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**TOWARDS THE APPLICATION OF THE INTERNATIONAL WATER RELATED
ENVIRONMENTAL INDICATORS IN HUNGARY**

Paper submitted by the Hungarian Central Statistical Office¹

Summary: The main aim of this paper is to provide an overview on the implementation of the Hungarian application work on the water related environmental indicators.

This paper is based on the water-related indicators of international institutions (Eurostat, EEA and OECD).

The paper presents the first results of the survey on the application of the water related environmental indicators and indices according to the international indicator issues, and summarizes the main directions of the future work.

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I. INTRODUCTION

The environmental threats and the growing interest in sustainable development have urged governments to monitor the state of the environment and detect changes in conditions and courses. The environmental indicators prove to be a necessary tool for helping to present and monitor the trends towards a sustainable future.

In 1996 the Hungarian Government has decreed a developing work on implementation of a so-called Integrated Environmental and Economic Information System, with special regard to satisfaction of EU and OECD requirements including also the improvement of the environmental indicators. By reason of this decision started an analysis of statistics on water resources, water uses and used water discharges with the final aim to elaborate a database on water management statistics, which is suitable for the EU and OECD statistical standards.

The EU and OECD have developed their statistical data collection system in the 1980's, which give a database for different analyzing, regulating and methodological work with reference to the environment. This statistical data collection system has covered also Hungary since 1990.

II. WATER MANAGEMENT AND THE NEED OF ENVIRONMENTAL INDICATORS

Hungary is situated mostly on plain land in the Carpathian basin. The significant part of the catchment area lies outside the borders of the country, therefore the carried water amount and quality of our rivers, the usability of the renewable water resources, depend mainly on the water management system of upstream countries. The concept of intensive river management takes environment and nature development into consideration, and has regard for sustainable development.

The conditions in upstream countries determine the water quality of our large water streams. With respect to certain components, due to self-purification the level of pollution slightly increases and decreases within the country. About 5% of our surface waters can be made suitable for water utilization purposes, including drinking water production without special expenditures and 90% of them at an acceptable cost.

The Hungarian water base protection program determines the tasks of the preservation of the vulnerable water bases, the elimination of pollution, the remediation of territories and the provision for the protection of prospective water bases.

In the different water utilization areas, measures are taken to elaborate price relationships reflecting the availability of resources. The large-scale development of sewage drainage and purification in communities, cheaper and more efficient water usage solutions, and the introduction of new technical processes are all very important.

In relation to policy-making of water management, water related environmental indicators could be used mainly for the following aims:

- to support priority setting, by determining main factors that cause pressure on the water related environment;
- to supply policy-makers with information on the state of water related environment;
- to control the impacts of policy responses of water management.

III. WATER RELATED ENVIRONMENTAL INDICATORS

Water is necessary for almost all kinds of life, but only a small part of the world's population has access to drinking (tap) water. In areas with a high population density concentrated industrial activity and intensive agriculture, the human activities especially affect the available water resources and water quality.

The water related indicators selected by international water experts give a detailed description of the pressures imposed on quality and quantity of water resources and the responses of the policy-makers of water management to reduce them.

For the year 2000 the Fifth EU Environment Action Programme determined the following key targets:

- the prevention of over-exploitation of ground water and surface water for drinking water or industrial or other purposes;
- the prevention of pollution of ground water from diffuse sources;
- and a better ecological quality of surface and marine water.

In this paper surveyed international water related environmental indicators are more detailed: nutrients (nitrogen, phosphorous), overuse of ground water resources, pesticides, heavy metals and organic matter are listed as the most important pressures on water. Some indicators on waste water treated or water pricing are also included as a measure of the responses of society to protect the water resources and water quality. In the Sixth EU Environment Action Programme (2001-2010) the Commission proposes also strong action to preserve natural resources such as soil, water, air and timber.

In general a water related environmental indicator is a number that is meant to indicate the state or the development of important aspects of the water related environment. An indicator without a unit of measurement is an index, which is often constructed from several indicators weighted together to include the total effect on the state of the environment. In this paper generally an indicator will be presented as a set of numbers, e.g. a time series, but strictly speaking, indicators concern a specific number along the time or space dimension.

The users of water related indicators will obviously differ in their need for information and their ability to understand and make use of a specific type of information provided by indicators. The water related environmental indicators provide in some cases a general, compact description on the water resources and water quality that is easily understandable even without advanced knowledge of ecology, chemistry or biology. So anybody who is concerned with the water resources and water quality might be a potential user of the presented water related environmental indicators, and in some cases a set of water related environmental indicators will not give environmental experts new information.

Many countries and international organizations regularly present 'state of environment' reports or environmental statistics publications, which consists lots of available information on the state and development of the environment including water. Since economic development of society is closely connected with the environmental development, it would be very useful to present the set of internationally comparable environmental indicators in these publications.

In the following this paper presents the first results of the survey on the application of water related environmental indicators based on the methodology of the water related indicators of international institutions (Eurostat, EEA and OECD).

IV. OVERVIEW TABLE OF THE SURVEYED WATER RELATED INDICATORS

The following table provides information on the surveyed water related internationally developed indicators. The table presents the sources of indicators, which determine mainly the applied methodology in this survey.

Reference code	Sectors / Driving forces Issues	Indicator	DPSIR	Source	Remarks
AG-3	Agriculture	Irrigated land, as % of agricultural area	D	EEA [2]	P
RD-1	Resource depletion	Water consumption	P	Eurostat [3]	P
TX-4	Dispersion of toxic chemicals	Index of heavy metal emissions to water	P		N
UP-3	Urban environmental problems	Non-treated waste water	P		P
WP-1	Water pollution	Nutrient (N + P) use (eutrophication equivalents)	S		P
WP-2		Ground water abstraction	P		P
WP-3		Pesticides used per hectare of utilized agriculture area	P		D
WP-4		Nitrogen quantity used per hectare of utilized agriculture area	P		D
WP-5		Water treated/water collected	R		P
WP-6		Emissions of organic matter as BOD	P		P
WN-1	Water quantity	Water balance	S		EEA [2]
WN-3		Water use by sector	D-P	D	
WN-4		Irrigation water use	D-P	P	
WN-5		Public water supply	D-P	P	
WN-6		Water price	R	D	
E-1a		Eutrophication	Nitrogen source apportionment	P	
E-1b	Phosphorus source apportionment		P	D	
E-2	Nitrogen balance – N-surplus		P	N	
E-3a	P and N in large rivers		S	P	
E-3b	P in lakes		S	P	
E-4a	Status of nitrate in groundwater		S	P	
E-8	Urban waste water treatment		R	P	
E-9	Point source emissions of phosphorus		P	D	
E-10	Consumption of phosphorus in detergents per capita		P	D	
W-7.1	Waste		Sludge from waste water treatment	P-R	EEA [2]
W-7.2		Content of sewage sludge	P-R	N	
WR	Freshwater resources	Intensity of use of water resources	P	OECD [1], [4]	See: RD-1, WN-1
WQ	Freshwater quality	Waste water treatment connection	R		See: WP-5, E-8

