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WATER SUPPLY AND SEWERAGE INFRASTRUCTURE IN THE KRAKOW METROPOLITAN AREA OVER THE PERIOD 2003-2013

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Abstract

Water supply and sewerage infrastructure, which characterizes a particular territorial unit, is one of the key elements of its economic development. The sustainability index of water and sewage management system of the specific area, for which the total lengths of both water supply system and sewerage system are similar as it can be clearly seen, looking at the urban units of the Krakow Metropolitan Area, is absolutely vital. The apparent disparity between the lengths of both the water supply system and sewage system in the urban-rural and rural communes with a particularly significant shortage of sewerage infrastructure was shown. This proves the unsustainability of water and sewage management system in the area. A significant improvement in the condition of infrastructure in the analysed decade should be noted. This is clearly linked with the main objective of the Water Framework Directive and the subsequent participation of the analyzed area of KMA in the EU funds and other aid programs which aim at achieving a good level of water by 2015.

Keywords: Krakow Metropolitan Area, water supply and sewerage infrastructure, commune, the municipality, the Water Framework Directive

INTRODUCTION

Expansion of water and sewerage infrastructure is an important determinant of the development of the domestic economy and of improving the standard of living of the population (Piasecki 2013b). Municipal infrastructure, especially sewage and water supply systems, within the Krakow Metropolitan Area showed at the very beginning of establishing the specific functional region of Malopolska a considerable degree of diversity in its various constituent governments. The report of the Statistical Office in Krakow (2013), summarizing the development of the Krakow Metropolitan Area in the years 2004 and 2011, states that water and sewerage infrastructure in the indicated period, as well as in the previous years, was systematically modernized. Intensification of investment in this respect is related to the adjustment of the level of municipal infrastructure to the requirements of the EU law and reasserted in the Water Framework Directive (WFD) the EU 2000/60/EC in which the year of 2015 was set as the date of achieving an optimal state of water and sewerage infrastructure by Poland (Piasecki 2013a). Undertaken investments are also part of a trend of overcoming infrastructure stagnation during and after political transformation in the field of water and sewage management system, particularly in rural communes resulting from negligence of the post-war period (Piasecki 2013c, Kwapisz 2005). In this context, the evaluation of the development of water and sewerage infrastructure of the Krakow Metropolitan Area after the first decade of its functioning provides grounds for research.

THE PURPOSE AND METHODOLOGY OF RESEARCH

The purpose of the study was to determine the saturation and dynamics of changes in water and sewerage infrastructure in the years 2003-2013 in urban, urban-rural, rural communes and towns with county rights being part of the Krakow Metropolitan Area. The data obtained allowed to determine whether establishing in 2003 the urban settlements with the city of Krakow as an economic and administrative centre, contributed within a decade of functioning of the metropolitan area to the increase of water and sewerage infrastructure saturation of municipalities, communes and towns with county rights being part of the area. Individual communes of Malopolska counties, that are Bochnia, Krakow, Miechow, Myślenice, Proszowice, Olkusz and Wieliczka's counties, were incorporated into the Krakow Metropolitan Area. Due to the fact that not all communes of Bochnia, Proszowice, Wadowice, Miechow and Olkusz's counties had been included in the Krakow Metropolitan Area, communes and towns which had county rights were considered as the basic administrative unit thereby

resigning from taking a county as the basic research unit. The condition of water and sewerage infrastructure in the years 2003 and 2013 was described using saturation indicators. To determine the indicators have been taken into consideration the length of collective sewerage system and the length of distributive water supply system based on surface area of 100 km^2 (Gruszczyński, Kwapisz 2000). The obtained results were used to determine a degree of saturation change and a pace of saturation of the mentioned infrastructure in the decade considered in the research consecutively for towns with county rights, municipalities, urban-rural and rural communes. To make the full characteristics of the development of water and sewerage infrastructure of KMA in the analyzed period the assessment of number of water supply and sewerage connections as well as the number of people using the water supply and sewerage systems was carried out. The pace of change in this area was estimated using a dynamic percentage index. The source data was collected on the basis of resources from Local Data Bank of CSO.

