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Ryszard Gładysz

THE STATE OF SEWAGE SYSTEM ECONOMICS IN RURAL AREAS IN POLAND

Summary

Infrastructure is the basis of economic activities both in urban and in rural areas. It is also one of main conditions for improving quality of life. Among its most important elements are: water delivery system, as well as sewage treatment network and sewage treatment plants. These devices should create one composite techno-economical system. Non-integrated water delivery contributes to bigger waste of water, and without connection to integrated sewage treatment systems, it can be a serious threat to the environment

In Poland, and in rural areas particularly, this situation is highly unsatisfactory. In 2007, share of population connected to water network in rural areas was 73.3%, while for sewage network is was only 21.3%. In many communes, this share was even less than 10%. One can mention a few reasons of this state, mainly: lack of sufficient investment for 40 years after the 2nd World War, big water deficit in rural areas (brought about by droughts and thus, big reduction or decline of water level in shallow homestead wells, being a main water source), big dispersion of rural settlements in the country, limiting economies of scale achievement, and lack of resources available for local authorities.

The latter, having not enough resources for infrastructure development, made a decisions to concentrate on water system firstly, while more costly waste management was treated as a second-tier need. In consequence, bigger investment in this field has just started since the half of nineties in the 20th century.

Despite this late investment, in December 2007 one could observe that the total length of sewage network was still 4 times shorter than water network. Only 15.5% of rural administrative units were canalized. A quantity of household wastewater purified was 5 times smaller than a quantity of water used. There was also a small number of household sewage treatment plants (figure 4), which can be a good response for dispersed rural settlements. Thus, cesspools (many of them leaking), remain the main way of wastewater collection, being a serious threat for environment.

However, there is a hope that this situation will change during next 7–10 years, mainly by obliging Poland to follow the EU Directive 91/271/EEC. This law expects any European Union member state to create, till the end of 2015,

wastewater networks and sewage treatment plants in any agglomeration having more than 2 thousand inhabitants. In Polish National Sewage Treatment Program, almost 1600 administrative units of these kind, were indentified. 1400 of them are totally or partially inhabited by rural community. Releasing this program is, however, determined strongly by local self-government activity and its ability to gain sufficient financial resources for this purpose.

Key words: rural areas, wastewater management, investments, local self-government, environmental protection

INTRODUCTION

Infrastructure, particularly technical one, is the basis of economic activities both in urban and in rural areas. It has a huge impact on the scope, structure, and spatial distribution of economic activity. Its level of development affects substantially the attractiveness or unattractiveness of particular areas, the inflow of capital resources and, thus, the creation of new workplaces. It is also one of the most important conditions for improving the living standards of the population and is the basis of social organization [Jasiulewicz 2002]. In weakly urbanized areas, development of technical infrastructure is considered to be one of the most important conditions for eliminating disparities between villages and towns. Currently, in majority of regions, this ratio is worse in villages than in urban areas.

Water supply and water treatment are very important elements of technical infrastructure. Well functioning water systems, with dwellings equipped with sanitary installations, improve the quality of water, eliminate its deficit and the need for long-distance transporting, as well as facilitate personal hygiene and improve health conditions. These systems promote also modernization of agriculture and the intensification of agricultural production, particularly breeding. However, they can also contribute to also multiplication of water consumption and increase the quantity of wastewater generated. In case of low-level of water treatment systems' development, deterioration of sanitary conditions and degradation of many elements of the environment, (especially groundwater and surface water) can be a threat. Thus, these problems should be perceived as a complex challenge and must be solved together. Rural areas, which are eligible for the integrated water supply and sewage drains, combined with wastewater treatment systems, should create one complex system. In other places, equipping homesteads with local household sewage treatment plants is necessary. However, they should be effective enough to prevent damaging the environment by wastewater [Gładysz 1997, 2007].

In Poland, almost till the half of nineties, this issue has been treated as a one-side problem (ensuring water supply while neglecting investment concerning sewage treatment). In effect, while in 1990 the overall length of integrated

sewage system in rural areas was 20 times shorter than water pipelines' length, in 1998 this ratio has fallen only to 14.

