

EU FUNDING FOR THE DEVELOPMENT OF WATER MANAGEMENT INFRASTRUCTURE IN LATVIA

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Abstract. Water is one of the most important resources not only for individual consumption but also for all the industries of the national economy. For this reason, the development of water management infrastructure is an essential matter in any country's government policy. Funding from the European Union (EU) Funds is available for water management infrastructure in Latvia and other EU Member States. The research aim is to assess the development of water management infrastructure in Latvia in the programming period 2007-2013 and give recommendations for the next programming period's activities. The specific research tasks to achieve the aim are as follows: 1) to analyse the amounts of funding from the EU Funds for Latvia and support instruments for the development of water management infrastructure in the programming period 2007-2013; 2) to assess the contribution of the EU Funds to the water management infrastructure in Zemgale region in order to identify opportunities for its enhancement in the period 2014-2020. The research found that funding from the EU Funds, including that for the development of water management infrastructure, was spent unequally across the regions, as a considerably greater proportion of the funding was invested in Riga region, compared with the other regions. Funding from the European Regional Development Fund (ERDF) and the Cohesion Fund (CF), depending on the size of a populated area, is available for the development of water management infrastructure. After assessing the situation in Zemgale region, proposals were developed for responsible institutions distributing funding from the EU Funds for regional infrastructure projects in the period 2014-2020.

Key words: EU Funds, water management, infrastructure, regions.

JEL code: H54; O18

Introduction

Water is one of the most important natural resources. Water is necessary not only for individual consumption but also for all the industries of the national economy, beginning with agriculture through to energy production. It has been estimated that in the temperate zone every urban resident consumes on average 200-220 litres of water per day; yet, to meet all the needs of an individual, including the production of food and other goods as well as services, the consumption of water exceeds 320 litres per capita per day (Klavins, Nikodemus, Seglins et al., 2010). The United Nations Organisation (UN) declared in 2002: "Water is a constrained natural resource and a common good, which is the basis for life and health". According to the UN data, 1.1 billion people have no sufficient access to water and 2.4 billion people live in insanitary conditions (General Comment, 2002). Many countries have introduced water saving programmes (Klavins, Zaloksnis, 2010). According to the World Health Organisation's data, 1.6 million deaths are annually associated with the diseases caused by

insufficiently clean drinking water or the lack of the water (Bartram, Lewis, Lenton et al., 2005; Barry, 2007). A new concept – "the water footprint" – has been developed in the world to measure fresh water resources on the planet (Hoekstra, 2013; 2016).

There are large disparities in the availability of clean water among the EU Member States; it is affected not only by the availability of water itself but also climatic conditions and industrial and agricultural burdens. In the period 2001-2013, the availability of clean water increased by 26 % in Cyprus and 25 % in Malta, whereas it decreased by 77 % in Lithuania and 46 % in Slovakia (Energy, Transport and Environment, 2015). The state of Latvia's rivers has been evaluated as the fifth best in the EU. In Latvia, water streams and reservoirs form a single hydrological network and are an important biodiversity factor (Latvijas ilgtspējīgas attīstības..., 2010). Water quality is one of the most important aspects of any water supply system. Poor quality water can harm human health and also negatively affect household

appliances and water management infrastructure. Water management is important in the whole world (Shiklomanov, Rodda, 2004; Loizou, Koutroulis, 2016). In Latvia, it became very urgent after the accession to the EU as well as after the 2009 administrative and territorial reform (Zakis, Ernsteins, 2008). Water management infrastructure networks are classified into three categories: water supply; sewage drainage and rainwater drainage. Today, the water management system is much more complicated (Bell, 2012; Marchis, Fontanazza, Freni et al., 2014). Water management infrastructure involves both the production of drinking water and the supply of it to consumers as well as the collection and purification of sewage (Avritzer, Carnevali, Ghasemieh et al., 2015; Arregui, Cabrera, Cobacho et al., 2006). In the modern world, the management of water resources has to be a priority for governments (Heathcote, 2009). Many world countries exhaust their natural resources and, consequently, water becomes more scarce (Bouwer, 2000). The managers of water resources should focus on climate change (Khouri, 2006), water pollution, the growing population and migration, as the number of water extraction sites decrease (Biswas, 2004; Rodrigues, Nilson, Holanda, 2015).

In accordance with Section 15 of the Law on Local Governments (1994), local governments have to organise for residents the provision of utilities, including water supply and sewerage, irrespective of the ownership of the residential property. According to the National Development Plan of Latvia for 2014-2020 (2012), the availability of water-related services is one of the tasks of the government's economic policy related to government expenditure priorities.

The creation of any infrastructure is expensive, and it is difficult for Latvia to do it without financial assistance from the EU Funds. Accordingly, the **research object** is funding from the EU Funds for the creation and improvement

of water management infrastructure. The **research aim** is to assess the development of water management infrastructure in Latvia in the programming period 2007-2013 and give recommendations for the next programming period's activities. The specific **research tasks** to achieve the aim are as follows: 1) to analyse the amounts of funding from the EU Funds for Latvia and support instruments for the development of water management infrastructure in the programming period 2007-2013; 2) to assess the contribution of the EU Funds to the water management infrastructure in Zemgale region in order to identify opportunities for its enhancement in the period 2014-2020.