CHARACTERISTICS OF THE RESEARCHED AREA

The Krakow Metropolitan Area (KMA) was appointed by the Act No. XV/174/03 of the Malopolska Regional Assembly on 22 December 2003 during modification the zoning plan of the Malopolska Region. The territory of KMA is 4 065,1km^2, covering an area of 50 municipalities (including the City of Krakow), urban-rural and rural communes located in the north-western part of the Malopolska Region (Figure 1). The Krakow Metropolitan Area is located in the area of the Krakow-Czestochowa Upland, the Malopolska Upland, the Sandomierz Basin, the Oswiecim Basin and the Carpathian Foothills. Density of population stands at 370 persons$\times 10^3$m^{-2}. The population oscillates at around 1.5 million, representing 44.6% of the total inhabitants of the Malopolska Region. A concentration of the population is visible in the metropolis (50.6%) and in the municipalities directly adjacent to it. The coefficient of urbanization in 2011 reached the level of 62.6%. Urban-rural and rural communes show a comparable percentage of the population (approx. 23.5%), half lower than in municipalities (53%). The most densely populated urban-rural communes are Wieliczka, Świątniki Górne and Skawina, while the most densely populated rural commune is Zielonki commune. The lowest population density was recorded in rural communes: Gołcza and Drwina. The analyzed settlement area is characterized by significant industrialization and a high share of the service sector in the economy of the region, with their visible concentration in Krakow and neighbouring municipalities. Agricultural communes dominate the northern part of the Metropolitan Area (Report *Krakow Metropolitan Area in the years 2004-2011*,

the US in Krakow in 2013; Report on the condition of zoning of Malopolska Region 2014; *Krakow Metropolitan Area*, Statistical Handbook of Regional Civil Servant 2015).

Source: *Krakow Metropolitan Area*, Statistical Handbook of Regional Civil Servant 2015

Figure 1. The administrative structure of the Krakow Metropolitan Area

RESULTS AND DISCUSSION

In 2003 the total length of the water supply system in the rural communes of KMA amounted to 3501.7 kilometres. Of the 36 rural communes three of them: Tokarnia, Lubień and Trzciana did not have a water supply system. The water supply infrastructure saturation index reached the level of $127.9 \cdot 10^3 m \times 10^5 m^{-2}$. By 2013, there had been an increase of the total length of the system by 733,9 km.

Among the group of the rural communes only the Tokarnia commune still did not have a public water supply system. In the decade 2003-2013 was observed an increase of saturation of water supply infrastructure at 21% (Table 1).

Table 1. Saturation of distributive water supply systems and collective sewerage systems in rural communes of KMA in the years 2003 and 2013.

Rural communes	The length of water supply system in km 2003	The length of water supply system in km 2013	The length of sewerage system in km 2003	The length of sewerage system in km 2013
Biskupice	40,3	101,1	0,0	0,0
Gdów	233,0	257,9	30	37,5
Kłaj	104,7	92,5	47,5	46,7
Brzeźnica	139,2	136,1	15,1	23,1
Trzyciąż	104,8	106	9,0	18,4
Lanckorona	26,8	82,5	2,6	9,5
Stryszów	26,4	53,3	0,0	92,5
Proszowice	180,9	223,1	21,4	28,5
Koniusza	218,8	221	10,8	52,3
Koszyce	39,6	95	24,2	115,0
Nowe Brzesko[1]	98,7	101,8	5,1	0,0
Lubień	0,0	8,4	75	42,2
Pcim	3,4	3,4	8,6	18,0
Raciechowice	64,7	66,7	3,5	3,5
Siepraw	100,7	106	32,3	85,2
Tokarnia	0,0	0,0	0,3	24,2
Wiśniowa	35,1	56,6	15,3	53,1
Gołcza	124,1	128,7	0,0	23,1
Czernichów	132,8	137	48,4	83,4
Igołomia-Wawrzeńczyce	5,3	77,5	1,3	0,0
Iwanowice	155,7	162,2	0,0	12,4
Jerzmanowice-Przeginia	108,9	121,5	0,0	34,3
Kocmyrzów-Luborzyca	204,4	211,2	0,0	33,2
Liszki	166,8	178,0	25,2	90
Michałowice	101	101,4	3,6	18,5
Mogilany	125,8	137,3	31,9	47,6
Sułoszowa	88,0	91,9	0,0	39,2