Among the main reasons of this state one can mention:

– scarcity of state financial resources dedicated to sewage system investment with simultaneous concentration of investment decisions on central government level (neglecting local needs);

– big water deficit in rural areas in eighties and in first half of nineties, brought about by long period of droughts and thus, big reduction or decline of water level in shallow homestead wells, being a main water source;

– cost of building sewage treatment system, being several times larger than water system development; in the face of the problem of scarcity of budgetary resources, building wastepipes was cheaper and gave faster results.

For over 40 years after the 2nd World War, infrastructure investment was financed almost only from state budget or other public resources. This situation changed after administrative reform of Poland in 1990, introducing local self-government and equipping communes with properties and financial resources (local taxation). From that time, communes as local self-governments became responsible for meeting the collective needs of the community, including water delivery and sewage treatment. In the face of water deficit and being under pressure of local communities requiring better conditions of water delivery, rural communes having indeed only their own budgetary resources at disposal, concentrated on water system investment, regarding waste treatment as a second-tier public need.

The aim of this paper is to present the scope and the effectiveness of investment projects, undertaken by local authorities in the field of sewage system economics in Polish rural areas in years 1999-2007. Besides, description of the current state of this system, in the context of its regional differentiation , is also a subject of this analysis.

CHARACTERISTICS OF RURAL AREAS IN POLAND

Poland as a country with area of 312,700 square kilometer and 38.1 million of inhabitants (in year 2007), is one of the biggest and most populated countries in Europe. It is divided into 16 regions called voivodships (Polish *województwo*), 379 counties (Polish *powiat*) and 2478 communes as basic self-government units (Polish *gmina*). Over 93% of territory of Poland are rural areas, which are relatively low populated (average population density of 53 persons per square kilometer). Polish rural areas have 14.8 million inhabitants, so 38.8% of total population of Poland (in December 2007).

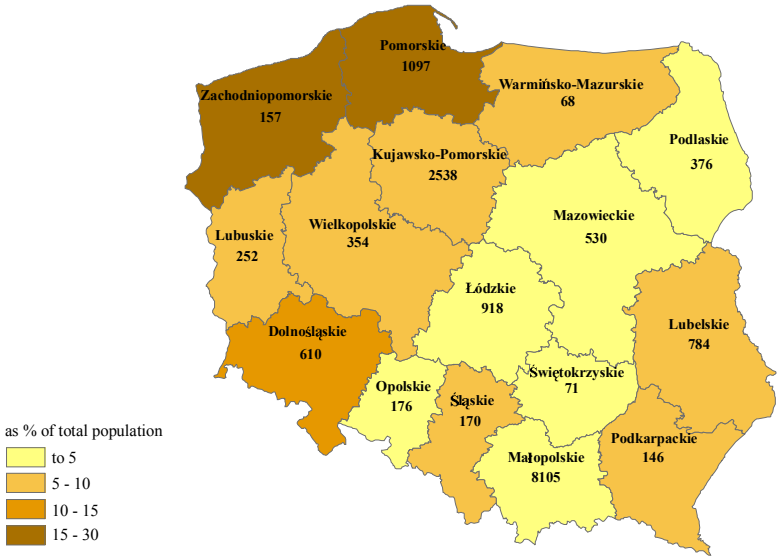
In 2007, network of rural settlements network consisted of 53,815 administrative units composing together 40,398 sub-communal local communities

(Polish *sołectwo*) [Rocznik… 2008], which can be characterized by high level of spatial dispersion. This settlement network, especially in south-eastern part of Poland, is dominated by very small sizes of local administrative units. Over 20% of them consist of several homesteads only. It is one of important reasons of making costs of infrastructure development very costly (lack of economies of scale). In many areas, building sewage system network is just economically unjustified. What is more, these 2171 rural communes are also lacking budgetary resources. In 2007, in 1060 of them average own budget revenue *per capita* stated for only 700 PLN with Polish average of 1046 PLN. Over 75% of these cases was observed in following voivodships: Lubelskie, Świętokrzyskie and Podkarpackie. The smallest number of indigent rural communes (less than 20% of communes in region) was observed in: Dolnośląskie, Lubuskie and Zachodniopomorskie [Bank…].