According to the international studies the DPSIR model has been adopted as the most appropriate way to structure environmental information by international organizations dealing with environmental information, such as Eurostat, the European Environment Agency (EEA), and by the OECD since the early 1990s, as PSR model.

The locations of the indicators in the DPSIR framework are indicated in the overview table according to the following structure:

- **D** Driving forces: basic sectorial trends, e.g. agriculture, tourism, energy, transport, industry;
- **P** Pressure: human activities directly affecting the environment e.g. waste water emissions;
- **S** State: observable changes of the environment, e.g. changes of water quality in lakes;
- **I** Impact: effects of a changed environment, e.g. decrease in water resources, floods;
- **R** Response: response of society to solve the problem, e.g. waste water treatment, water prices;

The P, F and N letters in the remarks column categorize the results of the survey of each indicator into three categories:

- **P** Indicator presented in the Annex;
- **D** Indicator is presented in Annex, but it is needed to develop the methodology;
- **N** Indicator is not available yet (lack of data or methodology etc.).

At the same time this categorization points out the main direction of the further work on the adaptation of the international water related indicators too.

V. CONCLUSIONS AND FURTHER WORK

The Hungarian experience on application of water related international indicators shows that environmental indicators are cost effective and powerful tools for observing and describing environmental progress and measuring environmental performance. However, experience also shows significant lags between the demand for and the supply of water related environmental indicators.

In general terms further efforts should be done to:

- improve the quality and comparability of existing data ;
- further develop concepts and estimation methods;
- cover also the sectoral water related indicators (industry, energy, agriculture, tourism);
- force the co-operation of national institutions in the developing work;
- link the indicators more closely to national goals and international commitments;
- complement our publication policy with environmental indicators.

The development of an EU and OECD-compatible statistics of indicators is important from the point of view of EU enlargement's conditions, but a good water related indicator statistics is very important for protection of our water resources and environment in Hungary too.

VI. REFERENCES

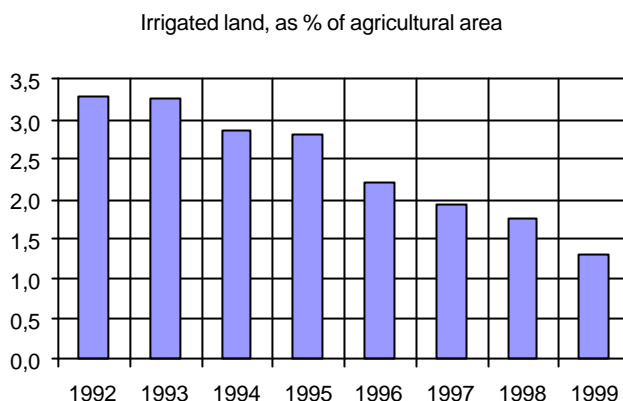
- [1] **OECD:** Environmental indicators, OECD core set, Paris 1994
- [2] **European Environment Agency (EEA):** Environmental signals 1999, Indicator fact sheets for the EEA, Yearly indicator report (For review), Copenhagen 1999
- [3] **Eurostat:** Towards environmental pressure indicators for the EU, First edition, Luxembourg 1999
- [4] **OECD:** Ten indicators for the Environment (Draft), Paris 2001

ANNEX

PRESENTATION OF SOME WATER RELATED INDICATORS IN HUNGARY

AG-3 Irrigated land, as % of agricultural area

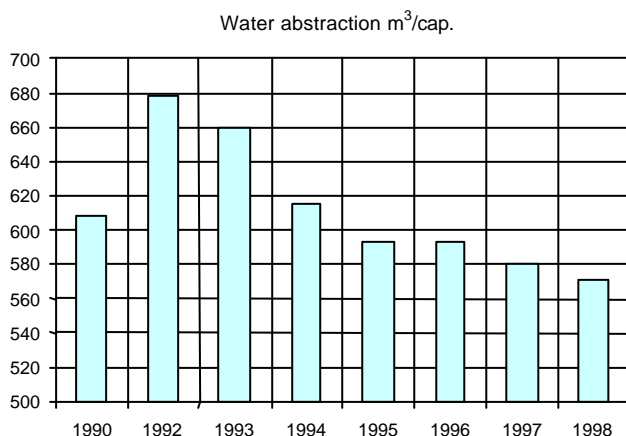
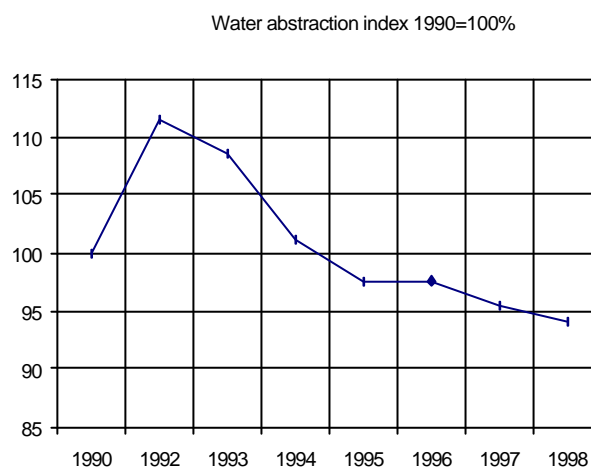
Year	Agricultural area, 1000 ha	Irrigated area, 1000 ha	% of agricultural area
1992	6 135,7	201,2	3,3
1993	6 129,1	199,9	3,3
1994	6 122,0	175,4	2,9
1995	6 179,3	173,4	2,8
1996	6 184,5	135,6	2,2
1997	6 194,6	119,0	1,9
1998	6 192,7	108,4	1,8
1999	6 186,3	81,0	1,3



Source: HCSO; Ministry of Transport and Water Management.

