the quality of the receiving waters, and not on the pollution flow generated per quantity of product produced, or the number of people connected. Therefore, the permit does not encourage the polluter to reduce the pollution burden or introduce cleaner technology. About 3 000 permits are given each year. A permit can be temporarily withdrawn if the polluter fails to comply with certain conditions. But this rarely happens. As industry is in dire financial straits and cities are often on the verge of bankruptcy, problems tend to be solved through negotiations (see Chapter 1 on enforcement). The Water Law sets the level of penalties at 400 to 40 000 kunas. Any work to prevent or clean up pollution damage is at the expense of the polluter.

Water is classified on the basis of limit values of certain substances (physical indices, dissolved oxygen, nutrients, metals, organic compounds, microbiological and biological indices, and radioactivity) and other water properties. Emission limit values are prescribed: (1) for industrial waste water before release, (2) for municipal waste water after treatment and before release and (3) for waste water discharged in sumps and collection tanks. A special ordinance of 1999 sets the maximum allowed concentration of hazardous/dangerous substances discharged into water.

The list and number of these water standards are in line with the EU requirements. There are two series of standards: one for direct discharges into waters (natural receiving body) and standards for waste water discharged into municipal sewage. However, emission limit standards based on technology performance do not yet exist, although their introduction was announced several years ago.

Economic instruments

The following instruments are in force:

Contribution to water management: The water contribution is levied only on businesses, and is also a source of financing for water management. Its rate is defined by the Parliament. In 1998, the water contribution amounted to 0.76 per cent of the total payroll. As of 1 June 1998, the water contribution has been suspended to relieve businesses.

Charge on water use: A charge is paid for extracting and using water and for using waterpower. It is intended for financing tasks and activities related to water use. The level of the charge is set by the Government and depends on the quantity (m^3) of extracted or supplied water. It varies according to the type of water, the means of extraction and supply, the purpose and the necessary investments. Since the beginning of 1998, 22 per cent VAT is levied on the water use charge.

Water protection charge: A water protection charge is paid for water pollution (1995 Decision on the Level of Water Protection Charges). The Government sets the level of the charge. The charge applies to industrial and household users. As mentioned above, a permit for discharging waste water is required. The protection charge is calculated on the basis of the permit. The charge is proportional to the water quantity discharged and the deterioration in the receiving water's quality and usability. For instance, the charge for a change in water temperature caused by a power plant is far smaller (0.00081 kuna/m^3 in 1997) than that for industrial pollution (0.81 kuna/m^3). For industrial users, the charge is proportional to the measured discharged pollution. Users connected to the public water supply pay according to the quantities of water supplied. Their charge is calculated and collected by municipal service enterprises according to the monthly water consumption.

Pursuant to the Law on Water Management Financing, the water protection charge cannot be below the cost of waste-water purification. However, at present, due to economic difficulties and the consequences of the war, the protection charge is about 25 per cent of the average purification cost, which removes much of its incentive effect.

All the collected protection charges are eventually remitted to Hrvatske Vode. This revenue is used for preparing and implementing water protection plans; monitoring water quality and taking protective measures; financing water protection facilities; and participating in various water management activities. In 1998, 235 million kunas

were collected with a collection efficiency rate of 85 per cent.

Water basin charge: paid by the owners and users of land and other real property in the basin. The rate of this tax is determined by the county assemblies of the river on a proposal by Hrvatske Vode. It is paid to Hrvatske Vode.

Waste-water and sewage non-compliance fees: According to the 1995 Water Law, fees are imposed for non-compliance with the conditions prescribed to protect water against pollution. They range from 40 000 to 500 000 kunas. They are paid into county budgets and earmarked for financing activities to regulate watercourses and water bodies pertaining to the basin within which the violation was committed.

All water charges are collected by Hrvatske Vode in a special account (see Chapter 2). The funds collected from the water use charges, the water protection charges and the water basin charges represent almost equal amounts. According to the 1998 budget plan, the overall revenue from these charges was to be around 825 million kunas, i.e. almost 70 per cent of Hrvatske Vode's total revenues (Figure 2.1 in Chapter 2). The rest of its revenues are funds from the State budget, which are mainly earmarked for the maintenance of flood protection, a task entrusted to Hrvatske Vode. 90 per cent of the income from charges is redistributed to finance water supply and waste-water treatment facilities.