Research hypothesis: funding from the EU Funds for the development of water management infrastructure in Zemgale region in the programming period 2007-2013 was used efficiently.

Research methods applied: the monographic, descriptive and analysis methods, statistical analysis and a questionnaire survey.

The research employed research papers on economic development, assessment of the effects of funding from the EU Funds in the field of environmental economics, information provided by the Environmental Protection and Regional Development Ministry (EPRD) (2014a; b; s.a.) and the Ministry of Finance (2007; 2014; s.a.) of the Republic of Latvia, legal documents passed by the Cabinet of Ministers (2007; 2008) and information available on the website www.esfondi.lv. In accordance with the Regional Development Law (2002), there are five planning regions in Latvia: Kurzeme, Latgale, Riga, Vidzeme and Zemgale. However, Latvia's administrative division is as follows: 9 cities of national significance (with a population of more than 25000) and 110 municipalities (LR Administratīvo teritoriju..., 2008). This means that the research performs an assessment at two territorial levels: regional and municipal.

Novelty and topicality of the research. An examination of the situation in Zemgale region in the programming period 2007-2013 will provide more complete information about the amounts of and returns from investments in the water management infrastructure and the development of water management services and contribute to drawing up proposals for the programming period 2014-2020.

Research results and discussion

1. Funding from the EU Funds for Latvia and support instruments for the development of water management infrastructure

There were two EU Funds (the ERDF and the CF) available to Latvia in the programming period 2007-2013, the funding of which was intended for the development of water management infrastructure. According to the National Strategic Reference Framework for 2007-2013 (Finansu ministrija, 2007), EUR 4.53 billion were allocated for Latvia for implementing the Cohesion Policy targets by means of the EU Funds. The ERDF appropriation for Latvia in the programming period 2007-2013 equalled EUR 2.40 billion or 53.1 % of the total funding from the EU Funds, followed by the CF appropriation at EUR 1.54 billion or 34 % of the total.

The key principle of the EU's Cohesion Policy is to reduce disparities among various regions and the backwardness of less developed regions, mainly focusing on public infrastructure improvement and entrepreneurship promotion. The EU Funds make a positive effect on Latvia's economy. In 2011, funding attracted from the EU

Funds effectively assisted Latvia in coping with the global financial crisis. An assessment of the effect of the EU Funds reveals that since 2011 the positive annual effect of the Cohesion policy on gross domestic product (GDP) growth has been, on average, 1.4 %. Funding from the EU Funds mainly contributed to the domestic market. The projects funded by the EU Funds resulted in, on average, a 1.7 % increase rate in the average real wage and salary per year, causing a positive effect on private consumption, on average, at 1.2 % (Finansu ministrija, 2014).

An important indicator is the amount of funding from the EU Funds for the regions. A regression analysis revealed that there was a very strong relationship (0.99 for 2013; 0.98 for 2014; 0.98 for 2015) between the amount of funding invested in a region and GDP growth in the region, which became stronger from year to year. An increase in funding from the ERDF, the ESF and the CF for a region by EUR one million led to an increase in GDP per capita by: 1) EUR 20.75 in 2013; 2) EUR 28.15 in 2014; 3) EUR 52.64 in 2015.

In the programming period 2007-2013, the greatest amount of funding from the EU Funds, EUR 1.99 billion or 44 % of the total, was received by Riga region. The greatest number of all the projects implemented in Latvia in the programming period 2007-2013, 3856 or 54 % of the total, was implemented in Riga region, while the smallest amount of funding, EUR 0.49 billion, was received by Vidzeme region (Table 1).

Table 1

Funding from the EU Funds for and the number of projects implemented in Latvia in the programming period 2007-2013 as of 9 September 2015, EUR, %

Region	Funding disbursed		Number of projects		Avg per project	Devi-ation from avg
	bln. EUR	%	number	%	thou. EUR	%
Kurzeme	0.840	19	977	14	860.5	+ 26
Latgale	0.597	13	672	9	888.4	+ 29
Riga	1.999	44	3856	54	518.5	-21
Vidzeme	0.488	11	875	12	557.8	-12
Zemgale	0.573	13	770	11	744.4	+ 15
Total:	4.498	100	7150	100	629.1	x

Source: authors' calculations based on ES fondi (s.a.)

According to the available data, 13 % of funding from the EU Funds in the programming period 2007-2013 were allocated for water management. Of the total CF appropriation for Latvia, more than EUR 427 million or 28 % were allocated for water management improvement, and the ERDF appropriation for water management in Latvia comprised approximately EUR 100 million or 6 % of the total. Financial assistance for environmental and service improvement was available under six activities. Two activities were established to attract funding for the development of water management infrastructure; under the activities, projects could be submitted on both a fully and a partially competitive basis (Noteikumi par darbības programmas..., 2007; 2008):

- activity 3.4.1.1. "Development of water management infrastructure in areas with a population of less than 2000";
- activity 3.5.1.1. "Development of water management infrastructure in agglomerations with a population of more than 2000".