RD-1 Water consumption, fresh ground and surface water consumption

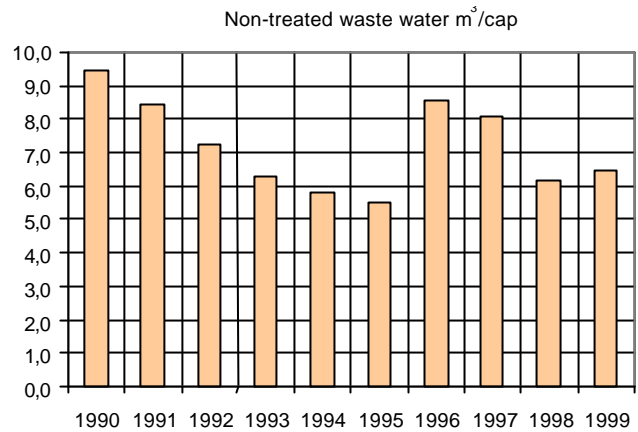
Year	Water abstr., million m ³	Population (at the end of the year), cap.	Water abstr. m ³ /cap	Water abstr. index, %
1990	6 294,8	10 354 842	608	100
1992	6 988,5	10 310 179	678	112
1993	6 781,0	10 276 968	660	109
1994	6 296,6	10 245 677	615	101
1995	6 054,4	10 212 300	593	98
1996	6 035,4	10 174 442	593	98
1997	5 878,0	10 135 358	580	95
1998	5 771,4	10 091 789	572	94



Source: HCSO; Ministry of Transport and Water Management.

UP-3 Urban environmental problems, non treated waste water from public sewerage

Year	Non-treated waste water ^{a)} , million m ³	Population (at the end of the year), cap.	Non-treated waste water m ³ /cap
1990	97,8	10 354 842	9,4
1991	87,5	10 337 236	8,5
1992	74,6	10 310 179	7,2
1993	64,9	10 276 968	6,3
1994	59,2	10 245 677	5,8
1995	56,3	10 212 300	5,5
1996	87,4	10 174 442	8,6
1997	81,8	10 135 358	8,1
1998	62,1	10 091 789	6,2
1999	65,2	10 043 224	6,5

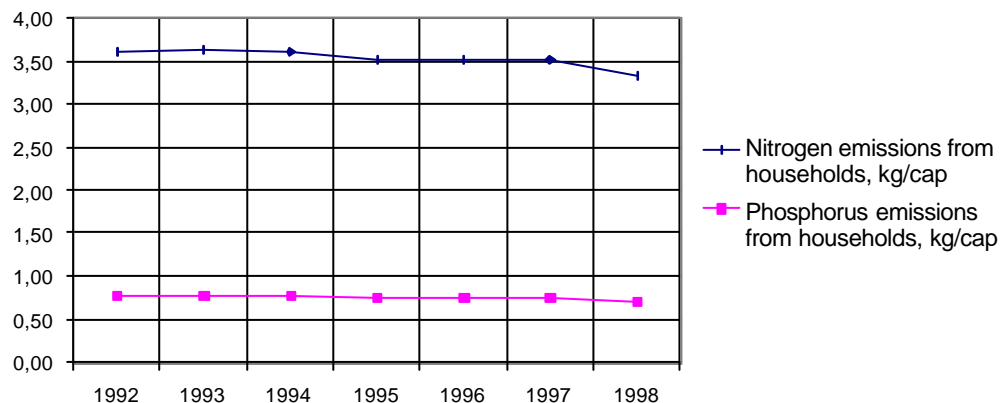


a) Conducted by public sewerage.
Source: HCSO.

WP-1 Nutrient (N+P) use (eutrophication equivalents) N+P emissions from households, after treatment

Year	Population connected to the ^{a)}			Population (at the end of the year), cap.	Nitrogen emissions coefficient kg/cap	Phosphorus emissions coefficient kg/cap	Nitrogen emissions from households, kg/cap	Phosphorus emissions from households, kg/cap
	primary waste water treatment, %	secondary waste water treatment, %	tertiary waste water treatment, %					
1992	4,4	11,0	0,9	10 310 179	4,4	1	3,61	0,77
1993	5,1	14,3	0,9	10 276 968	4,4	1	3,62	0,78
1994	4,3	15,7	0,9	10 245 677	4,4	1	3,59	0,77
1995	2,7	16,9	0,9	10 212 300	4,4	1	3,52	0,75
1996	3,0	17,7	1,1	10 174 442	4,4	1	3,51	0,75
1997	2,7	19,8	1,0	10 135 358	4,4	1	3,51	0,75
1998	2,6	20,1	2,8	10 091 789	4,4	1	3,32	0,71

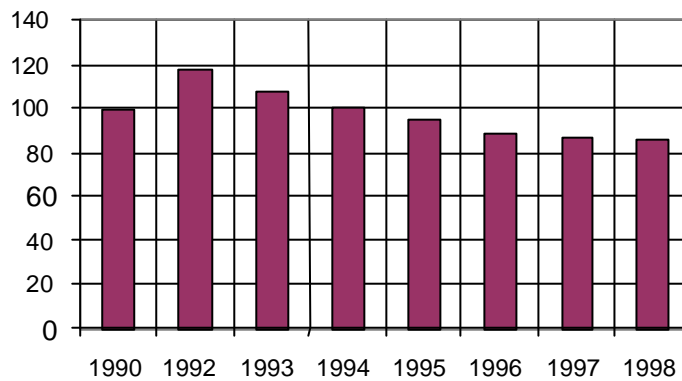
a) Estimated data.
Source: HCSO; Ministry for Environment