The factors mentioned above do not change the fact that integrated systems should be in the future the basic way of sewage treatment in both urban and rural areas. According to Polish National Sewage Treatment Program, circa 900 of rural communes being totally included to agglomerations with the number of inhabitants bigger than 2 thousand, are in 80–90% intended to be connected to integrated complex systems. In remaining ones, the percentage of connections should be between 40 and 60. In other communes, self-governments are obliged to initiate investments aiming at building small household sewage treatment plants, replacing hitherto functioning less effective and often permeable septic tanks.

CHANGES IN THE SEWAGE SYSTEM ECONOMICS IN THE PERIOD 1999–2007

At the beginning of 1999, just after introducing administrative reform of Poland (replacing "old" 49 voivodships with 16 "new ones"), the length of water treatment system in rural areas was 10,662 km with 167.8 thousand homesteads connected. Waste was transported to 1010 sewage treatment plants. The share of rural population having access to water systems was 8.5% and to sewage systems – 7.0% only. From the spatial point of view, the best situation was observed in the Zachodniopomorskie, Pomorskie and Dolnośląskie voivodships (it was an effect of big number of administrative units, having water and sewage system infrastructure in former state-owned agricultural farms). The worse situation was observed in Łódzkie, Świętokrzyskie and Mazowieckie (see Fig. 1). As far as local household sewage treatment plants are concerned, only 16,355 were recorded and what is more, almost 50% (8,105) was concentrated in one region only (Mazowieckie), while Świętokrzyskie or Śląskie had only 70 household sewage treatment plants each [Ochrona… 2008].



Numbers on the map reflect the numbers of household sewage treatment plants

Fig. 1. Population having access to integrated sewage treatment plants at the beginning of 1999 (based on *Ochrona środowiska 1999*)

SEWAGE TREATMENT PLANTS

Since the half of nineties, when vast majority of communes managed to develop water systems, more and more of them decided to concentrate on sewage treatment. For example, expenditures on these goals in 1997 were higher than investment concentrating on water systems and water treatment stations for the first time in the history.

In almost every case, building or modernizing sewage plants was the first step of an investment. In the period 1999–2002, taking into account spending and number of projects realized, the biggest expenditures were observed in voivodships: Wielkopolskie and Mazowieckie and the smallest in: Świętokrzyskie, Warmińsko-Mazurskie, Podlaskie and Lubuskie. Average expenditures stated for 230–300 million PLN yearly. In effect, 662 objects with a total throughput of 217.8 thousand cubic meters daily, were built.

The peak of water treatment system expenditures was observed in 2003 (554.3 million PLN), mainly thanks to the Kujawsko-Pomorskie voivodship, where many modernization projects have been realized (56% of total expenditures in Poland). Next years, expenditures varied within the limits of 273–348 PLN per inhabitant (current prices). The biggest activity, similarly to previous

years, was observed in big voivodships: Wielkopolskie and Mazowieckie, but also in smaller ones: Małopolskie, Podkarpackie and Śląskie. The smallest expenditures were noticed in voivodships: Podkarpackie and Świętokrzyskie.

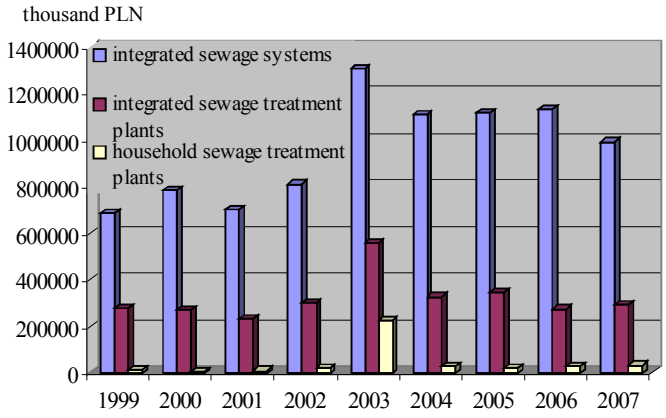


Fig. 2. Expenditures of communes on sewage system development in years 1999–2007 (author's own study)

