INSTITUTE OF GEOGRAPHY, Ljubljana

Republic of

SLOVENIA:

GEF - DANUBE RIVER BASIN POLLUTION REDUCTION PROGRAMME

Part A:

Social and Economic Analysis in Relation to Impact of Water Pollution

Project group

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SOCIAL AND ECONOMIC ANALYSIS IN RELATION TO IMPACT OF WATER POLLUTION

1. Summary

The state of the Danube environment in the national context: Its diverse landscape and natural and geographical features contribute strongly to the extent and level of environmental pollution in Slovenia, as does its industrial development until now. The most polluted countryside lies in the basins and deep mountain valleys among the Alps and their foothills. They can be found in basins (the Celje Basin, the Ljubljana Basin e.t.c.) and in deep valleys (the Zasavje, Mežica, upper Sava valleys...). The enclosed relief enhances negative landscape effects of environmental pollution even with relatively small emission levels, produced by relatively small cities. The period from the end of the 1960s to the beginning of 1980s was the period of greatest pollution of Slovene industrial and energy supplying areas. It is generally accepted that environment pollution was on the increase until the middle of the previous decade and that from that time onwards, a gradual decrease in pollution of rivers is noticeable. However, the quality of surface water is diminishing.

The effects of human activities on water are observed through the prism of changes in the extent of urbanisation and employment structure. The population increased by almost half a million after the war. As early as in the 1960 has the domination of the primary sector in the active population structure passed to the domination of the secondary structure, while at the same time -especially in the last decade- there was an increase in the share of the tertiary and quaternary sectors. The process of urbanisation increases the concentration of population in the lowlands and its decrease in the highland, karstic and hilly areas. The conclusion is that the concentration of population, industrial areas and animal farms has a decisive impact on the pollution of water in the Danube river basin, especially in the river basins of

the Drava: Maribor, Ptuj with Kidričevo, Ravne in Koroška, Ormož and Ruše,
the Mura: Murska Sobota, Lendava, Ljutomer and Gornja Radgona and
the Sava: Ljubljana, Kranj, Velenje, Celje, Kamnik, Trbovlje, Škofja Loka, Vrhnika, Jesenice, Rogaška Slatina, Hrastnik, Krško, Kočevje, Domžale, Štore, Šoštanj.

Population affected by water pollution: Systematic research of number and share of the Slovenian population that have health and other problems due to contamination of drinking and other water sources has never been conducted, therefore the extent of contamination of water supply sources can only be indirectly inferred. The contamination of the Danube river basin rivers varies from moderate to wide-spread and the rivers are not used for drinking water supply. Data on water quality of groundwater and karstic sources point to a gradual deterioration of drinking water quality. The population of some regions in the Sava, Drava and Mura river basins is supplied with groundwater that often contains a concentration of nitrates and pesticides that exceeds the allowed limit, especially the concentration of atrazin. The water from the karstic sources in the river basins of the Sava and Kolpa needs to be disinfected since it is often bacteriologically inadequate. The increase of heavy metals and micro pollutants in the sediments of some sources points to the endangered health of the population of the Karst region of the Danube river basin.

Water quality and impact on ecosystems: Due to the pollution of the Danube basin rivers of many years, the polluted rivers mainly affect biotopes in river beds, but have a lesser impact on other elements of the ecosystem or river basin. In the Sava basin, the biotopes are, due to severe water pollution, changed the most in the lower streams of the Ljubljanica, the Kamnik Bistrica, Rinža, Paka, Savinja and Voglajna and the middle courses of the Sotla, and because of PCB, life forms in the Krupa in Bela krajina are affected. In the Drava river basin, life forms were most affected in the Meža, however, the situation is improving. In the Mura river basin, water life was degraded most in the Ščavnica. Severe water pollution caused the population of salmonidae to drop and an increased pollution of river sediments and of sediments of karstic sources was also noticeable.

The diminishing of surface water quality does not necessarily affect other elements of the ecosystem. Due to pollution of the Bled Lake there is eutrophication or occasionally accelerated growth of the algae. Rehabilitation measures are improving the situation.

Water sources: The Mura (1376 km^2), the Drava (3253 km^2) and the Sava (with the Kolpa and the Sotla rivers) (11 734 km^2) river basins in Slovenia all belong to the Danube river basin. The watershed between the Black Sea and the Mediterranean basins runs in Slovenia from the north-west and across the highest ridges of the Julian Alps, the northern parts of the Alpine foothills and across the ridges of the Dinaric-Karstic planes to the border between Slovenia and Croatia in the south-west part of Slovenia. The major part of the watershed runs over carboniferous rock formations, therefore the underground watershed is predominant. The river basins of major rivers in the Danube river basin share one feature: they rise in the mountainous area with a high rainfall, then transverse through the foothills of the Alps and the hilly area to the lowlands. They usually leave the Slovenian territory after a 100 km long course in a day or two, which emphasises water transitoriness. The length of surface river streams is approximately 22 600 km, and the average river network density is 1,33 km/km^2. River network density is 1,38, (the biggest in the Drava basin -1,88 and is high with regard to more than 40 % of karstic surface, especially because of the high rainfall. In the Black Sea basin there are 98 % of dynamic underground water resources in aquifers with intergranular porosity and 85 % of all dynamic underground water resources in Slovenia.

Ecosystems and biological resources: Physical, geographical and ecosystem characteristics of the Danube river basins are mainly a reflection of her transit geographic position, where alpine, subalpine, dinaric-karstic and subpannonian characteristics interweave. The Drava basin bioclimatically marks a transition from the Alpine and dinaric part of the basin with very humid climate to the humid climate of the main part of the Sava basin and to the semi-humid and partly semiarid climate of the Drava and the Mura river basins. Almost entire Danube basin area belongs to potentially forest ecosystem, which is, however, reduced. The forest surface has increased by approximately 10 % in the last forty years, and the trees are damaged due to diseases and air pollution. Forest ecosystem covers approximately half of the Danube basin area and is prevalent in the dinaric-karstic, Alpine and subalpine part of the Sava river basin and highland areas of the Drava river basin.

Humid biotopes include various forms from the high and the low moor, swamps, flood and swamp forests and meadows, backwaters e.t.c. It is estimated that they cover an area of 26.000 ha or 1,25 % of the Slovenian territory. Some wetlands are parts of natural parks or protected as natural reserves. It is estimated that 10.500 ha of humid biotopes are protected in the Black Sea basin, which represent 17,5 % of protected areas in natural parks. Half of protected wetlands is situated in the Sava river basin, however, the wetlands only represent 10 % of areas protected in natural parks.

Human impact and key problems of environment degradation in view of water pollution: Due to the hilly relief, rivers flow at different rates at different times of year. River pollution levels change from low in Spring and Autumn to high in Summer and Winter. Slovenia has many rivers with small streams polluted from dispersed industry dumping its waste leading to the whole water system being polluted. After 1990, there has been a noticeable reduction in water pollution due to reduced production levels, better waste management and punitive actions. Industrial pollution of rivers and streams has fallen by 30 to 40 % since 1990 whereas municipal pollution has remained at the same level.

The Sava river basin covers 58 % of Slovenian territory, has 53 % of population and two thirds of all sources of drinking water, and in the Sava and her tributaries as much as 4/5 of Slovenian waste water is discharged. Her pollution begins already at the source, with waste water discharge from Kranjska gora and Bohinj, and strongly increases with the Sora tributary, but especially after Ljubljana, which is one of the rare European capitals that has yet to take care of its waste water treatment. From Ljubljana onward, the river is in the 3rd or 2nd to 3rd pollution class, all the way to the border with the neighbouring Croatia. It is further polluted by waste water from the Zasavje region, especially from the mining industry after the coal separation, and by the Savinja river at Zidani most. Waste water treatment is more properly conducted in small settlements, with over 100 small municipal waste water cleaning plants.

By the time the Drava flows into Slovenia, it already falls into 2nd to 3rd class in pollution rating (especially noticeable are lead and zinc additions). Moderately polluted tributaries flow into it on its course through Slovenia although they do not greatly change her pollution rating until the Croatian border.

The Mura has improved its pollution rating from the 3rd to 2nd class in the last five years, also due to improvements in pollution control in Austria. The acutely polluted Ščavnica tributary(4th class) and the Ledava (3rd class) flow into it.

On the Drava, Mura and Celje fields, intensive farming with a high use of protective chemicals and mineral fertiliser has lead to pollution of groundwater. The high level of pesticides in the water is already exceeding safety levels for drinking water by European standards.

Population development and water sector relevant characteristics: Three variant projections made for the period until 2020 by the Office of the Statistics of the Republic of Slovenia, caution that, according to the most optimistic variant, the population growth will reach approximately 2,21 million of inhabitants, or annual growth of approximately 8400 inhabitants. The middle variant predicts the continuation of slow population growth, so that it will only increase to approximately 2,05 million, while the pessimistic projection estimates a drop of between 105.000 to 150.000 inhabitants in the next 25 years. The number of inhabitants in Slovenia would therefore regress from nearly 2 million to 1,89 million.

In the urbanised, lowland and valley areas a further growth of population and economic activities can be expected, mainly channelled to products less demanding both with regard to energy and raw materials, and to service activities. The most optimistic estimation of the population growth in the urbanised areas is an annual rate of + 0,5 %, while the population number will continue to decrease in the countryside. The total of population in the Slovenian part of the Danube river basin will at best increase from the present 1,74 million to 1,94 million in 2020.

Estimation of actual and future demand for water: From the viewpoint of drinking water supply of the Slovenian part of the Danube river basin population, groundwater areas were the most important in the middle of the 1990s, and they were followed by karstic sources. In the Mura river basin, the groundwater areas were the only, and in the Drava and Sava basins, prevalent drinking water resources.

In 1995 there were 91 million m^3 of drinking water available from the drinking water supply for the Slovenian population. The annual water consumption has not changed greatly in recent years and is between 45 and 50 m^3. In 1995, it was 46,4 m^3/inhabitant. In the Black Sea basin, 80 % of all drinking water is used for household supply. Drinking water consumption will not drastically change in the years to come. Due to water losses in water supply systems, a greater exploitation of water supply systems is to be expected. The quantity of the existing drinking water resources is adequate and will be able to procure the needed quantity of drinking water in all river basins, even with minor consumption growth. The smallest reserves of drinking water in the captured river sources are, with regard to the relatively low share of population connected to public water supply systems, in the Mura river basin.

Estimation of actual and future production of waste water: The sewage system in the Slovenian part of the Danube basin is poorly developed, since less than a half of households is connected to public sewage systems. A goal set in the previous decades, namely to bring water into every household, has been achieved, and now effort will have to be made for an adequate waste water disposal. The sewage system network is denser in extensive fields with urban centres, under which there are the biggest drinking water resources. In the next two decades, the sewage system can be expected to expand and it ought to be of better quality. Central waste water cleaning plants will have to be constructed for big urban settlements. A simultaneous expansion of the sewage system in less densely populated areas and construction of small waste water cleaning plants will is a necessity, especially up to 1000 EE.

Analysis of health hazards through water pollution and unsanitary conditions: Systematic research of health and other hazards through water pollution and pollution of other surface waters does not exist in

Slovenia. Surface water is only exceptionally used as a source of water supply of the population, since most of the Danube river basin water in Slovenia is moderately or very to extremely polluted. In 1994, 1995 and 1996, only the river sections at the source of Alpine rivers of the Sava river basin fell into the 1st and 1st to 2nd quality class (the Tržič Bistrica, Kokra, Kamnik Bistrica, Savinja) and the Meža in the Drava river basin. The Sava Dolinka, Sava Bohinjka, Sora, the upper section of the Ljubljanica, the middle section of the Kamnik Bistrica and Savinja, the upper section of the Krka, and the Kolpa as far as the confluence with the Lahinja in the Sava river basin, all fell into the 2nd quality class. There are no major river sections in the Drava and Mura river basins that would fall into the 2nd quality class. Due to poor river quality and temperature conditions, only certain upper and/or middle river sections are suitable for bathing in the summer (for example: the Kolpa, Krka, Sora and Savinja rivers), however, few people also bathe in the rivers that fall into the 2nd or 3rd or an even lower quality class. Therefore we can indirectly conclude, that in spite of moderate pollution of the rivers and other surface waters, there is no health hazard for the population when using drinking water from groundwater and sources, while river water is only exceptionally used as the source of household water supply. If the negative trend of deterioration of captured water sources (groundwater, karstic sources) continues, water supply problems, health problems and other negative effects on the population can be expected. In the case of a sudden accidental pollution, the karstic sources of the Sava river basin (the river basins of the Ljubljanica, Krka and Kolpa) will be potentially more affected. In 1995, 5 % or approximately 90 000 inhabitants of the Danube river basin were dependant on water from the water supply systems where the concentration of nitrates was exceeded.

Analysis of actual and expected impact of economic activities on water demand and potential pollution of aquatic systems: Industrial activities: In 1995, Slovenian industry and mining spent 113 million m^3 of fresh water, namely 76,6 million m^3 as industry water and 36,3 million m^3 as drinking water. For production, 48 million m^3 of water was spent and 50,7 million m^3 for cooling. Coal mining spent 2,2 million m^3 of fresh water, 1,6 million m^3 of industry water and 0,7 million m^3 of drinking water. Industry water was mainly used for production, while drinking water was mainly used for sanitary purposes. 1,4 million m^3 of water was abstracted from rivers and the rest from other sources.

Industrial and mining activities discharged 765,728.000 m^3 of waste water into environment, 2,606.000 m^3 directly into the ground, somewhat more than 30 million m^3 into the municipal sewage system, and as much as 733,102.000 m^3 into surface waters. The following activities discharge the biggest quantities of waste water: paper manufacture and production (27,562.000 m^3), metal manufacture (6,827.000 m^3) and chemical manufacture (8,223.000 m^3). 46,775.000 m^3 or 6,11 % of waste water is treated in industry and mining, 17,319.000 m^3 mechanically and 26,128.000 m^3 chemically and biologically.

Municipal discharges: In 1995, 131,816.000 m^3 of water was accumulated in the municipal sewage systems in Slovenia, and as much as 118,958.000 m^3 in the Black Sea basin alone. 71,376.000 m^3 or 60,0 % of waste water are completely treated in waste water treatment plants. Data valid for the whole of the country state that 61,0 % of waste water is only mechanically treated, 0,1 % only chemically treated, and 2,7 % only biologically treated. 36,2 % of all treated waste water are treated combining various treatments. 60 waste water treatment plants, with an overall capacity of 1,446.491 EE have been built in the Sava river basin, while those waste water treatment plants with the capacity of 1000 EE total 46. Therefore more than a half of all WWTPs is situated in the Sava river basin, however, only 226.536 or 19,1 % of inhabitants are connected to the 42 waste water treatment plants that treat municipal waste water. The greatest number of inhabitants connected to a waste water treatment plant is in the Domžale – Kamnik system (50.000), Šoštanj (27.000), Kranj (25.000) and Novo mesto (20.000). The most urgent problems are the incomplete Ljubljana and Celje WWTPs. Celje and more than 50.000 of its inhabitants extremely pollute the Savinja river.

Agricultural activities: There are 93 680 ha of land (84 %) in the Slovenian part of the Danube river basin that is often affected by drought and needs to be irrigated. Most part or 74 % of land is in the Mura and the Drava river basins, where there are eight hydromeliorization systems (which also include drainage systems), and the rest or 26 % of irrigated land is in the Sava river basin. The national irrigation plan (1994) states that 120 080 ha of cultivable surface can be irrigated, which would take 235,6 million m^3 of water, mostly abstracted from the Mura, Drava, Sava and Kolpa, and from groundwater and reservoirs. In 1995, 4200 ha of land surface in Slovenia was prepared for irrigation, of which 1592 ha were actually irrigated. It is estimated that approximately 80 % of Slovenian irrigated surfaces are in the Danube river basin. In 1995, 4785 000 m^3 of water was accumulated for irrigation, 6 % from groundwater, 29 % from rivers and 63 % from reservoirs.

Intensive use of mineral fertilisers and protective chemicals is the main surface source of groundwater area pollution, while massive animal concentration is an considerable cause of water pollution. Numerous pig, cattle and poultry farms are preserved from the past. Extensive pig especially farms present the most problematic, dispersed form of stream and river pollution. In the Sava river basin there are huge pig farms with the following average number of pigs: Ihan (53700), Stična (12000) and Klinja vas near Kočevje (17300) (in the karstic part of the Krka river basin) and Pristava near Leskovec (15000). In the Drava river basin there is a pig farm in Draženci near Ptuj (40500), and in the Mura river basin Cven near Ljutomer (10000), in Podgrad near Gornja Radgona (21300) and the Nemščak farm near Beltinci with the Jezera farm (56300). Big pig farms in the Donava river basin with the average number of pigs of approximately 230.000, present a problem especially due to the lack of agricultural land in the vicinity of the farms and only partial waste water treatment. Pig farms in the karstic areas (e.g. Klinja vas), in groundwater areas (e.g. Pristava, Nemšak) and in the vicinity of water streams with modest flow (Ihan, Stična), are a particular cause of problems. All of the farms have yet to reach the demanded quality of waste water before discharge into surface water.

2. DESCRIPTION OF THE STATE OF THE DANUBE ENVIRONMENT

2.1. WATER RESOURCES

A. Landscape characteristics of the Danube river basin

Slovenian water sources obtain water from an area that covers over 43 000 km^2, while the state territory covers an area of 20 256 km^2 (Lah, 1996). The Drava and Mura rivers, which flow into Slovenia, have their upper courses in Austria, and also partly in Italy (the Drava river). Slovenian territory belongs to the Black Sea and the Adriatic basins, where four European macro-geographic units meet: the Alps, the Mediterranean, the Pannonian Plains and the Dinaric Plains. The Danube river basin covers 16336 km^2 of Slovenia or 81 % of the state territory. Approximately 88 % of Slovenia's population live there. The basin extends over the south-east part of the Alps, its foothills, part of dinaric-karstic area and a part of subpannonian area. Great relief diversity, lithologic duality (carboniferous and non-carboniferous formations), rainfall transitoriness (lower annual rainfall toward the east and north-east) and extensive forests are characteristic of the basin. Landscape diversity and hydrological transcience both reflect in geographical arrangement and the dynamics of the water sources.

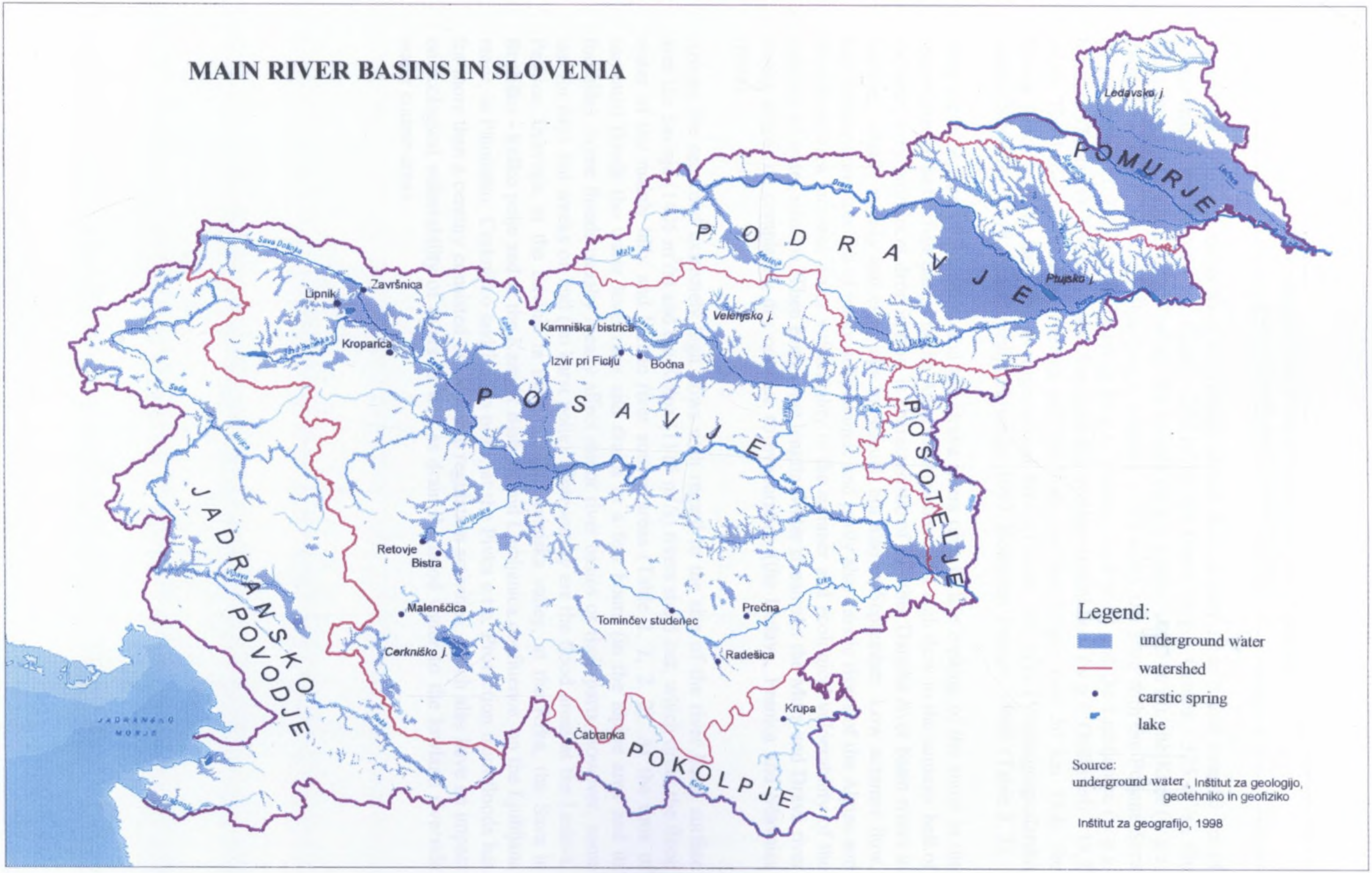
The Mura (1376 km^2), the Drava (3253 km^2) and the Sava (with the Kolpa and Sotla rivers) (11 734 km^2) have a part of their river basin in Croatia as well (Kolbezen, Pristov, 1998). Their river basins in Slovenia all belong to the Danube river basin. In Slovenia, the watershed between the Black Sea and the Mediterranean basins runs from the north-west and across the highest ridges of the Julian Alps (Mangart, Jalovec, Vogel, Kuk), the northern parts of the foothills of the Alps and across the ridges of the Dinaric-Karstic plains to the border between Slovenia and Croatia in the south-west part of Slovenia. The major part of the watershed runs over carboniferous rock formations, therefore the underground watershed is predominant.

B. Hydrogeographical characteristics of the water streams

The river basins of the major rivers in the Danube river basin share one feature: they rise in the mountainous area with a high rainfall, then transverse through foothills of the Alps and hilly area to the lowlands. The water courses usually leave Slovenia after 100 km or after a day or two, which emphasises water transitoriness.

Slovenia has 7 transborder rivers (Economic Commission for Europe, 1997, p. 56). The length of surface river courses in the Danube river basin is 22 600 km, the river network density is 1,38 km/km^2, the biggest being in the Drava river basin (1,88) (Kolbezen, Pristov, 1998, p. 8). The river's network is dense, especially if we take into consideration that there are more than 40 % of karstic surface area (almost no surface water courses), especially due to high humidity level (Table 2. 1).

Because of river water inflow from Austria, extreme humidity and higher specific flow, the rivers on average contain more water than one would estimate by the surface area of their river



MAIN RIVER BASINS IN SLOVENIA
Ledavsko j.
POMURJE
PODRAVJE
Ptujsko j.
Velenjsko j.
Završnica
Lipnik
Kroparica
Kamniška bistrica
Izvir pri Ficlju
Bočna
POSAVJE
POSOTELJE
JADRANSKO POVODJE
Retovje
Bistra
Malenščica
Cerkniško j.
Tominčev studenec
Prečna
Radešica
Krupa
Čabranka
POKOLPJE
Legend:
underground water
watershed
carstic spring
lake
Source:
underground water , Inštitut za geologijo, geotehniko in geofiziko
Inštitut za geografijo, 1998

basins. The following rivers have the average annual flow of over 10 m^3/s and over 50 km of course length: the Sava (w.g.s. Čatež - 290 m^3/s), the Drava (w.g.s. Ormož - 325 m^3/s), the Mura (w.g.s. G.Radgona - 157 m^3/s), the Savinja (w.g.s. Laško - 41,5 m^3/s), the Krka (w.g.s. Podbočje - 54,7 m^3/s), the Kolpa (w.g.s. Metlika - 73,1 m^3/s), the Sora with the Poljane Sora (w.g.s. Suha - 20,7 m^3/s), the Dravinja (w.g.s. Videm - 12,0 m^3/s) and the Ljubljanica (w.g.s. Moste - 57,3 m^3/s). The Meža also has quite big average annual flow (w.g.s. Otiški vrh - 13,2 m^3/s). The Ledava, Ščavnica, Pesnica and the Sotla are also longer than 50 km. Only the Drava, Mura in Sava have the average annual flow of over 100 m^3/s (Vodnogospodarske osnove Slovenije, 1978; Enciklopedija Slovenije, 1997; Kolbezen, Pristov, 1998) (Table 2. 2).

With the exception of the Mura and the Drava rivers (due to late melting of the snow in the source area of both river basins in the Austrian Alps there is a high flow in the summer half of the year) very prominent drop in flow is characteristic of all other Danube river basin rivers in summer, usually in July and especially in August, but also in September. Low summer flow, high temperature, low fall of minor subpannonic and partly also karstic rivers of the Alpine and dinarskega area increase water vulnerability in the summer and ecological vulnerability of the majority of water streams. Then even some lengthy water streams in the Mura and Drava river basins almost or completely dry out due to evaporation (the Ledava, Pesnica and Ščavnica rivers).

Among the recorded extremely high flows with regard to the size of the river basin surface area the Savinja (1406 m^3/s) and the Kolpa (1116 m^3/s) rivers stand out, which drain the flood water of the mainly hilly and karstic river source areas (Table 2. 1, 2. 2). At the time of torrential floods the water level rises and drains in a few hours (in the alpine area and its foothills). Some floods usually locally affect minor river basins or their parts, however, some last for days and weeks on end (on karst polje). Noteworthy are the flood areas at the Ledava, Pesnica, Dravinja, at the Savinja in the Spodnja Savinjska valley, at the Krka, the Sava in Brežiško - Krško polje and at the Kamnik Bistrica and Ljubljanica confluence, on the Ljubljana moor, in Planinsko, Cerkniško and Loško polje, at the Pivka e.t.c. Protection from floods has for more than a century consisted of extensive regulation activities, which also have an impact on ecological vulnerability of rivers as well as drain the flood water to the lowland riverside water course areas.

