

DEVELOPMENT OF KOŠICE REGION BY IMPLEMENTATION OF ENVIRONMENTAL PROJECTS IN THE FIELD OF WATER MANAGEMENT – CASE STUDY

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Abstract

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The development of the regions in Slovakia in recent years has significant disparities in both socio-economic as well as environmental issues, as evidenced by the eight environmentally polluted areas (these areas are highly urbanised with industrial agglomerations or intensive agricultural production).

This article deals with a management system model of regional by implementation of projects in environmental field of water management with application-specific benefits and risks arising from the process of their implementation in relation to regional development. It analyses projects in the area of water management of one of the regions of Slovakia, Košice region in particular, in terms of connection to public water duct and sewer, identifies a strategy for development of the region and its socio-economic and environmental benefits based on the analysis of drinking water, the quantity and quality of treated wastewater through wastewater treatment plants (WTPs). It identifies the influencing factors of benefits and risks and proposes procedure for solving at various stages.

Key words: regional development, water, environmental quality.

Introduction

The direction of regional development in Slovakia profiles a wider range of regional types, which always leads to the deepening of inter-regional disparities on the basis of social, economic and, more recently, environmental indicators (Fraternali et al., 2012). The environmental quality is in an interaction with the overall level of regional development (Izakovičová, 2005), therefore, it is also included into the interest on addressing the EU, which is aimed to systematically aid in the form of non-repayable funds for individual projects of the Operational Programme Environment, in order to improve the environmental situation through reduction of environmental burdens in the particular region. An environmental burden, in terms of the Act No. 384/2009 Coll., is basically pollution of an area caused by anthropogenic activity, which poses a significant risk to human health or the surrounding rocks, soil and groundwater, with the exception of environmental damage. Elimination of such areas can

raise the overall level of regional development and thereby mitigate the significant differences in the further development of the Slovak regions (Sobotka et al., 1991). One possible solution is the implementation of environmental projects for the construction of water infrastructure, ensuring not only an improvement of the quality of water (March, 2012) and soil, but also the standard of living (Mander, Meyer, 2012).

Case study of socio-economic and environmental benefits of water management projects to be implemented in the Košice region

The priority to water management of the Košice region is the supply of drinking water to the growing population through public water supply and disposal of sewage through public sewage wastewater treatment plants (WTPs).

The above-mentioned activities, not only in the Košice region, are provided by individual water companies managing the water infrastructure which is owned by municipalities. In general terms, the primary efforts of individual water companies, of course, with the support of private institutions in the area, are to improve the lives and welfare of people through the implementation of environmental projects in water management sector.

The primary aim of water company projects is to improve the drinking water supply and sewage collection and disposal, which is currently substantially lower the environmental quality of the region due to poorly treated or untreated waste water is either discharged into the environment or, in municipalities where public sanitation is lacking (households only have septic tanks), infiltrated into the soil, thus threatening not only the quality but also posing a risk of contamination of local water sources. Implementation of these projects is costly; therefore, it requires the cooperation of several entities both in the public sector at the regional or local level and the third and the private sectors. Options of financing environmental projects are provided by a matrix showing the proportion of co-financing projects (Table 1).

T a b l e 1. Matrix of co-financing of projects in Slovakia.

Beneficiary Source	Organization of the state administration	Another government body	Higher territorial unit	Municipality	The private sector, outside of state aid schemes	Subject to state aid rules
ERDF, ESF, Kohézny fond	85.0%	85.0%	85.0%	85.0%	76.5%	Maximum of state aid intensity
State budget	15.0%	5.0%	5.0%	5.0%	13.5%	
Another government body	0.0%	10.0%	0.0%	0.0%	0.0%	0.0%
Higher territorial unit	0.0%	0.0%	10.0%	0.0%	0.0 %	0.0%
Municipality	0.0%	0.0%	0.0%	10.0%	0.0%	0.0%
Private sector	0.0%	0.0%	0.0%	0.0%	10.0%	According to the aid scheme

Source: Prepared according the data from VVS, a.s.