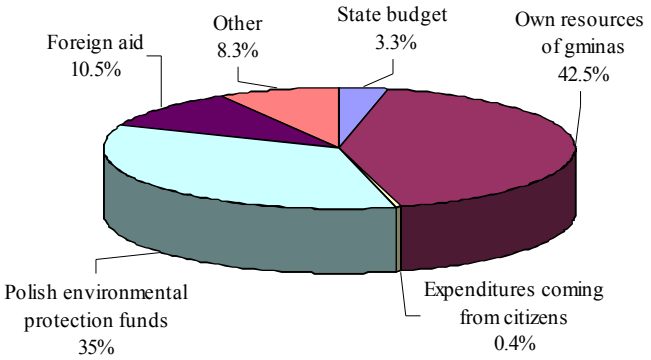


Fig. 3. Sources of financing of integrated sewage plants in rural areas in years 1999–2007 (author's own study)

In years 1999–2007, around 1350–1400 investment projects concerning construction and modernization of sewage systems in rural areas, have been undertaken. In effect, new 1100 large-scale objects (and circa 200 local ones)

were created, while next 300 were modernized. The biggest number of them comes from: Wielkopolskie, Mazowieckie and Małopolskie (111); the smallest in: Opolskie, Świętokrzyskie and Podlaskie (see Table 1).

Own budgetary resources of communes was a basic source of financing these projects (see Fig. 3). They accounted for 42.5% of all expenditure during years 1999–2007. The second important source of resources were Polish environmental protection funds (35.0%). These were primarily (2/3) low-interest loans coming from Regional Funds for Environmental Protection and Water Management, and to smaller extent – loans and grants from National Fund for Environmental Protection and Water Management. In years 2004–2007, some part of local self-governments obtained foreign grants, mainly from European Union programs. Two of these programs have played the major role: SAPARD (Special Accession Program for Agriculture and Rural Development), being a pre-accession fund aiming at supporting infrastructure development in rural areas (projects submitted and realized in years 2002–2004, payment were made till 2006), and IROP (The Integrated Regional Operational Program) realized just after Poland's accession to EU in years 2004–2006 (payments till the end of 2008). In effect, while during the years 1999–2007, the share of foreign grants in total sewage infrastructure financing was 10.5%, it was already 29.1% in the period 2004–2007.

Beside integrated sewage plants, expertise and finances from local self-governments helped also to build 23,735 household sewage treatment plants with throughput 1–5 cubic meter daily each. The biggest number of them was built in Kujawsko-Pomorskie and Lubelskie (over 4.5 thousand in each region), while very few (less then 300) in: Warmińsko-Mazurskie, Opolskie, Lubuskie and Podkarpackie (see Table 1). In this case, loans from Regional Funds for Environmental Protection and Water Management were the main source of financing (60.1%). Budgetary aid stood for 16.1% while expenditures coming directly from citizens – 14.7%. Some projects were also financed form EU funds (of a total sum 13.1 million PLN).

INTEGRATED SEWAGE SYSTEMS

Like building sewage treatment plants, also development of sewage pipelines exacerbated just in the second half of nineties. In 1996, the expenditures on this goal were only 384.0 million PLN, but it was much more already in 1997 (530 million PLN). Expenditures in 1999 stood for 681.9 million PLN and in 2003, they exceeded 809,4 million PLN [Ochrona… 2004]. The biggest share of these investment was observed in the Mazowieckie, Podkarpackie, Wielkopolskie and Małopolskie voivodships.

In the period 1999–2002, 13,363.0 km of integrated sewage treatment network were open (it was 125% more than in December 1998) and 204.7 thousand

connections to buildings were constructed. In effect, total length of integrated sewage systems was nearly 30 thousand km and the share of population connected to it grew by 12.3%. These systems worked in 3,829 villages (9% of their total number), of which 1,666 were canalized partially [Ochrona… 2003].

In 2003, because of big activity of communes from Kujawsko-Pomorskie, this region has noted the investment peak of 1,303.9 million PLN. What is more, this trend was sustained in next years also (see Fig. 2). In consequence, thanks to projects realized in years 2003–2007, 22,357.8 km of new wastewater treatment network and 371.3 thousand of new connections were created. The fastest development was observed in: Mazowieckie, Małopolskie, Wielkopolskie and Śląskie, while the slowest, comparatively to previous 4 years, in Podlaskie and Lubuskie.