The key purpose of activity 3.4.1.1 was the improvement of water supply, sewage collection and sewage purification quality and the expansion of availability of water management services through ensuring a high-quality living environment, reducing environmental pollution and water reservoir eutrophication and promoting the rational use of water resources and energy (Noteikumi par darbības programmas "Infrastruktura...", 2008). The beneficiaries of funding were providers of public water management services that provided their services in the project's territory. The activities supported the production of quality drinking water, water supply and the protection of water resources, the reduction of environmental pollution from sewage and the provision of availability of related services. The maximum reimbursement rate for eligible costs per project was 85 % for ERDF funding and 15 % for national government

funding. Activity 3.4.1.1 had seven project submission rounds in the period 2008-2013.

Activity 3.5.1.1 focused on water management services - the improvement of water supply, sewage collection and sewage purification quality and the expansion of availability of water management services through ensuring a high-quality living environment, reducing environmental pollution and water reservoir eutrophication and promoting the rational use of water resources and energy (Noteikumi par darbības programmas..., 2007). The activity had six project submission rounds in the period 2008-2015.

The data on funding from the EU Funds for the development of water management infrastructure are summarised in Table 2.

Table 2

Funding from the ERDF and the CF absorbed under activities 3.4.1.1 and 3.5.1.1 in Latvia in 2007-2013 as of 1 April 2016

Territory	National funding, mln. EUR	ERDF or CF, mln. EUR	Total, mln. EUR	Num-ber of projects	Avg per project, mln. EUR
Activity 3.4.1.1					
Latvia	202	128	330	419	0.78
Zemgale	34	22	56	81	0.69
Activity 3.5.1.1					
Latvia	710	442	1152	117	9.84
Zemgale	105	69	174	21	8.31

Source: authors' calculations based on ES fondi (s.a.)

Funding from the ERDF allocated under activity 3.4.1.1 (Table 2) totalled EUR 143.4 million, of which approximately EUR 128.32 million were absorbed until 1 April 2016. Of the total number of projects, 81 were intended for the improvement of water management infrastructure in Zemgale region at a total cost of EUR 56.04 million; of the total cost, funding from the ERDF comprised EUR 22.8 million or 40.68 % of the total. The total cost per project was, on average, EUR 0.78 million; the projects implemented in Zemgale region, on average, were smaller in size, at EUR 0.69 million.

Under activity 3.4.1.1, according to the EPDM data as of 9 September 2015, the amount

of funding absorbed in Vidzeme region was the greatest, at EUR 37.37 million, of which the ERDF funding comprised EUR 32.14 million or 86 % of the total; the amount of funding absorbed in Riga region was the smallest, at EUR 25.32 million, of which the ERDF funding comprised EUR 22 million or 87 % of the total; the amounts of funding absorbed in the regions of Kurzeme, Latgale and Zemgale ranged from EUR 26.10 million to EUR 28.5 million, of which the ERDF funding accounted for 85-86 % of the total.

Funding from the CF allocated under activity 3.5.1.1 amounted to EUR 444.9 million (Table 2), of which approximately EUR 442.16 million were absorbed until 1 April 2016. Of the total number of projects, 21 were intended for the improvement of water management infrastructure in Zemgale region at a total cost of EUR 105.46 million; of the total cost, funding from the CF comprised EUR 69.2 million or 65.6 % of the total. The total cost per project was EUR 9.84 million, while in Zemgale region it was EUR 8.31 million.

Under activity 3.5.1.1, according to the EPRDM data as of 9 September 2015, the amount of funding absorbed in Riga region equalled EUR 182.66 million, of which EUR 162.20 million or 89 % of the total came from the CF; the smallest amounts of funding were absorbed in the regions of Latgale and Zemgale, EUR 65.78 million and EUR 75.30 million, respectively, of which 90 % and 89 % of the total were received from the CF; similar amounts were absorbed in the regions of Vidzeme and Kurzeme, EUR 81.10 million and EUR 77.26 million, respectively, of which 88-89 % came from the CF.

An analysis of the distribution of funding allocated under activities 3.4.1.1 and 3.5.1.1 by region in the programming period 2007-2013 shows that 29.72 % of the total available funding was allocated to Riga region, 16.92 % to Vidzeme region, 14.98 % to Kurzeme region and 14.49 % to Zemgale region, while the smallest amount was allocated to Latgale region, which

indicates that no equal EU financial assistance opportunities were created for regional development and the improvement of water management infrastructure in all the regions of the country.