Identification and development of the basic indicators of water contamination in Košice region

Košice region is an industrially developed and urbanised region of Slovakia with great developmental potential but has a negative impact on the overall environmental quality (Pavolová et al., 2012). Various types of industrial plants burden not only the air, but also the water resources and the soil of the region. Agricultural activity is developed mainly in the south of the territory so the quality of local water sources and soil is reduced. Another important aspect influencing the reduction of quality of soil and water resources of the region is the recklessness of people who collect sewage effluent in private septic and do not dispose it in accordance with applicable government regulations. Some of them are equipped with sumps, drainage, other are often discharged directly into the nearest water body, or on the boundary of their land, contributing to the deterioration of environmental quality.

The above facts are also confirmed by the classification of the Košice region, in terms of environmental regionalisation of Slovakia, between the regions with strong disturbance that affects three environmentally polluted areas: Rudňany-Gelnica congested area, Košice-Prešov congested area and Zemplín congested area (Pavolová et al., 2012).

In the area of environmental quality of the Košice region the quantity of produced wastewater is crucial, whose quality indicators are quantified with respect to the water quality in the environment where it is discharged after adequate treatment. The quantities of wastewater produced in the period were unstable in the years 2000–2005, with the proportion of 98.38% treated wastewater in 2010. Despite the continuous expansion of sewerage networks (an increase in the year 2010 was 4.3% compared to 2009, by over 48.4% from 2000) the share of treated wastewater dropped by approximately 9.6% compared to 2000 (Fig. 1). This is due to, especially, small villages where the households do not connect to the public sewer system or the capacity of the WwTP is insufficient.

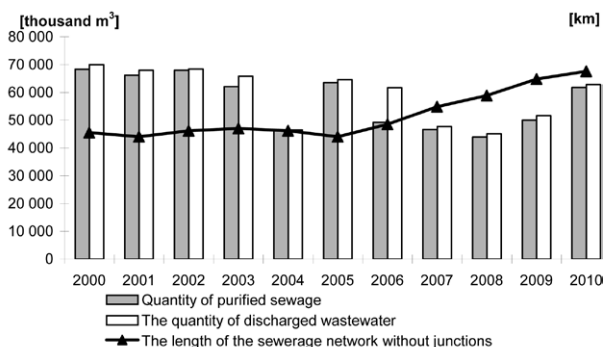


Fig. 1. Development of the sewage production in the Košice region. Source: Statistical Office of the SR, 2011.

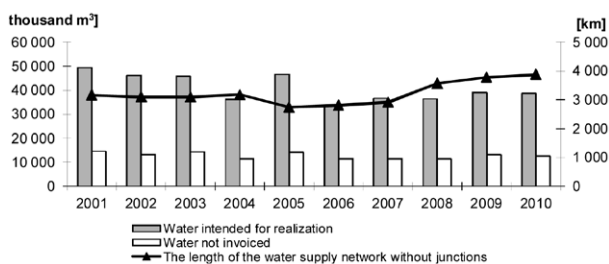


Fig. 2. The development of production and loss of drinking water in the Košice region. Source: Statistical Office of the SR, 2011.

The development of the region is related to the use of water resources for the purpose of drinking water to the population, which is limited by their qualitative and quantitative indicators, that directly impact on the overall level of financial costs required for treatment of drinking water in accordance with the Government Regulation No. 354/2006 Coll. In the Košice region groundwater as well as surface water (mainly the water tanks Starina and Bukovec) is used for water supply. The primary indicator of rational use and management of water resources is the proportion of unaccounted water which was unstable during the monitored period. Despite the long-term trend of increase in population of the region connected to the public water supply, the water consumption decreased in the monitored period (decrease of water consumption in 2010 was 25.25% compared to 2001) which was associated with a decline in water withdrawal from the water sources. Despite this development, the loss (i.e. the proportion of unaccounted for water) in the monitored period was in the average of one third of water produced and intended to be conducted (Fig. 2).

The above developments of the basic indicators of water management clearly confirm that the water company operating in the region constructs and completes the water infrastructure, including intensification of old and construction of new WTSs, which contributes to the improvement of environmental quality and general living conditions. Four environmental projects have been implemented in the water management in the region since 2004.