To sum up, in years 1999–2007, over 35.7 thousand km of collectors and 576.0 thousand of connections to households were created. Table 1 presents the share of Polish voivodships in tangible results of investment in sewage system.

Table 1. Tangible results of investment in sewage system in rural areas realized by communes in years 1999–2007

VOIVODSHIP	Communes with rural population	Sewage treatment system		Sewage treatment plant		
		Integrated	Connections to buildings	Integrated		Household plants
				New objects	Through-put	
	items	km	items	items	m^3/day	items
Dolnośląskie	133	2210.1	36802	65	30543.8	1178
Kujawsko-pomorskie	127	2326.0	28979	76	23609.4	4719
Lubelskie	193	1256.9	22658	113	20867.0	4529
Lubuskie	74	854.9	12777	51	8595.1	230
Łódzkie	159	1087.9	24143	98	23388.8	1643
Małopolskie	167	3612.7	61998	120	38332.2	2124
Mazowieckie	279	2694.6	61448	141	47594.7	2010
Opolskie	68	1132.5	21040	26	20950.9	217
Podkarpackie	143	6463.1	86391	118	50905.7	289
Podlaskie	105	712.2	15516	41	5695.0	2357
Pomorskie	98	2630.4	35064	76	46553.3	720
Śląskie	118	1894.2	41433	53	24491.8	782
Świętokrzyskie	97	1275.7	21724	36	10956.2	268
Warmińsko-mazurskie	100	1872.6	16744	80	32148.4	160
Wielkopolskie	207	3771.2	70468	180	78490.5	1992
Zachodniopomorskie	103	1935.6	18829	70	32081.8	517
Polska	**2171**	**35720.6**	**576014**	**1344**	**495206.6**	**23735**

Source: Author's own study, based on Ochrona środowiska... 2000–2008

Communes' own budgetary resources were, comparatively to sewage treatment plants, the main source of these investment (35.3% of share, according to Fig. 4). Loans from Polish environmental protection funds were the second

source of resources (31.7%) – mainly form Regional Funds for Environmental Protection and Water Management. This funds were also donators of grants for these purposes (4.6%). Citizens' own resources stated only for 3.6% of total expenditures on sewage systems' development. Also, a foreign aid was not a predominant form of financing – in the period 1999–2007, it was 12.7% of total expenditures, but in years 2004–2007 it accounted for 39.1% (similarly to finances designated to sewage system plants).

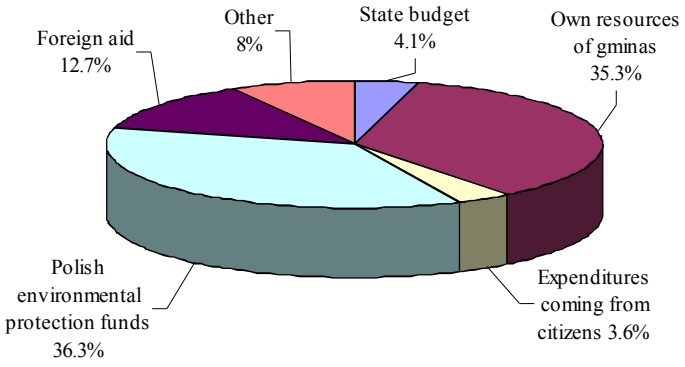


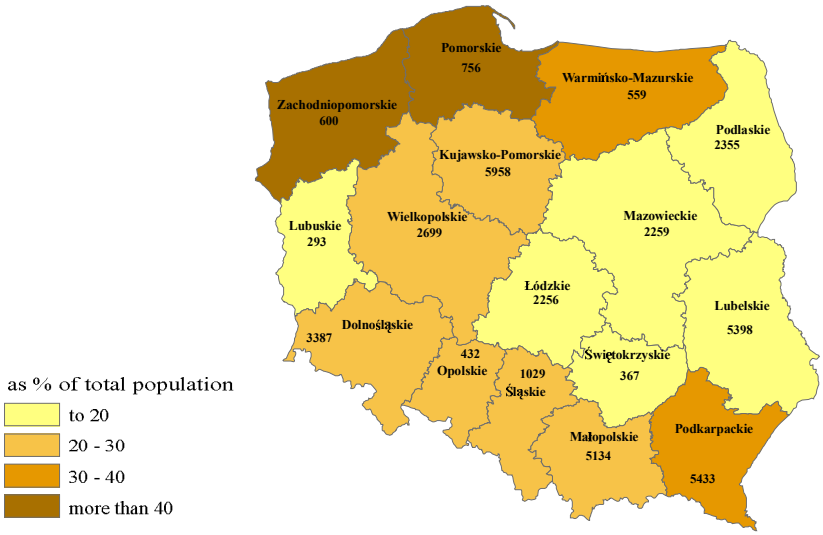
Fig. 4. Sources of financing construction and modernization of integrated sewage treatment system in rural eras in years 1999–2007 (author's own study, based on *Ochrona środowiska…*)