2. Assessment of the contribution of the EU Funds to the water management infrastructure in Zemgale region

Several methods were employed in assessing the efficiency of funding from the EU Funds for the development of water management infrastructure: 1) a questionnaire survey; 2) statistical analysis for the amounts of funding from the EU Funds disbursed under activities 3.4.1.1 and 3.5.1.1 in Zemgale region's municipalities.

A questionnaire survey was conducted from February to March 2016. The questionnaire was sent to individuals, business entities and institutions in Zemgale region. The purpose of the survey was to assess the development of water management infrastructure in Zemgale region in the programming period 2007-2013 and to draw up proposals for the next programming period's activities. In total, 164 questionnaires were received back.

A general analysis of the data showed that most of the respondents (58 %) resided in apartments, while the others lived in private houses. An analysis of the users of water management services in Zemgale region revealed that most of them, 66 %, used centralised sewerage services and 58 % used centralised water supply services. Part of the respondents had a private water well and a private sewage purification system.

An analysis of the data on information available to the respondents about available funding from the EU Funds for the development of water management infrastructure allows concluding that the Funds have considerably contributed to the water management infrastructure. Of the respondents, 59 % replied that a water management project had been implemented in their place of residence; such

projects made water management services more available for 45 %, while 56 % stressed that the water management services became of higher quality (cleaner water, less environmental pollution etc.). However, 37 % of the respondents had no opinion about the availability of services and 26 % had no opinion about the quality of the services, which indicated that the public were not aware of the water management projects implemented in their place of residence and the related improvements.

When asked: "Is the amount of funding allocated for water management projects in the period 2007-2013 sufficient?", 58 % had no opinion about the funding from the EU Funds for water management projects, which indicated the insufficient participation of the public in the implementation of the projects funded by the EU Funds and in benefiting from it. That is why 55 % of the respondents had no opinion on the effectiveness of water management projects funded by the EU Funds. Of the respondents, 44 % believed that the project implemented in their place of residence was effective.

An analysis of the respondents' opinions about the idea that the size of co-funding has to depend on the number of registered residents in a territory, most of them – 43 % – believed that the size of co-funding did not have to be fixed based on the population size.

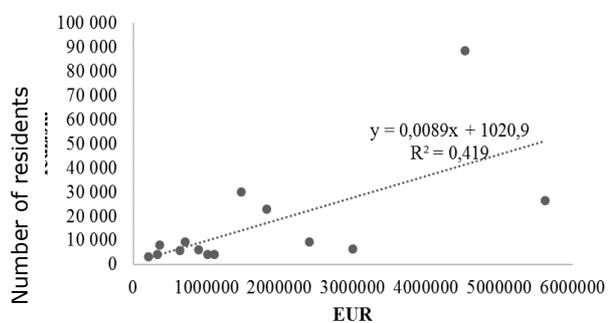
Most of the respondents (62 %) believed that all the costs, including those arising from constructing a central sewerage or water supply system and those arising from making a connection from a residential house to the main pipeline system, have to be included in the project's costs.

Although the opinion that such projects have to cover the cost of making a connection from a residential house to the main pipeline system is popular among the respondents, this increases the project's costs and decreases the number of beneficiaries of investments made by the EU Funds in the development of water management

infrastructure, as per capita project costs increase, which reduces the possibility to construct a longer main pipeline system in order that a greater number of residents can have access to the water management system.

The analysis of the amounts of funding absorbed in Zemgale region's municipalities in the programming period 2007-2013 under activity 3.4.1.1 in 2014 took into consideration: 1) the number of residents at the beginning of the year (CSB, 2016a); 2) the territorial development index (VRAA, 2016); 3) the number of market sector economically active statistical units (CSB, 2016b).

A regression analysis showed a causal relationship between the dependent and the independent variable. An increase in the amount of absorbed funding from the EU Funds for the water management infrastructure by one unit led to an increase in the number of residents by 0.008 units. The relationship between the amount of absorbed funding and the number of residents was medium strong (Fig. 1).

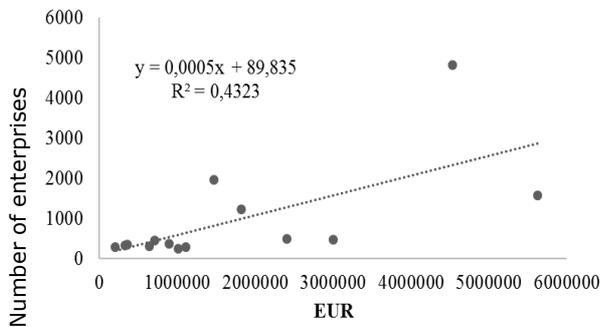


Source: authors' calculations based on CSB, 2016a; ES fondi, s.a.

Fig. 1. Relationship between the amount of absorbed funding for the water management infrastructure under activity 3.4.1.1 and the number of residents in Zemgale region in the programming period 2007-2013

An increase in the amount of absorbed funding from the EU Funds for the water management infrastructure by one unit resulted in an increase in the territorial development index by $8E^{-08}$ units. The relationship between the amount of absorbed funding and the territorial development index was weak (authors' calculations based on VRAA, 2016; ES fondi).