In the process of examining the socio-economic and environmental benefits of the implementation of individual projects, we focused on two main areas: public water and public sewers and WTSs, including their impact on the overall development of the region. In the construction of public water supply 91 indicators in four main groups of indicators were monitored (Table 2), which determine the overall quality of drinking water. The values were monitored in terms of minimum and maximum levels measured in the total length of water supply pipes, from which the mean values were calculated. These values should not exceed the maximum limit set by the standards for the parameter. This average value is the standard for examining the quality of drinking water. Based on the results of the laboratory analysis, it can be concluded that all the observed variables satisfy the required limits in accordance with applicable governmental regulations and standards. This will ensure delivery of hygienically safe and healthy drinking water to end consumers.

Table 2. Indicators of drinking water analyses.

Type of indicator	Measuring range	Number of defective measurements	Meets/does not meet the requirement of limit of standards
Microbiological and biological parameters	1–5	0	Meets the standards
Physical and chemical parameters	1–5	0	Meets the standards
Organic parameters	1–5	0	Meets the standards
Additional parameters	1–5	0	Meets the standards

Source: Prepared according the data from VVS, a. s.

While examining the quality of water inflow and outflow, we focused on the fundamental parameters which are COD, BOD, insoluble substances, soluble substances, N-NH₄⁺, N-NO₂,

N-NO₃⁻, organic N, total N, total P and insoluble extractable substances. The values of variables are expressed in mg L⁻¹ for particular years depending on the construction year and implementation of the project. The graphs of selected quality indicators monitored in particular WwTP below (Figs 3–5) clearly show a high-treating efficiency (an average of about 95%) of sewer water, eliminating the potential contamination of soil and water resources.

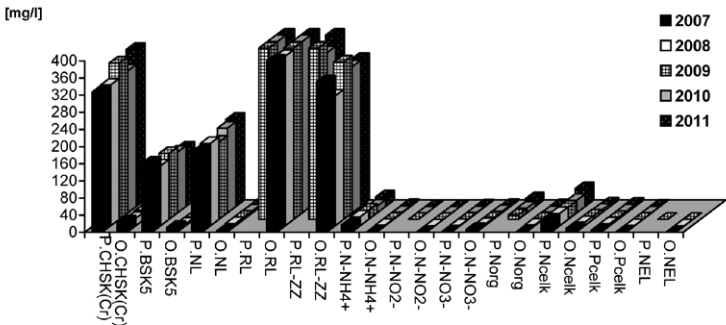


Fig. 3. Qualitative indicators of treated waste water in the WwTP Košice. Source: Prepared according the data from VVS, a. s.

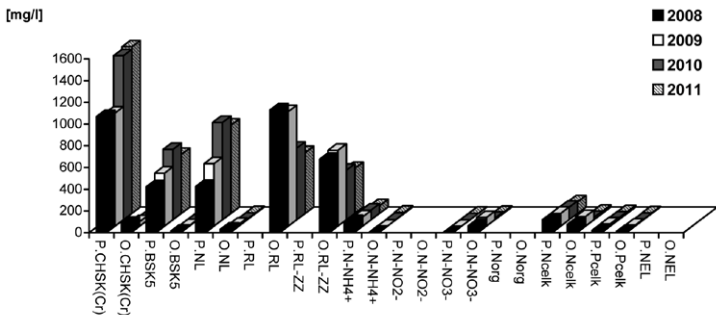


Fig. 4. Qualitative indicators of treated waste water in the WwTP in Kavečany. Source: Prepared according the data from VVS, a. s.

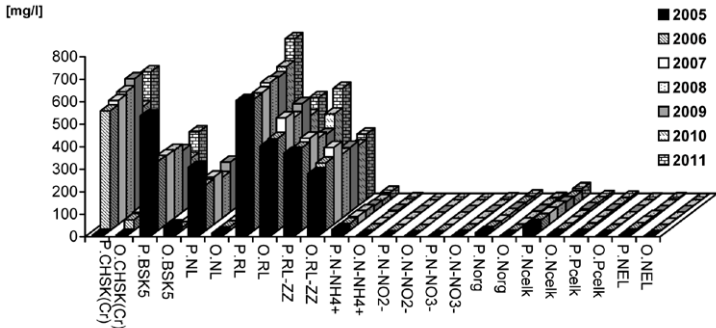


Fig. 5. Qualitative indicators of treated waste water in the WwTP Michalovce. Source: Prepared according the data from VVS, a. s.