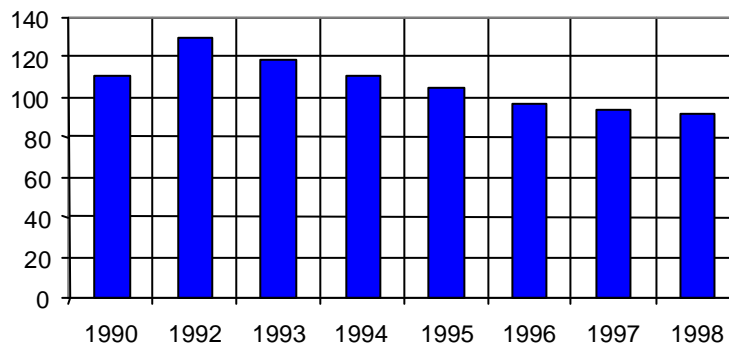
WP 2 Ground water abstraction

Year	Fresh ground water abstraction, million m ³	Area, ha	Fresh ground water abstraction per surface area, m ³ per ha	Population (at the end of the year), cap.	Fresh ground water abstraction, m ³ per capita
1990	1 028,4	9 303 000	111	10 354 842	99
1992	1 207,1	9 303 000	130	10 310 179	117
1993	1 108,0	9 303 000	119	10 276 968	108
1994	1 021,8	9 303 000	110	10 245 677	100
1995	968,7	9 303 000	104	10 212 300	95
1996	899,3	9 303 000	97	10 174 442	88
1997	873,4	9 303 000	94	10 135 358	86
1998	857,7	9 303 000	92	10 091 789	85

Fresh ground water abstraction, m³ per capita



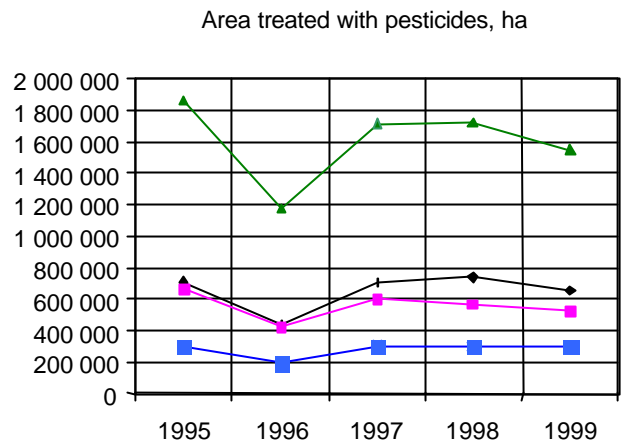
Fresh ground water abstraction per surface area, m³ per hectare



Source: HCSO; Ministry of Transport and Water Management.

WP-3 Pesticides used per hectare of utilized agriculture area
Area treated with pesticides, ha

Year	Area treated with			
	fungicides	insecticides	herbicides	other pesticides
1995	711 241	669 849	1 859 123	296 102
1996	437 982	423 205	1 174 865	195 850
1997	704 490	605 340	1 709 086	306 254
1998	742 239	566 446	1 723 233	296 504
1999	656 955	529 541	1 546 481	300 799



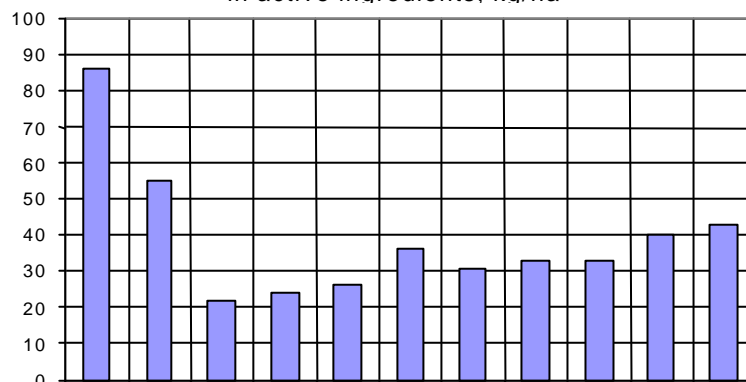
—○— fungicides —■— insecticides —▲— herbicides —■— other pesticides

Source: HCSO.

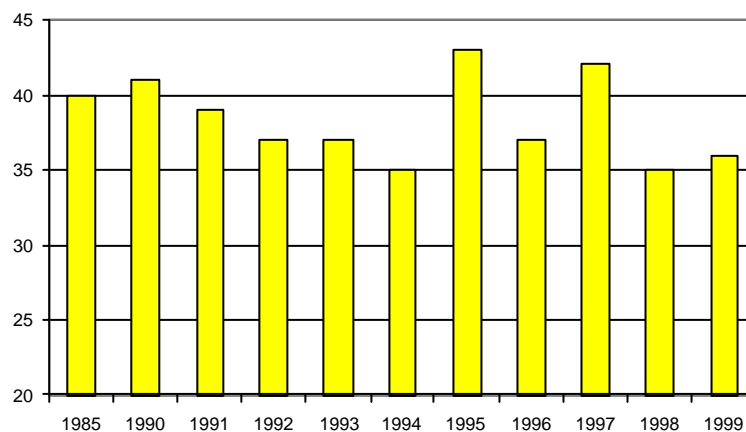
WP-4 Nitrogen quantity used per hectare of utilized agricultural area

Year	Nitrogenous fertilizer supply of agricultural organizations in active ingredients, kg/ha	Use of manure of agricultural organizations, t/ha
	1985	86
1990	55	41
1991	22	39
1992	24	37
1993	26	37
1994	36	35
1995	31	43
1996	33	37
1997	33	42
1998	40	35
1999	43	36

Nitrogenous fertilizer supply of agricultural organizations in active ingredients, kg/ha



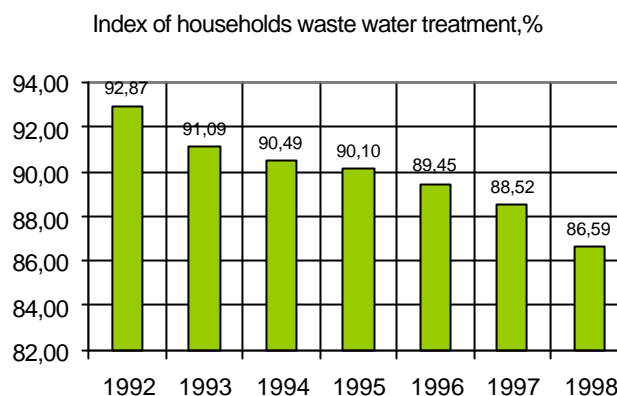
Use of manure of agricultural organizations, t/ha



Source: HCSO.