TABLE 2. 1: BASIC CHARACTERISTICS OF THE MAIN DANUBE BASIN RIVERS IN SLOVENIA (LONGER THAN 50 KM AND/OR WITH THE AVERAGE ANNUAL FLOW OF OVER 50 M^3/S) (1961 - 1990)

River	Height above sea level at source or inflow into Slovenia (m)	Height above sea level at mouth or runoff from Slovenia (m)	Relative difference in height (m)	River surface area in Slovenia (km^2)	River length-together (km)	River length-in Slovenia and at the border (km)	Water gauge station (lower course)	Average annual flow (sQs) (m^3/s)	Specific runoff ($l/s/km^2$); runoff coefficient (%)	Lowest recorded flow (nQnk) (m^3/s)	Highest recorded flow (vQvk) (m3/s)
Sava	833	132	701	10 746	727	221	Čatež	290	30,4; 60,2	51,9	3267
Drava	340	175	165	3253	707	142	Ormož*	325	20,4; 50,1	55,0	2708
Kolpa	313	130	183	1943**	294	118	Metlika	73,1	37,3; 64,6	4,6	1116
Savinja	1310	185	1125	1848	102	102	Laško	41,5	25,2; 55,5	4,2	1406
Mura	250	130	120	1376	438	95	G. Radgona	157	8,5; 28,3	40,5	1205
Krka	275	141	134	2315	94	94	Podbočje	54,7	24,6; 54,2	4,5	362
Sotla	580	135	445	451**	90	86	Rakovec	9,06	15,8; 42,5	0,4	281
Dravinja	1150	210	940	817	73	73	Videm	12,0	17,2; 45,2	0,63	291
Ledava	250	140	110	675	76	68	Polana	1,37	6,2; 22,4	0,02	80,5
Pesnica	300	190	110	539	69	65	Zamušani	5,5	11,8; 35,5	0,21	150
Ščavnica	360	175	185	288	56	56	Pristava	2,44	9,6; 31,0	0,06	48,7
Sora	700	308	392	636	52	52	Suha	20,7	40,9; 67,2	2,12	687
Ljubljanica	300	260	37	1890**	41	41	Moste	57,3	36,0; 63,7	3,41	405

* period between 1926 - 1965
** river basins both in Slovenia and Croatia

Source: Kolbezen, Pristov, 1998; Statistični letopis RS, 1995; Vodnogospodarske osnove Slovenije, 1978

TABLE 2. 2: CHARACTERISTIC FLOWS (NQNK, SQS, VQVK) (M^3/S) OF THE MAIN RIVERS (SQS>40 M^3/S) IN THE DANUBE RIVER BASIN IN SLOVENIA BETWEEN 1961 - 1990 (EXCLUDING THE DRAVA)

River Water gauge station	J	F	M	A	M	J	J	A	S	O	N	D	Year
Sava	60,4	51,9	75,7	106	108	82,0	55,0	52,0	53,0	56,3	52,6	60,8	51,9
Čatež	263	269	328	393	325	295	228	185	228	291	362	313	290
	3114	2012	2042	2220	2860	1631	2003	1993	2873	3001	3267	2383	3267
Ljubljanica	4,07	4,76	7,68	9,34	9,14	9,24	5,99	3,80	3,41	3,72	3,76	5,86	3,41
Moste	61,6	60,4	72,0	80,4	54,3	50,8	35,8	28,9	40,8	56,2	75,2	72,2	57,3
	335	259	405	273	344	296	289	240	352	377	297	320	405
Savinja	5,69	5,69	7,56	10,4	10,9	8,80	5,60	4,20	5,85	4,80	5,60	6,90	4,20
Laško	35,2	36,2	47,0	57,1	46,4	43,5	35,2	27,6	32,7	43,0	51,9	42,7	41,5
	810	461	831	536	593	759	722	744	1030	1179	1406	926	1406
Krka	7.69	7,04	9,54	14,0	11,7	10,9	8,18	5,75	4,50	6,21	7,60	6,82	4,50
Podbočje	48,1	56,1	75,6	80,9	51,8	48,6	38,8	30,7	40,0	53,1	68,8	64,5	54,7
	307	295	338	299	329	280	356	276	336	362	317	315	362
Kolpa	8,32	7,23	11,1	20,1	14,5	11,7	5,76	4,60	6,10	5,76	8,20	10,6	4,60
Metlika	75,4	78,8	98,8	110	69,5	51,5	31,6	32,6	51,4	77,1	104	97,9	73,1
	1072	929	794	737	814	550	568	996	1116	1050	1072	1100	1116
Mura	44,9	45,4	56,8	82,2	89,8	101	46,4	66,3	54,8	55,8	44,8	40,5	40,5
G.Radgona	87,5	94,5	133	188	251	241	208	178	147	128	119	103	157
	369	438	794	1130	903	1145	1205	1142	913	1067	781	589	1205

Source: Kolbezen, Pristov, 1998

The Danube basin rivers have the following river regimes: (mitigated) nival (the Mura and Drava rivers), nival - pluvial (e.g. the Sava Bohinjka and Sava Dolinka, the upper Savinja) and pluvial - nival (e.g. the lower Sava, lower Savinja, Krka, Kolpa, Dravinja and Ledava rivers) (Enciklopedija Slovenije, 1997). Major rivers have combined river regimes. The nival - pluvial regime with a more prominent flow climax in late spring and a primary flow low in winter, which below Ljubljana transforms into pluvial - nival regime with two coequal heights (spring, autumn) and a more prominent low in the summer months, is characteristic of the Sava's upper course. The middle and lower sections of the Savinja, the entire course of the Dravinja and Krka are characterised by a typical pluvial - nival regime (coequal heights in autumn and spring, and summer and winter lows). The Kolpa has features of a mediterranean variant of pluvial - nival regime with somewhat more prominent autumn height and a very prominent summer low. The flow value of the Drava has, due to the construction of a chain of hydroelectric power stations and disturbance in the natural flow that stems from that (damming with an artificial water regime), significantly changed and adapted to the demand for energy supply.

C. Water balance

Slovenia has the average precipitation of 1567 mm, or 1005 m^3/s or 31,694 km^3 of water. Evaporation rate is 417 m^3/s (650 mm) or 13,151 km^3 of water, which is 41,5 %.

Therefore the annual runoff is 588 m^3/s (917 mm or 58 % of rainfall) or 18,543 km^3 of water (Kolbezen, Pristov, 1998, p. 63). With the transitory Mura and Drava rivers (approximately 13,2 km^3 on average) approximately 32 km^3 of water annually drains out of Slovenia, or approximately 41 % of water from the neighbouring Austria. Average annual runoff is 18,543 km^3 or 588 m^3/s, the specific runoff is 29 $l/s/km^2$, and the runoff coefficient is 59 % (Europe - 43 %) (Table 2. 3, 2. 4). High runoff (917 mm) and the specific runoff related to it (29 $l/s/km^2$), which is almost three times lower than the European average (319 mm, 10 $l/s/km^2$) (Europe's Environment, 1995), is a result of high rainfall, karstic surface and characteristics of the relief (višinska pasovitost in reliefna energija). Out of approximately 18,5 km^3 of water from the water reservoir area approximately 71 % of water (417 m^3/s) drains into the Danube, and approximately 29 % (171 m^3/s) into the Adriatic (Kolbezen, Pristov, 1998, p. 63).

Average annual runoff in the Danube river basin rivers are (Kolbezen, Pristov, 1998, p. 63) (Table 2. 3):

- the Mura basin (1376 km^2): 228 mm, 10 m^3/s
- the Drava basin (3253 km^2): 571 mm, 59 m^3/s
- the Sava basin (10 746 km^2): 936 mm, 319 m^3/s
- the Kolpa basin (998 km^2): 910 mm, 29 m^3/s

TABLE 2. 3: WATER BALANCE OF THE DANUBE RIVER BASIN IN SLOVENIA

River basin of	Surface area (km^2)	Precipitation (mm)	Precipitation (m^3/s)	Evaporation (mm)	Evaporation (m^3/s)	Runoff (mm)	Runoff (m^3/s)
Mura	1376	903	39	675	29	228	10
Drava	3253	1222	126	650	67	571	59
Sava	10 746	1576	537	641	218	936	319
Kolpa	998	1562	49	652	21	910	29
SLOVENIA	20 230	1567	1005	650	417	917	588

Source: Kolbezen, Pristov, 1998

TABLE 2. 4: WATER BALANCES OF EUROPE AND SLOVENIA

Volume unit	Precipitation (mm)	Evaporation (mm)	Runoff (mm)	Runoff coefficient (%)
Europe (10.519,367 km^2)	734	415	319	43
Slovenia (20.230 km^2)	1567	650	917	59

Source: Kolbezen, Pristov, 1998

D. Natural and artificial lakes

In Slovenia there are 1271 registered stagnant waters. Out of 15 major ones, as many as 14 belong to the Black Sea basin. The biggest three natural lakes are in the Sava river basin. The Cerknica Lake, having the maximum surface area of 24 km^2, is the biggest lake in Slovenia and the world-famous intermittent karstic lake, which only fills up from time to time. The other two are Alpine lakes: the Bohinj Lake (3,18 km^2) with the volume of 120 million m^3 and depth of 44,5 m and the Bled Lake (1,4 km^2).

The major artificial lakes are the Ptuj lake with the surface area of 3,46 km^2 and volume of almost 20 million m^3, Vuhred with 2,41 km^2, the Maribor Lake with 2,39 km^2, Vuzenica with 1,96 km^2 , Ožbalt with 1,54 km^2 and Dravograd with 1,42 km^2. In the Sava river basin there are also the Zbilje Lake and Moste with 0,69 km^2 each.

The Ledava Lake with the surface area of 2,18 km^2 serves as a protection from floods and the Šmartinsko lake with 1,07 km^2 as a protection from high levels of water of the neighbouring Celje and as a reservoir for industry water.

The so-called montanogeous lakes are a special kind of artificial lakes. The Velenje lake with the surface area of 1,24 km^2 and the volume of 22 million m^3 is the biggest of them.

TABLE 2. 5: THE BIGGEST LAKES IN THE DANUBE RIVER BASIN IN SLOVENIA (STATISTIČNI LETOPIS 1997)

Lake	**type of lake**	**Catchment**	**Area (km^2)**	**Height above sea level (m)**	**Greatest depth (m)**	**Extent (m)**	**Volume (million m^3)**
Cerknica	**natural**	Sava	24,00	552	10,7	40200	76,0
Ptuj	**anthropogenous**	Drava	3,46	220	12,1	14400	19,8
Bohinj	**natural**	Sava	3,18	526	44,5	11000	120,0
Vuhred	**anthropogenous**	Drava	2,41	317	23,0	26600	11,2
Maribor	**anthropogenous**	Drava	2,39	267	10,7	31400	13,8
Ledava	**anthropogenous**	Mura	2,18	222	6,0	8900	5,7
Vuzenica	**anthropogenous**	Drava	1,96	330	10,8	24000	7,5
Ožbalt	**anthropogenous**	Drava	1,54	299	23,9	25400	10,2
Dravograd	**anthropogenous**	Drava	1,42	339	12,4	20400	5,6
Bled	**natural**	Sava	1,40	475	30,6	5590	31,7
Dražmer	**anthropogenous**	Sava	1,24	368	55,8	4780	22
Šmartinsko	**anthropogenous**	Sava	1,07	261	7,0	9800	6,5
Zbilje	**anthropogenous**	Sava	0,69	328	20,0	11500	6,5
Moste	**anthropogenous**	Sava	0,69	523	50,0	9300	7,0

Source: SORCE; Statistični letopis, 1997.

E. Karstic water sources

Karstic areas are characterised by numerous and abundant water sources, which provide for a vast hinterland area. Flow and quality of karstic water sources is very varied, since the karstic underground does not have a great self-purification ability. There are 16 karstic sources with the abundance of over 350 l/s, 12 in the Sava river basin.

TABLE 2. 6: MAIN SOURCES IN SLOVENIA WITH ABUNDANCE OF OVER 350 L/S

Source	basin	Settlement	Abundance (l/s)
Bistra	Sava	Bistra	1600
Lipnik	Sava	Zgornje Gorje	1500
Malenščica	Sava	Planina	1400
Tominčev studenec	Sava	Žužemberk	1350
Krupa	Kolpa	Gradac	1000
Izvir pri Ficlju	Sava	Gornji Grad	624
Kroparica	Sava	Kropa	600
Prečna	Sava	Prečna	550
Retovje	Sava	Verd	500
Završnica	Sava	Žirovnica	480
Bočna	Sava	Bočna	448
Kamniška bistrica	Sava	Kamniška Bistrica	400
Čabranka	Kolpa	Čabar	350
Radešca	Sava	Dolenjske Toplice	350

Source: Vodnogospodarske osnove, 1978

F. Dynamic underground water resources in aquifers with intergranular porosity

Dynamic underground water resources amount to 50,4 m^3/s. Dynamic resources of aquifers with crevice and karstic porosity amount to 31,6 m^3/s or 62 % and aquifers with intergranular porosity amount to 18,8 m^3/s or 36,8 %. Aquifers with intergranular porosity total 3726 km^2 or 18,4 % .

In the Black Sea basin, there are 98 % of dynamic resources of underground water in aquifers with intergranular porosity and 85 % of all Slovenian dynamic underground water resources. The biggest dynamic groundwater resources are in the Sava river basin, estimated to be 11,7 m^3/s or 62,2 %. Areas with high quantity of groundwater in the Sava river basin are: the Kranj, Sorica and Ljubljana basins, with the total of dynamic resources of over 8,0 m^3/s, and low quantity of groundwater is in Skaručen-Vodice basin, near the Kamnik Bistrica, on the Ljubljana moor, in Krško, Brežice and Čatež polje and in the Savinja valley, where the dynamic resources of an area do not exceed 1,0 m^3/s. In the Sava river basin there are 67 % of all dynamic underground water resources, namely 25 % in the upper course of the Sava, 24 % in the middle course of the Sava including the Ljubljanica, 10 % in the Savinja and Sotla river basins and 8 % in the lower course, including the Krka river.

In the Drava and Mura river basins, the dynamic resources of groundwater amount to 6,8 m^3/s or 36 %. The most important groundwater areas are the Dravsko polje, the Vrbanski plato near Maribor and the Ptujsko, Mursko, Prekmursko and Apaško polje. In the Drava river basin there is a total of 5,4 m^3/s or 28,5 % of dynamic groundwater resources and 1,4 m^3/s or 7,4 % of resources in the Mura river basin. This area does not contain high underground water resources in crevice and karstic aquifers, which is demonstrated by the data, that the Drava river basin contains 13 % of all dynamic resources of underground water, while the Mura river basin only contains 3 %.

TABLE 2. 7: DYNAMIC GROUNDWATER RESOURCES AND AQUIFER RESOURCES WITH INTERGRANULAR POROSITY

	dynamic groundwater resources	*% of all dynamic resources in Slovenia*	*dynamic resources of aquifers with intergranular porosity*	*% of all dynamic groundwater resources in Slovenia*	*% of all dynamic underground water resources in Slovenia*
the Black Sea basin	42,8 m^3/s	85,0	18,4 m^3/s	98,0	36,5
the Sava basin	33,8 m^3/s	67,0	11,7 m^3/s	62,2	23,2
the Drava basin	6,6 m^3/s	13,0	5,4 m^3/s	28,5	10,7
the Mura basin	1,5 m^3/s	3,0	1,4 m^3/s	7,4	2,8
the Kolpa basin	1,0 m^3/s	2,0	insignificant	/	/
Slovenia	50,4 m^3/s	100	18,8 m^3/s	100	37,3

Source: Enciklopedija Slovenije, 1997; Lah, 1995

G. Wetlands and other humid biotopes

Record of humid biotopes - wetlands is incomplete. It is estimated that they cover a surface of 26.000 ha or 1,3 %. In future, wetlands register will be made according to EC methodology. Some wetlands are incorporated into natural parks or protected as natural reserves: Zelenci, Malo polje, Udinboršt, Bobovek near Kranj, Kostanjevica and Goriški mah in the Ljubljana moor, Krakovski gozd, Negovsko jezero, Rački ribniki, Drava, the Maribor lake. It is estimated that approximately 10.500 ha of wetlands is protected in natural parks in the Black Sea basin, which represent 17,5 % of all protected areas in natural parks. Half of protected wetlands is situated in the Sava river basin. Wetlands protected in the Drava and Sava river basins represent more than 60 % of all protected areas in natural parks.

TABLE 2. 8: SURFACE AREA AND SHARE OF WETLANDS IN SLOVENIA

	Wetlands incorporated into natural parks-estimation	*Share of natural parks surface area -estimation*
the Black Sea basin	10.500 ha	17,5 %
the Sava basin	5.500 ha	10,6 %
the Drava and Mura basins	4.737 ha	63,3 %
the Sotla basin	0	0,0 %
the Kolpa basin	260 ha	100,0 %
Slovenia	11.500	9,5 %

Source: Vrt Evrope, 1996

Many wetland areas were suggested to be protected, especially in the Mura, Drava and the Kolpa river basins. The entire course of the Mura, the Ljubljana moor and the Kolpa, and some sections of the Drava and Ormož lake are planned to be protected.

2. 2. BIOLOGICAL RESOURCES AND ECO-SYSTEMS

A. Physical, geographical, landscape and ecological characteristics of the river basins

Physical, geographical and ecosystem characteristics of the Danube river basins are mainly a reflection of the transit geographic position, where alpine, subalpine, dinaric-karstic and subpannonian characteristics interweave. The Drava basin bioclimatically marks a transition from the Alpine and dinaric part of the basin with very humid climate to the humid climate of the main part of the Sava basin and to the semi-humid and partly semiarid climate of the Drava and Mura river basins. Almost entire Danube basin area belongs to potentially forest ecosystem, which is, however, reduced. The forest surface has increased by approximately 10 % in the last forty years. Forest ecosystem covers approximately half of the Danube basin area and is prevalent in the Dinaric-karstic, Alpine part and the Alpine foothills of the Sava river basin and the highland areas of the Drava river basin (Gams, 1996).

The Mura river rises in Austria and her basin surface area in Slovenia covers 1376 km^2. The Slovenian part of the Mura river basin extends over mainly agricultural subpannonian landscape ecosystem of flatland and hills, with predominant tertiary impermeable rock formations and Pleistocene gravel alluvia. Riverside soil is predominant on gravel and sand alluvia. The main tributaries with a low flow rate are Ledava and Ščavnica, which drain water from the tertiary and hilly part of the Mura basin.

The Drava river rises in Austria and her basin surface area in Slovenia covers 3253 km^2. The Slovenian part of the Drava river basin can be said to consist of predominantly alpine and karstic basin of the Meža river, subalpine and non-karstic area of small river basins of Pohorje and Kozjak water sources, subalpine - subpannonian basin of the Dravinja with Dravinjske gorice and Haloze, river basins of small water sources of Slovenske gorice and the flatland, gravelly Dravsko - Ptujsko polje (groundwater area) (Kolbezen, Pristov, 1998).

The Sava river basin extends over 11 734 km^2 or 58 % of the Slovenian territory (Table 2. 9). It covers the following landscape units: mountainous, predominantly karstic-alpine area (the Julian Alps, the Savinja Alps and the Karavanken Mountains), extensive, mainly karstic hill ranges at the foothills of the Alps with basins (the Ljubljana and Celje Basins with groundwater areas), a part of dinaric-karstic area (the Ljubljanica, Krka and Kolpa river basins) and a small part of the subpannonian area (the Sotla river basin). The following bioclimatical belts are present (Gams, 1996, p. 40): valley and basin bottoms-floors, thermal belt, hill belt (450 - 950 m), mountain belt (950 - 1700 m) and alpine belt (above timber line). Coniferous forest prevails in the mountainous part and mixed forests in the remaining high altitude river basin part.

Due to ecosystem diversity of Slovenia, differences in precipitation rate and precipitation regimes, the condition of water greatly varies among the river basins. The average specific flow in the Slovenian part of the Black Sea basin is approximately 25 l/s/km^2, and the runoff coefficient is 55 %. Annual specific runoff in the river basins of the subpannonian rivers (e.g. the Ledava) is lower than 5 l/s/km^2, while runoff coefficient is below 20 % or below 200 mm. In the Sava Bohinjka river basin, the annual specific runoff is 90 l/s/km^2, while the runoff coefficient exceeds 80 % or 2500 mm (Kolbezen, Pristov, 1998).

ECOLOGICAL UNITS AND SUBUNITS OF SLOVENIA

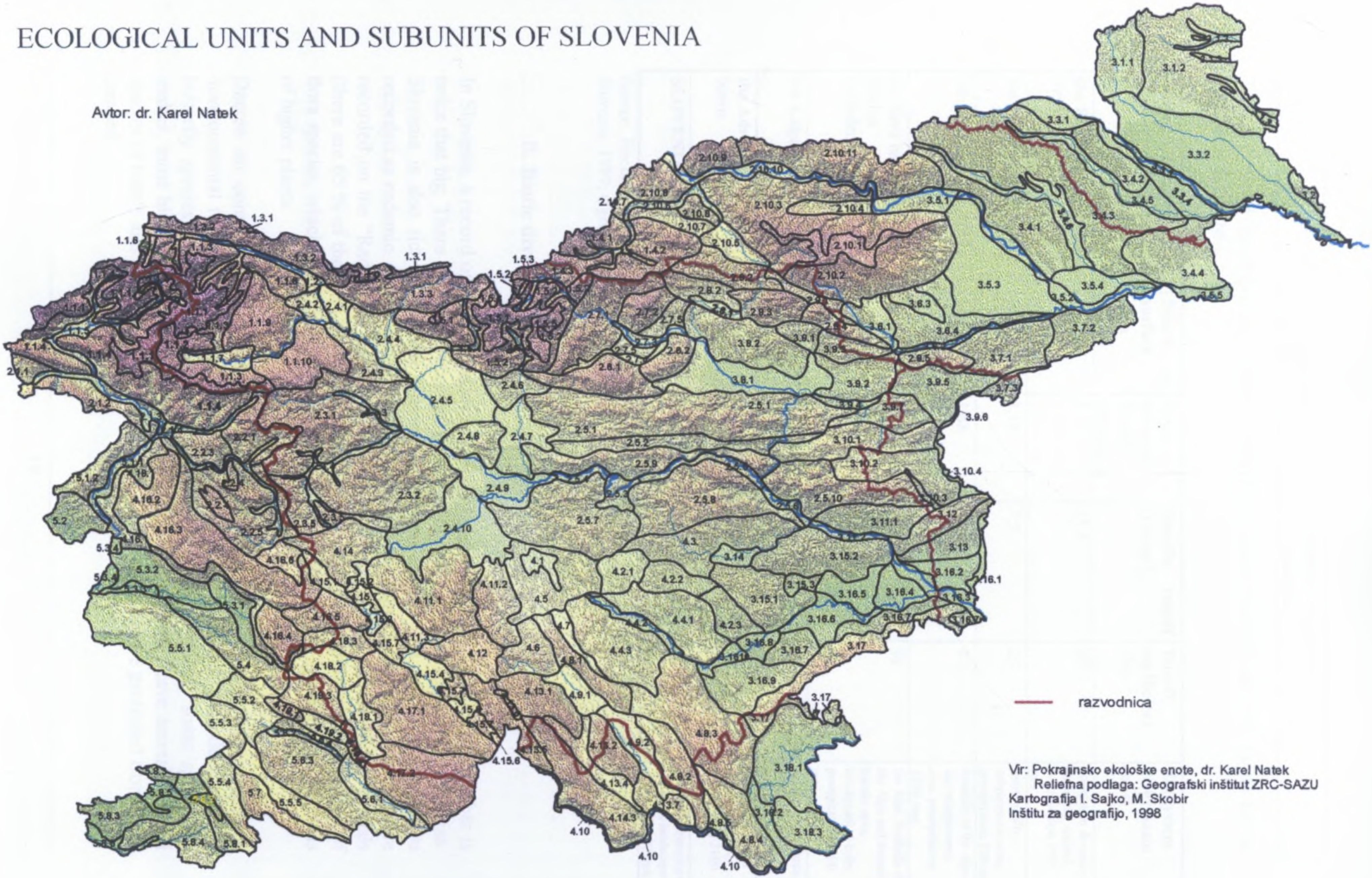


TABLE 2. 9: HYDROLOGICAL AND ECOSYSTEM CHARACTERISTICS OF THE MAIN RIVER BASINS IN SLOVENIA

Basin	Surface area (km^2)	Share of surface area (%)	River network density (km/km^2)	Specific runoff ($l/s/km^2$)	Runoff coefficient (%)	Ecosystem river basin label
the Black Sea basin	16363	80,9	1,38	25,4	55	ecosystem diversity, humidity, annual precipitation 1550 mm
the Mura basin	1376	6,8	1,48	7,3	25	mainly hilly subpannonic area, precipitation 900 mm
the Drava basin	3253	16,1	1,88	18,1	47	foothills of the Alps and subpannonic area, precipitation 1200 mm
the Sava basin (Kolpa excluded)	10 746	53,2	1,30	29,6	59	the Alps, foothills of the Alps and dinaric-karstic area, bioclimatical belts, precipitation 1600 mm
the Kolpa basin	998 (1943 in all)	4,9	0,53	29,1	58	dinaric-karstic area, precipitation 1600 mm
the Adriatic basin	3857	19,1	1,06	44,6	68	submediterranean and Alpine area, precipitation 2100 mm
SLOVENIA	20 230 (20 256)	100,0	1,32	29,0	58	ecosystem transience and great landscape diversity, 1570 mm

Source: Enciklopedija Slovenije, 1997; Kolbezen, Pristov, 1998; Environmental Performance Reviews - Slovenia, 1997; Ogrin, 1996; Plut 1988

B. Biotic diversity

In Slovenia, a record of 24.000 species is kept, however, it is estimated that the number is twice that big. There are 8.888 recorded flora species and 13.632 terrestrial fauna species. Slovenia is also rich in endemic species. 850 fauna species and 46 flora species are recorded as endemic. 550 of endemic species are edaphon animals. 2000 fauna species are recorded on the "Red List", the most endangered of them being the vertebrate animals (there are 65 % of them on the list; most of them are amphibians and reptiles) and 810 of flora species, which include 88 lichen species, 213 deciduous moss species and 509 kinds of higher plants.

Decree on conservation of rare and endangered fauna and flora species and their developmental forms stipulates the conservation of 47 fauna species: 8 beetle species, 5 butterfly species, one locust species, proteus, the "sklednica" turtle, some species of snakes, most bird species, hedgehog, meadow saffron, dormouse, cave animals and all species of beetle and butterfly above timber line. 28 flora species are protected from 1976 onward.

C. Protected areas

In Slovenia, 710 areas and natural monuments and approximately 140.000 ha of pieces of land or 7 - 8 % of the national territory in all are incorporated into various protected areas. 83.807 ha or 59,7 % of protected area is within the Triglav National Park (according to IUCN II./V. category), 413 ha or 0,3 % within the (III. category) the Škocjanske jame regional park and 56.180 ha or 40,0 % within 34 country parks (V. category). There are also 49 natural reserves in Slovenia (I. in IV. category), whose surface area has not been estimated and 623 natural monuments (III. category).

In the Danube river basin, 60.034 ha of land or 42,8 % of all protected areas are incorporated into natural parks. 52.100 ha or 37,1 % in the Sava river basin, 7.478 ha or 5,3 % in the Drava and Mura river basins, the Trebče Memorial Park with 196 ha or 0,1 % of land in the Sotla river basin and the Lahinja regional park with 260 ha or 0,2 % of protected surface area in the Kolpa river basin.

TABLE 2. 10: SURVEY OF PROTECTED AREAS IN THE SLOVENIAN PART OF THE DANUBE RIVER BASIN

	Surfaces incorporated into national parks in ha	*Share of all protected surfaces in Slovenia*
The Black Sea basin	60.034	42,8 %
the Sava basin	52.100	37,1 %
the Drava and Mura basins	7.478	5,3 %
the Sotla basin	196	0,1 %
the Kolpa basin	260	0,2 %
Slovenia	140.400	100,0 %

Source: Vrt Evrope, 1996

In the Black Sea basin, over 100.000 ha of surfaces is to be protected in natural parks. That would increase the share of protected surfaces to 12 %. There are approximately 72.000 ha in the Sava river basin and approximately 32.000 ha in the Drava and Mura river basins.

2. 3. HUMAN IMPACT

The population increased by almost half a million after the war. The share of rural population dropped drastically. As early as in the 1960s has the domination of the primary sector in the active population structure passed to the domination of the secondary structure, while at the same time -especially in the last decade- there was an increase in the share of the tertiary and quaternary sectors. In the middle of the 1990s, service activities dominate in the workplace structure.