Results and discussion

The research on the impact of the projects in the field of water management in the region of the analysis revealed the following facts:

- 1. Implementation of the analysed projects revealed a positive development in the number of connections to public water and sewer system (Fig. 6). The increase of the share of population connected to public sewerage system determines the correct method of dealing with wastewater in accordance with applicable legislation in Slovakia, accepting the principles and rules of the European environmental policy, including the sustainable development of the environment. This method of disposal of wastewater is in close interaction with the quality of the individual components of the environment of the region as it prevents improper disposal of sewage generated.

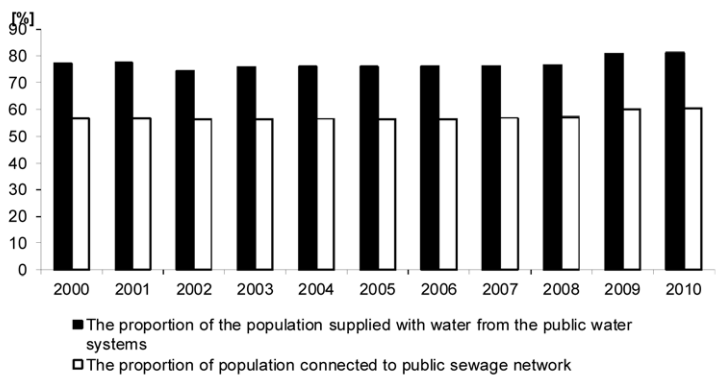


Fig. 6. Development of the number of inhabitants of the Kosice region connected to public water supply and public sewerage. Source: Statistical Office of the SR, 2011.

- 2. Construction, extension and intensification of WwTPs within the region allow wastewater disposal in accordance with applicable government regulations. Wastewater treatment in these facilities provides the required environmental quality parameters of effluent into water bodies accepting the current EU standards in the field of wastewater management. The system approach to disposal and adequate wastewater treatment is in close interaction with the quality of recipients, because it contributes to reducing environmental loads of water bodies and secondary and other elements of the environment.
- 3. Implementation of projects in the field of water policy had a positive impact on the socio-economic sphere of regional development as ensuring continuous supply of hygienic and healthy drinking water reduces the incidence of disease in the interaction to sick leave and reduced work activity. Drinking water supplied this way can also secure a better taste. Sewerage and sewage treatment demonstrated a positive impact on the overall development of the region as it determines savings from disposal of the contents of cesspools, improves the quality of water sources, reduces the odour, sludge recovery

and hence the development of the regional economy, which showed benefits in terms of financial savings associated with system of water management in the municipal sector as well as economic benefits to the local economy of the region.

The results of quantitative and qualitative analyzes of the implemented environmental projects in the field of water management within the region are closely related to general support of further development in primary, secondary and tertiary levels hence the need for close cooperation of subjects from the public sector at the regional or local levels, as well as the third sector and the private sector in terms of elimination of local social, economic and environmental disparities, and not least to ensure the demands of the quality of life in the region considered. Thus the defined system approach to the regional development management ensures sustainable development of the environment accepting the use of water resources to meet the needs of the population which integrates the probability of uncertainty resulting from the reluctance of some generational groups to exploit the availability of a comprehensive water infrastructure in their subregion.

The above information indicates the need for a clear quantification of the benefits and risks of implementation of environmental projects in the field of water management in relation to other regional development as an integral part of regional development management model in order to minimise or eliminate local disparities.

In assessing the percentage of the benefits is based on a comparison of the factors identified in the analysed projects in the water management. It determined seven basic factors that were compared in relation to the positive impact on further regional development. The factors are considered by attributing importance weights while the weight 1 values the factor significantly more important in terms of binding to a positive impact on regional development, while conversely the weight 0 values the factor as less important. In the case of weight 0.5 the value of compared factors corresponds to equal importance with regard to the linkage to the positive impact on regional development.

The matrix of contributions follows (Fig. 7) that in assessing benefits of projects implementing in the field of water management in relation to the regional development of the utmost importance is public health whose weight percentage reached its highest level among the compared factors. In order to the lowest percentage of weight achieved the factor of odour reduction, which ultimately does not mean lack of importance of this factor, but in comparison with the fundamental particularity of the benefits of the environmental projects in the field of water management is a less important factor of benefit.