WP-5 Water treated/water collected
Index of municipal waste water treatment, (0,00%=BAT)

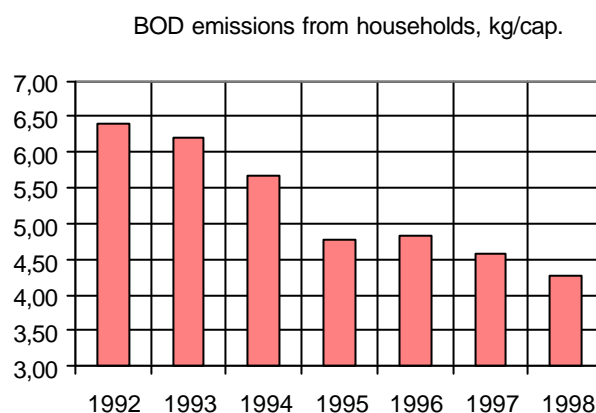
Year	Population connected to the ^{a)}			Popula- tion without ^{a)}	Index of house- holds
	prim- ary	second- ary	terti- ary		
	waste water treatment,%				
1992	4,4	11	0,9	83,7	92,87
1993	5,1	14,3	0,9	79,7	91,09
1994	4,3	15,7	0,9	79,1	90,49
1995	2,7	16,9	0,9	79,5	90,10
1996	3,0	17,7	1,1	78,2	89,45
1997	2,7	19,8	1,0	76,5	88,52
1998	2,6	20,1	2,8	74,5	86,59



a) Estimated data.
 Source: HCSO; Ministry for Environment.

WP-6 Water pollution, Emissions of organic matter as BOD
BOD emissions from households, after treatment

Year	Population connected to the ^{a)}			Population (at the end of the year), cap.	BOD emissions from house- holds ^{b)} , kg/cap
	prim- ary	second- ary	terti- ary		
	waste water treatment, %				
1992	4,4	11	0,9	10 310 179	6,42
1993	5,1	14,3	0,9	10 276 968	6,21
1994	4,3	15,7	0,9	10 245 677	5,67
1995	2,7	16,9	0,9	10 212 300	4,78
1996	3,0	17,7	1,1	10 174 442	4,83
1997	2,7	19,8	1,0	10 135 358	4,58
1998	2,6	20,1	2,8	10 091 789	4,27



a) Estimated data.
 b) BOD emissions coefficient, 60 g/cap/day.
 Source: HCSO; Ministry for Environment.

WN1 Water balance

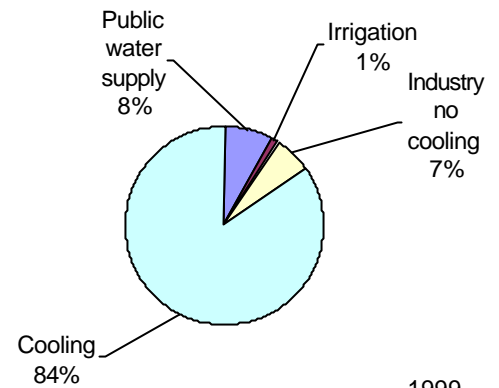
Year	Land area 10 ³ km ²	Population (at the end of the year)	Precipitation	Evoptran spiration	Internal resource	Available resource m ³ /inh.	Total ab- straction mio. m ³	Ab- straction m ³ /inh.	Abs. In% of runoff %
			million m ³						
1995	93,0	10 212 300	64 300,0	59 300,0	5 000,0	489,6	6 054,4	592,9	121,1
1996	93,0	10 174 442	63 500,0	54 600,0	8 900,0	874,7	6 035,4	593,2	67,8
1997	93,0	10 135 358	49 700,0	46 000,0	3 700,0	365,1	5 878,0	579,9	158,9
1998	93,0	10 091 789	68 100,0	54 100,0	14 000,0	1 387,3	5 771,4	571,9	41,2

Source: HCSO, Water Resources Research Centre PLC Hydrological Institute.

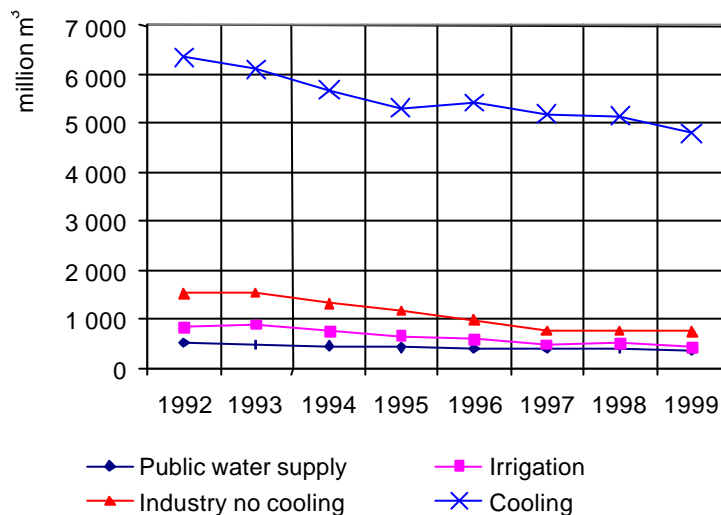
WN3 Water use by sectors

million m ³					
Year	Public water supply	Irrigation	Industry no cooling	Cooling	Total
1992	511,9	325,5	685,9	4 827,4	6 350,7
1993	474,3	426,9	650,5	4 564,5	6 116,2
1994	444,8	290,1	575,5	4 368,1	5 678,5
1995	421,4	227,3	507,5	4 146,3	5 302,5
1996	396,3	192,0	402,0	4 417,6	5 407,9
1997	380,3	92,5	305,6	4 409,8	5 188,2
1998	377,2	115,6	281,3	4 364,5	5 138,6
1999	368,7	55,5	312,1	4 059,7	4 796,0

Source: HCSO; Ministry of Transport and Water Management.