Water pricing

Water delivered to users by municipal water services is metered. Prices for drinking water are not uniform throughout the country. They are composed of the price of the resource itself, including the cost of purification and supply specific for each location and determined at the municipal level, increased by a charge on water use, a water protection charge, and a water basin charge. Moreover, contributions to the construction of waterworks , sewage and purification facilities may be added. VAT is due on the total amount. As charges and taxes may be very different from one county to another, final prices can vary by as much as a factor of 1 to 3 for the same category of users. They are higher in the Adriatic zone than inland. Also, water prices for industrial use are significantly higher than for household consumption. Table 6.6 shows that in 1997 water prices varied from 2 to 6 kunas for household users and from 4 to 9 kunas for industry. These prices are like those in western Europe and very high compared to the average income in Croatia. While the collection rate is more than 80 per cent among households, it hardly reaches 50 per cent among industry. In particular in the coastal area, hotel resorts which are still State-owned rarely pay (15-18 per cent collected). No social measures are applied at the household level (for instance, progressive prices as a function of the quantity used, a common practice in many countries).

Hrvatske Vode (Croatian Waters), which collects the water charges, gives part of them (between 20 and 50 per cent) to municipalities, partly taking local circumstances into account. For instance, in 1998, the town of Vukovar got 50 per cent of the collected tax back, Sisak only 20 per cent. Most of the money that Hrvatske Vode receives is spent on investments (Figure 2.1, Chapter 2).

Financing and projects

Currently, most environmental investments are for water protection. They include the construction of sewage systems and waste-water treatment facilities. Investments in water supply have been important over the past four years but are now

Table 6.6: Mean water prices, 1997

kuna/m ^{3}

	Industry		Households	
	Charges and taxes **excluded**	Charges and taxes **included**	Charges and taxes **excluded**	Charges and taxes **included**
Mean water price	4.12	5.91	2.23	4.06
Range of water prices	2.37 <average< 6.79	3.68 <average< 9.47	1.00 <average< 3.27	2.17 <average< 6.02

Source: Account of water prices in the Republic of Croatia, 1997, Hrvatske Vode.

decreasing. Priorities and an implementation schedule have been set according the Long-term Plan for the Development of Water Management. Also, as pointed out in Chapter 3, the water infrastructure was ravaged by the war.

Flood protection works are covered directly by the State budget. They are investment-intensive. Environmental funding is tight in Croatia, and in general it is extremely difficult to obtain funds from the central budget. The estimated DM 200 million project on the Sava downstream from Sisak might be partially covered by a loan from the World Bank if negotiations go through. Recently, the World Bank has approved a credit line for reconstructing the flood control system in Eastern Slavonia worth DM 74 million.

The other major sources of domestic funding are funds collected from water charges by Hrvatske Vode, as mentioned above (Figure 2.1, Chapter 2). Hrvatske Vode carries out feasibility studies and manages the projects. Investments are decided at the higher level by the SWD and Hrvatske Vode, according to the Long-term Plan's objectives. Usually, Hrvatske Vode finances 50 per cent of the investment. The rest is to be found by the investing municipality, which often turns to loans from domestic credit banks (where loans are expensive -- no soft loans for environmental purposes) and to international funds. For instance, the protection works (sewage and primary waste-water treatment) and the development of the water supply in the Split, Kastela and Trogir area received 36.6 million USD from the World Bank in 1998. The European Bank for Reconstruction and Development (EBRD) is considering helping the Koprivnica agribusiness complex with its waste-water treatment and discharge plan.

In 1999, the SWD budget represented 92 per cent of the overall budget devoted to environmental expenses by SDEP and SWD. In particular, its budgeted capital expenditures amounted to 166 million kunas against 3 million in the SDEP budget.

Information, participation in decision-making and cooperation between stakeholders

The Water Law does not explicitly spell out the role of municipalities and users in the decision-making process regarding water strategies at the local level and water pricing. Similarly, the Act creates water basins, but does not emphasize the need to create multi-stakeholder steering committees (basin committee) to head its structures and guide Hrvatske Vode in the implementation of the basin management strategies.

It also seems that the users are not involved in the decision-making process regarding new investment projects and water pricing. For instance, in Sisak the municipality informs and consults its inhabitants about household waste collection and treatment cost and charges. But the price of water is not subject to any discussion. Similarly, it seems that when a new treatment facility is planned, the public is not informed in advance of the consequences it will have on the water price.

6.4 Conclusions and recommendations

Water management and protection are highly centralized in Croatia. They are in the hands of the State Water Directorate and its agency, Hrvatske Vode (Croatian Waters). Their policy and objectives are spelt out in a series of strategies, programmes and plans. The priorities are clear. Protection against floods, which is particularly important for the country, has been tackled first. Then comes water supply, with the objective of increasing public water supply and ensuring that the whole population has access to safe drinking water. The third priority is to construct or reconstruct sewage and waste-water treatment plants in order to protect water bodies from pollution.

All these tasks are set and driven from the national level by the State Water Directorate. Very few responsibilities are left at the local (county, municipal and city) level. The time has come to evolve toward more participatory and transparent decision-making, delegating more tasks to local institutions and involving more actors in water management be it at the national, basin/catchment or local (county-municipal) level. To this end, a series of measures has to be taken.