Rural communes	The length of water supply system in km 2003	The length of water supply system in km 2013	The length of sewerage system in km 2003	The length of sewerage system in km 2013
Wielka Wieś	78,7	95	14,2	111,1
Zabierzów	209,0	232,4	117,0	334,4
Zielonki	126,6	161,6	48,2	167,5
Bochnia	198,1	219,7	36,1	133,5
Drwinia	29,8	120,4	0,0	0,0
Łapanów	125,2	159,2	22,6	28,0
Rzezawa	78,0	108,6	23,7	95,8
Trzciana	0,0	52,6	0,8	34,6
Żegocina	26,4	28,0	13,5	23,7
Total length of systems for rural communes of KMA (10^3m)	3501,7	4235,6	687,2	1960,0
The area of rural communes of KMA (10^3m^2)	2736,91			
Saturation index for rural communes of KMA ($10^3m \times 10^5m^{-2}$)	127,9	154,8	25,1	71,6
Dynamic index (%)	21,0		185,2	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The total length of the sewerage system in rural communes of the Metropolitan Area in 2003 amounted to 687.2 km. Eight of the 36 rural communes among which were Biskupice, Stryszów, Gołcza, Iwanowice, Jerzmanowice-Przeginia, Kocmyrzów-Luborzyca, Sułoszowa, Drwinia did not have a sewerage system. The sewerage infrastructure saturation index equalled to $25.1 \cdot 10^3m \times 10^5m^{-2}$. By 2013, there had been an increase of 1272.8 km of the total length of the sewerage system in the group of rural communes. But two of them, which are Drwina and Biskupice, still do not have a sewerage system, while Igołomia-Wawrzeńczyce and Brzesko communes, which in 2003 had access to the researched infrastructure, there was no active sewerage system in 2013. However, in the decade was observed a significant increase of 185.2% in the sewerage infrastructure saturation index (Table 1).

In the rural communes the number of water supply connections in 2003 amounted to 61816 units. Of the 36 rural communes, residents of three communes: Tokarnia, Lubień and Trzciana did not have water supply connections. By 2013,

[1]The Ordinance of the Council of Ministers of 20 December 2010 classified Municipality of Nowe Brzesko as urban-rural commune from 1st January 2011. For statistical purposes because of the area and nature of the municipality it was adopted as a rural commune.

the number of connections had increased by 37%. But, at the end of the research period residents of the Tokarnia commune still did not have access to water supply connections (Table 2).

Table 2. Water supply and sewage connections in rural communes of KMA in years 2003 and 2013.

Rural communes	The number of water supply connections 2003	The number of water supply connections 2013	The number of sewerage connections 2003	The number of sewerage connections 2013
Biskupice	1052	2132	0	0
Gdów	3675	3989	512	988
Kłaj	2757	2750	943	1126
Brzeźnica	2255	2600	161	281
Trzyciąż	1894	2043	215	333
Lanckorona	412	1246	14	133
Stryszów	427	835	0	1229
Proszowice	2748	3471	755	918
Koniusza	1957	2182	103	409
Koszyce	681	838	387	1048
Nowe Brzesko	1384	1444	233	309
Lubień	0	262	1130	614
Pcim	42	62	115	277
Raciechowice	636	844	59	74
Siepraw	1295	1902	423	832
Tokarnia	0	0	6	429
Wiśniowa	504	1023	270	697
Gołcza	1690	1790	0	378
Czernichów	3164	4041	779	1356
Igołomia-Wawrzeńczyce	99	1038	12	0
Iwanowice	1992	2426	0	236
Jerzmanowice-Przeginia	2607	2841	0	497
Kocmyrzów-Luborzyca	2924	4373	0	497
Liszki	3601	4442	630	1990
Michałowice	1964	3452	64	231
Mogilany	2060	3772	825	1219
Sułoszowa	1351	1457	0	793