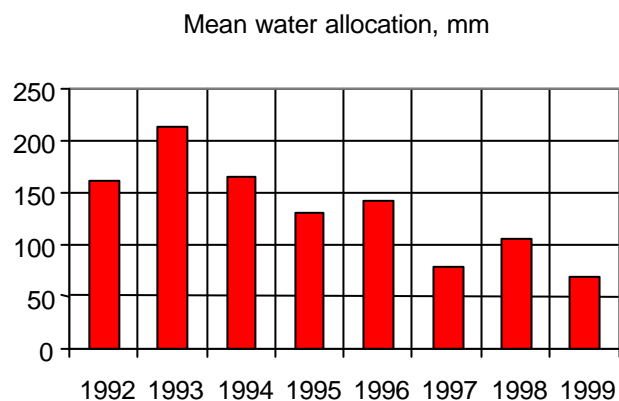


1999



WN4 Irrigation water use

Year	Irrigated area 1000 ha	Irrigation water 10 ⁶ m ³	Mean water allocation, mm
1992	201,2	325,5	161,8
1993	199,9	426,9	213,6
1994	175,4	290,1	165,4
1995	173,4	227,3	131,1
1996	135,6	192,0	141,6
1997	119,0	92,5	77,7
1998	108,4	115,6	106,6
1999	81,0	55,5	68,5

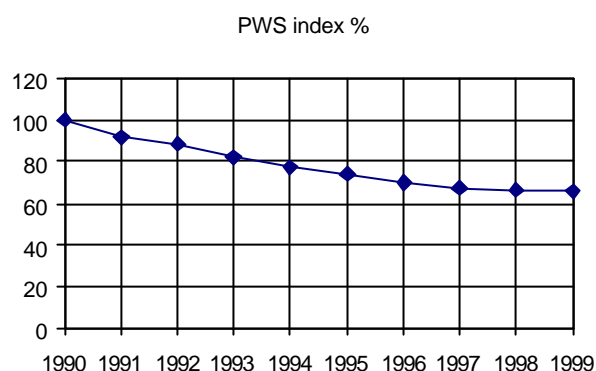
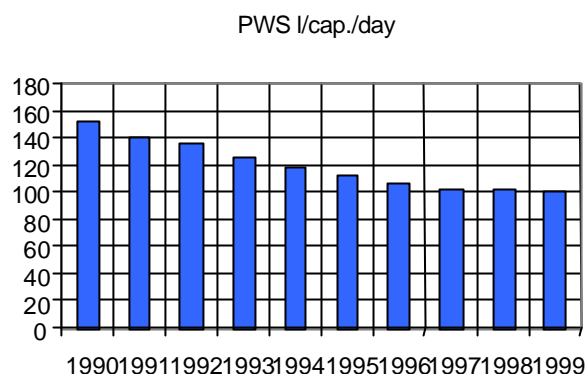


Source: Ministry of Transport and Water Management.

WN5 Public water supply (PWS)

Year	PWS million m ³	Population (at the end of the year), cap.	PWS l/cap./day	PWS index, %
1990	579,29	10 354 842	153	100
1991	530,11	10 337 236	140	92
1992	511,91	10 310 179	136	89
1993	474,28	10 276 968	126	82
1994	444,83	10 245 677	119	78
1995	421,39	10 212 300	113	74
1996	396,30	10 174 442	107	70
1997	380,28	10 135 358	103	67
1998	377,21	10 091 789	102	67
1999	368,73	10 043 224	101	66

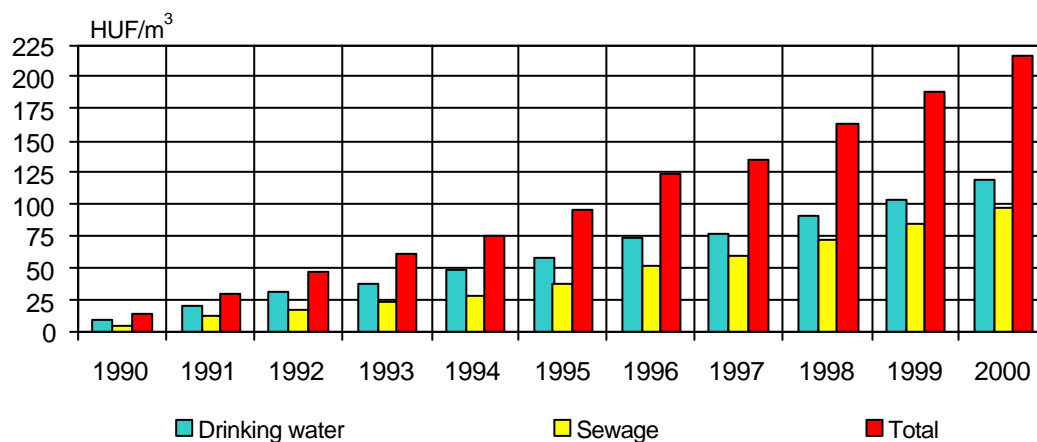
Source: HCSO.



WN6 Water and sewage costs paid by inhabitants

Average costs paid by inhabitants, HUF/m³ (without VAT)

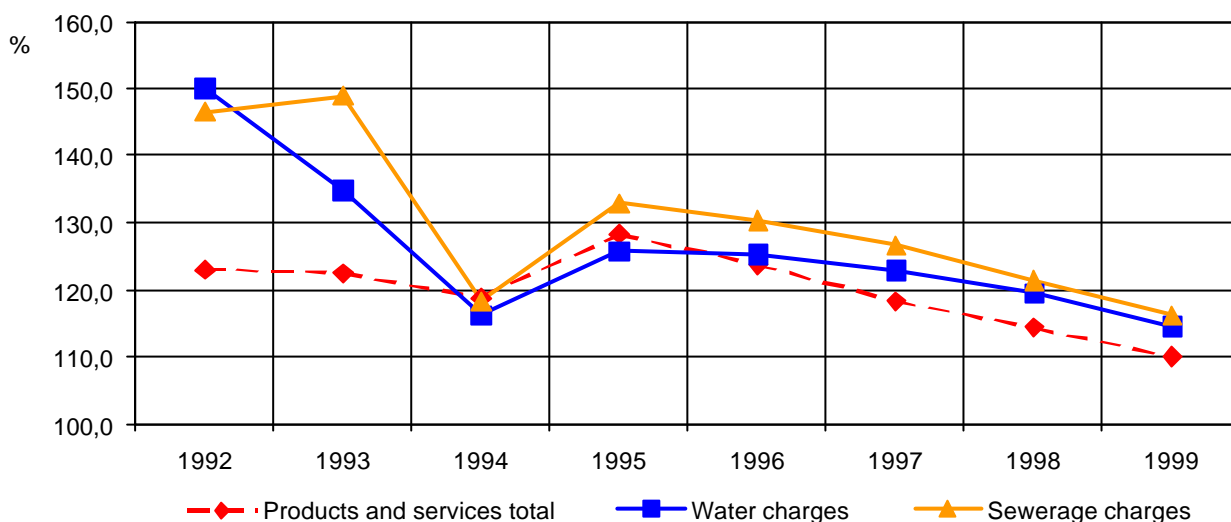
Denomination	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Drinking water	9,1	19,2	31,0	37,7	47,6	57,6	72,4	77,3	91,1	103,9	118,6
Sewage	4,3	11,1	16,4	22,9	28,2	38,4	51,6	58,2	70,9	84,4	96,9
Total	13,4	30,3	47,3	60,6	75,7	95,9	124,0	135,5	162,0	188,3	215,5



Source: HCSO.