In the post-war era, several new development centres appeared alongside old industrial areas, which gradually started to take over the function of new development centres. The traditional centres, such as Ljubljana, Celje, Kranj, Jesenice, Trbovlje and Maribor in the Drava river basin were joined by new centres, especially: Novo mesto, Velenje and somestje Krško-Brežice in the Sava river basin and Murska Sobota in the Mura river basin. The backbone of the economy are the 82 job centres with an excess of more than 1000 workplaces. They provide 84 % of all workplaces. Ljubljana has a dominant position in the Sava river basin, since there are three times as many of workplaces than in the centre of the Drava river basin - Maribor. Kranj and Celje come third and fourth and have approximately a half less of workplaces put together than Maribor. Otherwise, the Ljubljana-Gorenjsko-Kamnik employment basin is prevalent, (with 40 % of all workplaces), and it is followed by the Podravje and Celje-Velenje (each with 10 % of workplaces) employment basins. Next there are minor employment centres or groups of centres: Novo mesto, Murska Sobota (each with approximately 4 % of workplaces) and koroško somestje of industrial centres (Slovenj Gradec-Dravograd-Ravne-Mežica), the Zasavje cities, Ptuj, Postojna (with approximately 2,5 % of workplaces). There are more than 10 000 workplaces in these cities, a quarter in industry (in the Mura river basin as much as 44%). Besides, there is a string of small industrial towns, which have one or two industrial branches on average. Workplaces are getting distributed more and more evenly, since they can be found in 3705 settlements. Settlements with less than 50 workplaces are in majority and there is 3200 of them. Only 3 % of the employed population worked there. There were 216 settlements with more than 100 workplaces, which presented 95 % of all workplaces in the Slovenian part of the Danube river basin.

A more thorough analysis showed that some major changes have occurred in the last decade. The arrangement of workplaces according to natural and geographical or political and territorial criteria crucially depends on the level of the economical or general development of the settlement. There is a rule that holds true for less developed settlements and that is that they tend to concentrate workplace development in one (industrial) centre. The more developed regions, on the other hand, usually spontaneously develop most settlements together with workplaces, which follow each other in strings - "carpets". Because of the increase in the population density and activities in the flatland areas with groundwater, conflicts concerning water supply are on the increase

2. 4. KEY ISSUES OF ENVIRONMENTAL DEGRADATION

Its diverse landscape and natural geographic features contribute strongly to the extent and level of environmental pollution in Slovenia as does its industrial development to now. The most polluted countryside lies in the basins and deep mountain valleys among the Alps and their foothills, most of them are in the Sava river basin (Zasavje, the Celje, Šaleško, Ljubljana, upper Savsko imisijsko area), only exceptionally are they in the Drava basin (the Mežica valley), while there are no strongly polluted areas to speak of in the Mura basin, but more of negative effects on landscape of various actions (regulations, big farms, irrational use of chemicals in agriculture e.t.c.).

The enclosed relief enhances negative landscape effects of environmental pollution even with relatively small emission levels. In general, environmental pollution was increasing up to the middle of the last decade, then began to decrease with a reduction in air and river pollution and less damage to vegetation caused directly by high emission levels. Worse has become the quality of underground water, traffic pollution has increased and many local authorities have difficulty in managing their waste.

Contributing to air pollution are unfavourable stillness of winds, all-to-frequent temperature inversions and the location of the main sources of emissions being in relief depressions. With respect to SO_2 emissions, the main sources are three coal-fired power stations which account for more than 80 % of emissions (cca 120 000 t/year). All three coal-fired power stations are situated in the Sava river basin. The remaining 20 % of SO_2 emissions are due, in approximately equal proportions, to industry and residential heating. Between 1990 and 1995, SO_2 emissions have fallen by 39 %, or from 97 kg to 59 kg per person in Slovenia (from 195 000 t in year 1990 to 119 300 t in year 1995). The causes of this reduction were a fall in industrial production (industry's share of the GDP fell from 36 % in 1990 to 30 % in 1995), more use was made of imported coal which is more environmentally-friendly than domestic coal and alternative energy sources (gas and fuel oil), the introduction of piped gas to many towns and ecological improvements, a considerable lessening of SO_2 emissions is also the result of environmental rehabilitation of one of Šoštanj's coal-fired power stations (Onesnaženost zraka...,1996, HMZ-MOP). Considering that the Danube basin has as much as 88 % of population, some positive changes regarding the use of more environmentally-friendly kinds of fuel in households have been made, and the annual municipal emissions have fallen most exactly in that part of Slovenia, and especially in the Sava river basin.

There has been a progressive rise in nitrogen oxides mainly due to increased emissions from traffic (there has been a 65 % increase in motor vehicles) both domestic and international (more traffic to and from countries of former Yugoslavia). More than 92 % of all nitrogen oxide emissions are from traffic.

In looking at the most polluted parts of Slovenia, it is evident that, unlike other central and Eastern European countries, these are not the biggest urban centres (Ljubljana or Maribor) but places in the vicinity of coal-fired power stations and large industrial plants that also have very unfavourable meteorological conditions as they lay in basins and narrow valleys (of The Sava and Drava tributaries). The most polluted regions of Slovenia are still Zasavje in the Sava basin (Trbovlje, Hrastnik and Zagorje), where there is a confluence of town, industrial and power station emissions, the Šaleško valley - the Sava river basin (and its borders - coal-fired power station pollution - and Celje -the Sava river basin - industrial and municipal emissions and its location in a basin. Experts warn of increasing summer concentrations of ozone that are already at dangerous levels in the summer months.

Due to the hilly relief, rivers flow at different rates at different times of year. River pollution levels change from low in Spring and Autumn to high in Summer and Winter. Slovenia has many rivers with small streams polluted from dispersed industry dumping its waste leading to the whole water system being polluted. After 1990, there has been a noticeable reduction in water pollution due to reduced production levels and better waste management. Industrial pollution of rivers and streams has fallen by 30 to 40 % since 1990 whereas municipal pollution has remained at the same level.

Among the larger (international) rivers in Slovenia, the most polluted is still the Sava which is 2nd or 3rd class polluted from Ljubljana to neighbouring Croatia. The Mura has improved its pollution rating from 3rd to 2nd class due to improvements in pollution control in Austria. Tributaries have become critically polluted, especially their shorter lengths such as the lower Kamniška Bistrica, Ljubljanica, Voglajna, Sotla and Ščavnica. A shortage of cleaning devices remains a crucial problem especially in the larger towns such as Ljubljana, Maribor and Celje. At the same time cleaning waste water has improved in smaller places. Continuing reductions in pollution is evident in both alpine lakes (Bohinj and Bled) ; (HMR, Kakovost...,1996). All the same, some biological and chemical factors in 1995 and 1996 warn, that the intake of fertilisers into the Bohinj Lake is too big (Poročilo o varstvu okolja 1996, 1998).

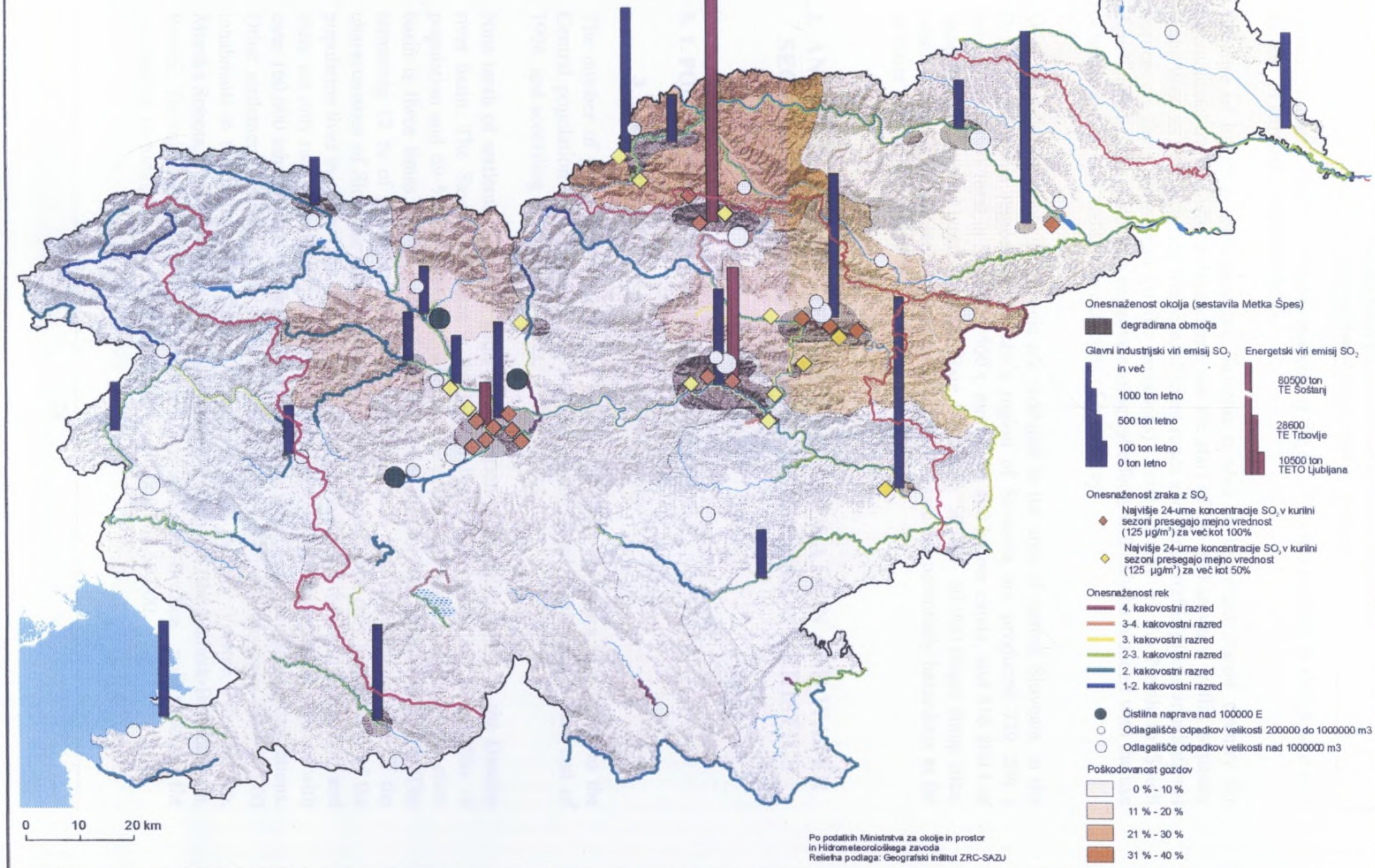
On the Drava, Mura and Celje fields, intensive farming with a high use of protective chemicals and mineral fertiliser has lead to pollution of groundwater. The high level of pesticides in the water is already exceeding safety levels for drinking water by European standards. Due to extensive meliorative activities on the Drava and Mura river basins, and to a minor extent also the Sava basin, many fauna and flora species are endangered or even extinct, therefore the natural equilibrium is strongly endangered, and it is even more intensified by big agriculture land density.

Forests cover 53 % of Slovenia and are growing at the expense of meadows and fields in the more unapproachable areas of the country. Damage to forests that is at least indirectly attributable to harmful emissions, are evident in the direct hinterlands of larger industrial and energy sources (the Mežiška valley -the Drava basin, Zasavje, the Šaleška valley and Celje's emission area - the Sava basin). 22.4 % of all trees are damaged - 14.8 % of conifers and 26.3 % of deciduous trees. Most affected are firs, pine, spruce and oak.

Rich biological diversity is mainly due to the convergence of different types of climate, geological structure and great differences in altitude. According to the Dobris Assessment, except for fish and vascular plant species, the rate of threatened species is higher than in the rest of Europe.

Industry has experienced great changes in the socio-economic upheavals after 1990 - in system, ownership, structure, technology and markets. In 1990, industry employed 345,000 people, five years later 251,500 or just as many as were employed a quarter of a century before. After the collapse of the Yugoslav market, independent Slovenia has

ENVIRONMENTAL DEGRADATION IN SLOVENIA



turned more and more towards the markets of the EC. This has resulted in the closure of a number of harmful industrial plants.

Because of its geographic position, Slovenia is also an important transit country for international traffic. After independence and the start of the Balkan wars, traffic is mainly in the West to East direction where insufficient roads and dense traffic places an additional burden on the environment (traffic emissions). Lately traffic in the North to South direction has reappeared. The negative ecological effects will only be reduced with the use of better quality fuel and the construction of motorways.

Most of waste materials in Slovenia are produced in the area of central Slovenia, in the Drava and Savinja region (in Danube's region of Slovenia are produced 729 200 t municipal waste - total in State 848 500 t, more than 400 kg per capita; and 416 860 t of hazardous and special waste - total in State 445 350 t). 50 000- 60 000 illegal dump sites, which contain approximately 10 million m^3 of solid waste are potentially hazardous as far as water pollution is concerned.

3. ANALYSIS AND PROJECTION OF POPULATION AND WATER SECTOR - RELEVANT DEMOGRAPHIC CHARACTERISTICS

3. 1. POPULATION AND ECONOMIC SITUATION

3. 1. 1. Settlement pattern, population density

The number of population has been the same for the last few years. According to the Central population register data, 1,9895 million people lived in Slovenia at the end of 1996, and according to the 1991 census, 1,9748 million.

Nine tenth of settlements of four fifths of population (1,74 million.) live in the Danube river basin. The Sava river basin is the biggest basin, since there are three fifths of population and 69 % of settlements, whereas the population number in the Drava river basin is three times lower. 6 % of the population live in the Mura river basin. The remaining 12 % of population live near rivers that flow into the Adriatic. One of the characteristics of Slovenia is a big diffusion of settlements, since only a good half of the population lives in cities. Less than two million people live in six thousand settlements and there are only two cities (Ljubljana with more than 300.000 inhabitants and Maribor with over 160.000 inhabitants), which can hardly compare with other, foreign agglomerations. Other settlements are small. Only Kranj and Celje city agglomerations have over 50.000 inhabitants in the Danube river basin. A group of cities follows: Velenje, Novo mesto, Murska Sobota, Ptuj and Škofja Loka and merged settlements (the Kamnik-Bistrica plain, Revirji, Zgornje Gorenjsko, the Slovenian Koroška, Krško-Brežice polje), where the population, including the suburbs, totals between 20.000 and 50.000.

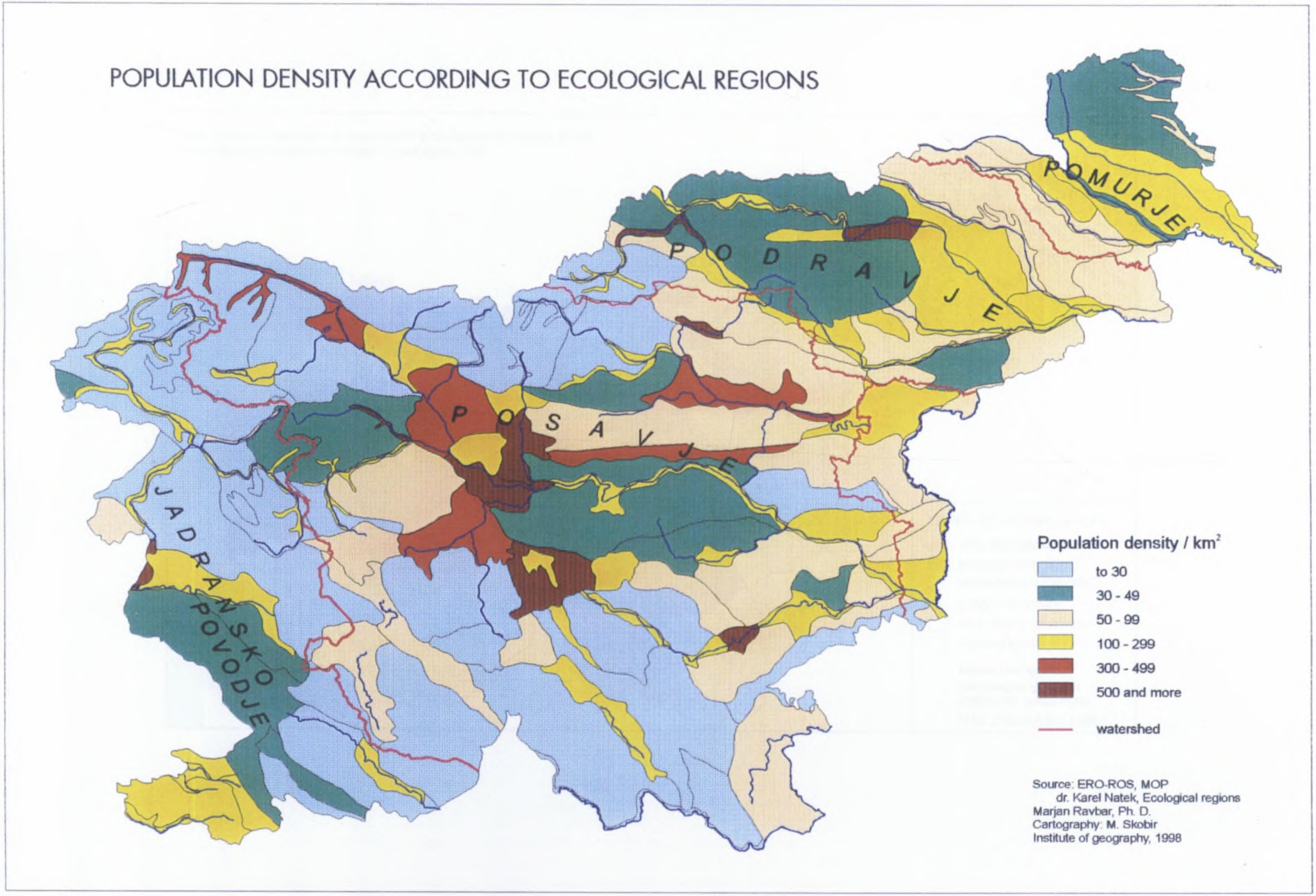
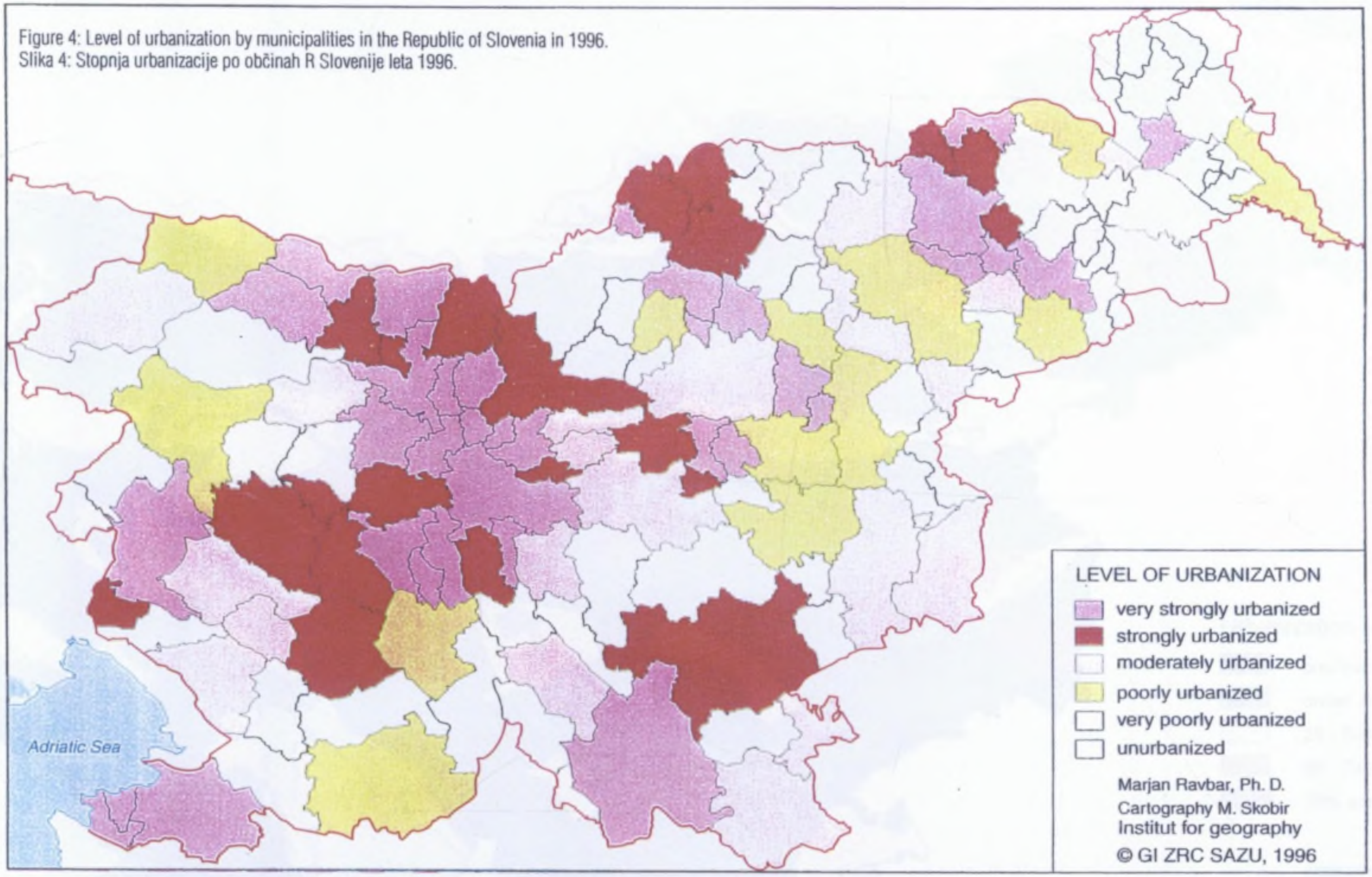
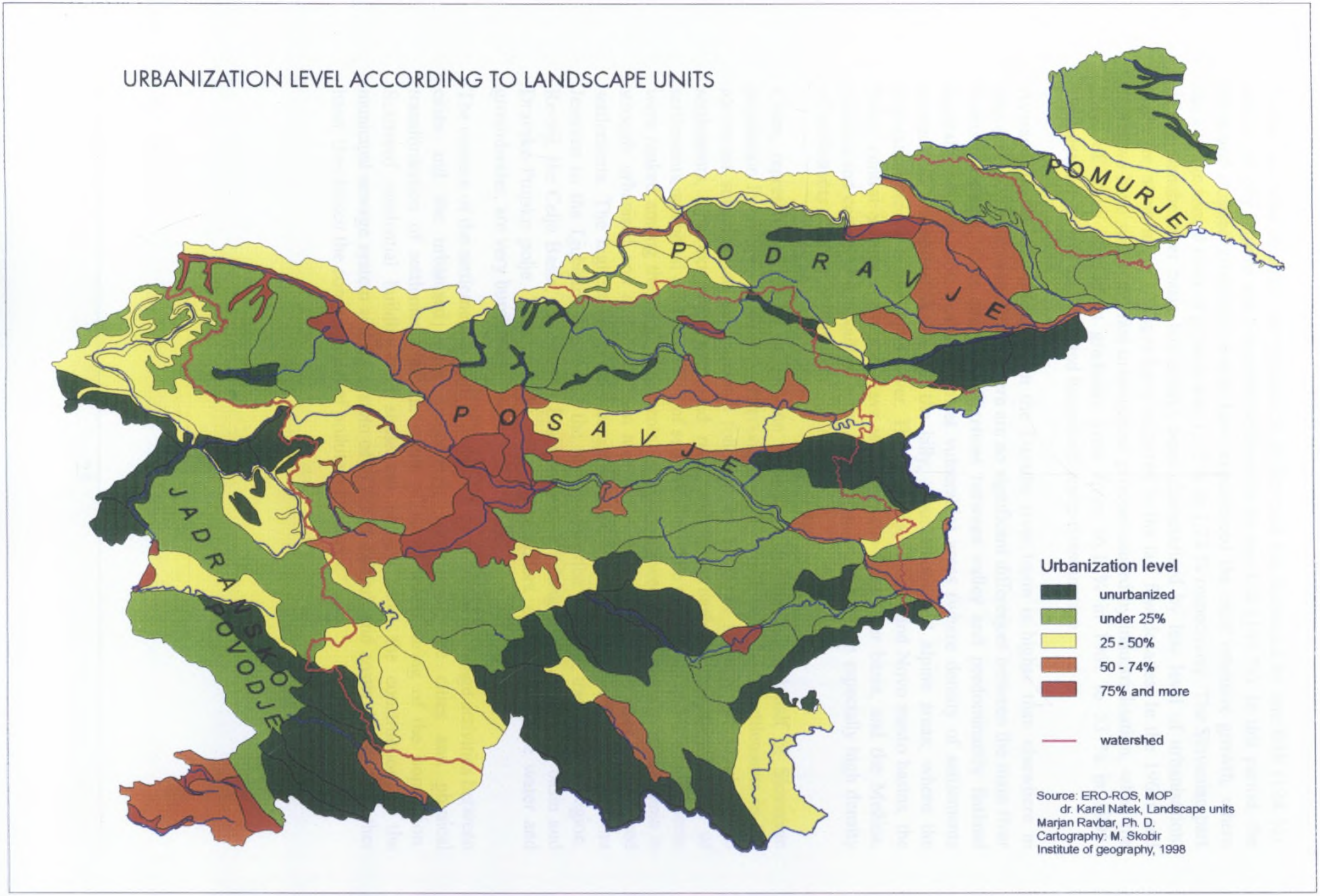

POPULATION DENSITY ACCORDING TO ECOLOGICAL REGIONS
POMURJE
PODRAVJE
POSAVJE
JADRANSKO POVODJE
Population density / km²
to 30
30 - 49
50 - 99
100 - 299
300 - 499
500 and more
watershed
Source: ERO-ROS, MOP
dr. Karel Natek, Ecological regions
Marjan Ravbar, Ph. D.
Cartography: M. Skobir
Institute of geography, 1998

Figure 4: Level of urbanization by municipalities in the Republic of Slovenia in 1996.
Slika 4: Stopnja urbanizacije po občinah R Slovenije leta 1996.





URBANIZATION LEVEL ACCORDING TO LANDSCAPE UNITS
POMURJE
PODRAVJE
POSAVJE
JADRANSKO POVODJE
Urbanization level
unurbanized
under 25%
25 - 50%
50 - 74%
75% and more
watershed
Source: ERO-ROS, MOP
dr. Karel Natek, Landscape units
Marjan Ravbar, Ph. D.
Cartography: M. Skobir
Institute of geography, 1998

In the last three decades, the population of Slovenia has increased by one fifth (124 %), and in the city regions and urbanised settlements by one half (146 %). In this period, the cities and isolated urbanised centres have experienced the most intensive growth, where the average annual level of growth was 1,64 % or 1,73 % respectively. The Slovenian part of the Danube river basin has always been characterised by low level of urbanisation. However, some major changes have occurred in the last few decades. In the 1960s and 1970s we have witnessed fast urbanisation process caused by industrialisation, when the share of urban population gradually grew from 36,1 % in 1961 to 53 % in 1996. Urbanisation growth also affected household water consumption.

Average density of settlements in the Danube river basin is higher than elsewhere in Slovenia (105 inhabitants/km^2). There are no significant differences between the main river basins. However, there are big differences between valley and predominantly flatland coastal (and also ecologically the most vulnerable) areas (where density of settlements exceeds 250 inhabitants/km^2) and the hilly, mountainous and alpine areas, where the population density is five times lower. The Ljubljana, Velenje and Novo mesto basins, the Selce, central Savinja and upper Sava valleys in the Sava river basin, and the Mežica, Mislinja and central Drava valleys in the Drava river basin have an especially high density of settlements - 500 inhabitants/km^2.

Cities, representing 1,2 % of Slovene settlements (where a good half of Slovenian population lives) are immediately surrounded by a wreath of 5 % of settlements in the narrowest suburbanised surroundings followed by 11 % of strongly urbanised suburb settlements. The extremely urbanised rural and half-urbanised, transitional areas of settlements numbered a further 16 % of settlements, while the remaining 3942 settlements were ranked among the rural settlements. Analysis showed that one third of Slovenia is strongly urbanised and that more than nine tenths of the population lives in urbanised settlements. The highest levels of urbanisation are found in the central Slovenia from Jesenice to the Ljubljana Basin and the Kamnik-Bistrica plain, in the Kočevje region, Revirji, the Celje Basin, the Šaleška Basin, which all belong to the Sava river basin and Dravsko-Ptujsko polje. These are the areas where waters, especially surface water and groundwater, are very burdened.