CURRENT STATE

Investment projects conducted by Polish local self-government in years 1999–2007 have contributed, but insufficiently, to improvement of the state of wastewater management in rural areas.

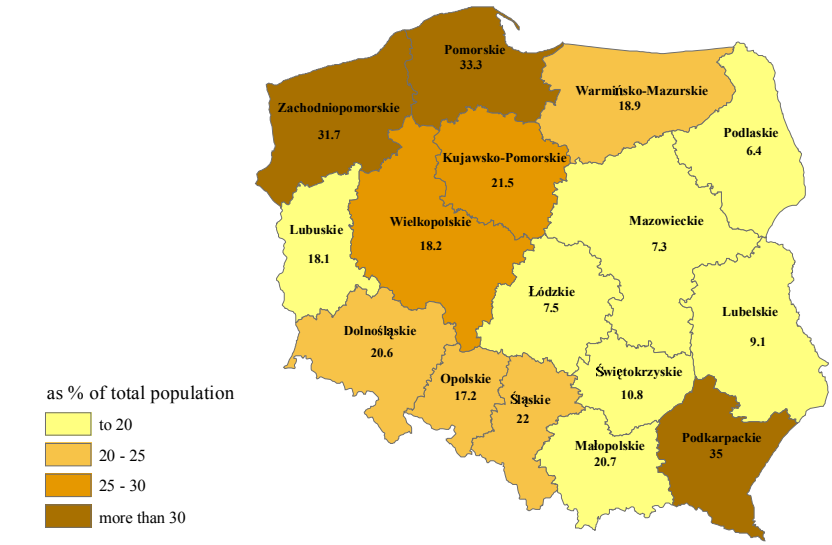
In December 2007, 2168 sewage treatment plants connected to integrated systems were operated (including 55 mechanical, 1735 biological and 378 plants with increased removal of nutrients). Also, there were 468 other local objects. Total throughput of them was 1,458.8 thousand cubic meters per 24 hours [Ochrona…2008].

The share of population connected to plants was 23.8% (3.5 millions of people). The highest rate was noted in voivodships: Pomorskie (41.6%), Zachodniopomorskie (40.3%), Podkarpackie (35.0%) and Warmińsko-Mazurskie (31.4%), while the lowest in: Łódzkie (11.6%), Lubelskie (15.8%), Mazowieckie (15.9%) and Świętokrzyskie (16.2%). The number of household sewage treatment plants has grown to 38,915. The biggest concentration of them was observed in voivodships: Kujawsko-Pomorskie, Podkarpackie and Lubelskie and also in: Małopolskie and Dolnośląskie, while the smallest in: Świętokrzyskie and Opolskie (Fig. 5).



Numbers on the map denote numbers of household sewage treatment plants

Fig. 5. Population connected to integrated sewage treatment systems in December 2007 (author's own study, based on *Ochrona środowiska 2008*)



Numbers on the map denote the number of rural administrative units having waste treatment network

Fig. 6. The share of population using waste treatment network in December 2007 (author's own study, based on *Infrastruktura…2007* i *Ochrona… 2008*)

The total length of sewage treatment network (excluding connections to buildings and rainwater network) was 43.5 thousand km, while together with networks of industrial plants it was almost 47.0 thousand km. The number of connections to households has reached the number of 716.9 thousand (with industrial objects it was 787.3 thousand km).