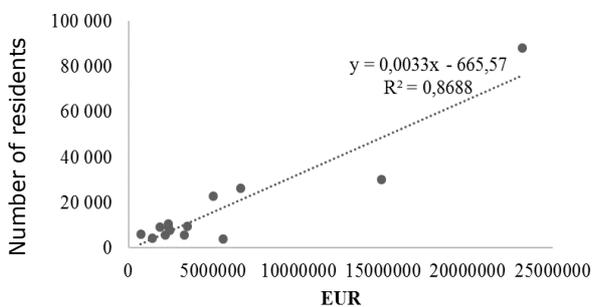
An increase in the amount of absorbed funding from the EU Funds for the water management infrastructure by one unit led to an increase in the number of enterprises by 0.008 units. The relationship between the amount of absorbed funding and the number of enterprises was also medium strong (Fig. 2).



Source: authors' calculations based on CSB, 2016b; ES fondi, s.a.

Fig. 2. Relationship between the amount of absorbed funding for the water management infrastructure under activity 3.4.1.1 and the number of enterprises in Zemgale region in the programming period 2007-2013

The analysis of the amounts of funding absorbed in Zemgale region's municipalities in the programming period 2007-2013 under activity 3.5.1.1 in 2014 took into consideration the following indicators: 1) the number of residents at the beginning of the year (CSB, 2016a); 2) the territorial development index (VRAA, 2016); 3) the number of market sector economically active statistical units (CSB, 2016b).

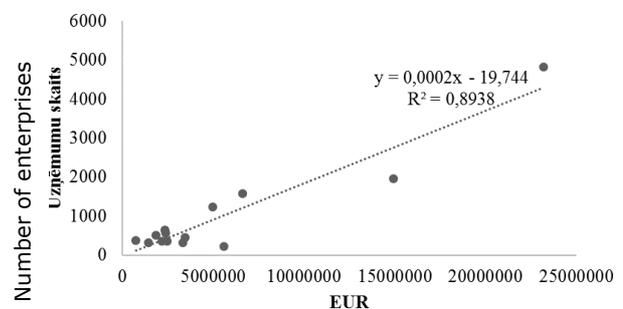


Source: authors' calculations based on CSB, 2016a; ES fondi, s.a.

Fig. 3. Relationship between the amount of absorbed funding for the water management infrastructure under activity 3.5.1.1 and the number of residents in Zemgale region in the programming period 2007-2013

An increase in the amount of absorbed funding for the water management infrastructure by one unit led to an increase in the number of residents by 0.003 units (Figure 3). The relationship between the amount of absorbed funding and the number of residents was very strong.

An increase in the amount of absorbed funding for the water management infrastructure by one unit led to an increase in the number of enterprises by 0.0002 units (Figure 4). The relationship between the amount of absorbed funding and the number of enterprises was also very strong.



Source: authors' calculations based on CSB, 2016b; ES fondi, s.a.

Fig. 4. Relationship between the amount of absorbed funding for the water management infrastructure under activity 3.5.1.1 and the number of enterprises in Zemgale region in the programming period 2007-2013

There was a very weak relationship between the amount of absorbed funding and the territorial development index value, which allowed concluding that investments in the water management infrastructure did not increase the value of the territorial development index (author's calculations based on VRAA, 2016; ES fondi).

The ERDF and CF investments in the water management infrastructure were partially effective, as there was a strong or medium strong correlation between the amount of absorbed funding and the numbers of residents and enterprises in Zemgale region. Undoubtedly, funding from the EU Funds and national co-funding for the water management infrastructure in Zemgale region: 1) enhanced the quality of

services; 2) reduced environmental pollution from non-purified sewage; 3) increased the availability of the services; 4) increased opportunities for the region to attract residents and enterprises; 5) improved the overall economic situation in the region.

However, the projects funded by the EU Funds for the purpose of improving the water management infrastructure in Zemgale region involved too high costs if measured per unit and did not result in the expected value-added because: 1) the funding was spent, yet, the number of connections to the water management system was insufficient; 2) enterprises were established at a low rate, as the investment costs had to be recovered; 3) in remote municipalities, the number of residents continued decreasing owing to urbanisation.

3. Proposals for raising the efficiency of use of funding from the EU Funds for the development of water management infrastructure in Latvia

In the programming period 2014-2020, EUR 4.418 billion are available to Latvia under the Cohesion Policy, of which EUR 623.05 million or 14 % of the total are intended for environmental protection and efficient resource use. Financial assistance is available for the reconstruction and expansion of sewage collection networks as well as the construction of connections to the water management system, the development of waste recycling and regeneration infrastructure, flood risk reduction, the preservation of biodiversity etc., of which EUR 142 million or 23 % of the total are allocated for the development of water management infrastructure, which is about four times less than in the programming period 2007-2013.