The essence of the settlement system is in the rich spectrum of exchange activities between cities and the urbanised areas immediately surrounding the cities and physical transformation of settlements as the result of social restructuring of the population. Scattered residential building and settlement pattern make the construction of the municipal sewage system and the system of WWTPs difficult and costly, but on the other hand, they lessen the concentration of polluters in cities.

Figure 3: Urbanization in Slovenia (typology of areas – settlements).
Slika 3: Urbanizacija v Sloveniji (tipologija območij – naselij).

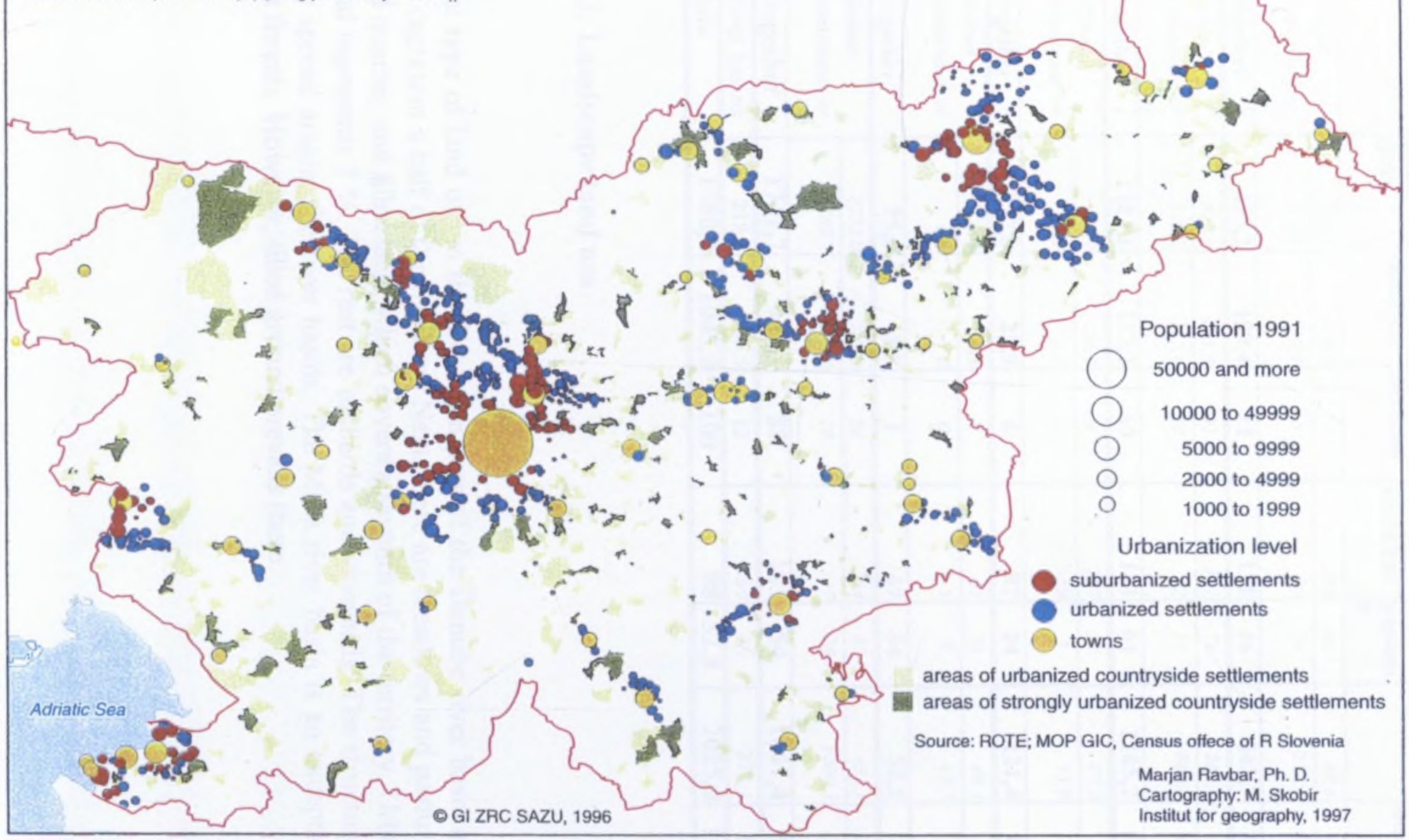


TABLE 3. 1: TYPICAL INDICES OF POPULATION SETTLEMENT IN THE SAVA, DRAVA, MURA AND KOLPA RIVER BASINS AND MAIN TYPES OF SURFACE IN THE SLOVENIAN PART OF THE DANUBE RIVER BASIN IN 1996

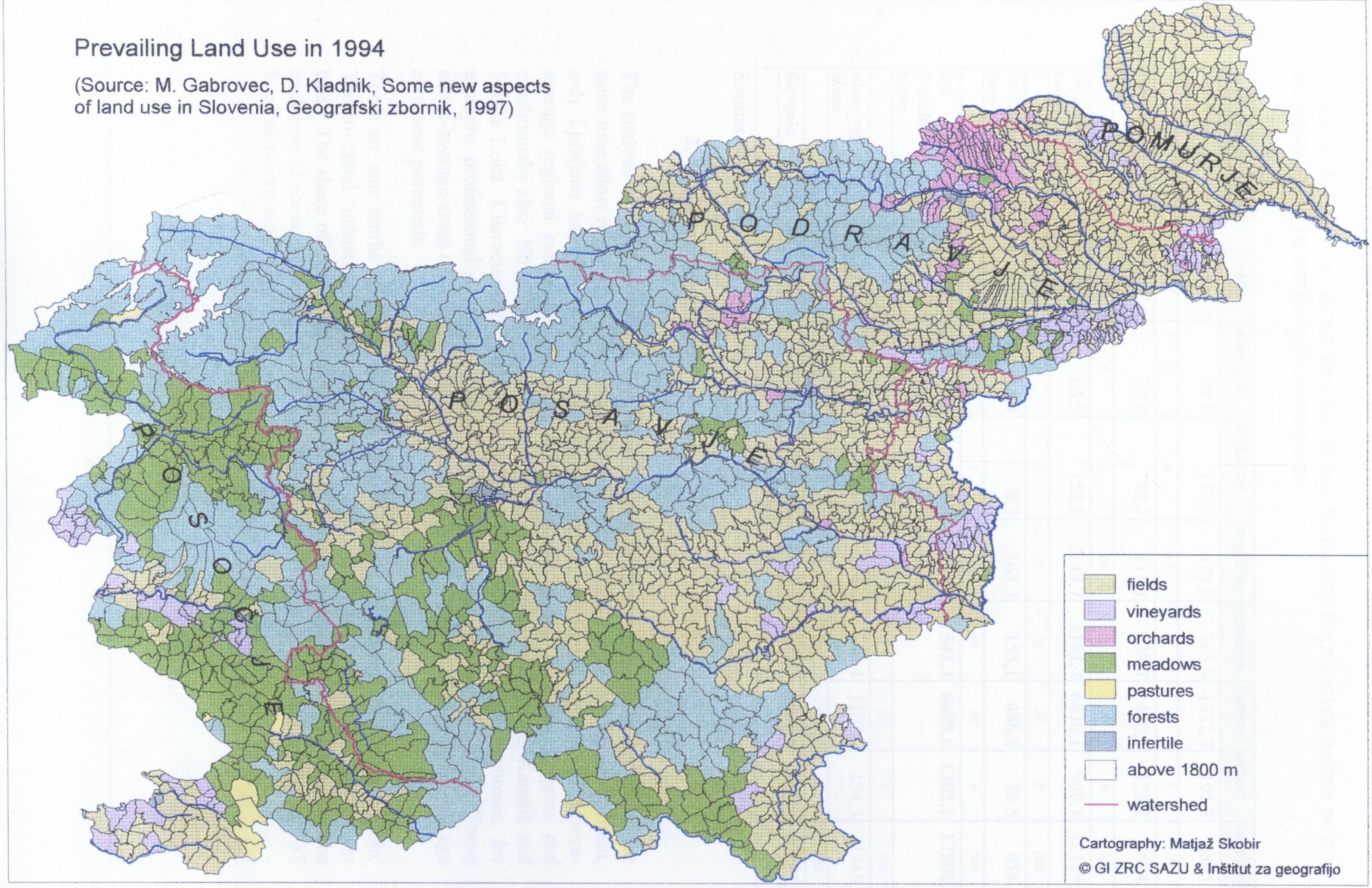
river basin	type of surface	inhabitants - together (1000)	no. of inhabitants in cities (1 000)	% of inhabitants in river basins	population density inhabit./km^2	% of urban population	surface area km^2	% of surface area	% urban area acc. to type of surface
	valley-flatland	*248,2*	*150,4*	*13*	*280*	*61*	*88,6*	*4*	*79*
	hilly, mountainous or alpine	*167,1*	*39,9*	*8*	*66*	*24*	*254,1*	*13*	*21*
the Drava	**together**	**415,2**	**190,4**	**21**	**121**	**46**	**342,7**	**17**	**100**
	valley-flatland	*812,9*	*601,8*	*41*	*307*	*74*	*264,4*	*13*	*84*
	hilly, mountainous or alpine	*370,2*	*115,4*	*19*	*42*	*31*	*880,8*	*43*	*16*
the Sava	**together**	**1183,1**	**717,2**	**60**	**103**	**61**	**1145,2**	**57**	**100**
	valley-flatland	*85,9*	*26,3*	*4*	*127*	*31*	*67,5*	*3*	*94*
	hilly, mountainous or alpine	*31,9*	*1,7*	*2*	*59*	*5*	*53,9*	*3*	*6*
the Mura	**together**	**117,8**	**27,9**	**6**	**97**	**24**	**121,4**	**6**	**100**
	valley-flatland	*25,0*	*8,8*	*1*	*62*	*35*	*40,5*	*2*	*100*
	hilly, mountainous or alpine	*0,6*	*0*	*0*	*5*	*0*	*11,7*	*1*	*0*
the Kolpa	**together**	**25,6**	**8,8**	**1**	**49**	**34**	**52,1**	**3**	**100**
	valley-flatland	*1172,0*	*787,3*	*59*	*254*	*67*	*461,1*	*23*	*83*
	hilly, mountainous or alpine	*569,7*	*157,0*	*29*	*47*	*28*	*1200,3*	*59*	*17*
the Danube-	**together**	**1741,7**	**944,3**	**88**	**105**	**54**	**1661,4**	**82**	**100**
	other river basins	218,3	100,5	12	59	46	373,1	18	
Rep. of Slovenia		**1980,0**	**1045,0**	**100**	**98**	**52,8**	**2025,0**	**100**	

3. 1. 2. Landscape land use

The prevalent type of land use in the Slovenian part of the Danube river basin are forest areas, which represent a half of the territory. Next, there are meadows and pastures which cover a good quarter, and tilled land, which covers a seventh of the territory. Urbanised or barren ground represents 7 %. The rest are orchards and vineyards. The structure of land use is evenly spread among the river basins. The Mura river basin is an exception, since there are less forests. However, tilled ground prevails there.

Prevailing Land Use in 1994

(Source: M. Gabrovec, D. Kladnik, Some new aspects of land use in Slovenia, Geografski zbornik, 1997)



Cartography: Matjaž Skobir

TABLE 3. 2: LAND USE IN THE DRAVA, MURA, SAVA AND KOLPA RIVER BASINS IN THE SLOVENIAN PART OF THE DANUBE RIVER BASIN

land use 1994 (km^2)		fields	vineyards	orchards	meadows	pastures	forests	other	together
the Drava basin	no.	474,9	44,8	117,2	479,0	165,9	1332,7	191,3	2805,7
	%	*17*	*2*	*4*	*17*	*6*	*47*	*7*	*100*
The Mura basin	no.	589,2	33,9	88,1	311,3	39,7	440,3	122,2	1624,8
	%	*36*	*2*	*5*	*19*	*2*	*27*	*8*	*100*
the Sava basin	no.	1174,5	65,9	158,6	2148,7	1181,7	6430,1	960,1	12119,5
	%	*10*	*1*	*1*	*18*	*10*	*53*	*8*	*100*
the Kolpa basin	no.	103,6	10,4	8,3	165,3	155,1	486,8	28,5	958,1
	%	*11*	*1*	*1*	*17*	*16*	*51*	*3*	*100*
the Danube basin	**no.**	**2342,3**	**155,0**	**372,2**	**3104,3**	**1542,3**	**8689,8**	**1302,1**	**17508,1**
	%	*13*	*1*	*2*	*18*	*9*	*50*	*7*	*100*
other river basins	no.	211,3	60,5	26,3	559,4	530,4	1202,9	154,3	2745,1
	%	*8*	*2*	*1*	*20*	*19*	*44*	*6*	*100*
Slovenia	**no.**	**2553,5**	**215,5**	**398,6**	**3663,7**	**2072,7**	**9892,8**	**1456,4**	**20253,2**
	%	*13*	*1*	*2*	*18*	*10*	*49*	*7*	*100*

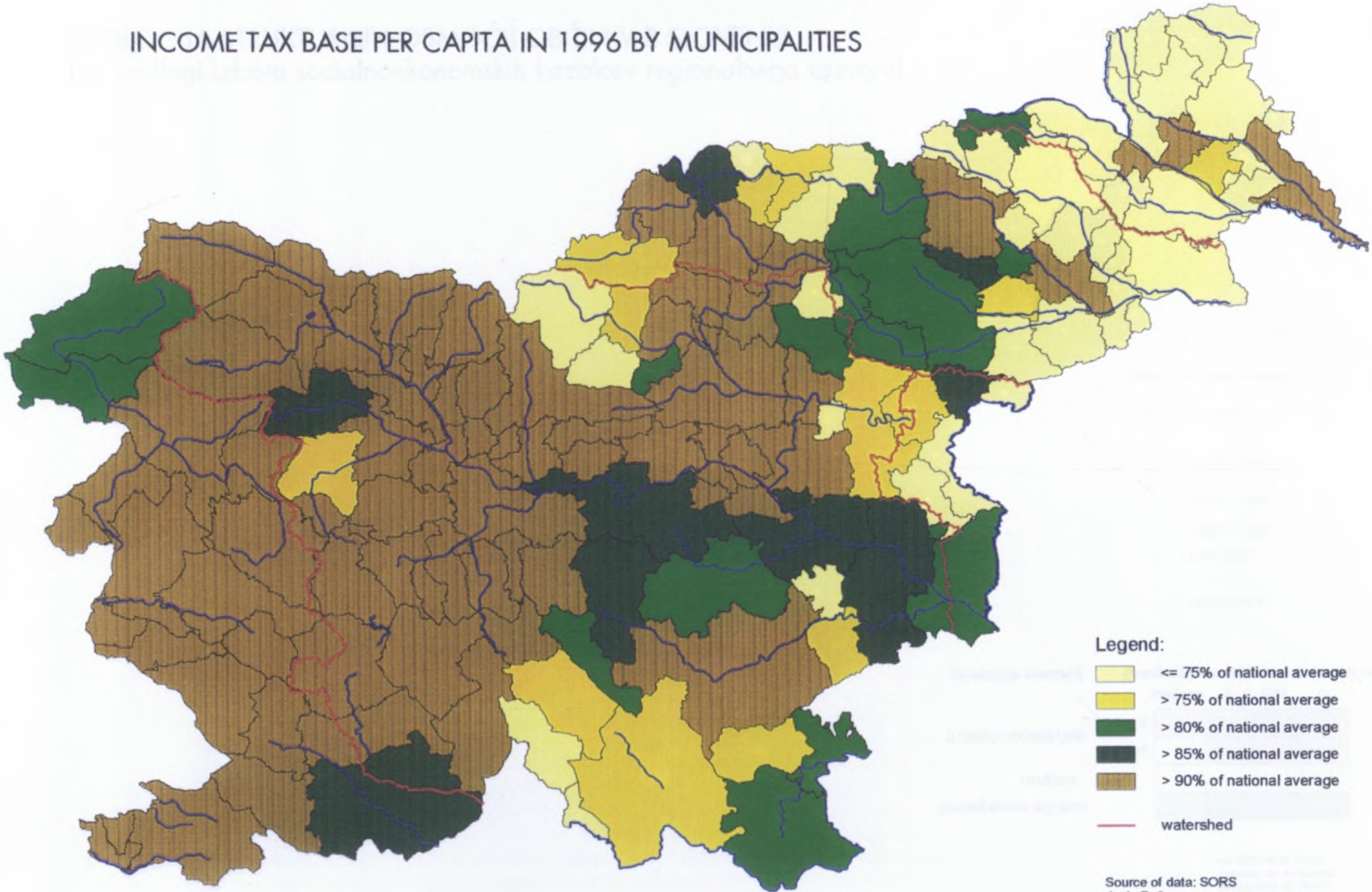
Source of data: SORSE, 1996

3. 1. 3. Economic structure

The analysis of developmental factors, which help to form economic potentials and at the same time allow regional disparities measurement, has shown that, in the Sava river basin, only Ljubljana has above-average development potentials. In the category of above-average regional centres are Celje, Maribor, Velenje, Kranj, Postojna, Logatec and conditionally also Novo mesto, as well as Ljubljana's "satellites": Domžale, Kamnik and Škofja Loka. Characteristic of those cities is a mixture of favourable economic, for example, professional structure, opposed to inferior infrastructure or vice versa. Those above-average areas represent a good quarter of Slovenia. Other areas have under-average economic potentials.

There are nine tenths of all workplaces in the Slovenian part of the Danube river basin. The so-called "industrial" workplace structure still prevails, especially in the Mura river basin. The share of service activities has already reached one half of all workplaces. The backbone of economy are the 82 job centres with over 1000 workplaces. They provide 85 % of all workplaces.

INCOME TAX BASE PER CAPITA IN 1996 BY MUNICIPALITIES



TIPOLOGIJA STRUKTURNIH OBMOČIJ OBČIN V R SLOVENIJI
(na podlagi izbora socialnoekonomskih kazalcev regionalnega razvoja)

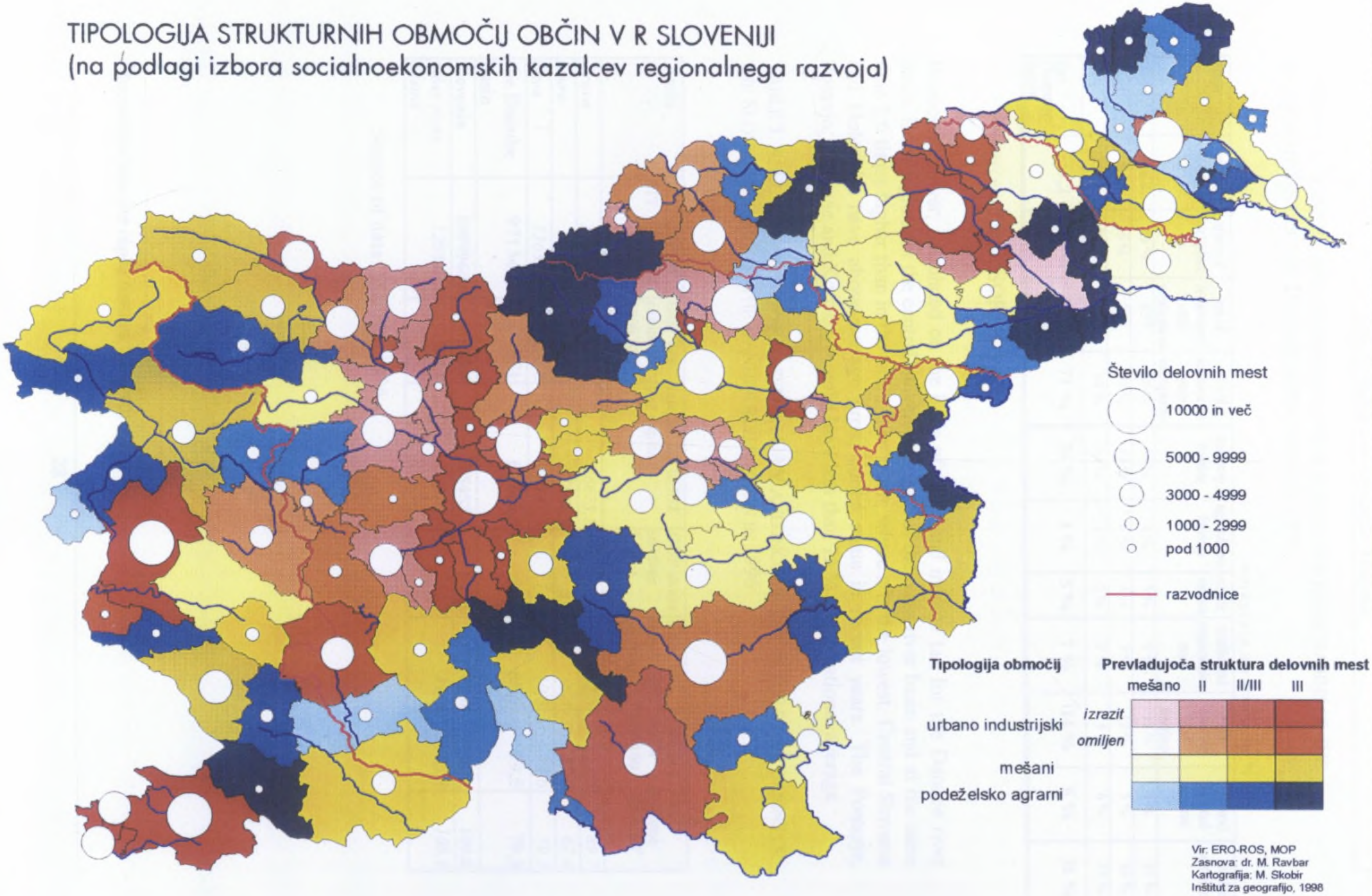


TABLE 3. 3: NUMBER AND WORKPLACE STRUCTURE IN THE RIVER BASINS OF THE SLOVENIAN PART OF THE DANUBE RIVER BASIN IN 1996

					workplace structure in %						
basin	workplaces - together	share of workplaces	no. of settlements with workplaces	% of settlements with workplaces	industry, mining	agriculture, forestry	construction	traffic and communications	trade, catering and tourism	craft and personal services	service activities
Drava	136,4	19 %	657	80 %	35 %	4 %	5 %	9 %	13 %	7 %	27 %
Mura	41,9	6 %	284	83 %	42 %	6 %	5 %	3 %	12 %	5 %	26 %
Sava	557,8	76 %	2764	68 %	34 %	2 %	5 %	7 %	14 %	6 %	33 %
the Danube basin	**736,2**	**100 %**	**3705**	**71 %**	**34 %**	**3 %**	**5 %**	**7 %**	**14 %**	**6 %**	**31 %**

Source of data: SORSE, 1996

Economic power, calculated on the basis of GAV and income tax for the Danube river basin, is the highest in the central Slovenian region of the Sava river basin and at the same time 2,6 times higher than in the Mura river basin, where it is the lowest. Central Slovenia and Dolenjska have above-average gross added value in recent years. The Pomurje, Posavje, Podravje and Koroška regions have less than 75 % of the national average.

TABLE 3. 4: ECONOMIC POWER BASED ON GAV AND INCOME TAX IN THE RIVER BASINS OF THE SLOVENIAN PART OF THE DANUBE RIVER BASIN IN 1996

basin	GDP in 1000 SIT	GDP per capita in 1000 SIT	income tax in SIT per capita	GDP share in river basins	share of inhabitants in river basins	GDP per capita RS=100	tax income RS=100[1]
Drava	*776098,6*	*624,6*	*76675,8*	*70,6*	*62,5*	*112,8*	*89,7*
Mura	*38862,2*	*307,9*	*57608,8*	*3,5*	*6,4*	*55,6*	*67,4*
Sava	*156388,8*	*396,6*	*67743,5*	*14,2*	*19,8*	*71,6*	*79,3*
the Danube basin	**971349,6**	**551**	**67743,5**	**88,3**	**88,7**	**99,5**	**79,3**
Slovenia	**1099960,5**	**553,6**	**85453,7**	**100,0**	**100,0**	**100,0**	**100,0**
other river basins	*128610,9*	*574,4*	*92272,5*	*11,7*	*11,3*	*103,8*	*108,0*

Source of data: SORSE, 1996

[1] Income tax base per capita (indices; RS=100)

3. 1. 4. Number and share of the population connected to municipal water supply systems

In 1995, 80,7 % of inhabitants of the Black Sea basin were connected to municipal water supply systems managed by municipal enterprises (Študija..., 1995; Sanacija..., 1996), which is a somewhat lower percentage than elsewhere in Slovenia (88 %). Additional 10 % of population are estimated to be connected to water supply systems managed by local and village communities. In urban areas, almost all inhabitants are connected to bigger water supply systems, while in the countryside, smaller water supply systems are more frequent and a part of the population still acquires water from their own sources. There are 256 water sources for the supply with drinking water with a total of 7.575 l/s of dynamic resources. The biggest share of the population connected is in the Sava river basin - 83,9 %, followed by the Sotla, Kolpa and Drava river basins, and the smallest share is in the Mura river basin with 67 % of connected population. In 1995, the average water consumption from the public water supply system was 127 l/day or 46,355 m^3/year. In cities, household water consumption was higher, while in the countryside, drinking water consumption for livestock is added to the household drinking water consumption.

The main source of drinking water for the population supply is underground water from aquifers with intergranular porosity, and the karstic sources. In 1995, 86,5 million m^3 of drinking water was needed for drinking water supply of the population through public water supply systems, and the year before that, 91,8 million m^3. In comparison to 1980, the consumption of water for household use grew by 26 million m^3, and in comparison to 1990 it hardly changed at all (Statistični..., 1997). Considering the average public water supply system consumption per inhabitant, and the number of inhabitants connected to public water supply systems in the Danube river region, 81 % of drinking water from public water supply systems managed by municipal enterprises is in this area.