Rural communes	The number of water supply connections 2003	The number of water supply connections 2013	The number of sewerage connections 2003	The number of sewerage connections 2013
Wielka Wieś	2580	3669	245	1706
Zabierzów	5191	6741	1854	6101
Zielonki	3375	5998	1365	3755
Bochnia	3647	4896	4387	10209
Drwinia	398	1329	0	0
Łapanów	1344	1813	323	456
Rzezawa	1650	1916	481	1791
Trzciana	0	326	39	459
Żegocina	460	740	256	685
The total number of connections for rural communes of KMA	61816	84683	16586	42056
Dynamic index (%)	37		154	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The number of sewerage connections in rural communes in 2003 amounted to 16586 units. In the group of 36 rural communes residents of eight of them among which were Biskupice, Stryszów, Gołcza, Iwanowice, Jerzmanowice-Przeginia, Kocmyrzów-Luborzyca, Sułoszowa, Drwinia did not have sewerage connections. By 2013, the number of connections had increased by 154%. But still, in two communes Biskupice and Drwina there were no sewer connections while in Igołomia-Wawrzeńczyce commune, which in 2003 had 12 connections, no increase has been observed by 2013 (Table 2).

The number of people using a water supply system in rural communes of KMA in 2003 amounted to 225.3 thousand residents. In the decade was observed an increase of 22% in the number of residents using water supply infrastructure (Table 3).

In 2003 the number of people using sewerage infrastructure in rural communes of KMA amounted to 53.7 thousand residents. By 2013 there had been a significant increase of 129% in the number of residents using a sewerage system (Table 3).

In urban-rural communes of the Krakow Metropolitan Area in 2003, the total length of the water mains was 1,528.5 km. Of the 12 urban and rural communes all of them had water supply systems. The water supply infrastructure saturation index was equal to $157.3 \cdot 10^3 m \times 10^5 m^{-2}$. By 2013 there had been an increase of 388.5km of the total length of the system. Thus, the water supply infrastructure saturation index increased by 25.4% compared to 2003 (Table 4).

Table 3. Number of people using the collective water supply and sewage systems in rural communes of KMA in years 2003 and 2013

Rural communes	Users of water supply system 2003	Users of water supply system 2013	Users of sewerage system 2003	Users of sewerage system 2013
Biskupice	3117	5820	0	0
Gdów	11895	13775	2093	4120
Kłaj	9778	9435	4025	4703
Brzeźnica	8230	8550	533	960
Trzyciąż	6732	6720	1044	1410
Lanckorona	1202	3209	52	589
Stryszów	860	2088	0	3484
Proszowice	12267	13184	5651	6275
Koniusza	7092	7483	541	1786
Koszyce	2135	2500	1433	2786
Nowe Brzesko	4442	4537	723	965
Lubień	8864	9657	2271	2721
Pcim	509	1015	1551	2282
Raciechowice	2555	3172	196	407
Siepraw	5359	6589	884	3041
Tokarnia	481	307	63	2158
Wiśniowa	1179	2756	781	2660
Gołcza	5417	5308	0	1224
Czernichów	9944	11417	2848	4537
Igołomia-Wawrzeńczyce	653	3412	122	127
Iwanowice	7114	7924	0	528
Jerzmanowice-Przeginia	10094	10496	0	2588
Kocmyrzów-Luborzyca	10432	12705	0	1756
Liszki	11584	13288	2031	6087
Michałowice	6467	9047	396	1331
Mogilany	6590	10220	2553	4362
Sułoszowa	5439	5362	0	2665
Wielka Wieś	8181	10395	1003	5562
Zabierzów	18052	21476	8718	17819
Zielonki	11851	17364	5023	11771
Bochnia	12375	15301	1075	3287