The Water Law provides that the principal management tool, namely the Water Management Master Plan, should be regularly adjusted to other strategies developed for other sectors. This requires good communication between the various ministries in charge of those sectors. A special body which should contribute to this harmonization has been created by the Water Law. It is the National Water Council, a parliamentary committee. Parliamentary committees are traditionally constituted of members representing

the different political parties. They discuss the laws, programmes and strategies that are proposed to the Parliament. They can usually call on experts, groups of specialists, people involved in the implementation of the laws, NGOs representing economic actors, and others to assist them. It would be helpful if the National Water Council adopted the same kind of functioning.

Recommendation 6.1:
The National Water Council should be revived. It should be representative of Parliament, and involve water management experts and scientists as well as NGOs. It should coordinate its decisions with the Committee of Environmental Protection and Physical Planning in matters regarding waters and environmental protection.

Managing water resources, ensuring their sustainable use and providing the population with safe drinking water are important tasks that cannot be separated from protecting the quality of the resource itself. The present institutional structure, with the two separate State Directorates (Water and Environment), both represented at cabinet level by different ministries, is unlikely to make for a strong «protection policy», and does not facilitate synergies between the two State Directorates. Merging these two entities into one ministry, with Croatian Waters as its water agency, would allow Croatia to formulate and implement a more consistent environmental policy. See Recommendations 1.1 and 1.2 in Chapter 1.

Croatia should go ahead with the implementation of its water basin management strategy. The aim of this organizational structure is to better adapt local solutions to specific local problems. Therefore, water management plans for each of the basins have to be worked out as requested in the Water Law. Few water basin management plans are ready. It seems that the entities at the head of each basin are not independent, but rather branches of Hrvatske Vode. They have no financial autonomy. They do not decide the charge rate on their territory -- this is decided by the Government -- and, moreover, they do not receive a budget from Hrvatske Vode that they can spend according to the priorities set in the water management plan of the basin. Furthermore, no consultative or participatory bodies, i.e. basin committees, seem to have been set up yet. A basin committee should be the consultative body which voices its opinion on new projects, coordinates action amongst local administrative units and is consulted on the level of charges collected on the basin territory. Water management plans should be drawn up and implemented under its responsibility.

Recommendation 6.2
Basin water management plans should be urgently completed. Basin agencies should obtain greater autonomy, in particular regarding the spending of the financial resources collected in their basin. Basin committees should be created or their role strengthened in decision-making. These committees should be equally made up of representatives of local territorial authorities, users (or their associations) and the State.

Special emphasis should be put on protecting and managing waters in the karstic areas. In these territories, springs are numerous and underground waters abundant, although they fluctuate according to the season. However, they are also much more vulnerable to any pollution from the surface. Sanitary protection around underground extraction sites deserves particular attention.

Recommendation 6.3:
The efficient protection of complete river catchments in the karstic area deserves a special protection regime.

Not only at the State and basin level should the participatory process and transparency be improved, but also at local level, closer to the user. It is important that the municipalities and, ultimately, the users, who will have to bear the debt burden if investments are made, should be informed in advance of the decisions and their consequences. It seems that too often investments have been decided at a high level which the local level could not afford. Currently, many facilities are not operated and not maintained in order to save money; but at the same time new investments are being made. For the investments announced in the 1999 Water Protection Plan, it will be important to avoid that political position and commercial interests take precedence over expert analysis and stakeholders' opinion. The same principle should apply to smaller units and investments.

Priorities in allocating the funds should be re-oriented. They should:

- make existing waste-water treatment plants function (for instance by alleviating the debt of municipalities) optimize operation, maintenance, repair and modernization of the existing plants;

- build new installations for several settlements together (to be operated at the basin, county or municipality level).

Recommendation 6.4:
Funds collected from charges, or obtained from other sources, and earmarked for water protection at the basin level should be allocated case by case depending on the results of a cost-effectiveness analysis. See also Recommendation 9.8.

In these times of hardship, it seems that the water price is high for individual consumers. Paying the bill may be a problem for a substantial part of the population. There is no differential pricing to adjust the price to the consumer's circumstances. In its Declaration of 5 June 1992, the President of Parliament declared that drinking water was a strategic natural resource. However, this vital resource has been subject to 22 per cent VAT since early 1999. In most countries, vital goods are taxed below the normal rate. Applying true cost pricing to water is a sound policy, if certain arrangements can be found to ease the burden for the poorest. (See Recommendation 2.1).