Public sewage network was functioning in 6,427 rural administrative units only (15.5% oh their total number). What is more, 2,447 of them were canalized only partially. The ratio of number of connections per 100 inhabitants was 5.4, so 4 times lower then similar ratio for water networks. The best situation was in voivodships: Podkarpackie (ratio 8.8) and Zachodniopomorskie (6.6), while the worse in: Lubelskie (2.8), Łódzkie (3.5) and Świętokrzyskie (4.0). The share of population using waste treatment network was 21.3%, being the smallest in Łódzkie region (12.2%) and the highest in Zachodniopomorskie – 38.1% (Fig. 6).

CONLUSIONS

Despite the progress in years 1999–2007, expressed primarily by over fourfold increase of sewage network length and number of households' connections, as well as twofold increase of sewage treatment plants, the state of sewage system economics in rural areas is still far from perfect. In 2007, the length of integrated sewage system was still 3.5-times shorter then water pipelines network. The share of population being connected to wastewater network was 21.3%, while the share of household connected to water system: 73.3%. Households' water usage from pipelines was 359.3 hm^3, while quantity of wastewater deposited stated for only 80.4 hm^3 [Infrastruktura… 2007]. The worse situation was observed in voivodships: Lubelskie, Łódzkie, Mazowieckie, Świętokrzyskie and Podlaskie, where in 2007, only few percent of rural areas' dwellers was connected to water treatment system.

A scale of investment gap presented here shows a need for actuating new investment in this field. Besides, there is also a necessity of adjusting Polish law to European, namely to EU Directive 91/271/EEC, obliging member countries to create, till the end of 2015, wastewater networks and sewage treatment plants, serving at least 80% of dwellers in any agglomeration having more than 2 thousand inhabitants. The Polish National Sewage Treatment Program presents a list of almost 1600 administrative units of these kind [Aktualizacja… 2005]. In these areas, there are around 1400 units, being totally or partially inhabited by rural community.

However, making this deadline is unlikely to be realized in Polish rural areas, and the lack of sufficient own budgetary resources of self-government is the main reason of that. Thus, the units performing high-value projects are preferred in Regional Operational Programs 2007–2013. Moreover, small communes, not

included into The Polish National Sewage Treatment Program, are in much worse position. That is why a support from Rural Development Programme for 2007–2013, as well as from Regional Funds for Environmental Protection and Water Management, is far more preferable here. However, the ability of getting finances from these resources depends strictly on local authorities' competences.

Building household sewage treatment plants is a separate problem, and it concerns mainly areas of central and eastern Poland, where the big rural settlement dispersion limits the development of integrated sewage systems. However, also in this case, the involvement of local authorities is a necessary condition. Without their help, not too many rural households will be interested in self-financing it.

REFERENCES

Aktualizacja krajowego programu oczyszczania ścieków komunalnych, Ministerstwo Środowiska, Warszawa, maj 2005.

Bank Danych Regionalnych GUS (Regional Data Bank of Central Statistical Office), www.stat.gov.pl, accessed 6.04.2009

Gładysz R. *Wodociąg jako istotny element infrastruktury technicznej wsi* [in:] Terytorialne i ekologiczne aspekty rozwoju gospodarczego pod red.. A. Jewtuchowicz, Folia Oeconomica 143, Wyd. Uniwersytetu Łódzkiego, Łódź 1997.

Gładysz R. *Ekonomiczne i społeczne przemiany zaopatrzenia w wodę gospodarstw wiejskich i gospodarki ściekowej w regionie piotrkowskim*, Wyd. Uniwersytetu Łódzkiego, Łódź 2007.

Infrastruktura komunalna 2007, www.stat.gov.pl, accessed 6.04.2009

Jasiulewicz M. *Rozwój infrastruktury warunkiem poprawy życia mieszkańców wsi (na przykładzie* województwa *zachodniopomorskiego),* [in:] Społeczne problemy wsi pod red. J. Bańskiego i E. Rydza, Studia Obszarów Wiejskich t. 2, Warszawa 2002.

Ochrona środowiska…, GUS, Warszawa 1999, roczniki 1999–2008.

Ryszard Gładysz, Ph.D.
Lecturer in Department of Regional Economy and Environment
University of Łódź, Poland

Reviewer: *Prof. Zdzisław Wójcicki, Ph. D, Dr. Sc.*