Rural communes	Users of water supply system 2003	Users of water supply system 2013	Users of sewerage system 2003	Users of sewerage system 2013
Drwinia	1635	3869	0	0
Łapanów	4833	5668	1367	2071
Rzezawa	5993	6977	2011	5549
Trzciana	0	1229	201	1721
Żegocina	1927	2804	1194	2602
Percentage share in relation to the total population of KMA(%)	15,0	18,4	3,6	8,2
Dynamic index(%)	22		129	
KMA population (2013) (thousand)	1 498 499			

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

Table 4. Saturation of distributive water supply systems and collective sewerage systems in urban-rural communes of KMA in years 2003 and 2013.

Urban-rural communes	The length of water supply systems in km 2003	The length of water supply systems in km 2013	The length of sewerage systems in km 2003	The length of sewerage systems in km 2013
Nowy Wiśnicz	23,4	76,1	9,7	24,6
Krzeszowice	247,4	266,6	51,5	105,4
Skała	100,00	106,3	16,8	110,4
Skawina	156,8	254,2	36,6	91,5
Słomniki	146,3	174,2	9,4	16,9
Świątniki Górne	70,5	73,6	6,7	18,8
Dobczyce	133,9	145,7	28,3	46,3
Myślenice	198,5	256,5	97,6	292,6
Sułkowice	37,1	77,3	11,0	67,7
Proszowice	180,9	223,3	21,4	28,6
Kalwaria Zebrzydowska	127,7	138,2	9,2	16,2
Wadowice	106	125,0	98,1	157,9
Total length of systems for urban-rural communes of KMA (10^3m)	1528,5	1917,0	396,3	976,9

Urban-rural communes	The length of water supply systems in km 2003	The length of water supply systems in km 2013	The length of sewerage systems in km 2003	The length of sewerage systems in km 2013
The area of urban-rural communes of KMA (10^3m^2)	971,43			
Saturation index for urban-rural communes of KMA ($10^3m \times 10^5m^{-2}$)	157,3	197,3	40,8	100,6
Dynamic index (%)	25,4		146,5	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The total length of the sewerage system in urban-rural communes of KMA in 2003 amounted to 396.3 km. All of the analyzed municipalities and communes had a sewerage system. The saturation index was equalled $40.8 \cdot 10^3 m \times 10^5 m^{-2}$. By 2013, there had been an increase of 580.6 km of the total length of the sewage system. This indicates a significant increase of 146.5% in the sewerage infrastructure saturation index in the audited decade (Table 4).

The number of water supply connections in the urban-rural communes of the Krakow Metropolitan Area amounted to 12051 units in 2003. All of the 12 urban and rural communes had water connections. By 2013, there had been an increase of 26% in the number of connections (Table 5).

Table 5. Water supply and sewage connections in the urban-rural communes of KMA in years 2003 and 2013

Urban-rural communes	Number of water supply connections 2003	Number of water supply connections 2013	Number of sewerage connections 2003	Number of sewerage connections 2013
Nowy Wiśnicz	693	756	253	315
Krzeszowice	7684	8101	1734	2943
Skała	2866	3629	1082	2100
Skawina	4964	7272	908	2483
Słomniki	2033	2445	645	793
Świątniki Górne	1545	2553	168	322
Dobczyce	2910	3647	661	1193
Myślenice	5806	7671	3373	6560
Sułkowice	1325	2024	166	1119
Proszowice	2748	3471	755	918

Urban-rural communes	Number of water supply connections 2003	Number of water supply connections 2013	Number of sewerage connections 2003	Number of sewerage connections 2013
Kalwaria Zebrzydowska	3268	3930	294	316
Wadowice	4352	5048	2012	3347
The total number of connections for urban-rural communes of KMA	40194	50547	12051	22409
Dynamic index (%)	26		66	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

Table 6. Number of people using the collective water supply and sewage systems in urban-rural communes of KMA in years 2003 and 2013