TABLE 3. 5: NUMBER AND SHARE OF INHABITANTS CONNECTED IN NON-CONNECTED TO MUNICIPAL WATER SUPPLY SYSTEM

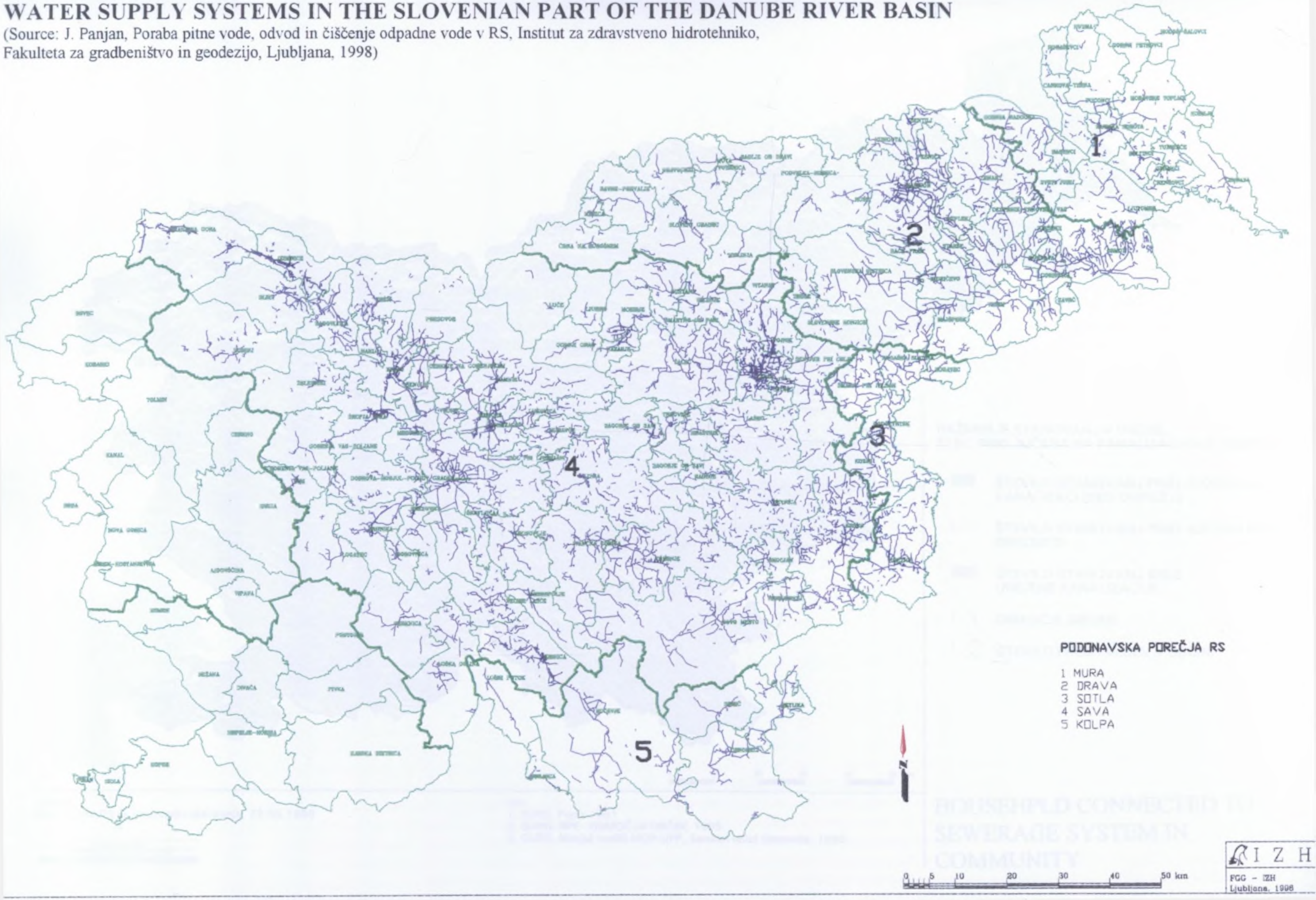
	Total population	*Share of population*	*Population connected to centralised water supply systems*	*Share of population connected to public water supply systems*	*Population supplied by other sources*	*Share of population connected to local water supply systems*	*An estimate of annual water demand from centralised water supply systems*	*An estimate of water demand from centralised water supply systems (litres/capita/day)*	*Losses of water from centralised water supply systems*	*Annual water demand for population supplied by other sources*	*Losses of water for population supplied by other sources*	*An estimate of annual water consumption of connected population*	*An estimate of annual water consumption of population with other sources*	*An estimate of annual water consumption*
The Black Sea basin-tot	1.741.700	100	1.405.071	80,7	336.629	19,3	100.454.762	195,9	40,1	...	..	72.284.907	14.037.429	86.322.336
Urban	944.300	54,2	944.300	100	0	0	67.505.600	195,9		...	...	48.574.848	0	48.574.848
Rural	797.400	55,8	460.771	57,8	336.629	42,2	32.949.161	195,9		...	..	23.710.059	14.037.429	37.747.488
the Sava basin - total	1.208.700	100	1.083.712	89,7	124.988	10,3	76.619.179	193,7	42,5	...	...	54.003.130	5.212.000	59.215.130
Urban	726.000	60,1	726.000	100	0	0	51.334.850	193,7		...	...	36.182.010	0	36.182.010
Rural	482.700	39,9	357.712	74,1	124.988	25,9	25.284.329	193,7		...	...	17.821.120	5.212.000	23.033.120
the Drava basin - total	415.200	100	304.478	73,3	110.722	26,7	19.815.460	178,3	30,6	...	..	15.172.633	4.617.107	19.789.740
Urban	190.400	45,9	190.400	100	0	0	12.384.663	178,2		...	...	9.467.328	0	9.467.328
Rural	224.800	54,1	114.078	50,7	110.722	49,3	7.430.797	178,5		...	..	5.705.305	4.617.107	10.322.412
the Mura basin - total	117.800	100	62.393	53,0	55.407	47,0	4.020.123	176,5	29,3	...	...	3.109.144	2.310.472	5.419.616
Urban	27.900	23,7	27.900	100	0	0	1.796.995	176,5		...	...	1.386.614	0	1.386.614
Rural	89.900	76,3	34.493	38,4	55.407	61,6	2.223.128	176,6		...	...	1.722.530	2.310.472	4.033.002
Slovenia	1.980.000	100	1.724.800	87,1	255.200	12,9	122.378.000	194,4	42,3	...	..	85.949.586	10.641.840	96.591.426
Urban	1.045.000	52,8	1.045.000	100	0	0	74.161.068	194,4		...	...	51.999.145	0	51.999.145
Rural	935.000	47,2	679.800	72,7	255.200	27,3	48.216.932	194,3		...	...	33.950.441	10.641.840	44.592.281

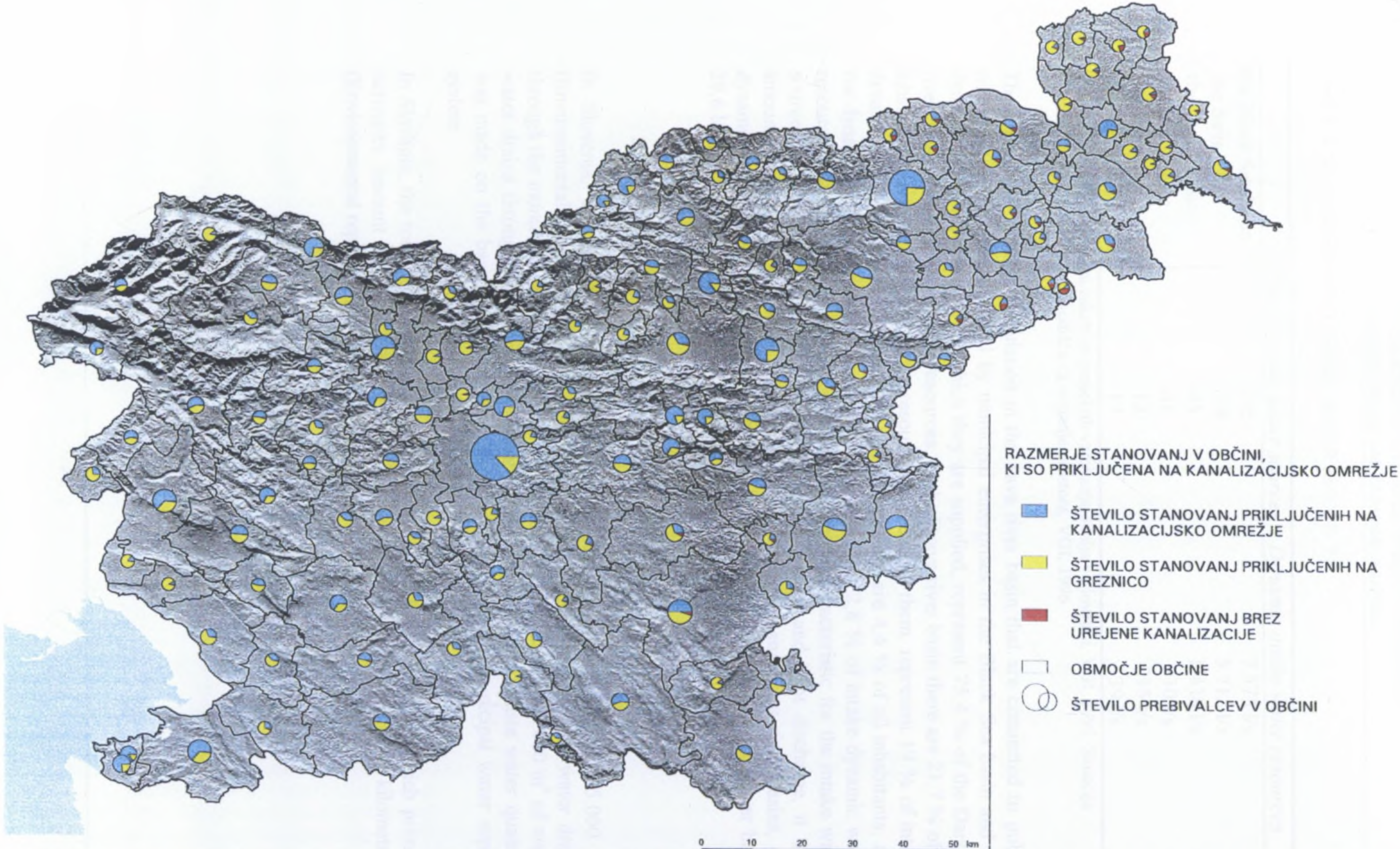
Source: Source: Študija o komunalni oskrbi in projektih varovanja okolja v Sloveniji, VGI, 1995; Sanacija komunalne infrastrukture in izhodišča za urejanje prostora, VGI, 1996

Note: * Household water supply is determined with the help of average water consumption from municipal water supply systems per capita in Slovenia, which in 1993 amounted to 127 l/inhabitant/day or 46,355 m^3/inhabitant/year

WATER SUPPLY SYSTEMS IN THE SLOVENIAN PART OF THE DANUBE RIVER BASIN

(Source: J. Panjan, Poraba pitne vode, odvod in čiščenje odpadne vode v RS, Institut za zdravstveno hidrotehniko, Fakulteta za gradbeništvo in geodezijo, Ljubljana, 1998)





Izdelal:
MOP - Urad RS za prostorsko planiranje, 22.05.1998

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA OKOLJE IN PROSTOR
URAD RS ZA PROSTORSKO PLANIRANJE

Vir:
1. SURS, Popis 1991
2. GURS, RPE - OBMOČJA OBČIN, 1995
3. GURS, Matjaž Ivačič MOP-UPP, Senčen relief Slovenije, 1996.

HOUSEHPLD CONNECTED TO SEWERAGE SYSTEM IN COMMUNITY

TABLE 3. 6: NUMBER AND DYNAMIC WATER RESOURCES

	No. of intake water sources	*Dynamic intake water resources*
the Black Sea basin	256	7.575 l/s
the Sava basin	158	5.712 l/s
the Drava basin	45	1.438 l/s
the Mura basin	41	210 l/s
the Sotla basin	12	215 l/s
the Kolpa basin	17	139 l/s

Source: Študija o komunalni oskrbi in projektih varovanja okolja v Sloveniji, VGI, 1995; Sanacija komunalne infrastrukture in izhodišča za urejanje prostora, VGI, 1996

There are 70,7 % of all population in the Sava river basin that are connected to public water supply systems managed by municipal enterprises in the Black Sea basin and the dynamic water resources, from which they are supplied, represent 75,4 % of the Danube river basin intake dynamic water resources. In the Drava river basin there are 21,7 % of all inhabitants, and the dynamic water resources that supply them, represent 19 % of intake dynamic water resources. In the Mura river basin there are 4,4 % of all inhabitants, and the dynamic water resources that supply them, represent 2,8 % of intake dynamic water resources in the Danube region. Poor outflow is quite characteristic for the intake water sources in the Mura river basin. Considering the number and joint discharge, it only amounts to 5,12 l/s per water source, while in the Drava and Sava river basins, the dynamic outflow of a intake water source exceeds 30 l/s, and in the Danube river basin 29,6 l/s.

3. 1. 5. Domestic Waste Water Production

In Slovenia, the quantity of sewage from households amounts to 81,395.000 m^3 (Environmental report 1995, 1996), out of which 37,786.000 m^3 of waste water drains through the municipal sewage system. In the Danube river basin, 31,650.000 m^3 of waste water drains through the municipal sewage system. Estimation of waste water quantity was made on the basis of the quantity of water used from the municipal water supply system.

In Slovenia, the total length of networks amounts to 3973 kilometres, of which primary networks amount to 736 kilometres and secondary networks to 3237 kilometres. (Environmental report 1995, 1996)

TABLE 3. 7: NUMBER AND SHARE OF THE POPULATION CONNECTED TO THE SEWAGE SYSTEM AND WASTE WATER QUANTITY IN 1995

	Total population	*Share of population*	*Population connected to centralised water supply systems*	*Share of population connected to public waste water systems*	*An estimate of annual production of population connected to centralised water supply systems*	*An estimate of annual production of population connected to centralised water supply systems/inhabitant (litres/capita/day)*	*Population using other options*	*Share of population using other options*	*An estimate of annual production of population using other options*	*An estimate of annual production of population using other options/ inhabitant (litres/capita/day)*	*An estimate of total annual waste water*	*An estimate of total annual waste water/ inhabitant (litres/capita/ day)*	*Waste water treatment plants*
The Black Sea basin - total	1.741.700	100	803.295	46,1	31.649.823	107,9	938.405	53,9	35190188	102,7	66.840.011	105,1	...
Urban	944.300	54,2	...	...	...	...	...	...	...	...	...	...	...
Rural	797.400	55,8	...	...	...	...	...	...	...	...	...	...	...
the Sava basin - total	1.208.700	100	618275	51,2	24.360.035	107,9	590.425	48,8	22140938	102,7	.46.500.973	105,4	...
Urban	726.000	60,1	...	...	...	...	...	...	...	...	...	...	...
Rural	482.700	39,9	...	...	...	...	...	...	...	...	...	...	...
the Drava basin - total	415.200	100	157639	38,0	6.210.977	107,9	257.561	62,0	9658538	102,7	15.869.515	104,7	..
Urban	190.400	45,9		...	...	....	...	...	...	...	...	...	...
Rural	224.800	54,1		...	...	...	...	...	...	...	...	...	...
the Mura basin - total	117.800	100	27381	23,2	1.078.811	107,9	90.419	76,8	3390713	102,7	4.469.524	103,9	...
Urban	27.900	23,7	...	...	...	...	...	...	...	...	...	...	...
Rural	89.900	76,3	...	...	...	...	...	...	...	...	...	...	...
Slovenia	1.980.000	100	959048	48,4	37.786.491	107,9	1.020.952	51,6	38285700	102,7	76.072.191	105,2	..
Urban	1.045.000	52,8	...	...	...	...	...	...	...	...	...	...	...
Rural	935.000	47,2	...	...	...	...	...	...	...	...	...	...	...

Note: * *the Velenje supply system data missing*
** *the Lenart supply system data missing*

Source: Sanacija komunalne infrastrukture in izhodišča za urejanje prostora, VGI, 1996

Attainable data assert that 959.048 of inhabitants are connected to the public sewage system, and 803.295 in the Danube river basin alone. Therefore, 46,1 % of inhabitants are connected to the sewage system (48,4 % is the Slovenian average) (Poročilo o stanju okolja 1996, 1998).

There are 32 supply systems in the Sava river basin and 599.035 inhabitants (or 50,4 % of the population that are connected to sewage system in the entire Danube river basin) with 23,602.000 m^3 of waste water are connected to them. The Trbovlje supply system is best at covering its area, since almost 95 % of inhabitants are connected to it. More than two thirds of the population are connected to the network also in the Ljubljana, Kranj, Hrastnik and Celje systems. The lowest share of connected population is in the Mozirje system with 10,5 %, and the Šmarju pri Jelšah, Ribnica and Trebnje systems have less than two fifths of the population connected to them. It is remarkable that the majority of settlements in the basins, where there are larger quantities of groundwater, are relatively well equipped with sewage systems (Ljubljansko, Kranjsko and Celjsko), while the situation on the Brežiško - Krškem polju, where only approximately three tenths of the population are connected to the sewage system, is quite worse. The sewage network density in the Karst is quite disquieting, since there is no supply system, that would include at least half of the population. A poor self-purification ability is very characteristic of the Karst, therefore the consequences of uncontrolled leakage into the underground are quite more grave.

Only a good third of the Drava river basin population (38,0 %) is connected to the sewage system, which annually drains 6,211.000 m^3 of waste water. The Ravne - Prevalje supply system is the best regulated system for waste water discharge with 70,3 %, and the Slovenske Konjice system is also adequate - 60,0 %. The two biggest urban settlements on the Dravsko - Ptujskem polju - Maribor (42,9 %) and Ptuj (24,4 %), each have, with their respective hinterlands, less than half of their population connected to the sewage system.

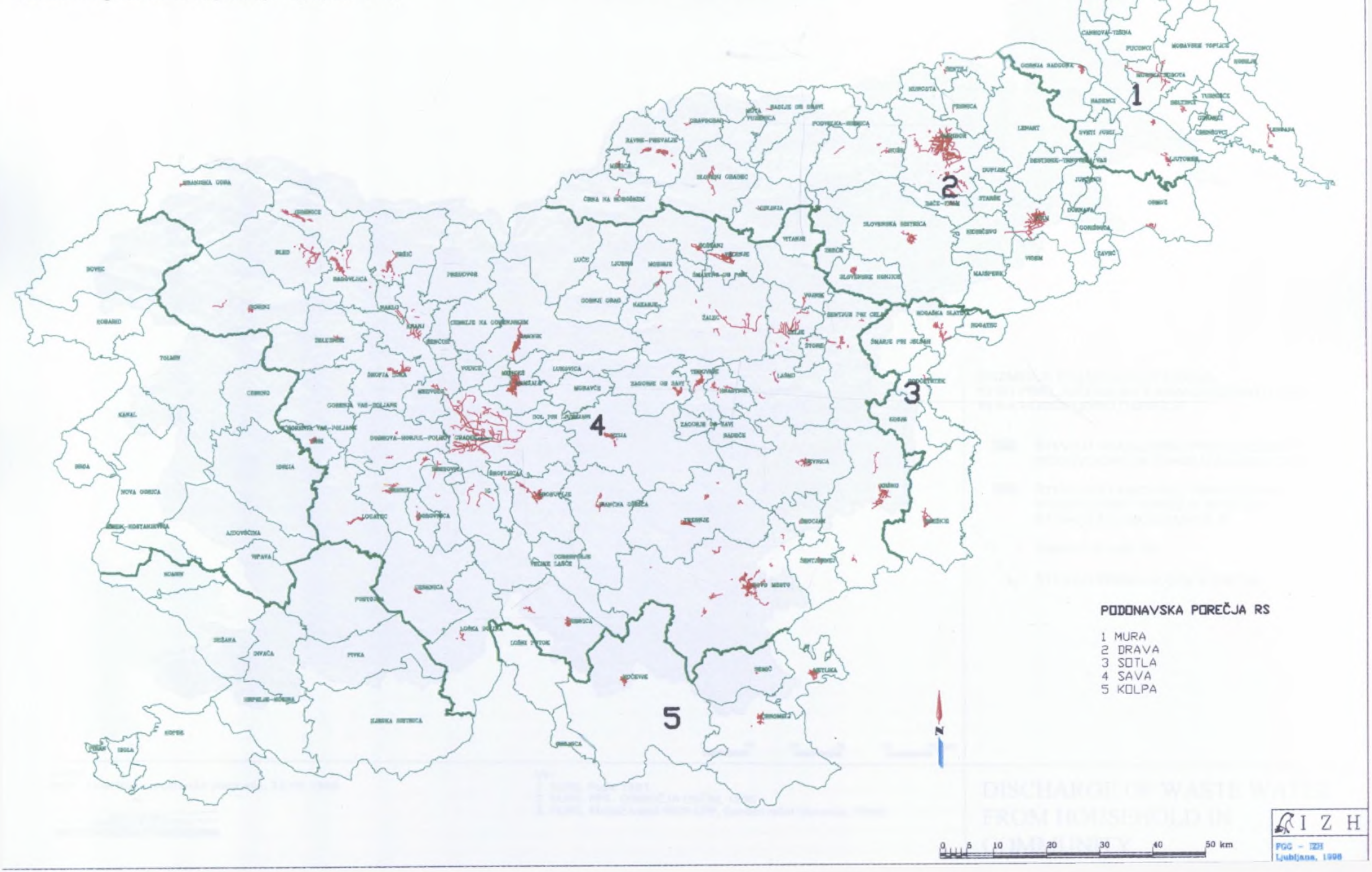
The situation is the worst in the Mura river basin, where 23,2 % of the population are connected to the sewage system network and where none of the supply systems covers 30 %. The Ljutomer supply system covers as little as 13,8 %, therefore it is not a surprise that only 1,079.000 m^3 of waste water is annually drained. Groundwater on the Murskem and Prekmurskem polju is close to the surface, which even intensifies the hazard of pollution.

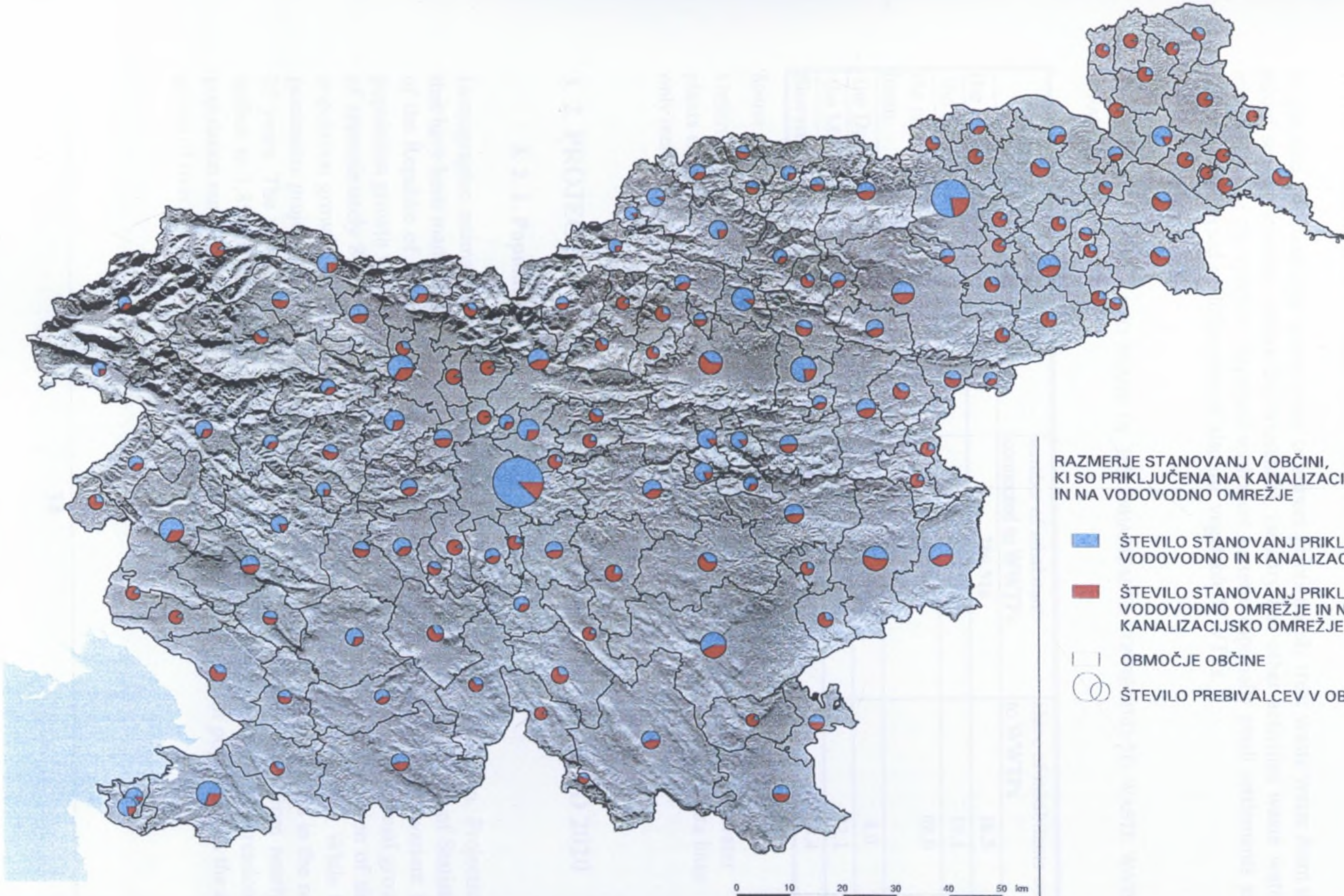
Inappropriate and badly maintained sewage system networks represent a hazard of contamination of the areas through which they are led as well as contamination of underground water which is the main source of drinking water. Water losses in the sewage system networks are not specified. (Environmental report 1995, 1996)

In Slovenia, there is a relatively large number of sewage systems of which only a few have treatment plants. They are managed by 54 municipal enterprises. There are 73 facilities for sewage purification with a total capacity of over 1000 EE. (Environmental report 1995,

WASTE WATER SYSTEMS IN THE SLOVENIAN PART OF THE DANUBE RIVER BASIN

(Source: J. Panjan, Poraba pitne vode, odvod in čiščenje odpadne vode v RS, Institut za zdravstveno hidrotehniko, Fakulteta za gradbeništvo in geodezijo, Ljubljana, 1998)





RAZMERJE STANOVANJ V OBČINI,
KI SO PRIKLJUČENA NA KANALIZACIJSKO OMREŽJE
IN NA VODOVODNO OMREŽJE

ŠTEVILO STANOVANJ PRIKLJUČENIH NA VODOVODNO IN KANALIZACIJSKO OMREŽJE

ŠTEVILO STANOVANJ PRIKLJUČENIH NA VODOVODNO OMREŽJE IN NE NA KANALIZACIJSKO OMREŽJE

OBMOČJE OBČINE

ŠTEVILO PREBIVALCEV V OBČINI

Izdelal:
MOP - Urad RS za prostorsko planiranje, 22.05.1998

REPUBLIKA SLOVENIJA
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DISCHARGE OF WASTE WATER FROM HOUSEHOLD IN COMMUNITY

1996) The total of all WWTPs is 107. In the Danube river basin there is a total of 85 WWTPs, while 63 have the capacity of more than 100 EE.

In Slovenia, the municipal waste water treatment plants mainly treat waste water from the mixed sewage systems, where the household, industry and other activities waste waters mingle. Due to the specific, dispersed settlement pattern, especially small settlements and sources of dispersed pollution should also use vegetable WWTPs.

TABLE 3. 8: NUMBER AND SHARE OF THE INHABITANTS CONNECTED TO WASTE WATER TREATMENT PLANTS IN 1997

	number of inhabitants	number of inhabitants connected to WWTPs	share of inhabitants connected to WWTPs
the Danube basin	**1,741.700**	**286.516**	**16,5**
the Sava basin Sava	1,183.100	226.536	19,1
the narrower Kolpa basin	25.600	17.400	68,0
the Drava basin	415.200	16.580	4,0
the Mura basin	117.800	26.000	22,1
Slovenia	**1,960.000**	**361.406**	**18,4**

Source: the archive of Uprava Republike Slovenije za varstvo narave, 1998

Unfortunately, no estimate of quantity of various waste waters treated at waste water plants especially for municipal waste can be given, since the already deficient data base only includes the total of waste waters.

3. 2. PROJECTION FOR PLANNING HORIZONS 2010 AND 2020

3. 2. 1. Population

Demographic estimations do not foresee a significant growth of population. Projections that have been made in three variants for the period until 2020 by the Bureau of Statistics of the Republic of Slovenia, forewarn that according to the most optimistic variant the population growth will reach approximately 2,21 million of inhabitants, or a annual growth of approximately 8400 inhabitants. The middle variant predicts the continuation of slow population growth, so that it will only increase to approximately 2,05 million. While the pessimistic projection estimates a drop of between 105 do 150.000 inhabitants in the next 25 years. The number of inhabitants in Slovenia would therefore regress from nearly 2 million to 1,89 million of inhabitants. In the long run, all variants estimate a regression in population number in the age group of up to 39, while the number of population in the age group of over will continue to increase.