Changes in consumer price indexes, as a percentage of previous year

Denomination	1992	1993	1994	1995	1996	1997	1998	1999
Products and services total	123,0	122,5	118,8	128,2	123,6	118,3	114,3	110,0
Water charges	150,0	134,7	116,3	125,6	125,3	122,9	119,4	114,6
Sewerage charges	146,6	148,9	118,2	133,0	130,3	126,7	121,4	116,2

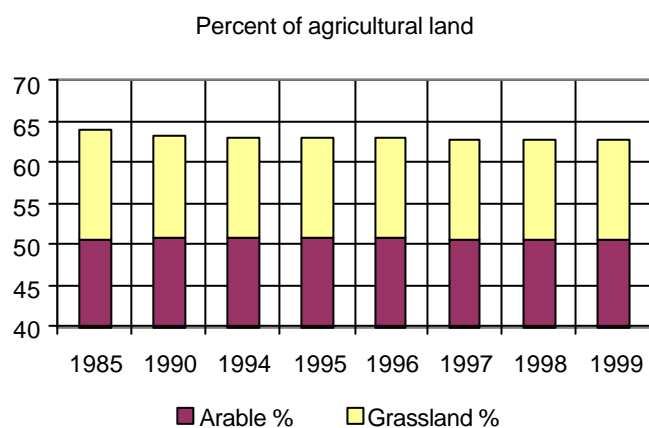


Source: HCSU.

E1a Nitrogen source apportionment % of land area which are arable and grassland Fertilizer application rates kg N,P/ha

Year	Arable %	Grassland %
1985	50,50	13,4
1990	50,7	12,7
1994	50,7	12,3
1995	50,7	12,3
1996	50,7	12,3
1997	50,6	12,3
1998	50,6	12,3
1999	50,6	12,3

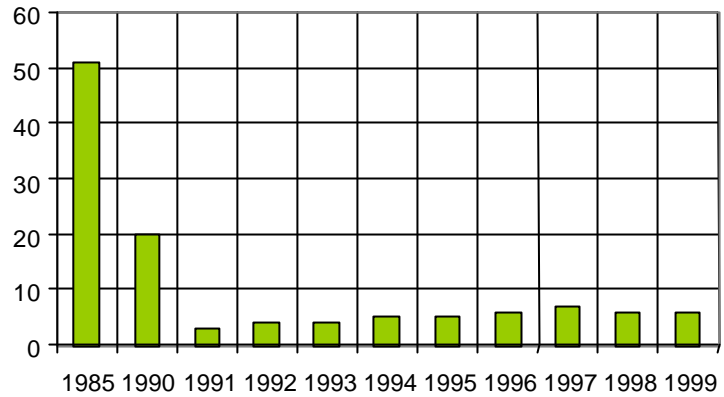
Source: HCSO.



Year	N fertilizer application kg N/ha ^{a)}	P fertilizer application kg P/ha ^{a)}
1985	86	51
1990	55	20
1991	22	3
1992	24	4
1993	26	4
1994	36	5
1995	31	5
1996	33	6
1997	33	7
1998	40	6
1999	43	6

a) In kg of active ingredients.
Source: HCSO.

P fertilizer application (kg P/ha)



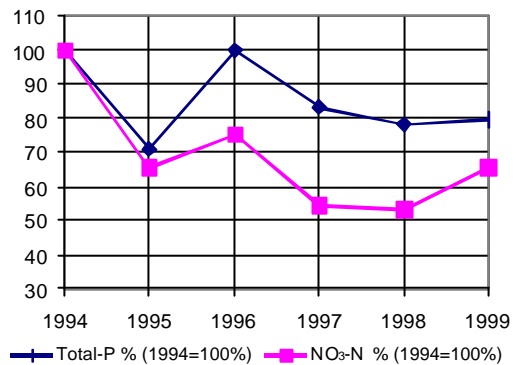
E3a P and N in large rivers

Year	Total-P µg/l	NO ₃ -N mg/l	Total-P% (1994=100%)	NO ₃ -N% (1994=100%)
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Duna – Nagytétény

1994	183	3,51	100	100
1995	130	2,29	71	65
1996	183	2,64	100	75
1997	152	1,90	83	54
1998	143	1,86	78	53
1999	145	2,30	79	66

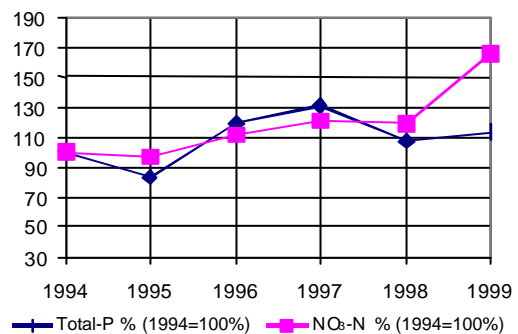
Duna – Nagytétény



Tisza – Tiszasziget

1994	183	1,27	100	100
1995	152	1,23	83	97
1996	219	1,42	120	112
1997	240	1,54	131	121
1998	198	1,52	108	120
1999	207	2,10	113	165

Tisza – Tiszasziget



Source: Institute for Environmental Protection.

E3b P in lakes

Year	Total-P µg/l	Total-P % (1996=100%)
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Balaton – Keszthelyi-öböl

1996	20,5	100
1997	11,1	54
1998	11,1	54

Velencei-tó – Fürdető-medencerész

1996	16,2	100
1997	14,8	91
1998	14,8	91

Tisza-tó – Tiszavalki-medence

1996	145	100
1997	210	145
1998	210	145

Source: Institute for Environmental Protection.