Both population agglomerations and the regions have to be categorised to provide equal opportunities for all the regions to receive funding for their water management infrastructure. Like in the programming period 2007-2013, funding has to be allocated for two activities: 1) financial assistance for

agglomerations with a population of less than 10 000; 2) financial assistance for agglomerations with a population of more than 10 000. Funding for agglomerations with a population more than 100 000 (Riga and Daugavpils) has to be earmarked and allocated on a partially competitive basis, as the two agglomerations show greater deviations from the indicators of cities with smaller populations.

The second categorisation has to be done at regional level – each region has to be assigned a score according to several indicators: 1) a ratio of the land area of regions/municipalities (industrial or residential) having an appropriate water management infrastructure to the land area with no appropriate water management infrastructure, in accordance with the EU directive. The highest score is assigned to a territory having an inappropriate water management infrastructure; 2) agglomerations that had not complied with the EU directive regarding the sewage purification standards until 31 December 2015. Agglomerations that have not complied with the EU directive are divided into groups by number of residents, and the highest score is assigned to a territory that has the highest population burden and produces the greatest environmental pollution; 3) the number of residents who will benefit from the improved water management infrastructure. Municipalities are grouped by number of residents who will have the improved water management infrastructure; 4) the number of enterprises that will benefit from the improved water management infrastructure. Municipalities are divided into groups by number of enterprises that will benefit from the improved water management infrastructure. The highest score is assigned to a territory having the greatest number of enterprises; 5) the average investment made using funding from the EU Funds per new job. Any project has to specify how many new jobs will be created in the place where funding from the EU Funds is invested in

water management. The highest score is assigned to a territory having the lowest cost per new job; 6) the average investment made using funding from the EU Funds per new connection to the water management system. Any project has to specify how many new connections to the water management system will be made on average and how many residents/enterprises will have access to the services. The highest score may be assigned to a territory having the lowest cost per new connection; 7) the average investment made in water management services by using funding from the EU Funds per new enterprise. Any project has to specify how many new enterprises will be established in the territory where the water management infrastructure is going to be reconstructed. The highest score is assigned to a territory having the lowest cost per new enterprise; 8) the territorial development index. Any project submitter has to specify the municipality's territorial development index. The highest score is assigned to a territory having the lowest territorial development index value.

Scores are assigned to projects after the criteria have been assessed, and funding is allocated for the projects having the highest score.

Conclusions, proposals, recommendations

- 1) The purpose of the EU Funds is to reduce regional disparities. In Latvia, however, 44 % of the total EU funding was disbursed in Riga region where 54 % of the total projects were implemented, while the other regions received 9-14 % of the total EU funding.
- 2) The development of water management infrastructure in Latvia is impossible without financial assistance from the EU Funds. In the

Bibliography

1. Arregui, F.J., Cabrera, E., Cobacho, R. and Garcia – Serra, J., (2006). Reducing Apparent Losses Caused by Meters Inaccuracies. *Water Practice & Technology*, 1(4), doi: 10.2166/WPT. 2006093.
2. Avritzer, A., Carnevali, L., H. Ghasemieh, H. (2015). Survivability Evaluation of Gas, Water and Electricity Infrastructures. *Electronic notes in theoretical computer science*, The Elsevier, Science Direct 310 5 – 25, doi: 10.1016/j.entcs. 2014.12.010.
3. Barry, J.A., (2007). WATERGY: Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment Cost-Effective Savings of Water and Energy, pp. 1-44.

programming period 2007-2013, the following sources of funding were available for this purpose:

- 3) ERDF funding in the amount of EUR 330 million for areas with a population of less than 2000. There were implemented 419 projects with an average budget of EUR 0.78 million;
- 4) CF funding in the amount of EUR 330 1.1 billion for areas with a population of more than 2000. There were implemented 117 projects with an average budget of EUR 9.84 million;
- 5) The whole amount of ERDF and CF funding for the development of water management infrastructure was unequally distributed across the regions, as 30 % was received by Riga region, while the other regions received only 13-17 % of the total amount.
- 6) Zemgale region received 17 % of the total amount of ERDF funding and 15 % of the total amount of CF funding. The survey revealed that the EU Funds considerably contributed to the water management infrastructure; yet, the public was insufficiently informed about the water management projects. A regression analysis revealed an effect of funding from the EU Funds for water management on the numbers of residents and enterprises in Latvia's regions, while no association was identified between the funding and the territorial development index.
- 7) To foster the development of the regions in future, the responsible institutions, when redistributing funding from the EU Funds, have to allocate a certain amount of funding for each region through two activities according to the agglomeration size and a special project evaluation method.