The above suppositions have been verified in the river basins, according to already existing tendencies. The projection for future tendencies for the year 2021 gave the following results:

TABLE 3. 9: THE PROJECTION FOR FUTURE POPULATION GROWTH FOR 2020

Basin / Type of surface	No. of inhabitants in 1996 – in 1000	Estimated annual rate of change in %	Estimated number of population and share of urban pop. in the year 2010 in 1000[2]		Estimated number of population and share of urban pop. in the year 2020 in 1000	
	N		N	% URB	N	% URB.
valley-flatland	248,2	+ 0,2	266,4	65%	282,8	63%
hilly, mountainous or alpine	167,1	- 0,6	156,0	26%	145,9	27%
the Drava river basin	**415,2**	**+ 0,1**	**422,2**	**47%**	**428,5**	**47%**
valley-flatland	837,9	+ 0,5	955,9	75%	1062,6	78%
hilly, mountainous or alpine	370,8	- 0,4	350,9	33%	332,9	35%
the Sava river basin	**1208,7**	**+ 0,4**	**1306,8**	**62%**	**1395,6**	**65%**
valley-flatland	85,9	+ 0,5	93,3	35%	100,0	40%
hilly, mountainous or alpine	31,9	- 0,6	23,8	7%	16,4	10%
the Mura river basin	**117,8**	**0,0**	**117,0**	**23%**	**116,3**	**23%**
valley-flatland	1172	+ 0,5	1315,5	70%	1445,4	72%
hilly, mountainous or alpine	569,7	- 0,5	530,5	30%	495,0	32%
the Danube river basin	**1741,7**	**+ 0,3**	**1846,0**	**56%**	**1940,4**	**58%**
other river basins	218,3	+ 0,3	231,5	49%	243,5	51%
R of Slovenia	**1985**	**+ 0,6**	**2077,5**	**55%**	**2183,9**	**58%**

In the urbanised, lowland and valley areas a further growth of population and economic activities can be expected, mainly channelled to products less demanding both with regard to energy and raw materials, as well as to service activities. The most optimistic estimation of the population growth in the urbanised areas is a annual rate of + 0,5 %, while it will continue to decrease in the countryside. The sum of population in the Slovenian part of the Danube river basin will at best increase from the present 1,74 million to 1,85 million in 2010 and 1,94 million in 2020.

With regard to this, the demand for drinking and industrial water will not increase. Environmentalists have always been concerned because of delayed rehabilitation of pollution sources and lack of punitive action. The burdening of the environment will grow simultaneously with the increase in the traffic, and with regard to the water sources, the hazard of increase in accidents during the transport of dangerous substances is the most troublesome.

[2] Estimated number of population and share of urban populatin is prepareted on the basyis the most optimistical prognosis

3. 2. 2. Quantity of abstracted household water in future

In 1980, 60 million m^3 of drinking water from the drinking water supply system was used by the Slovenian population, 75,6 million m^3 in 1985, 86 million m^3 in 1990 and 91 million m^3 in 1995. According to the Ministry of environment and (Poročilo o stanju okolja 1996, 1998) household water consumption was 60 million m^3 in 1980 and 86 million m^3 in 1995.

The share of population connected to public water supply system is already relatively high and a 10 % rise is estimated by 2020. Only those inhabitants living in the peripheral areas are expected to be excluded from the major supply systems. The annual water consumption has not greatly changed in recent years and is between 40 and 50 m^3 and not expected to change in the next 25 years. In the Black Sea basin 80 % of all drinking water is used for household supply. Drinking water consumption will not drastically change in the years to come. Due to big water losses in water supply systems, rehabilitation measures are to be expected in this sector, which would halve the losses in the next 25 years. The quantity of the existing drinking water resources is adequate and will be able to procure the needed quantity of drinking water in all river basins, even with minor consumption growth. The smallest reserves of drinking water in intake water sources are, with regard to the relatively low share of population connected to municipal water supply systems, in the Mura river basin.

TABLE 3. 10: PROJECTION OF POPULATION WATER SUPPLY IN THE DANUBE RIVER BASIN UNTIL 2020

	1996	2010	2020
Number of inhabitants	1.405.071	1409000	1413500
Share of inhabitants connected to municipal water supply system	80,7 %	cca .85,0 %	cca. 90 %
Average annual water consumption per inhabitant connected to municipal water supply systems	46,4 m^3	cca. 46,0 m^3	cca. 46,0 m^3
Average annual water consumption per inhabitant connected to other water supply systems	41,7 m^3	cca. 41,0 m^3	cca. 41,0 m^3
Share of losses in water supply systems	40,1 %	cca. 30,0 %	cca. 20, 0 %

3. 2. 3. Domestic Waste Water Production

The sewage system in the Slovenian part of the Danube basin is poorly developed, since less than a half of households is connected to the municipal sewage system. A goal set in the previous decades, namely to bring water into every household, has been achieved, and now effort will have to be made for an adequate waste water disposal. The sewage system network is adequate in flatland areas, under which there is the biggest quantity of drinking water in store. In the next two decades the sewage system can be expected to expand and it ought to be of better quality, so as to reduce the water losses. In addition, separate sewage systems will have to be constructed, since the share of water treated in mixed sewage systems is smaller at the time of rain. A simultaneous expansion of the sewage system in less densely populated areas and construction of small waste water cleaning plants will be/is a must, especially up to 1000 EE.

TABLE 3. 11: PROJECTION OF WASTE WATER DISCHARGE IN THE DANUBE RIVER BASIN UNTIL 2020

	1996	2010	2020
Number of inhabitants	1.741.700	1.840.000	1.940.400
Share of inhabitants connected to sewage system	46, 1 %	cca. 60 %	cca. 75 %

4. ACTUAL AND FUTURE POPULATION POTENTIALLY AFFECTED BY WATER POLLUTION

4. 1. ACTUAL AND FUTURE POPULATION POTENTIALLY AFFECTED BY HEALTH HAZARDS THROUGH RAW WATER QUALITY EXCEEDING DEFINED QUALITY STANDARDS FOR DRINKING WATER

If we compare the EC directives on drinking water with the Slovenian directives we observe that the Slovenian directives as to the maximum content of pollutants comply with the EC recommendations (Table 4. 1). Although no systematic research of health hazards for the population due to inadequate quality of drinking water has been conducted, it is concluded that it does not (yet) present a significant health hazard. However, it should be emphasised that the data on the quality of the intake groundwater and other water do point to gradual deterioration of important water sources.

TABLE 4. 1: BASIC DIRECTIVES FOR DRINKING WATER IN SLOVENIA

PARAMETER	UNIT	SLOVENIAN DIRECTIVES MC*	EC RECOMMENDATIONS MC	EC RECOMMENDATIONS RC*
PH		6,5 - 9,0	9,5	6,5 - 8,5
Ammonium	mg NH4/l	0,14	0,5	0,05
Nitride	mg No2/l	0,016	0,1	-
Nitrate	mg NO3/l	44,3	50	25
Ortho-phosphate	mg PO4/l	0,45	-	-
Sodium	mg Na/l	150	150	20
Potassium	mg K/l	12	12	10
PCB	microg./l	0,1	0,1	-
Copper	microg./l	100		100
Zinc	microg./l	5000	-	100
Cadmium	microg./l	5	5	-
Six-valent chromium	microg./l	50	-	-
Mercury	microg./l	1	1	-
Atrazin	microg./l	0,1	0,1	-
Total of pesticides	microg./l	0,5	0,5	-

MC - maximum content
RC - recommended content
Source: Kakovost voda v Sloveniji v letu 1995, HMZ RS, 1997

In the middle of the 1990s, the groundwater areas were the most important as far as the drinking water supply of the population was concerned. They were followed by water, especially karstic sources. The majority of groundwater supply areas is densely settled, burdened with the traffic and intensive agriculture. In the Mura river basin, the groundwater areas were the only, and in the Drava and Sava river basins almost the prevailing drinking water source. The intake karstic sources were the additional drinking water source, with the exception of the Kolpa river basin, where they were the only source.

Unlike the surface water quality, the quality of the groundwater and sources deteriorated in the first half of the 1990s. The nitrates and pesticides content in groundwater was especially high. The water from the deeper wells in carbonaceous rocks is chemically and bacteriologically adequate. However, the water from the karstic sources is bacteriologically contaminated and unfit to be used as drinking water without previous treatment (desinfection). Almost every sample contains bacteria, some even faecal bacteria. The sediments of some sources had a relatively high heavy metals content (Pb, Zn, Cu, Cd, Cr, Ni and Hg). Among the organic micropollutants in the sediments, esters of phtalic acid, phenol compounds and polyaromatic hydrocarbons were prominent. Toxic compounds should be more clearly defined in sources that are used for water supply of the population (Kakovost voda v ..., 1996, p. 46).

In the Mura river basin, the Prekmursko and Mursko polje had a regional drinking water supply value, since they supplied more than 100 000 of inhabitants in the Mura river basin, and the Apaško polje groundwater 20 000 of inhabitants. Due to great landscape vulnerability and mainly agricultural burdening, the groundwater quality was low, since the maximum content of nitrates, nitrides and pesticides was often exceeded, and occasionally also the AOX, organic solvents, phosphates and zinc content. In 1996, 37 % of samples in the Murska Sobota region were inadequate (especially nitrates and pesticides) according to physical and chemical indices (the Slovenian average is 7 %) (Poročilo o stanju okolja, 1996, 1998).

In the flatland area, the Dravsko polje (Maribor, Ptuj and its neighbourhood - 270 000 inhabitants) and the Spodnja Savinja valley (Celje, Žalec - 100 000 inhabitants) are especially important as far as the drinking water supply is concerned, but also Ptujsko polje. Groundwater quality of Dravsko polje is poor due to intensive agriculture and industry, and the content of nitrates and pesticides remains are often exceeded, but also of mineral oils. Pesticides are the biggest problem, most often the atrazin content is exceeded (Kakovost voda v ..., 1997). The Ptujsko polje groundwater is polluted by agricultural activities, therefore nitrates and pesticides content is occassionally exceeded. The Spodnja Savinja valley groundwater is burdened by agriculture, urbanization and the traffic, water quality is poor due to excessive content of nitrates, pesticides, orthophosphates and chlorinated solvents. In the Celje region, macrobiological results of drinking water showed that in 1996 36 % of all samples were inadequate (Poročilo o stanju okolja, 1996, 1998).

The Sava river basin is mainly supplied by groundwater, and dinaric-karstic areas with intake karstic sources, which are often bacteriologically inadequate, especially because of microorganisms. The intake karstic source Malni (Postojna) was in 1994 characterized by high content of estres of phosphoric acid. The water was bacteriologically contaminated and it contained too many metals. Pollution of the intake sources is also due to high content of heavy metals in sediments. The Ljubljansko polje is extremely significant as far as water supply is concerned (great groundwater depth, Ljubljana - 300000 inhabitants), but also Kranjsko (Kranj - 75 000 inhabitants) and Sorško polje (Škofja Loka, Medvode - 45 000 inhabitants) and the Kamnik Bistrica valley (Domžale - 45 000 inhabitants). The Krško-Brežiško (Krško - 30 000) and Čateško polje (Brežice - 25 000) are also very significant. The results of macrobiological analyses of drinking water in 1996 showed that the bacteriological drinking water quality was the worst in the Novo mesto area (karstic sources) in the Sava river basin. 32 % of all samples were biologically inadequate, but in the Ljubljana area (groundwater) only 2,6 % were.

In the case of pollution caused by an accident, the karstic water sources in the Sava river basin are potentially the most endangered. (the Ljubljanica, Krka and Kolpa river basins). Taking past experience into account (approximately 100 000 inhabitants were left without drinking water supply for a while because of pollution by pesticides), a gradual but persistent detorioration of intake groundwater in the Drava and Mura river basins is just as hazardous. 5 % or approximately 90 000 inhabitants of the Danube river basin depended on water supply from a water supply system with an excessive nitrates content in 1995 (Poročilo o stanju okolja 1996, 1998).

4. 2. POPULATION AFFECTED BY HEALTH AND OTHER HAZARDS DUE TO INADEQUATE RIVER AND OTHER SURFACE WATER COURSES QUALITY

There are no systematic analyses of health hazards for the population due to pollution of water sources and other surface water. Surface water is only exceptionally used as a source of water supply of the population, since most of the Danube river basin water in Slovenia is moderately or very to extremely polluted. From 1994 to 1996, only the river sections at the source of Alpine rivers of the Sava river basin fell into the 1st and 1st to 2nd quality class (the Tržiška Bistrica, Kokra, Kamniška Bistrica, Savinja) and the Meža in the Drava river basin. The Sava Dolinka, Sava Bohinjka, Sora, the upper section of the Ljubljanica, the middle section of the Kamnik Bistrica and Savinja, the upper section of Krka, and Kolpa as far as the confluence with Lahinja in the Sava river basin fell into the 2nd quality class (Kakovost voda v..., 1996, 1997). There are no major river sections in the Drava and Mura river basins that would fall into the 2nd quality class. Due to poor river quality and temperature only certain upper and/or middle river sections are suitable for bathing in the summer (for example: the Kolpa, Krka, Sora and Savinja rivers), however, few people also bathe in the rivers that fall into the 2nd or 3rd or an even lower quality class (for example: the section of the Krka before Novo mesto, the Kolpa after the confluence with the Lahinja, the Sava near Ljubljana).

The appearance of those water courses that fall into 3rd to 4th or 4th class is seriously affected: in the Sava basin especially the lower section of the Ljubljanica, the Kamnik Bistrica, the Rinža and the lower sections of the Paka, Voglajna and Sotla, whereas in the Mura the Ščavnica (Kakovost voda v ..., 1996, 1997).

Water courses quality was, due to lower discharge of industrial waste water, improving in the period between 1989 and 1994. However, in 1995 and 1996 a minor regression is noticeable, especially as far as heavy metals and organic compounds are concerned (Poročilo o varstvu okolja 1996, 1998).

With the exception of some settlements in the Kolpa river basin (Vinica and near-by settlements), river water is not used as a source of drinking water in the Danube river basin. Slovenian and EU standards for "raw water quality for drinking water purposes" (1st and 1st – 2nd quality grade) were in the first half of the 1990s exceeded by all major rivers, with the exception of the following few kilometres mountain river stretches:

The Sava river basin: the **Sava Dolinka** to Kranjska Gora (the Kranjska Gora Commune - 5435 inhabitants (all data for 1997)), the **Tržiška Bistrica** to Tržič (part of the Tržič Commune - 15010), the **Kokra** approximately to Preddvor (the Preddvor Commune - 3634), the **Kamniška Bistrica** to Stahovica (the Kamnik Commune - 29836), the **Savinja** approximately to Luče (the Luče Commune - 2203), the **Paka** to Dolič (the Mislinja Commune - 4544.). In those Sava river basin communes where the Slovenian and EU standards for "raw water quality for drinking water purposes" were not exceeded (1st and 1st – 2nd quality grade), 60,6 thousand or 5 % of inhabitants lived in the mid 1990s.

The Drava river basin: the **Meža** to Črna (the Črna Commune in Koroška - 3796), the **Mislinja** to Mislinja (the Mislinja Commune - 4544) and the **Dravinja** to Zreče (the Zreče Commune - 6234). In those Drava river basin communes where the standards for "raw water quality for drinking water purposes" were not exceeded (1st and 1st – 2nd quality grade), only 14,5 thousand or 3 % of inhabitants lived in the mid 1990s.

In the Mura river basin all major tributaries of the Mura belong to the group that exceeds the "raw water quality for drinking water purposes" standards (1st and 1st – 2nd quality grade), which signifies that in fact all inhabitants of the river basin live in settlements where the river water is not potable. The main reason is intensive agriculture and poor self-purification capacity of rivers with low runoffs (especially in the summer).

It is estimated that the length of river stretches where the "raw water quality for drinking water purposes" standards are not exceeded totals to only about 90 - 100 km (which represents approximately 1 % of Slovenian rivers in the Danube river basin), the communes of the area are inhabited by approximately 75 thousand or 4 % of the Danube river basin population. In addition, approximately 4100 km of rivers in the Danube river basin comply with "bathing water quality" standards, an area which approximately 27 % of population inhabits, 22 % in the Sava river basin, 26 % in the Drava river basin and 22 % in the Mura river basin.

In the Sava river basin, the following major rivers exceeded EU or Slovenian standards for "bathing water quality" in the first half of the 1990s: the **Sava** in its entire flow after Radovljica (the Communes: Radovljica - 18055 inhabitants, Naklo - 4783, Kranj - 52273 inhabitants, Medvode - 13591, Ljubljana - 275440, Dol pri Ljubljani - 4017, Litija - 19006, Zagorje - 17165, Trbovlje - 18855, Hrastnik - 10874, Radeče - 4597, Sevnica - 17597, Krško - 28274, Brežice - 24488); the **Tržiška Bistrica** after Tržič (Tržič - 15010), the **Kokra** after Preddvor (Preddvor - 3634 and Kranj - 52273), the **Sora** after Škofja Loka (Škofja Loka - 22189, Medvode - 13591), the **Kamniška Bistrica** after Kamnik (Kamnik - 29836, Domžale - 31535); the **Ljubljanica** after Vrhnika (Vrhnika - 16377, Brezovica - 8600, Ljubljana - 275440); the **Savinja** (including the **Paka**) after Braslovče

(Velenje - 34392, Šoštanj - 8163, Šmartno ob Paki - 2824, Žalec - 39386, Celje - 49875, Štore - 4167, Laško - 14136); the **Krka** after Novo mesto (Novo mesto - 51494, Škocjan - 2969, Šentjernej - 6538); the **Sotla** after Rogatec (Rogatec - 3196, Rogaška Slatina - 10653, Podčetrtek - 4804) and the **Kolpa** after Primostek (the Metlika Commune - 8096).

In the Drava river basin, the following major rivers exceeded EU or Slovenian standards for "bathing water quality" in the first half of the 1990s: the **Drava** in its entire flow on the Slovenian territory (Dravograd - 8689, Muta - 3778, Vuzenica - 2868, Radlje ob Dravi - 6235, Podvelka – Ribnica - 4213, Ruše - 15073, Maribor - 132386, Duplek - 5774, Ptuj - 31692, Dornava - 2636, Ormož - 17781); the **Meža** after Mežica (Mežica - 4067, Ravne – Prevalje - 19045), the **Mislinja** (Mislinja - 4544, Slovenj Gradec - 16738) and the **Dravinja** after Videm (Ljutomer - 18653).

In the Drava river basin, the following major rivers or river stretches exceeded EU or Slovenian standards for "bathing water quality" in the first half of the 1990s: the **Mura** in its entire flow on the Slovenian territory (Gornja Radgona - 12746, Cankova - 6383, Murska Sobota - 20730, Radenci - 5399, Beltinci - 8457, Ljutomer - 18653, Črenšovci - 6048, Lendava - 13370).

In the Sava river basin communes where the EU and Slovenian "bathing water quality "standards are exceeded, 805,7 thousand or 67 % of inhabitants lived in the middle of the 1990s. In the Drava river basin communes where the EU and Slovenian "bathing water quality "standards are exceeded, 294,2 thousand or 71 % of inhabitants lived in the middle of the 1990s. In the Mura river basin communes where the EU and Slovenian "bathing water quality "standards are exceeded, 91,8 thousand or 78 % of inhabitants lived in the middle of the 1990s.

It is estimated that the number of population in the communes where the EU and Slovenian "raw water quality for drinking water purposes" standards (1st and 1st – 2nd quality grade) are exceeded will stagnate until 2020. Furthermore, the population in the communes with exceeding "bathing water quality " standards is estimated to increase for 10 % by 2020.

4. 3. DESCRIPTION OF MAIN HEALTH HAZARDS THROUGH WATER POLLUTION IN THE DANUBE RIVER AND TRIBUTARIES

In Slovenia, local water supply systems present the main problem. The majority has been built without adequate technical documents and maintenance is not expertly done or even non-existent. The result is a growing number of bacteriologically contaminated water samples.

Alongside with the systematic monitoring of drinking water, in 1996, there was also pesticides monitoring. The analysis of drinking water leads to the conclusion that there is only rarely the maximum content of pollutants (according to EC recommendations). The cummulative synergetic effect of all substances present in drinking water can, however, be stronger than it could be concluded by individual parametres. Chemically, the most frequent cause is the overdose of the pesticide atrazine. This affects those water supply systems which use groundwater as their water source.

5. ANALYSIS OF THE ECONOMIC SIGNIFICANCE OF THE DANUBE RIVER SYSTEM AND IMPACTS OF ECONOMIC ACTIVITIES

5. 1. ACTUAL SITUATION

5. 1. 1. Abstraction of Raw Water from the Danube River System

Various sources state totally different quantities of abstracted and sold drinking water. The most realistic estimate of the quantity of abstracted water is probably 272 million m^3 (Environmental…; 1996), however, this datum is of no use for this research, since classification of river basins or activities is not possible as we go on. Therefore various sources have been used not only here, but also in the chapters 3. 1. 4. and 3. 1. 5. Which have sometimes caused seeming discrepancies.

In 1995, public-municipal water supply systems abstracted 138,2 million m^3 of water from groundwater. They acquired from intake karstic sources 113,7 million m^3 and mere 7,8 million m^3 of water from surface water. Out of 259,6 million m^3 of assured drinking water, 152,4 million m^3 has reached the users and 107,2 m^3 or 41 % of water has been lost in the water supply network. 86 million m^3 or 33,3 % of abstracted water was spent for household supply and 56 million m^3 or 21,7 % for activities. After 1990, household water use is between 80 and 90 million m^3, and the use of water in service activities dropped from 80 to 56 million m^3 (Statistični letopis, 1997).

In 1995, those public water supply systems managed by municipal enterprises abstracted 172,6 million m^3 of drinking water from the Black Sea basin and sold to users 103,5 milijonov m^3 of water. 70 million m^3 or 40 % of water was lost in, which is less than the total of losses in the water supply network. The biggest quantity of abstracted drinking water was lost in the Sava - 42,5 % and Kolpa river basins - 40,5 %, the least in the Sotla - 23,5 % and Mura river basin - 29,3 % (Študija..., 1995; Sanacija...,1996).

TABLE 5. 1: BASIC INDICES OF DRINKING WATER CONSUMPTION IN SLOVENIA

	Water abstracted in 1995 (m^3)	*Water sold in 1995 (m^3)*	*Share of lost water*	*Total consumption/ inhabitant in m^3*
the Black Sea basin	172.635.493	103.401.801	40,1	73,59
the Sava basin *	133.977.397	76.984.972	42,5	77,54
the Drava basin **	28.730.580	19.925.014	30,6	65,44
the Mura basin	5.195.516	3.674.579	29,3	58,89
the Sotla basin	5.033.103	3.849.366	23,5	84,58
the Kolpa basin ***	4.732.000	2.817.236	40,5	62.09
Slovenia	259.687.000	152.400.000	41,3	71,3

Source: Študija o komunalni oskrbi in projektih varovanja okolja v Sloveniji, VGI, 1995; Sanacija komunalne infrastrukture in izhodišča za urejanje prostora, VGI, 1996; Statistični letopis, 1997

Note: * a datum for Cerknica, Kamnik and Grosuplje missing
** a datum for Slovenj Gradec and Ormož missing
*** a datum for Metlika missing

The average annual water consumption from the municipal water supply systems is in the Black Sea river basin 73,6 m^3 per capita, and in river basins from 58,9 m^3 in the Mura river basin to 77,4 in the Sava river basin (Študija..., 1995; Sanacija...,1996). The average daily consumption water consumption from the municipal water supply systems is 240 l per capita or 87,6 m^3 annually (Stanje..., 1996).

5. 1. 1. 2. Industrial / Mining Raw Water Demand

In 1995, Slovenian industry and mining spent 113 million m^3 of fresh water, namely 76,6 million m^3 as industry water and 36,3 million m^3 as drinking water. For production, 48 million m^3 of water was spent and for cooling 50,7 million m^3. Coal mining spent 2,2 million m^3 of fresh water, 1,6 million m^3 of industry water and 0,7 million m^3 of drinking water. Industry water was mainly used for production, while drinking water was mainly used for sanitary purposes. 1,4 million m^3 of water was abstracted from rivers and the rest from other sources.

5. 1. 1. 3. Agricultural Raw Water Demand for Irrigation

In the Slovenian part of the Danube river basin there is 93 680 ha of land (84 %), which is almost every year affected by drought and needs to be irrigated (Matičič, 1993). Most part or 74 % of land is in the Mura and Drava river basins, where there are eight hydromeliorization systems (which also include drainage systems), and the rest or 26 % of land, which needs to be irrigated for intensive agricultural use, is in the Sava river basin.

The national irrigation plan (1994) states that 120 080 ha of cultivable surface can be irrigated, which would take 235,6 million m^3 of water. The plan furthermore states that only half of water needed for irrigation could be assured. 70 % of it would come from groundwater and rivers and 28 % from reservoirs (Lah, 1995).

In 1995, 4200 ha of land surface in Slovenia was prepared for irrigation(Letopis, 1997), of which 1592 ha were actually irrigated. It is estimated that approximately 80 % of Slovenian irrigated land is in the Danube basin. In 1995, 4785 000 m^3 of water was accumulated for irrigation, 6 % from groundwater, 29 % from rivers and 63 % from reservoirs(Statistični Letopis, 1997)..

5. 1. 2. Waste Water Discharge to the Danube River System

5. 1. 2. 1. Municipal Discharge

In 1995, 131,816.000 m^3 of waste water was collected in the municipal sewage systems, 118,958.000 m^3 in the Black Sea basin alone. 71,376.000 m^3 or 60,0 % of waste water is cleaned in WWTPs.

In the Sava river basin, the untreated waste water discharge from the municipal sewage systems amount to 27,864.000 m^3, in the Kolpa river basin 439.000 m^3, in the Drava river basin 18,474.000 m^3 and in the Mura river basin 805.000 m^3. The amount of treated waste water is: in the Sava river basin 60,241.000 m^3, in the Kolpa river basin 2,010.000 m^3, in the Drava river basin 4,487.000 m^3 and in the Mura river basin 4,638.000 m^3

According to statistic data, 61,0 % of waste water is mechanically treated, 0,1 % is only chemically treated, and 2,7 % only biologically treated. 36,2 % of all treated waste water undergoes a combined treatment. According to the Ministry of Environment, there were the following shares of type of treatment in the municipal waste water treatment plants in the middle of the 1990s (Poročilo o stanju okolja 1996, 1998): pretreatment 31 %, primary 5 %, secondary 64 % and tertiary 0 %.

There are 60 waste water treatment plants in the Sava river basin with the total capacity of 1,446.491 EE, and 46 waste water treatment plants with the capacity of 1000 EE, including the central Ljubljana waste water treatment plant with the capacity of 600.000 EE, which, however, can only treat waste water mechanically. Therefore more than a half of all waste water treatment plants is situated in the Sava river basin, but despite all that, only 226.536 or 19,1 % of inhabitants are connected to those 42 waste water treatment plants that treat municipal waste water. The majority is connected to the waste water treatment plant Domžale – Kamnik (50.000), Šoštanj (27.000), Kranj (25.000) and Novo mesto (20.000). The most urgent problems in the basin are the incomplete municipal waste water treatment plants in Ljubljana and Celje. Celje and more than 50.000 of its inhabitants severely pollute the Savinja river.

The situation in the Drava river basin with its 11 waste water treatment plants is not so good, either. Only six of them have a capacity of more than 1000 EE. Merely 16.580 or 4 % of inhabitants are connected to a waste water treatment plant. Only in Ptuj (10.000 of inhabitants connected), Črna na Koroškem (2400 of inhabitants connected) and Ormož (1200 of inhabitants connected) is municipal waste water treatment adequate. Maribor presents the most urgent problem. All of its waste water is discharged directly into the polluted Drava. Among other big urban centres, Slovenj Gradec, Slovenska Bistrica and Slovenske Konjice are also without waste water treatment system.

Municipal waste water treatment in the Mura river basin is satisfactory, since 26.000 or 22,1 % of inhabitants are connected to a waste water treatment plant. There are 6 waste water treatment plants, of which 2 have the capacity of less than 1000 EE. Only four of them are designed for municipal waste water treatment, however, they are overburdened. Murska Sobota has a big waste water treatment plant with the capacity of 20.000 EE, and there are some small ones in Beltinci and the Radenci and Moravske Toplice health resorts. Gornja Radgona and Lendava are without waste water treatment system.