At the same time, the higher water price for industrial users does not seem high enough to induce them to clean their waste water. The reason is twofold: (i) those who do not pay are not prosecuted, in particular State enterprises; (ii) it is far cheaper to pay the charges than to invest in treatment facilities, which are expensive to operate. In addition, fines are rarely enforced (see Chapter 1). At the same time, there is a lack of incentives to generate less pollution. In the past, a legal regulation provided for possible grants from the SDW or soft loans to help finance industrial water facilities. This measure has been abolished. Nowadays, waste-water pretreatment within industrial premises is not subsidized, nor is it eligible for preferential loans. Only pilot studies for defining the best type of treatment receive small subsidies. Therefore, it is important that other incentives should be created to make the introduction of clean technology attractive, and that command-and-control instruments should be reinforced. All instruments should have a synergetic effect (gradual shift toward an integrated permitting system). See Recommendation 1.3.

Recommendation 6.5:
Economic incentives and a command-and-control approach toward industry should be strengthened to encourage (i) the introduction of cleaner technology, and (ii) industrial investments in waste-water treatment units. See Recommendations 10.2 and 10.4.

Another typical feature is that industrial waste water, even after optimum treatment, cannot be discharged directly into natural water bodies unless it has gone through a municipal waste-water treatment plant. Consequently, industry also pays the municipality for the service and contributes to investing, maintaining and operating the municipal waste-water treatment plants. This obligation is a way to shift part of the financial burden to industry, but there is no technical justification for it. It has been proven that most of the time this kind of combined industrial/municipal treatment is difficult to operate and malfunctions are frequent. It works only in some specific cases where there is a true complementarity in the composition of the inputs. This situation should be assessed and decided case by case by specialists/experts after careful pilot studies.

Waste-water treatment facilities need to be operated by qualified people. Today, there are too few competent people to run the municipal treatment plants and sewage systems, as there is no professional accreditation for the job. This is also true for professionals at a higher level. There are too few competent people in the country who are able to carry out expert work, to work as consultants, to participate in debates on water management decisions. Such experts are needed to organize public participation at all levels, and to prevent Croatia having to turn to foreign experts and foreign equipment for each investment project.

Recommendation 6.6:
Professional training programmes should be set up for operators of waste-water treatment units. Engineers and experts employed in such units should be trained in water management, including all technical and policy-making issues, or adequate measures should be taken to retain chartered or other well qualified staff in these units.

Giving a clear picture of the water situation in terms of quality and availability in each basin, is a prerequisite for any reasonable and effective water management policy. Today, water bodies are monitored, as is waste water, but the monitoring data are not merged into one system that would make the impact of pollution on the quality of rivers clear. Data are not processed with a view to helping in decision-making. In addition, what exists is disconnected from other environmental considerations (waste generation, air pollution,

nature degradation). Therefore, it seems that the Environmental Emission Cadastre, which is being completed, can become a much needed instrument for decision-making. This set of data should also be seen as a first step towards the introduction of an integrated permitting system. Efforts should concentrate on making the most of it and avoiding other systems that would duplicate it. Consequently, the register of emissions into water compiled by the SWD and the EEC should be merged. The ultimate goal is that EEC should be an integrated database used by all institutions: SDEP, SWD and others.

Recommendation 6.7:
Once the Environmental Emission Cadastre will be reliable and complete, it should fully integrate the existing water emissions registers and should be used as a common decision-making tool, in particular in the introduction of an integrated permitting system.

A successful water monitoring programme should aim at providing a full insight into the quality of water resources. Processing the data, making use of them and disclosing information at all levels of decision-making should all be part of the programme. Croatia's monitoring programme falls short in this sense. Monitoring sites are not always located in the right places, the coverage and frequency of monitoring of surface, ground and sea water is uneven, the parameters checked are numerous but not always important, ecotoxicological measurements are not standard practice, and there is very little on-line, real-time analysis. Furthermore, data processing is underdeveloped.

Recommendation 6.8:
The existing monitoring system for waters should be harmonized and improved. The use of automatic monitoring should be increased. Integration and processing of data should be upgraded. The data should be processed and disclosed.

As most of the river basins of Croatia are to a large extent transboundary (e.g. the Danube, Drava, Mura and Sava), their sustainable use and protection depend critically on an effective cooperation with neighbouring States. In line with the provisions of the ECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, which Croatia has ratified (see Chapter 4), the riparian States should enter into agreements providing for the establishment of joint bodies. Such bodies exist and function already with Hungary (which has also ratified the ECE Convention) and Slovenia. The cooperation with Bosnia and Herzegovina and the Yugoslavia needs to be clarified and made effective, especially with regard to pollution prevention, control and reduction, as well as flood control.

Recommendation 6.9:
Cooperation between Croatia and all countries in the region concerned by transboundary water management and protection should be improved. The status of cooperation with Bosnia and Herzegovina and Yugoslavia should be clarified from the legal point of view, and a technical programme of cooperation should be defined in order to prepare the ground for the necessary international support and investments.