4. Bartram, J., & Lewis, K. Lenton, R. Wright, A., et al. (2005). Focusing on Improved Water and Sanitation for Health. *The Lancet*. 365 (9461), pp. 810–812. DOI: 10.1016/S0140-6736(05)17991-4.
5. Bell, S., (2012). Urban Water Systems in Transition Emergence Complex. *Organ.*, 14 (1), pp. 44–57.
6. Biswas, A.K., (2004). Integrated Water Resources Management: a Reassessment Water Int., 29 (2), pp. 248–256.
7. Bouwer, H., (2000). Integrated Water Management: Emerging Issues and Challenges Agric. *Water Manag.*, 45, pp. 217–228.
8. Central Statistical Bureau (CSB) (2016a). ISG01. Platība, iedzīvotāju blīvums un pastāvīgo iedzīvotāju skaits reģionos, republikas pilsetās un novados gada sakuma (*Area, Population Density and Resident Population by Statistical Region, City and County*). Retrieved: http://data.csb.gov.lv/pxweb/lv/Sociala/Sociala__ikgad__iedz__iedzskaitis/IS0010.px/?rxid=cdcb978c-22b0-416a-aacc-aa650d3e2ce0 Access: 10.12.2016.
9. Central Statistical Bureau (CSB) (2016b). SRG0111. Ekonomiski aktīvi uzņēmumi statistiskajos reģionos, republikas pilsetās un novados (*Economically active enterprises in statistical regions, cities under state jurisdiction and counties*). Retrieved: http://data.csb.gov.lv/pxweb/lv/uzreg/uzreg__ikgad__01_skaits/SR00111.px/?rxid=073f5e9f Access: 10.12.2016.
10. Energy, Transport and Environment Indicators – 2015 edition. Eurostat Retrieved: Retrieved: <http://ec.europa.eu/eurostat/documents/3217494/7052812/KS-DK-15-001-LIDZ-N.pdf/eb9dc93d-8abe-4049-a901-1c7958005f5b> Access: 01.12.2016.
11. ES fondi: www.esfondi.lv (*EU Funds*). (s.a.). Retrieved: <http://esfondi.lv/2007.-2013.g.-planosanas-periods> Access: 11.01.2016.
12. Fondi un investīcijas (*Funds and Investments*) (s.a.). VARAM. Retrieved: http://varam.gov.lv/lat/fondi/Esker07_13/?doc=13667 Access: 14.01.2016.
13. General Comment No. 15, E/C.12/2002/11 (2002) United Nations Economic and Social Council. Retrieved: [http://www.unhchr.ch/tbs/doc.nsf/0/a5458d1d1bbd713fc1256cc400389e94/\\$FILE/G0340229.pdf](http://www.unhchr.ch/tbs/doc.nsf/0/a5458d1d1bbd713fc1256cc400389e94/$FILE/G0340229.pdf) Access: 12.02.2016.
14. Heathcote, I. W., (2009). *Integrated Watershed Management: Principles and Practice*. s.l.:John Wiley & Sons
15. Hoekstra, Y. A., (2013). Sustainable, Efficient, and Equitable Water Use: the Three Pillars under Wise Freshwater Allocation. *Wiley interdisciplinary reviews. Water*: 1(1), pp. 31–40, DOI: 10.1002/wat.2.1000.
16. Hoekstra, Y. A., (2016). A Critique on the Water – Scarcity Weighted Water Footprint in LCA. *Elsevier, Ecological Indicators*: (66), pp. 564–573, DOI: 10.1016/j.ecolind.2016.02.026.
17. Khouri, G., (2006). *Integrated Water Cycle Management: "An Australian Perspective"*. s.l.:European Water Publications.
18. Loizou, K., Koutroulis, E., (2016). Water Level Sensing: State of the Art Review and Performance Evaluation of a Low-cost Measurement System. *Elsevier, Measurement*: (89), pp. 204 – 2014. DOI:10.1016/j.measurement.2016.04.019.
19. Klavins, M., Nikodemus, O., Seglins, V., Melecis, V., Virčavs, M., Aboltina, K. (2010). Vides zinātnes (*Environmental Science*): *LU Akadēmiskais apgads*, p. 598.
20. Klavins, M., Zaloksnis, J. (2010). Vide un ilgtspējīga attīstība (*Environment and Sustainable Development*): *Latvijas Universitātes Akadēmiskais apgads*.
21. Komunālo notekūdeņu un notekūdeņu dūņu apsaimniekošana Latvijā (*Communal Sewage and Sludge Management in Latvia*). (2014a). VARAM. Retrieved: http://www.varam.gov.lv/lat/publ/publikacija/vides_aizsardzibas_joma/?doc=11643 Access: 16.03.2016.
22. Latvijas ilgtspējīgas attīstības stratēģija līdz 2030. gadam (*Sustainable Development Strategy of Latvia until 2030*) (2010): LR Saeima. Retrieved: polsis.mk.gov.lv/LoadAtt/file16857.pdf Access: 26.02.2016.
23. LR Finanšu ministrija (*Ministry of Finance of the Republic of Latvia*) (s.a.) Finanšu ministrija. Retrieved: <http://www.esfondi.lv/jaunumi/fm:-es-fondi-ir-veicinajusi-latvijas-tautsaimniecibas-izaugsmi?print=1> Access: 11.12.2016.
24. LR Finanšu ministrija (*Ministry of Finance of the Republic of Latvia*). (2007). Valsts stratēģiskais ietvardokuments 2007. – 2013. gada periodam (*National Strategic Reference Framework for 2007-2013*), Rīga, Retrieved: http://www.esfondi.lv/upload/04kohezijas_politikas_nakotne/VSID_2009.pdf Access: 08.02.2016.
25. LR Finanšu ministrija (*Ministry of Finance of the Republic of Latvia*). (2014). ES fondi ir veicinājuši Latvijas tautsaimniecības izaugsmi (*The EU Funds Contributed to Economic Growth*), Rīga, Retrieved: http://www.fm.gov.lv/lv/aktualitates/jaunumi/es_fondi/48285-fm-es-fondi-ir-veicinajusi-latvijas-tautsaimniecibas-atlabsanu Access: 06.12.2016.
26. LR likums Par Pasvaldībām (*Law of Local Governments of the Republic of Latvia*). (1994). Retrieved: <http://likumi.lv/doc.php?id=57255> Access: 02.12.2016.
27. LR Reģionālās attīstības likums (*Regional Development Law of the Republic of Latvia*). (2002). "Latvijas Vestnesis", 53 (2628), 09.04.2002., "Zinotājs", 9, 09.05.2002.
28. LR Administratīvo teritoriju un apdzīvoto vietu likums (*Law On Administrative Territories and Populated Areas of the Republic of Latvia*). (2008). "Latvijas Vestnesis", 202 (3986), 30.12.2008., "Zinotājs", 3, 12.02.2009.
29. Marchis, de M., Fontanazza, M.C., Freni, G., Messineo, A., Milici, B., Napoli, E., Notaro, V., Puleo, V. (2014). Energy Recovery in Water Distribution Networks. Implementation of Pumps as Turbine in a Dynamic Numerical Model. *Procedia Engineering*: (70), pp. 439 – 448, DOI: 10.1016/j.proeng.2014.02.049.
30. Nacionālais attīstības plans no 2014. līdz 2020. gadam (National Development Plan for 2014-2020). (2012). Retrieved: <http://www.pkc.gov.lv/nap2020/par-nap2020> Access: 22.01.2016.