Urban-rural communes	Users of water supply systems 2003	Users of water supply systems 2013	Users of sewerage systems 2003	Users of sewerage systems 2013
Nowy Wiśnicz	3191	5527	1122	2383
Krzeszowice	29470	30710	9723	13790
Skała	8549	9651	3419	5810
Skawina	34947	38504	18549	23309
Słomniki	9476	10036	3455	3759
Świątniki Górne	6268	7994	586	1297
Dobczyce	11395	13047	4292	6087
Myślenice	25403	30598	18955	28154
Sułkowice	6308	8353	1160	5426
Proszowice	12267	13184	5651	6275
Kalwaria Zebrzydowska	10557	12637	16360	1769
Wadowice	27880	29590	20732	25158
Percentage share in relation to the total population of KMA(%)	12,4	14,0	6,9	12,3
Dynamic index(%)	13,0		18,5	
KMA population (2013) (thousand)	1 498 499			

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The number of sewage connections in the urban-rural communes amounted to 12051 units in 2003. Residents of all 12 urban and rural communes possessed sewage connections. By 2013, there had been an increase of 66% in the number of connections (Table 5). In 2003 the population using a water supply system in urban-rural communes of KMA amounted to 185.7 thousand residents. In the decade was observed an increase of 13% in the number of residents using water supply infrastructure (Table 6).

The number of people using sewerage infrastructure in the urban-rural communes of KMA in 2003 amounted to 104.0 thousand residents. By 2013, there had been a significant increase of 18.5% in the number of people with access to the sewerage system (Table 6).

In towns with county rights of the Krakow Metropolitan Area the total length of the water supply system in 2003was 1,121.4 km. The water supply infrastructure saturation index was equal to 343.1 persons$\times 10^3 m^{-2}$. By 2013, there had been an increase of 224.3 km of the total length of the system. Thus, the water supply infrastructure saturation index increased by 20% compared to 2003 (Table 7).

Table 7. Saturation of distributive water supply systems and collective sewerage systems in towns with county rights of the Krakow Metropolitan Area in years 2003 and 2013.

Towns with county rights	The length of water supply systems in km 2003	The length of water supply systems in km 2013	The length of sewerage systems in km 2003	The length of sewerage systems in km 2013
Krakow	1121,4	1345,7	1049,9	1360,0
Area of KMA ($10^3 m^2$)	326,85			
Saturation index for towns with county rights of KMA ($10^3 m \times 10^5 m^{-2}$)	343,1	411,7	321,2	416,1
Dynamic index (%)	20		30	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The total length of the sewerage system in towns with county rights of KMA in 2003 amounted to 1049.9 kilometres. The saturation index amount came to 321.2 persons$\times 10^3 m^{-2}$. By 2013, there had been an increase of the total length of the sewage system of 310.1 km. This suggest an increase of 30% in the sewerage infrastructure saturation index in the audited decade (Table 7).

In the municipalities of the Krakow Metropolitan Area the total length of the water supply system in 2003 equalled 66.8 km. The water supply infrastructure saturation index was amounted to 223.3 persons$\times 10^3 m^{-2}$. By 2013, there

had been an increase of 12.5 km of the total length of the system. Thus, the water supply infrastructure saturation index increased by 19% compared to 2003 (Table 8).

Table 8. Saturation of distributive water supply systems and collective sewerage systems in municipalities of KMA in years 2003 and 2013.

Municipalities	The length of water systems in km 2003	The length of water systems in km 2013	The length of sewerage systems in km 2003	The length of sewerage systems in km 2013
Bochnia	66,8	79,3	69,6	150,6
Area of KMA (10^3m^2)	29,92			
Saturation index for municipalities of KMA ($10^3m \times 10^5m^{-2}$)	223,3	265,0	232,6	503,3
Dynamic index (%)	19		116	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The total length of the sewerage system in the municipalities in 2003 amounted to 69.6 km. By 2013, there had been an increase of 81 km in the length of the sewerage system. The saturation index increased considerably by 116% in comparison with the year 2003 (Table 8).