Most of the operating treatment plants do not reach the planned effects. In comparison with the water supply the business of collecting, discharging and treating waste and rain water is, as far as its scope is concerned, rather modest and limited mostly to urban and concentrated settlements. (Environmental report 1995, 1996)

5. 1. 2. 2 Coal-mining and TPP waste water

Industrial, energy and mining activities discharged 765,728.000 m^3 of waste water into environment, 88 % of which was cooling water. 2,606.000 m^3 of waste water was discharged directly into the ground, somewhat more than 30 million m^3 into the municipal sewage system, and 733,102.000 m^3 into the surface waters (Poročilo o stanju okolja, 1996, 1998). After 1980, there was a decrease of 60 % in industry and mining waste water, however, a mere half of them is being treated (Poročilo o stanju okolja 1996, 1998). In the 1985 - 1995 period, a general tendency-trend of a decrease in industry and mining waste water runs simultaneously with a decrease in industrial and mining activities.

The following activities discharge the biggest quantities of waste water: paper production and manufacture (27,562.000 m^3), metal manufacture (6,827.000 m^3) and chemical manufacture (8,223.000 m^3). The industry and mining activities treat 46,775.000 m^3 or 50,8 % of waste water, 17,319.000 m^3 only mechanically, and 26,128.000 m^3 mechanically, chemically and biologically.

There are two major coal-bearing regions in the Sava river basin: Zasavje and the Šaleška valley. In 1996, 839 000 t of brown coal and 3 938 000 t of lignite was abstracted there (Natek, Natek, 1998).

In 1995, 2,22 million m^3 of water was spent for coal abstraction water, namely 1,56 million m^3 of industry water and 0,67 million m3 of drinking water. (Statistični letopis Slovenije 1997). Two thirds of spent water were pumped from water streams, and a third came from the municipal water supply systems. Waste water from coal abstraction amounted to 1,75 million m^3 in 1995, and 1,72 million m^3 of it was discharged into surface water (water sources - 1,47 million m^3), and only a minor part reached the municipal sewage network system. WWTPs treated 1,46 million of waste water, but only mechanically (Statistični letopis Slovenije 1997, Poročilo o stanju okolja, 1996, 1998).

The lignite coal mine Velenje does not have a direct discharge of mining waste water into the Paka and thus minimally burdens the running water. The neighbouring thermo power plant Šoštanj, on the other hand, requires 0,4 m3/s for full operation and due to great demand and low flow of the Paka (sQs - 2 m3/s), cooling towers were built. In 1994, a closed stride of electrofiltered transport was built in the thermo power plant Šoštanj, which significantly lessened the burdening of the Velenje lake and the Paka, however, the Paka is now warming.

Since the beginning of the 1990s, brown coal separation in Zasavje has been burdening the Sava with tailings and coal ash suspension due to wet separation for decades. The average annual anthropogenous coal suspension into the Sava prior to the construction of dry separation was approximately 600 000 t (Bricelj, 1991). The thermo power plant Trbovlje is the second biggest user of the Sava water (after NPP Krško), which pollutes and warms the Sava water. TPP - TO Ljubljana Moste uses the Ljubljanica water for cooling and then discharges it and thus affects the river life forms.

5.1.2.3 Agricultural Discharge (major point sources)

Especially extensive pig farms present the most problematic, disperse form of stream and river pollution. In the Sava river basin there are the following huge pig farms with the average number of pigs (Leskošek, 1994): Ihan (at the Kamnik Bistrica, 53700), Stična (12000) and Klinja vas near Kočevje (17300) (in the karstic part of the Krka river basin) and Pristava near Leskovec (Krško polje, 15000). In the Drava river basin there is a pig farm in Draženci near Ptuj (40500), and in the Mura river basin Cven near Ljutomer (10000), in Podgrad near Gornja Radgona (21300) and the Nemščak farm near Beltinci with the Jezera farm (56300). Big pig farms with the average number of pigs of approximately 230.000 present a problem especially due to lack of agricultural land in the vicinity of the farms and only partial waste water treatment. Pig farms in the karstic areas (e.g. Klinja vas), in groundwater areas (e.g. Pristava, Nemšak) and in the vicinity of low-flow water courses (Ihan, Stična), are a particular cause of problems. Inadequate and insufficient wastewater treatment from big pig farms in Slevenian par of DRB causes pollution of 450-550.000 PE (population Equvalent). There are not many detail data. All of the farms have yet to reach the required quality of waste water before discharge into surface water (Stanje okolja, 1996, p. 74).

5. 1. 3. POLLUTION OF AQUATIC SYSTEM THROUGH POTENTIAL SOIL AND GROUND WATER CONTAMINATION

5. 1. 3. 1. Municipal Solid Waste Disposal

Slovenia annually produces approximately 850 - 900 000 tons or 400 kg of municipal solid waste per capita. According to 1995 data, 75 % of the population's solid waste is regularly taken away, which is 10 % more than in the previous decade. Parallel with the more regular municipal solid waste disposal is the growth in the quantity of solid waste, and therefore also the growing problem of its disposal or solid waste management in general.

There are 53 solid waste dump sites, that are mostly designed for disposal of municipal solid waste. There are 43 or two good thirds of them in the Danube river basin. As many as 29 of them are illegal, which means they are not managed according to standards. The biggest of them, the Ljubljana, Novo mesto, Tržič and Velenje dump sites cover over 10 ha, but the rest of them are smaller. 72 900 tonnes of municipal solid waste or 86 % of all waste is annually disposed of in these more or less protected areas. In accordance with the number of inhabitants is the biggest quantity of municipal solid waste disposed of in the dump sites of the central Slovenia (258 800 t), in the Drava river basin (115 900 t) and in the Savinja river region (109 800 t); (MOP, Environmental...,1996).

Municipal dump site locations are evenly arranged, disregarding the groundwork adequacy. Every pit was used a dump site in the past, many of them were in disused gravel-pits and clay pits e.t.c Such dump sites were started approximately 20 years ago, whereas the artificial groundwork sealing only appears in the late 1980s, hence such dump sites remain a potential hazard for the environment. It is estimated that between 31 % and 56 % of rainfall exfiltrates from improperly sealed dump sites into the ground, therefore approximately 1,3 million m^3 of polluted water from the dump sites drains into surface water or ground water. It is estimated that 3/4 (cca. 980.000 m^3) of it are in the Slovenian part of the Danube river basin (Ignjatovič, 1996). The majority of existing dump sites will be filled in the next ten years, in the Danube river basin as many as 36 or 83,5 % of all municipal dump sites, including most of the major ones.

A closer survey of illegal dump sites shows that 10 000 to 15 000 illegal dump sites with 200 000 to 300 000 m^3 of rubbish cover approximately 6 km^2 or 0,03 % of the surface. (Šebenik, 1994).

5. 1. 3. 2. Industrial /Mining/ Hazardous Solid Waste Disposal

In 1995, manufacturing and the energy sector generated almost one quarter of total waste or some 2 million tonnes, of which approximately 41 % came from energy production, 29 % from manufacturing and 16 % from mining.

The quantities of generated waste are expected to grow till the year 2000, as the economy expands. A minor increase in energy waste is expected due to the introduction of further flue-gas desulphurization facilities in thermal power stations. In the municipal energy sector, especially in Ljubljana, a fuel switch is taking place to a type of coal which will produce fewer residues after combustion.

Some factories produce and accumulate waste, including hazardous waste, on their premises, sometimes without any control. Soil has been contaminated in industrial areas because of the inappropriate storage of raw materials and wastes and because of spillage.

However, the bulk of industrial wastes is deposited sites destined to receive either single or mixed waste types. There are currently 13 such sites, including the landfill at Ljubljana for the disposal of slag and ash generated in the district heating and power plant of Ljubljana, and the landfill for selected hazardous wastes mainly from local industry (manufacturing, supply and use of coatings) in Metava-near Maribor in the Drava valley. Some of these waste repositories, as well as the abandoned landfills, have been inadequately managed. The technical solutions of the resulting problems require considerable investments.

Two incineration plant for special industrial wastes operated in 1995: Lek-Lendava (pharmaceutical wastes, capacity 7000 t/y) and Pinus-Rače in Drava valley (phytopharmaceutical wastes, capacity 1000 t/y).

The recent expansion of the construction industry is reflected in its waste generation, currently reaching an annual 2,3 million tonnes. This equivalent to more than 25 % of waste generation in 1995. The new definition of construction waste includes excavation wastes, concrete and brick wastes, asphalt wastes and all demolition wastes.

Some 30 % of these wastes arise from excavations. This material is to a large extent reusable in surface construction. Problems are linked to construction wastes from new constructions and reconstructions, and discarded concrete, brick and gravel from the demolition of old structures in residential areas.

Farming, forestry and food processing generate 3,5 million tonnes of waste annually, measured as dry matter, while their actual mass is at least 4 to 6 times larger. The total amount is composed of animal tissue waste (approximately 0,05 million t/y), plant tissue waste (0,8 million t/y), animal faeces including spoiled straw collected separately and treated off site (about 1,57 million t/y) and forestry waste (1,1 million t/y).

Small-scale livestock farming is a major source of effluent waste biomass. Septic tank residues constitute a similar problem for the contamination of underground water reserves. At present, the average input of fertilisers and other chemical compounds to agricultural land amounts to 35,6 kg/ha nitrogen, 20,9 kg/ha phosphates, 23,3 kg/ha potassium, 1,1 kg/ha pesticides, up to 5,4 tonnes/ha of solid animal waste and 8 m3/ha of slurry.

Radioactive wastes are generated by the NPP Krško, the Research Reactor, hospitals, research institutes and industry, and in the past also by the Žirovski vrh Uranium Mine.

NPP Krško - all low and intermediate radioactive wastes generated by the NPP Krško are packed into 200-litre drums. Altogether 10 541 drums (approximately 753 per year) with an average specific activity of 31 Gbq/m3, had been stored by the end of 1995. Compaction and super compactium of standard drums was carried out in 1988/89 and in 1995. At the end of 1995 the amount of low and intermediate level radioactive wastes, stored at the Krško NPP was 1 873 m3. In addition, 442 spent fuel assemblies are stored in the storage pool. The entire amount of disused nuclear fuel is stored in a water basin with boric acid on the NPP Krško premises, however, its capacities will only suffice until 2004.

Research Reactor-other low and intermediate radioactive wastes generated in Slovenia, mainly by research reactor and smaller users (hospitals, industry, research institutes) are stored in the Low and Intermediate Level Radioactive Waste Interim Storage, constructed in Podgorica-near Ljubljana. The wastes are currently stored in 145 drums with an activity ranging from 3 to 30 GBq. Another 97 bigger contaminated items, with a total activity of 5400 GBq, as well as 234 sealed sources with a total activity of 1000 GBq are also stored there.

Žirovski vrh Uranium Mine-there are two disposal sites for the radioactive waste from past uranium mining and milling.

Non-uranium mines, thermopower plants, aluminium and phosphate factories have also generated highly radioactive waste (Kočevje, Šoštanj, Trbovlje, Kidričevo, Hrastnik). These contain up to 10 times more uranium and thorium than natural background levels.

The total of dangerous waste and specific substances annually produced in Slovenia is 445 350 ton (there are 94 % of the latter), 416 860 ton (or 93,6 %) only in the Danube river basin. The majority of such waste is contributed by the Zasavje region- the lower course of the Sava (98 386 ton per annum), followed by Koroška (the Drava river basin, after it flows into Slovenia) and central Slovenia and Gorenjska (the upper course of the Sava) with more than 50 000 tons of dangerous waste and specific substances.

Collection and disposal of dangerous waste takes place in accordance with regulations. The development of services in the field of handling waste or quantities of the disposed waste after 1991 is considerable. The quantity of the processed waste has grown, together with the number of enterprises dealing with the process of waste disposal-especially the waste from mineral oil production, old tyres, electro-plating sludge and waste dilutants.

5. 1. 4. Hydro Power

11 510 GWh of electric energy was produced in Slovenia in 1996. Hydroelectric power station produced 30 %, thermo power stations 32 % and the nuclear power station 38 % of electric energy. All major hydrolelectric power stations are runoff river power. In the Danube river basin the rivers and their electric potential produced as much as 2639 GWh of electric energy or 86,7 % of all energy produced in hydrolelectric power stations (Ministrstvo za gospodarske dejavnosti, Statistični...,1997).

TABLE 5. 2: HEP ON SLOVENE RIVERS OF DANUBE RIVER BASIN:

HEP	*no. of el. generator sets*	*power MW*	*production GWh in 1996*
Drava	**22**	**542**	**2327**
Dravograd	3	21	124
Vuzenica	3	45	194
Vuhred	3	60	269
Ožbalt	3	60	277
Fala	3	60	231
Mariborski otok	3	51	222
Zlatoličje	2	133	522
Formin	2	112	488
Sava	**11**	**116**	**246**
Moste	4	21	45
Mavčiče	2	38	57
Medvode	2	23	63
Vrhovo	3	34	81
Small HEP			**66**
Together	**33**	**655**	**2639**

Source:Ministrstvo za gospodarske dejavnosti, Statistični...,1997)

The expert opinion is that the future increase of electric energy production in hydrolelectric power stations will be made possible with the construction of new hydrolelectric power stations on the Sava and Mura rivers. Plans for the Mura river are not yet clearly defined, while the construction works on the Sava river are already in progress.

TABLE 5. 3: THE PLANNED HEP ON THE SAVA:

HEP	(MW)	(GWh)
Boštanj	33,7	135
Blanca	32,2	131
Brestanica	31,9	130
Krško	30,4	124
Brežice	32,7	136
Mokrice	31,7	151
Together	**192,6**	**807**

Source: Elektroprojekt Ljubljana, Tehnični podatki za HE, 1990

5.1.5 River Fisheries

Fresh water fishing is rather insignificant from the economical point of view (estimation - a few hundredths of a percent of GNP). It is most developed in the Sava river basin. The biological river potential is decreasing due to pollution and river amelioration. There is a total of approximately 10 000 ha of fishing area, 93 species and subspecies (59 endangered).

The majority or rivers and streams contains fishes from the cypriniformes and other families, due to pollution there are less representatives of the salmoniformes family (Sladkovodno ribištvo, 1998). Because of the pollution of the majority of water courses only the upper river sections are suitable for fishing, and in summer, fish killings are frequent. The following rivers or river sections of the Danube river basin are the most suitable for sport fishing for fish from the salmoniformes family: the Krka, the Sava Bohinjka, and also the Sava Dolinka, the Kokra, the Sava (upper course) and the Savinja (upper course). The most suitable for sport fishing for fish from the cypriniformes family are the Drava, the Mura, the Savinja (middle section), the Sava (middle section), the Krka (middle and lower sections), the Kolpa and the Ljubljanica (upper and middle sections).

In the Slovenian part of the Danube river basin 29,183 kg of fish from the salmoniformes family was caught in 1996 by the fishermen. The most frequent kinds were brown trout, šarenka and umber. More fish from the cypriniformes family were caught - 237,668 kg. The most frequent kinds were carp, podust and klen. 25.610 kg of salmonidae were caught in the Sava river basin in 1996. 100,603 kg of cyprinidae were caught.. In the Drava river basin, salmonidae were barely represented with 2853 kg in 1996. The catch of cyprinidae amounted to 93.556 kg. In the Mura river basin, the catch of salmonidae was minimal, not even 50 kg. However, 39.252 kg of cyprinidae ware caught.

TABLE 5.4: FISH CAUGHT IN RIVER BASINS OF THE BLACK SEA BASIN IN SLOVENIA

basin	Salmoniformes (kg)	Cypriniformes (kg)
the Sava basin	25.610	100.603
the Kolpa basin	670	4.465
the Drava basin	2.853	93.556
the Mura basin	49	40.672
the Black Sea basin	29.183	237.668
SLOVENIA	48.774	249.199

(Source: arhiv Zavoda za ribištvo, 1998)

5. 1. 6. River Shipping

There are no rivers suitable for shipping in Slovenia.

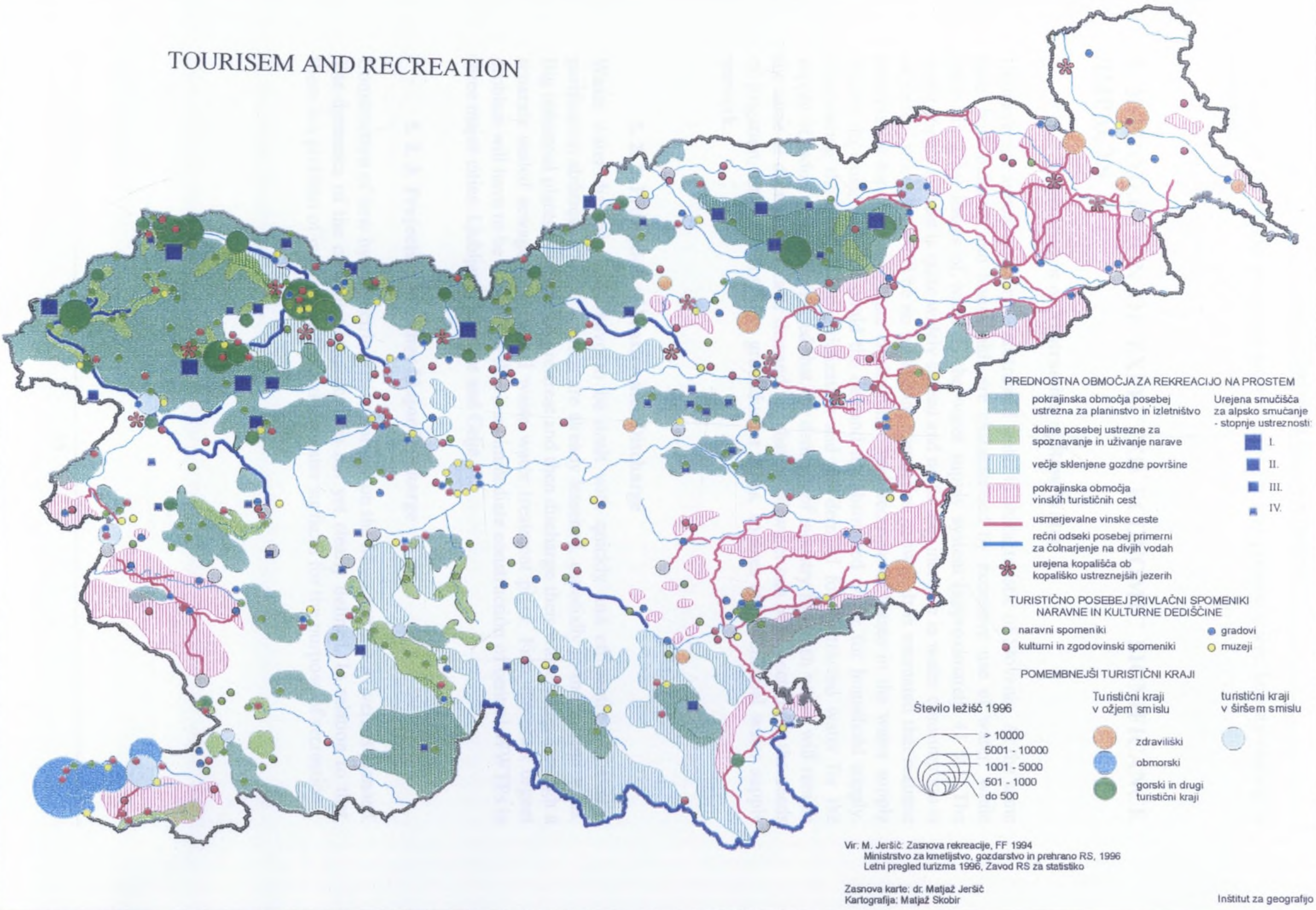
5. 1. 7. Water Related Recreation

Among the Danube's river basin tourist centres, the following are the biggest (according to the number of beds): 2. Bohinj - 3687, 4. Čatež ob Savi - 3527, 6. Bled - 3323, 7. Kranjska Gora - 3239, 8. Ljubljana - 2749 (Natek, Natek, 1998). Among tourist centres, those in the vicinity of lakes are the most popular, namely Bohinj and Bled.

Sport and recreational activities at riversides (angling, boating and rafting) are especially developed at the Sava Bohinjka, Sava Dolinka, Sava between Radovljica and Kranj, Kolpa, Krka and Savinja. The Drava and Mura rivers are the most appropriate for rowing, and the Sava Bohinjka and the upper course of the Krka, Kolpa and Savinja for white water rafting (Žirovnik, 1996). Major regulated bathing places are at the Bohinj and Bled Lakes and Šobčev Bajer. In the summer of 1996, the Kolpa (to the confluence with the Lahinja), Krka (to Straža above Novo mesto), Sora (to Medvode) and the Savinja (to Braslovče) were suitable for bathing, since the temperatures were high enough and the river water was of good quality (1st, 1st - 2nd, 2nd quality class) (Sladkovodno ribištvo, 1998). Because of the increase in quality of the Sora river after the closure of the pulp mill in Medvode, the river is almost clean enough to bathe in (2nd - 3rd quality class), and is occasionally suitable for bathing already. However, after the confluence with the Ljubljanica and the Kamnik Bistrica, her quality greatly deteriorates and is not suitable for bathing and that is true for the whole of her lower course. In the Drava and Mura river basins, none of the major rivers is suitable for bathing in the summer.

Water sources offer numerous opportunities for various forms of active riverside recreation, however, a significant improvement or river water quality is required (Plut, 1998). Only then can we expect a bigger recreational role (especially bathing) of the lower course of the Ljubljanica, Savinja, Sava, Drava and Mura. A variety of water sources signifies environment-friendly developmental opportunity for tourist offer enrichment,

TOURISEM AND RECREATION



especially as far as the more and more sought for and present active holiday-making is concerned.

5. 2. PROJECTION OF EXPECTED ECONOMIC SIGNIFICANCE /IMPACTS

5. 2. 1. Projection of Abstraction of Raw Water

High average annual quantity of abstracted water is characteristic of Slovenia. At the same time, both industry and households are characterised by excessive use of water, while there are great losses of water in the water supply system (approximately 41 %). The water supply system is quite widely spread and no further increase in water consumption is expected, since there will be no significant population growth. It is estimated that realistic possibilities for more moderate consumption and decrease of losses in the water supply system do exist, and that could the demand for abstracted water for household supply. Considering the level of industrialization and the demand for abstracted water for the supply of industry, it is estimated that the demand of industry for fresh water will remain the same or decrease. Greater demand for abstracted water can be expected for the needs of irrigation, although not from groundwater areas, sources and municipal water supply network.

5. 2. 2. Projection of Wastewater Discharge

Waste water discharge will have to be dealt with quickly and efficiently, since self-purification abilities of water sources are already lessened, especially in the flatland areas. Big industrial plants will have to pre-treat and then discharge their waste water through a separate sealed sewage to a central waste water treatment plant. First the most urgent problem will have to be solved and that is an immediate construction of central WWTPs in three major cities: Ljubljana, Maribor and Celje.

5. 2. 3. Projection of Other Major Discharge

Construction of new hydroelectric power stations on the Mura and Sava rivers is planned. The dynamics of the construction process is not yet clearly defined. In relation to that, there is a problem of increase in demand for water surfaces for the purpose of recreation.

6. ANALYSIS OF THE RELEVANT LEGAL AND INSTITUTIONAL FRAMEWORK AND ITS ADEQUACY FOR SOUND ENVIRONMENTAL MANAGEMENT OF WATER RESOURCES AND ECO-SYSTEMS

6. 1. DOCUMENTATION AND SHORT ANALYSIS OF THE RELEVANT LEGAL FRAMEWORK[3]

Slovenia has no recent legislation on water. The new **Act on waters** will stipulate the organisation structure, complete with composition, duties, liabilities, and obligations for the implementation of the programme. In accordance with general water improvement objectives the following programme fields are proposed in the draft:

- integrated development and water management
- judgement on the condition of water sources
- protection of water sources, water quality and water ecosystems
- drinking water supply, municipal waste water discharge and water treatment
- water and permanent development of urban settlements
- water for permanent food production and the development of countryside
- the effect of climate changes on water

6. 2. ANALYSIS OF RELEVANT INSTITUTIONAL FRAMEWORK[4]

For the implementation of the provisions of the water management programme, the suitable administrative bodies and organisation of planning and decision-making will be organised at the national level. 5 river basins administrative units at the regional level will conduct the administrative procedure in cooperation with the Ministry of Environment. The implementation of the integral national policy of water management of river basins demands the development of the administrative structure for:

- acquisition of wetland status
- allotment of the concessions for water use
- execution of the "polluters pay" principle and putting into force of the preferential introduction of the best technology available and of the most successful environmental policy
- protection of water from actions from unknown polluters and from unrehabilitated sources of pollution
- development and improvement of monitoring and information system
- solving of international issues.

[3] povzeto po delovnem osnutku: "Nacionalnega programa varstva okolja"- Gospodarjenje z vodami, MOP, Ljubljana, 1998

[4] povzeto po delovnem osnutku: "Nacionalnega programa varstva okolja"- Gospodarjenje z vodami, MOP, Ljubljana, 1998.

7. DESCRIPTION AND ANALYSIS OF ACTUAL POLICIES AND STRATEGIES

7. 1. ACTUAL POLICIES AND STRATEGIES

The condition of waters in the Republic of Slovenia is analysed in *The report on the state of environment in 1996* and *The programme for water management (PWW)*. *The national programme for environment protection* recapitulates the starting-points, which in view of the set objectives of water management support a programme of measures. A working draft is in the process of being completed: "The national programme for environment protection"- Water management, Ministry of environment, Ljubljana, 1998, from which the following problem identifications and priorities were taken :

Identification of problems in the field of adequate water quality assurance:

- resumed deterioration in quality of some water courses since 1995, especially with regard to heavy metals and organic compound content, e.g. mineral oils content is increased due to introduction of dangerous substances from dispersed industrial sources
- inadequate collection and treatment of municipal waste water (purification needed for bathing purposes)
- inefficient preventive measures for reduction of hazard of toxic spills in industrial plant sites, dangerous substance warehouses, illegal solid waste dump sites and transport of dangerous substances
- introduction of pollution from non-dispersed sources of agriculture, animal husbandry, dispersed settlements and illegal dump sites
- inadequate natural lake water quality
- intensive fish farms on small water courses
- purification of sewage system discharge, or WWTPs for the purpose of water for bathing
- problem of defining water for bathing

The problems of water supply in the Danube river basin are:

- great loss of water from badly maintained water supply systems - the lessening of losses usually means an additional water source
- protection of water sources: more than a half of municipal water supply systems lack any defined safety zones of water sources and does not monitor the water in the area
- quality of drinking water: groundwater and source water quality is not improving, the karstic sources are the most endangered ones. They are chemically and microbiologically contaminated.
- assurance of regular and adequate measurements in accumulation areas

- water supply is concentrated only on underground sources (groundwater, sources), it does not use surface water, which is in some areas, of much better quality and more appropriate for drinking water or use in other activities
- awareness-raising and education of the public that it is every citizen's duty to take measures for clean water and that that can be done by behaving responsibly

The problems of waste water treatment and collection and safeguarding from eutrophication in the Danube river basin are:

- less than half of the population is connected to the municipal sewage network
- sewage networks are not watertight - disperse groundwater pollution
- only approximately 15 % of waste water is treated biologically
- sewage systems have no needed antiflood protection in the case of water irruption from the outlet, inflow of other (hinterland) waters into the sewage system is a particular problem
- narrow and sectorial consideration of problems of waste water collection and treatment, which does not facilitate a realistic estimation of costs for the various possibilities of economic development of Slovenia
- presence of the acute eutrophication of natural and artificial lakes and of latent eutrophication of water courses, which threatens at accumulation construction on water courses
- third grade treatment will probably have to be introduced in the whole of Slovenia, considering the final outlet or defined eutrophication areas
- economic optimisation of priorities and stages of investment in the municipal sector

<u>Strategic directions of water management and measures for the protection of water sources in the Danube basin</u>

<u>the Drava river basin:</u>

- Protection and provision of additional capacity of existing and perspective water sources for the entire Drava basin and the plain between Fala and Ptuj
- Protection and increase in capacity of water source of Ormož and Slovenske gorice water supply system
- Neutralisation of pesticides from groundwater in Šikole, which is used as drinking water source for Slovenska Bistrica water supply system..