31. Noteikumi par darbības programmas "Infrastruktūra un pakalpojumi" papildinājuma 3.5.1.1.aktivitāti "Udenssaimniecības infrastruktūras attīstība aglomerācijas ar cilvēku ekvivalentu, lielāku par 2000" (*Regulation regarding Operation Programme "Infrastructure and Services" activity 3.5.1.1 "Development of Water Management Infrastructure in Agglomerations with a Population more than 2000"*). (2007). MK 2007. gada 4. decembra noteikumi Nr. 836. Retrieved: <http://likumi.lv/doc.php?id=168377>. Access: 06.05.2016.
32. Noteikumi par darbības programmas "Infrastruktūra un pakalpojumi" papildinājuma 3.4.1.1.aktivitāti "Udenssaimniecības infrastruktūras attīstība apdzīvotās vietās ar iedzīvotāju skaitu līdz 2000" (*Regulation regarding Operation Programme "Infrastructure and Services" activity 3.4.1.1 "Development of Water Management Infrastructure in Agglomerations with a Population less than 2000"*). (2008). MK 2008. gada 28. jūlija noteikumi Nr. 606. Retrieved: <http://likumi.lv/ta/id/180167-noteikumi-par-darbibas-programmas-infrastruktura-un-pakalpojumi-papildinajuma-3-4-1-1-aktivitati-udenssaimniecibas-infrastrukturu> Access: 11.05.2016.
33. Respondentu aptauja (*Survey of Residents*). (2016). Unpublished materials.
34. Rodrigues, P.L., Nilson, F., Holanda, F. (2015). Recycling of Water Treatment Plant Waste for Production of Soil-Cement Bricks. *Materials Science*, (8), pp. 197–202, DOI:10.1016/j.protcy.2016.01.071
35. Shiklomanov, I.A., Rodda, J.C. (2004). World Water Resources at the Beginning of the Twenty-first Century. *Cambridge, UK: Cambridge University Press*. p. 449.
36. Novadu teritorijas attīstības līmeņa indeksi pēc 2015. gada datiem (*Municipality Territorial Development Index 2015*). (2016). VRAA. Retrieved: http://www.vraa.gov.lv/lv/analitiska_darbiba/attistibas_indeks/ Access: 26.02.2016.
37. Zakis, G., Ernsteins, R., (2008). Premise of Optimal Water Management in Latvia, Institute of Environmental Science and Management, *University of Latvia, section B*, Vol. 62 pp. 55 – 62. DOI:10.2478/v10046-008-00005-2
38. Zinojums par vides investīcijām (*Report on Environmental Investment*). (2014b). VARAM. Retrieved: http://varam.gov.lv/lat/publ/publikacijas/investiciju_joma/ Access: 12.03.2016.