In towns with county rights of the Krakow Metropolitan Area the number of water supply connections in 2003 amounted to 33,705 units, while in the municipalities to 3691 units. By 2013, there had been an increase in the number of connections in towns with county rights of 22% and in municipalities of 21% (Table 9).

Table 9. Water supply and sewage connections in towns with county rights and municipalities of KMA in years 2003 and 2013

Towns with a county status	The number of water supply connections 2003	The number of water supply connections 2013	The number of sewerage connections 2003	The number of sewerage connections 2013
Krakow	33705	40662	28476	37986
Dynamic index (%)	21		33	
Municipalities				
Bochnia	3691	4490	1891	3187
Dynamic index (%)	22		69	

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

In 2003 the number of sewage connections in towns with county rights amounted to 28476 units. By 2013, there had been an increase of 33% in the number of connections. At the same time was noticed an increase of 69% in the number of connections in municipalities (Table 9).

The number of users the water supply system in towns with county rights of the Krakow Metropolitan Area amounted to 706.6 thousand residents. In the decade was observed an increase of the number of users water supply infrastructure of 7.1%. At the same time the number of residents using water supply system in the municipalities of KMA increased by 4.1% (Table 10).

Table 10. Number of users of water supply and sewerage systems in towns with county rights and municipalities of KMA in years 2003 and 2013.

Towns with a county status	Users of water supply systems 2003	Users of water supply systems 2013	Users of sewerage systems 2003	Users of sewerage systems 2013
Krakow	706650	756828	670646	692844
Percentage share in relation to the total population of KMA (%)	4,7	5,1	4,5	4,6
Dynamic index (%)	7,1		3,3	
KMA population (2013) (thousand)	1 498 499			
Municipalities				
Bochnia	26993	28102	23178	25413
Percentage share in relation to the total population of KMA (%)	1,8	1,9	1,5	1,7
Dynamic index (%)	4,1		9,6	
KMA population (2013) (thousand)	1 498 499			

Source: own calculations based on the Local Data Bank of Central Statistical Office in Warsaw

The number of people using the sewerage system in towns with county rights of KMA in 2003 amounted to 670.6 thousand residents. In the decade was observed an increase of 3.3% in the number of residents using water supply infrastructure. At the same time the number of residents benefiting from a sewerage system amounted to 23.2 thousand in the municipalities of KMA. By 2013, the number of residents utilizing sewerage infrastructure had grown by 9.6% (Table 10).

SUMMARY

Close values of the total lengths of both water and sewerage systems are a significant indicator of the sustainability of water and sewage management system of the given area. In the analyzed region a sustainable level of development of the water and sewage management system in 2013 was reached by the city of Krakow and the Bochnia Municipality with a constant upward trend of water and sewerage infrastructure saturation in these areas in the first decade of functioning of KMA. In 2013 in the urban-rural and rural communes was evident a significant disproportion between the lengths of water supply and sewerage systems with a significant shortage of sewerage infrastructure which indicates an unbalanced water and sewage management system in these municipalities in the analyzed decade.

For urban-rural municipalities in the year 2013, saturation factor increase of the water supply network by 25.4% while the sewerage network by 146.5% compared to the year 2003. The higher level of expansion of water supply system over sewerage system in the rural communities may result from the functional type of the communes and their focus on agriculture with the dominance of greenhouse cultivation and fruit farming. This trend is likely to continue in the coming years. In relation to 2003 in designated municipalities significantly increased the number of water supply and sewage connections in rural and urban-rural communes as well as the number of users the water and sewer infrastructure.

For rural municipalities in the year 2013, saturation factor increase of the water supply network by 21% while the sewerage network by 185.2% compared to the year 2003. There were municipalities, which in the years 2003-2013 did not undertake the construction of a sewerage system and numerous cases of municipalities that in the audited decade effectively finalized the construction process. All municipalities of the Krakow Metropolitan Area had had water supply system by 2013. Therefore it can be concluded that establishing the Krakow Metropolitan Area as an active beneficiary of national and the EU funds contributed overall to the increase of water supply and sewerage infrastructure saturation in the constituent municipalities, communes and towns with county rights.

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