<u>the Sava river basin:</u>

- Integral protection and long-term supply of Ljubljana with drinking water with the use of active aquifer protection and artificial infiltration.

<u>Municipal waste water collection and treatment measures, and safeguarding of water from eutrophication:</u>

the Mura basin:

Murska Sobota *Lendava*

Ljutomer

the Drava basin:

Maribor

the Sava basin:

1. Celje *6. Sevnica*

2. Črnomelj *7. Metlika*

3. Krško *8. Brežice*

4. Novo Mesto *9. Rogaška Slatina*

5. Vrhnika *10.Ljubljana*

Collection and treatment measures for industry:

1. Pivovarna Union - Ljubljana *7. Industrija usnja Vrhnika*

2. Pivovarna Laško *8. Ljubljanske mlekarne*

3. Tovarna papirja Paloma - Sladki vrh *9. KG Rakičan*

4. Tovarna papirja ICEC - Krško *10.Pomurka Murska Sobota*

5. Papir - Radeče *11.Mariborske mlekarne*

6. Farma Ihan - Domžale

7. 2. SECTOR POLICIES

Development planning on various sector levels is provided for with *national programmes*, which are crucial for water management. Several basic motions are defined there, for example, execution of an adequate system of spatial development; environment-friendly development and nature protection. 29 national programmes, resolutions, strategies and other documents have been prepared so far, of which 13 have been acceded to, 11 are still undergoing parliamentary procedures and 5 of them are either undergoing government procedures or are prepared to.

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TABLE OF CONTENT AND OUTLINE

Executive Summary

The state of the Danube enviroment in the national context (Stanje okolja v slovenskem delu Podonavja)

Na obseg in stopnjo onesnaženosti okolja v Sloveniji, kakor tudi na slovenski del Podonavja, močno vplivajo pokrajinska pestrost, naravnogeografske poteze pa tudi dosedanji gospodraski razvoj. Najbolj onesnažene pokrajine so v predalpski in alpski Sloveniji, omejene so na kotline (Celjska, Ljubljanska...) in globoke doline (Zasavje, Mežiška, Zgornjesavska...). Reliefna zaprtost stopnjuje negativne pokrajinske učinke onesnaževanja okolja že z razmeroma majhnimi količinami emisij, ki jih proizvajajo relativno majhna mesta. Največjo onesnaženost so slovenski industrijski in energetski kraji doživeli od konca 60. do začetka 80. let, na splošno nemreč velja, da je onesnaževanje okolja naraščalo vse do sredine prejšnjega desteletja, od tedaj dalje pa sledimo postopnemu zmanjševanju onesnaženosti zraka, vodotokov, manj je poškodb vegetacije, za katere bi lahko neposredne vzroke iskali v visokih koncentracijah škodljivih primesi v zraku, slabša pa je kvaliteta talnih vod, narašča tudi onesnaževanje s "prometnimi polutanti".

Population affected by water pollution (Vpliv onesnažene vode na prebivalstvo)

Sistematične raziskave o številu in deležu prebivalcev Slovenije, ki so zdravstveno ali drugače ogroženi zaradi onesnaženosti virov pitne in ostale vode, niso bile opravljene, zato lahko le posredno sklepamona osnovi onesnaženosti vodnih virov, uporabljenih za vodno oskrbo. V porečju Donave so vodotoki zmerno do močno onesnaženi in se ne uporabljajo za vodno oskrbo s pitno vodo. Podatki o kakovosti vode zajejtih območij talne vode in vod kraških izvirov kažejo na postopno slabšanje kakovosti pitne vode. Prebivalstvo posameznih območij v porečjih Save, Drave in Mure se oskrbuje z vodo podtalnice, kjer so pogosto presežene dovoljene koncentracije nitratov in pesticidov, zlasti koncentracije atrazina. Zajeto vodo iz kraških izvirov v porečju Save in Kolpe pa je potrebno dezinficirati, saj je voda pogosto bakteriološko neprimerna. Na večanje zdravstvene ogroženosti prebivalcev kraškega dela porečja Donave kaže naraščanje vsebnosti težkih kovin in organskih mikropolutantov v sedimentih nekaterih izvirov.

Water quality and impact on ecosystems (Kvaliteta voda in vplivi na ekosisteme)

Zaradi zmerne ali velike in dolgotrajne onesnaženosti vodotokov v porečju Donave le-ti vplivajo zlasti na življenjske združbe v rečnih strugah, skromenjši pa je vpliv na ostale elemente ekosistema oziroma porečja. V porečju Save so življenjske združbe zaradi velike onesnaženosti vode v rekah najbolj spremenjene v spodnjem toku Ljubljanice, Kamniške Bistrice, Rinže, Pake, Savinje in Voglajne ter srednjega toka Sotle, zaradi PCB pa življenje v belokranjski Krupi. V porečju Drave je bilo zaradi onesnaženosti vode prizadeto življenje v Meži, vendar se stanje izboljšuje. V porečju Mure je vodno življenje najbolj degradirano v Ščavnici. Zaradi onesnaženosti vode se je v močno onesnaženih rekah Podonavja zmanjšala populacija salmonidnih ribjih vrst, opazno pa je povečanje onesnaženosti rečnih sedimentov in sedimentov kraških izvirov.

Slabšanje kakovosti talne vode (še) ne vpliva na druge elemente ekosistema. Zaradi onesnaženosti Blejskega jezera prihaja do evtrofikacije oziroma občasnega cvetenja alg, s sana ijskimi ukrepi pa se stanje izboljšuje.

1. Description of the state of the Danube enviroment

1. a. Vodni viri

Porečju Donave na ozemlju Slovenije pripadajo porečja Mure (1376 km2), Drave (3253 km2) in Save (s Kolpo in Sotlo) (11 734 km2). Razvodnica med povodjem Črnega morja in Jadrana poteka v Sloveniji od severozahoda države najprej po najvišjih slemenih Julijskih Alp, severnih delih predalpskega hribovja ter preko slemen dinarsko kraških planot do slovensko - hrvaške meje na jugozahodnem delu Slovenije. Pretežni del razvodnice poteka po ozemlju karbonatnih kamnin, zato prevladuje kraška podzemeljska razvodnica. Splošna značilnost porečij največjih rek porečja Donave je dokaj podobna: njihova povirja so v goratem, močno namočenem svetu, nato pa prehajajo skozi predalpski in gričevnati svet v ravninskega. Vodotoki navadno že po okoli 100 km dolgem toku v dnevu ali dveh zapustijo naše ozemlje, kar podčrtuje vodno prehodnost in povirnost. Dolžina površinskih rečnih tokov je okoli 27 000 km (strug rek in potokov, hudournikov, umetnih jarkov in prekopov), povprečna gostota rečne mreže pa je 1,33 km/km2. Gostota rečne mreže je glede na več kot 40 % kraškega površja (skoraj brez površinskih vodotokov) velika, zlasti zaradi velike namočenosti. Dolžina površinskih rečnih tokov porečja Donave je 22 600, gostota rečne mreže je 1,38, največja pa v porečju Drave (1,88) V črnomorskem povodju se nahaja 98 % dinamičnih zalog podzemne vode v vodonosnikih z medzrnsko poroznostjo in 85 % vseh dinamičnih zalog podzemne vode v Sloveniji.

1. b. Ekosistemi in biološki viri

Fizičnogeografske in ekosistemske značilnosti porečij Donave so zlasti odraz prehodnega geografskega položaja, kjer se prepletajo alpske, predalpske, dinarskokraške in subpanonske značilnosti. Porečje Donave bioklimatsko označuje

prehod od zelo vlažne klime alpskega in dinarskega dela porečja k vlažni klimi osrednjega dela savskega porečja ter k semihumidni in delno semiaridni klimi Podravja in Pomurja. Skoraj celotno ozemlje porečja Donave pripada zaradi klimatskih značilnosti potencialno gozdnatemu ekosistemu, ki pa je skrčen. V zadnjih štiridesetih letih so se gozdne površine povečale za okoli 10 %, prisotna pa je obolelost dreves zaradi bolezni in onesnaženosti zraka. Gozdni ekosistem zavzema v porečju Donave okoli polovico ozemlja, prevladuje pa v dinarsko kraškem, alpskem in predlapskem delu porečja Save in višjih predelov porečja Drave.
Vlažni biotopi vključujejo različne oblike od visokih in nizkih barij, močvirij, poplavnih in močvirnih gozdov ter travnikov, mrtvic itd. Po ocenah obsegajo 26.000 ha ali 1,25 % državnega ozemlja. Nekaj mokrišč je vključeno v naravne parke ali so zavarovana kot naravni rezervati. Po ocenah je v črnomorskem povodju v naravnih parkih zavarovanih tudi 10.500 ha vlažnih biotopov, ki predstavljajo 17,5 % v naravnih parkih zavarovanih površin. Polovica zavarovanih mokrišč se nahaja v porečju Save, ki pa predstavljajo le 10 % v naravnih parkih zavarovanih površin.

1. c. Vplivi človeka in ključni problemi degradacije okolja glede na onesnaženje voda

Zaradi reliefne razgibanosti imajo reke velika odtočna nihanja, zato se onesnaženost spreminja od zelo nizke stopnje spomladi in jeseni, do visoke pozimi in poleti. Slovenija je razvodno in povirno območje z gosto, drobno in šibko rečno mrežo, zato lahko manjše vodotoke onesnažijo že odpadne vode posameznih tovarn, razpršeni industrijski obrati pa onesnažujejo že skoraj celotno rečno omrežje. Po letu 1990 se v celoti kaže trend rahlega zmnjševanja onenaženosti vodotokov, vzroke za to gre ponovno iskati v zmanjšani proizodnji, tehnoloških izboljšavah in sancijskih ukrepih. Industrijsko onesnaževanje vodotokov se je po letu 1990 zmanjšalo za 30-40%, medtem ko je komunalno ostalo na domala isti ravni.

Sava s svojim porečjem obsega 57% ozemlja Slovenije, tu živi 53% prebivalcev naše države in tu je tudi 2/3 izvirov pitne vode, reka s pritoki odnaša kar 4/5 slovenskih odplak. Njeno onesnaževanje se začenja že v povirju z odplakami Kranjske gore in Bohinja, močno pa se poveča s pritokom Sore, predvsem pa za Ljubljano, ki ena redkih evropskih prestolnic, ki še ni poskrbela za čiščenje svojih odplak. Reka je od Ljubljane naprej v 3. oziroma 2-3. razredu onesaženosti in to vse do meje s sosednjo Hrvaško. Onesnažijo jo še zasavske odplake, predvsem rudniške po separaciji premoga, pri Zidanem mostu pa še Savinja.

Drava priteče že v Slovenijo v 2-3 kakovostnem razredu (opazne so predvsem primesi svinca in cinka). Pri svojem toku skozi Slovenijo dobiva še zmerno onesnažene pritoke, vendar se njena onesnaženost do hrvaške meje bistveno ne spremeni.

Mura se je v petih letih izboljšala za en kvalitativni razred (od 3. na 2.), tudi zaradi sanacijskih ukrepov v sosednji Avstriji. Na svoji poti po Sloveniji se vanjo izlivata še kritično onesnažena Ščavnica (4. razred) in prekomerno onesnažena Ledava (3. razred)

Prekomerno oziroma že kar kritično pa so onesnaženi mnajši vodotoki oziroma njihovi krajši deli za večjimi onesnaževalci npr. spodnji tok Kamniške Bistrice, Ljubljanice, Voglajna pred izlivom v Savinjo, Sotla in Ščavnica, Krupa za Semičem, Rinža za Kočevjem..

Še vedno pa ostaja pereč problem v pomanjkanju čistilnih naprav, predvsem pri večjih slovenskih mestih (npr. Ljubljana, Maribor, Celje), ustrezneje pa je prečiščevanje odpadnih vod urejeno pri manjših krajih z več kot 100 manjšimi komunalnimi čistilnimi napravami.

Trend rahlega zmnajševanja onesnaženosti vode se kaže pri obeh alpskih jezerih (Bohinjsko, Blejsko), kar pa ne velja za kraško Cerkniško jezero.

Na poljih (Dravsko, Mursko, Celjsko) se, ob intenzivni kmetijski rabi in z veliko porabo kemičnih zaščitnih sredstev in mineralnih gnojil, pojavlja še problem prekomernega onesnaževanja podtalnice. Nevarne so predvsem previsoke koncentracije pesticidov v vodi, ki po evropskih standardih presega mejne vrednosti za pitno vodo.

2. Population development and water sector relevant characteristics (za vodni sektor relevantne značilnosti razvoja prebivalstva)

2. a. Analysis of demographic data and projection of urban and rural population in the Danube catchment areas (Analiza demografskih podatkov in projekcije urbanega in ruralnega prebivalstva)

Projekcije, ki jih je do leta 2020 v treh možnih variantah opravil Statistični urad RS nas opozarjajo, da lahko po najbolj optimistični varianti pričakujemo povečanje prebivalstva na okoli 2,21 mio., ali letni prirast za okoli 8400 prebivalcev. Po srednji varianti je pričakovati nadaljevanje skromne rasti prebivalstva, tako da do le-to naraslo na okoli 2,05 mio. Pesimistična projekcija pa ocenjuje, da bo Slovenija v naslednjih 25 letih izgubila od 105 do 150.000 prebivalcev in nazadovala od skoraj dveh milijonov na 1,89 mio. prebivalcev.

V urbaniziranih, ravninskih in dolinskih območjih je pričakovati nadaljnje naraščanje prebivalstva in gospodarskih aktivnosti, usmerjenih v energetsko in surovinsko manj zahtevne proizvode ter uslužnostne dejavnosti. V urbaniziranih območjih se bo prebivalstvo po najbolj optimističnih ocenah povečevalo po letni stopnji + 0,5 %, na podeželju pa še naprej upadalo. Skupno število prebivalcev v slovenskem delu Podonavja bo do leta 2020 po optimistični napovedi narastlo od sedanjih 1,74 mio. na 1,94 mio.

2. b. Estimation of actual and future demand for water (Stanje in bodoča porabe vode)

Z vidika vodne oskrbe prebivalstva s pitno vodo slovenskega dela porečja Donave so bila sredi devetdesetih let najpomembnejša območja talne vode, sledili pa so jim vodni, zlasti kraški izviri. V Pomurju so bila območja talne vode edini, v Podravju skoraj prevladujoči in v Posavju (brez Kolpe) prevladujoči vodni vir za pitno vodo. Dodatni vir pitne vode so predstavljali zlasti zajeti kraški izviri, ki so v Pokolpju edini vir.

Leta 1995 je bilo za oskrbo prebivalstva s pitno vodo iz vodovodnih sistemov v Sloveniji 91 mio m^3. Letna poraba pitne vode na prebivalca se v zadnjih letih ni bistveno spremenila in znaša od 45 do 50 m^3. Leta 1995 je znašala 46,4 m^3/preb. V črnomorskem povodju se za oskrbo prebivalstva porabi 80 % vse pitne vode za oskrbo gospodinjstev. Poraba pitne vode v gospodinjstvih se glede na prebivalstveno rast tudi v prihodnjih letih ne bo dosti povečala, razen če se bo povečal delež oskrbljenega prebivalstva s pitno vodo iz javnih vodovodnih sistemov. Ker naraščajo tudi izgube pitne vode v vodovodnem omrežju je pričakovati večje izkoriščanje vodnih virov. Obstoječi viri pitne vode so količinsko zadostni in bodo tudi ob manjši rasti potreb lahko zagotavljali potrebno količino vode v vseh porečjih. Najmanjše rezerve pitne vode v zajetih vodnih virih so glede na razmeroma nizek delež priključenega prebivalstva na javne vodovodne sisteme v porečju Mure.

2. c. Estimation of actual and future production of waste water (Stanje in bodoča proizvodnje odpadne vode)

Kanalizacijski sistem v slovenskem delu Podonavja je slabo razvit, saj je manj kot polovica gospodinjstev priključenih na javno kanalizacijo. V preteklih desetletjih postavljen cilj pripeljati vodo v vsako gospodinjstvo je skoraj izpolnjen, zdaj pa se bo potrebnoprizadevati, da bi na ustrezen način tudi odvajali odpadno vodo. Gostejše je kanalizacijsko omrežje na obsežnih poljih z urbanimi središči, pod katerimi so največje zaloge pitne vode. V prihodnjih dveh desetletjih lahko pričakujemo širjenje kanalizacijskega omrežja, ki naj bi bilo tudi kvalitetnejše, tako da bi bile izgube čim manjše. Za večja naselja bo potrebno zgraditi centralne čistilne naprave. Nujno bo istočasno širjenje kanalizacijskega omrežja v manj poseljenih območjih in gradnja tudi manjših čistilnih naprav, zlasti takšnih do 1000 PE.

2. d. Analysis of health hazardsthrough water pollution and unsanitary conditions (analiza nevarnosti za zdravje prebivalstva)

Sistematičnih raziskav o zdravstveni in drugi ogroženosti prebivalstva zaradi onesnaženosti vodotokov in drugih površinskih vod v Sloveniji ni. Voda iz površinskih voda se le izjemoma uporablja za vodno oskrbo prebivalstva, saj je večina vodotokov podonavske Slovenije zmerno, močno ali zelo močno onesnažena. V 1. in 1.- 2. kakovostni razred so se leta 1994, 1995 in 1996 uvrščali le povirni rečni odseki alpskih rek porečja Save (Tržiška Bistrica, Kokra, Kamniška Bistrica, Savinja) in Meža v porečju Drave. V 2. kakovostni razred so se v porečju Save uvrščale Sava Dolinka, Sava Bohinjka, Sora, zgornji odsek Ljubljanice, srednji tok Kamniške Bistrice in Savinje, zgornja Krka ter Kolpa do sotočja z Lahinjo. V porečju Drave in Mure ni bilo pomembnejše reke ali rečnega odseka, ki bi se uvrščala vsaj v 2. kakovostni razred. Zaradi slabše kakovosti rečne vode in temperaturnih razmer so le posamezni rečni odseki zgornjega in/ali srednjega toka poleti primerni za kopanje (npr. Kolpa, Krka, Sora in Savinja), vendar se manjše število prebivalcev poleti kopa tudi v vodotokih, ki se uvrščajo v 2. - 3. ali slabši kakovostni razred. Na podlagi posrednega sklepanja torej sodimo, da kljub zmerni onesnaženosti rek in drugih površinskih vodotokov prebivalstvo ob uporabi pitne vode podtalnice in izvirov ni zdravstveno ogroženo, rečna voda pa se le izjemoma uporablja kot vir vodne oskrbe gospodinjstev. V kolikor se bodo negativni trendi slabšanja kakovosti zajetih vodnih virov (podtalnica, kraški izviri) nadaljevali, lahko pričakujemo tudi večje vodnooskrbne, zdravstvene in druge negativne posledice za prebivalstvo. Potencialno so z vidika nenadnega onesnaževanja ob nezgodi bolj ogroženi kraški izviri porečja Save (porečje Ljubljanice, Krke in Kolpe). Glede na izkušnje iz preteklosti (Dravsko - Ptujsko polje: zaradi onesnaženosti s pesticidi je za določeno obdobje ostalo brez vira pitne vode okoli 100 000 prebivalcev) pa je prav tako tvegano postopno, a vztrajno slabšanje kakovosti zajetih podtalnic zlasti porečja Drave in Mure (kmetijstvo).

3. Analysis of actual and expected impact of economic activities on water demand and potential pollution of acvatic systems (Analize dejanskih in pričakovanih vplivov ekonomskih aktivnosti na porabo vode in potencialna onesnaženja vodnih sistemov)

3. a. Industrial activities

Industrija in rudarstvo v Sloveniji sta leta 1995 porabila 113 mio m3 sveže vode, od tega 76,6 mio m3 kot tehnološko vodo in 36,3 mio m3 kot pitno vodo. V proizvodnji je bilo uporabljeno 48 mio m3 vode in za hlajenje 50,7 mio m3. Pri pridobivanju premoga je bilo uporabljeno 2,2 mio m3 sveže vode, od tega 1,6 mio m3 tehnološke vode in 0,7 mio m3 pitne vode. Tehnološka voda je bila večinoma uporabljena pri proizvodnji, pitna voda pa večinoma za sanitarne namene. 1,4 mio m3 vode je bilo pridobljeno iz rek, ostalo pa iz drugih virov. Ker se vse pridobivanje premoga nahaja v črnomorskem povodju in v porečju Save, navedeni podatek kaže tudi porabo sveže vode pri pridobivanju premoga na tem območju. Kolikšna je industrijska poraba sveže vode v črnomorskem povodju in v posameznih porečjih ni znano.

Industrijske in rudarske dejavnosti so izpustile v okolje 765,728.000 m^3 odpadne vode, od tega neposredno v tla 2,606.000 m^3, v javno kanalizacijo nekaj več kot 30 milijonov m^3, v površinske vode pa kar 733,102.000 m^3 vode. Največje količine vode odvajajo naslednje dejavnosti: proizvodnja in predelava papirja (27,562.000 m^3), predelava kovin (6,827.000 m^3) in predelava kemičnih izdelkov (8,223.000 m^3). Iz industrije in rudarstva prečistijo 46,775.000 m^3 oziroma le 6,11 % odpadnih voda, od tega samo mehansko 17,319.000 m^3, mehansko-kemično-biološko pa očistijo 26,128.000 m^3.

3. b. Municipal discarges

Za Podonavje ni mogoče dobiti podatkov o količinah in vrstah odpadne vode po posameznih gospodarskih dejavnostih, zato navajamo podatke le za celotno državo leta 1995, ki jih je zbral Statistični urad R Slovenije. V javnih kanalizacijskih sistemih v R Sloveniji se je leta 1995 zbralo 131,816.000 m^3 vode, od tega v črnomorskem povodju kar 118,958.000 m^3. V čistilnih napravah ga v celoti prečistijo 71,376.000 m^3, kar znaša 60,0 % odpadnih voda. Po podatkih za celotno državo samo mehansko prečistijo 61,0 % odplak, samo kemično 0,1 %, samo biološko pa 2,7 %. S kombiniranim načinom prečiščevanja pa očistijo 36,2 % vseh prečiščenih odpadnih voda. Po podatkih Uprave R Slovenije za varstvo narave je v porečju Save zgrajenih 60 čistilnih naprav s skupno zmogljivostjo 1,446.491 PE, medtem ko je takih, ki dosegajo 1000 PE 46, med njimi pa je tudi 550 oz. 600.000 PE zmogljiva centralna čistilna naprava Ljubljana, ki pa ima le mehansko stopnjo čiščenja. Torej je precej preko polovice vseh čistilnih naprav postavljenih v porečju Save, kljub vsemu pa je le 226.536 prebivalcev ali 19,1 % priključenih na 42 čistilnih naprav, ki čistijo komunalne odplake. Največ prebivalcev je priključenih na čistilne naprave Domžale – Kamnik (50.000), Šoštanj (27.000), Kranj (25.000) in Novo mesto (20.000). Najbolj pereč problem v porečju pa je nedokončana čistilna naprava za kanalizacijski sistem Ljubljane. Še manj optimistično lahko gledamo na rešitev čiščenja odplak urbanega centra Celja, ki z več kot 50.000 prebivalci izjemno onesnažuje Savinjo.

3. c. Agricultural activities

V Sloveniji je v porečju Donave 93 680 ha zemljišč (84% od vseh slovenskih), kjer se vsako leto ali v presledkih pojavlja suša in jih je zato treba namakati. Od tega ja največ, 74% površin v porečju Mure in Drave, kjer že obstaja 8 hidromelioracijskih sistemov (poleg namakanja vključujejo še osuševanje), ostalih 26% površin, ki za intenzivno kmetijsko rabo zahtevajo namakanje, je še v porečju Save. Nacionalni program namakanja (1994) v Sloveniji navaja, da je v v Sloveniji primernih za namakanje 120 080 ha obdelovalnih površin, za kar je potrebnih 235,6 mil. m3 vode, ki bi jo največ načrpali iz Mure, Drave, Save, Kolpe, iz podtalnice in akumulacij. V letu 1995 je bilo v Sloveniji 4200 ha površin pripravljenih za namakanje, od tega pa 1592 ha dejansko namakanih. Ocenjujemo, da je okoli 80% namakanih površin Slovenije v porečju Donave. Za namakanje je bilo leta 1995 zajeto 4785 000 m3 vode, od tega so 6% prispevale podtalnice, 29% iz vododtoki in 63% akumulacije.
Intenzivna raba mineralnih gnojil in zaščitnih sredstev je osnovni ploskovni vir zlasti onesnaževanja območij talne vode porečja Donave, velike koncentracije živali pa pomembni viri onesnaževanja vodotokov. Od nekdanjega družbenega sektorja so se v novih razmerah v porečju Donave obdržale številne živinorejske farme prašičev, govedi in perutnine. Zlasti velike prašičje farme predstavljajo najbolj perečo točkasto obliko onesnaževanja potokov in rek. V porečju Save so velike prašičje farme z naslednjim povprečnim številom prašičev: Ihan (ob Kamniški Bistrici, 53 700), Stična (12 000) in Klinja vas pri Kočevju (17 300) (v kraškem delu porečja Krke) in Pristava pri Leskovcu (Krško polje, 15 000). V porečju Drave je prašičja farma v Dražencih pri Ptuju (40 500), v porečju Mure pa Cven pri Ljutomeru (10 000),v Podgradu pri Gornji Radgoni (21 300) in farma Nemščak pri Beltincih s farmo Jezera (56 300). Velike prašičje farme v porečju Donave s povprečnim staležem okoli 230.000 prašičev (skoraj polovica skupnega števila prašičev) so problematične zaradi premajhnih površin kmetijskih površin v bližini farm ter le delnega čiščenja odpadnih vod. Zlasti so problematične prašičje farme v kraškem svetu (npr.Klinja vas), na območjih talne vode (npr. Pristava, Nemšak) in v bližini vodotokov s skromnimi pretoki (Ihan, Stična). Nobena od farm še ni dosegla zahtevane kakovosti prečiščenih odpadnih vod pred izpustom v površinske vode.
Človeške vplive na vode opazujemo skozi prizmo sprememb v stopnji urbanizacije in strukture delovnih mest. Prebivalstvo se je v povojnem obdobju povečalo skoraj za pol milijona. Slovenija je ob dinamičnem razvoju zaposlovanja hitro dosegla polno zaposlenost in dosegla raven srednje razvite industrijske države. Delež kmečkega prebivalstva se je zmanjšal na komaj dvanajstino. Od prevlade primarnega je v strukturi aktivnega prebivalstva že sredi šestdesetih let prišla v prevlado sekundarnega sektorja, istočasno pa se je - posebej v zadnjem desetletju - povečal delež terciarnega in kvartarnega sektorja. Urbanizacija pospešuje koncentracijo prebivalstva v nižinskem in praznenje v hribovitem, kraškem in gričevnatem svetu, pospešena industrializacija pa ni povzročila le močnih ekonomskih sprememb, povečanja materialne proizvodnje in povečanja zaposlitve, marveč tudi daljnosežne posledice v degradaciji okolja ker preventivni ukrepi zaostajajo. Ugotavljamo, da zgoščanje prebivalstva in industrijski kraji in živinske farme odločujoče vplivajo na onesnaženost voda v Podonavju med njimi še posebej

- v porečju Drave: Maribor, Ptuj s Kidričevim, Ravne na Koroškem, Ormož in Ruše,
- v porečju Mure: Murska Sobota, Lendava, Ljutomer in Gornja Radgona ter
- v porečju Save: Ljubljana, Kranj, Velenje, Celje, Kamnik, Trbovlje, Škofja Loka, Vrhnika, Jesenice, Rogaška Slatina, Hrastnik, Krško, Kočevje, Domžale, Štore, Šoštanj.