E4a Status of nitrate in groundwater

Watertype ^{a)}	Min.	Max.	Average
	NO ₃ mg/l ^{b)}		
K (karstic)	0,00	175,43	15,84
B (bank filtered)	0,00	163,00	18,00
S1 (20–50m)	0,00	70,00	4,63
S2 (50–100m)	0,00	26,00	1,56
S3 (100–200m)	0,00	60,00	0,83
S4 (200–500m)	0,00	1,00	0,17
S5 (>500m)	0,00	0,50	0,19
G (ground water)	0,00	98,80	15,35

a) S1, S2, S3, S4, S5: Stratum water with depths.

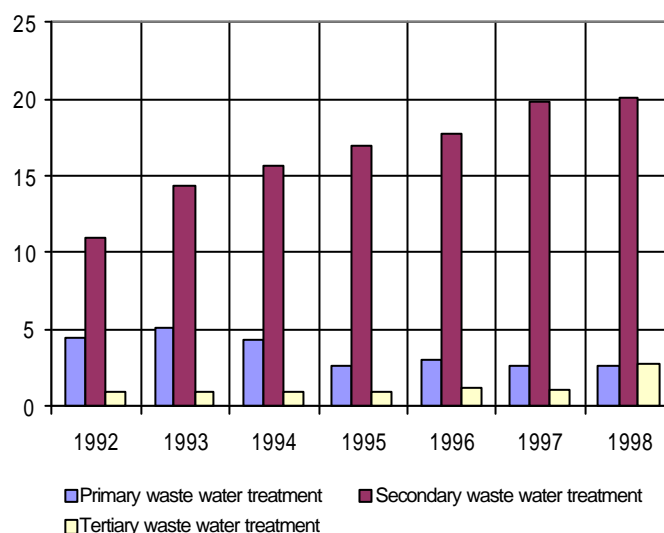
b) Data refer to 1997.

Source: Water Resources Research Center PLC
Hydrological Institute.

E8 Urban waste water treatment

Year	Percent of population which is connected to the ^{a)}			
	primary	secondary	tertiary	total
	waste water treatment			

1992	4,4	11,0	0,9	16,3
1993	5,1	14,3	0,9	20,3
1994	4,3	15,7	0,9	20,9
1995	2,7	16,9	0,9	20,5
1996	3,0	17,7	1,1	21,8
1997	2,7	19,8	1,0	23,5
1998	2,6	20,1	2,8	25,5

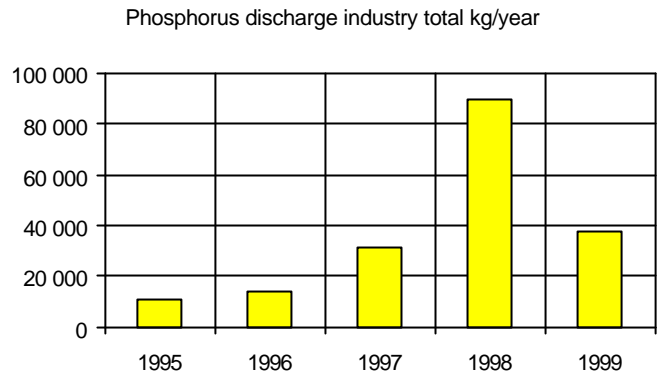


a) Estimated data.

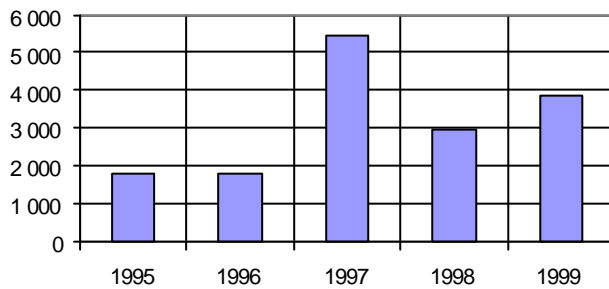
Source: HCSO; Ministry for Environment.

E9 Point source emissions of phosphorus

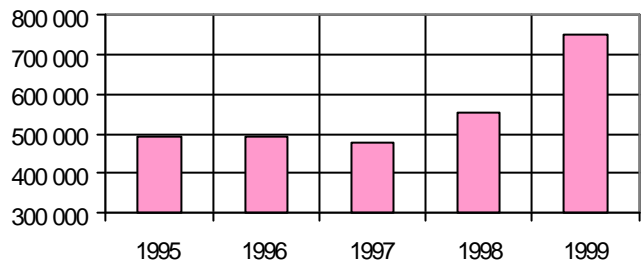
Year	Phosphorus discharge		
	industry total	from pulp and paper industry	from municipal waste water treatment plants
	kg/year		
1995	10 939,6	1 762,0	494 932,8
1996	14 384,0	1 775,0	489 567,0
1997	30 756,0	5 428,0	479 554,1
1998	89 551,0	2 963,0	552 946,0
1999	37 830,0	3 891,0	750 472,0



Phosphorus discharge from pulp and paper industry kg/year



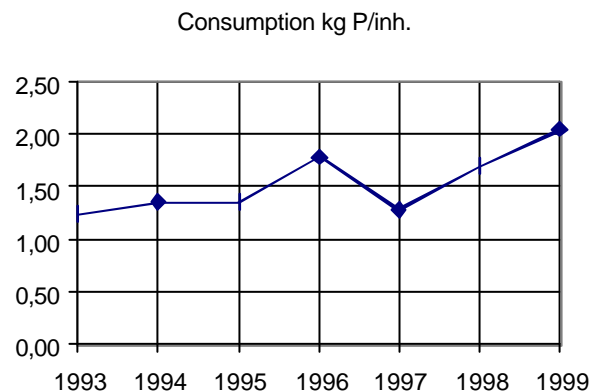
Phosphorus discharge from municipal waste water treatment plants kg/year



Source: Ministry for Environment.

E10 Consumption of phosphorus in detergents per capita

Year	Detergents (total sales), t	Population (at the end of the year), cap.	Consumption ^{a)} , kg P/inh.
1993	63 660	10 276 968	1,24
1994	69 126	10 245 677	1,35
1995	69 302	10 212 300	1,36
1996	90 853	10 174 442	1,79
1997	64 916	10 135 358	1,28
1998	85 550	10 091 789	1,70
1999	102 401	10 043 224	2,04



a) Estimated data from total sales and 20% average content of phosphorus.
Source: HCSO.