Then the potential risks (Fig. 8) of environmental projects in the field of water management in relation to regional development were analysed. Risks are analysed by the same procedure as the benefits of environmental projects with the help of the importance weights, while only five factors within the matrix have been set. As a result, we have shown the importance of risk factors affecting the implementation of environmental projects in relation to regional development.

The risk analysis highlighted particularly the high weight of the factor favouring private sources of drinking water and private septic tanks, which poses a major problem in the process of connection of the population at the end of the implementation of environmental projects in the area of water management.

Factor/interaction	Public health	Improvement of taste of water	Savings from the removal of cesspools content	The quality of water sources	Reduction of odour	Recovery of sludge	Economic development	Total	Weight significance [%]
Public health	X	1	1	0.5	1	1	1	5.5	26.19
Improvement of taste of water	0	X	0.5	0	1	0.5	0.5	2.5	11.90
Savings from the removal of cesspools content	0	0.5	X	0	1	0.5	0.5	2.5	11.90
The quality of water sources	0.5	1	1	X	1	1	0.5	5.0	23.81
Reduction of odour	0	0	0	0	X	0.5	0	0.5	2.38
Recovery of sludge	0	0.5	0.5	0	0.5	X	0.5	2.0	9.53
Economic development	0	0.5	0.5	0.5	1	0.5	X	3.0	14.29

Fig. 7. Matrix of the benefits of environmental projects in the field of water policy. Source: Prepared by authors.

Factor/interaction	Unwillingness of connection to the public water supply	Unwillingness of connection to public sewer	Preference for private drinking water sources	The lack of environmental awareness	Insolvency of the investor	Total	Weight significance [%]
Unwillingness of connection to the public water supply	X	0.5	0	0.5	1	2.0	20
Unwillingness of connection to public sewer	0.5	X	0.5	0.5	1	2.5	25
Preference for private drinking water sources	1	0.5	X	1	0.5	3.0	30
The lack of environmental awareness	0.5	0.5	0	X	0	1.0	10
Insolvency of the investor	0	0	0.5	1	X	1.5	15

Fig. 8. Matrix of environmental risks of projects in the field of water policy. Source: Prepared by authors.

Evaluation of benefits and risks of environmental projects mutual interaction (Fig. 9) in the water management determines the degree of regional development, which results in a quantification of the benefit-risk ratio summary resulting in a specific category of regional development (Fig. 10).

The implementation of the projects supported the socio-economic and environmental development of the region, as evidenced by the ‘scoring ratio’ quantifier of 2.1.

Factor		Score [%]	Total score [%]	Scoring ratio
Public health	+	17.74	67.73	2.1
Improvement of taste of water	+	8.06		
Savings from the removal of cesspools content	+	8.06		
The quality of water sources	+	16.13		
Reduction of odour	+	1.61		
Recovery of sludge	+	6.45		
Economic development	+	9.68		
-	Unwillingness of connection to the public water supply	6.45	32.26	
-	Unwillingness of connection to public sewer	8.06		
-	Preference for private drinking water sources	9.68		
-	The lack of environmental awareness	3.23		
-	Insolvency of the investor	4.84		

Fig. 9. The resulting matrix of environmental assessment of projects in the field of water policy in connection to regional development. Source: Prepared by authors.

Category support for regional development		Scoring ratio
Category	Excellent	Over 2.0
Category	Very good	1.99–1.70
Category	Good	1.69–1.40
Category	Satisfactory	1.39–1.10
Category	Sufficient	1.09–1.00
Category	Insufficient	0.99 and less

Fig. 10. The categorisation of support of regional development by implementing environmental projects in the field of water policy. Source: Prepared by authors.

An effective system for regional development management through the implementation of environmental projects in the field of water management must be clearly defined in rules on monitoring and periodical evaluation of quantitative and qualitative indicators of the regional development by an integrated matrix evaluation of regional development based on the amount of 'scoring ratio' quantifier reflecting the intensity of the positive aspects increasing the socio-economic and environmental level of the region. The defined management of regional development (Fig. 11) by the implementation of environmental projects in the field of water management is based on generally accepted principles of regional development. It accepts the governmental regulations of Slovakia, and the quantifier of regional development – 'scoring ratio', i.e. accounts for: the current environmental status of the region, the draft of the environmental project in the field of water management, identification and evaluation of the benefits and risks, the project implementation and after-use monitoring of the development.

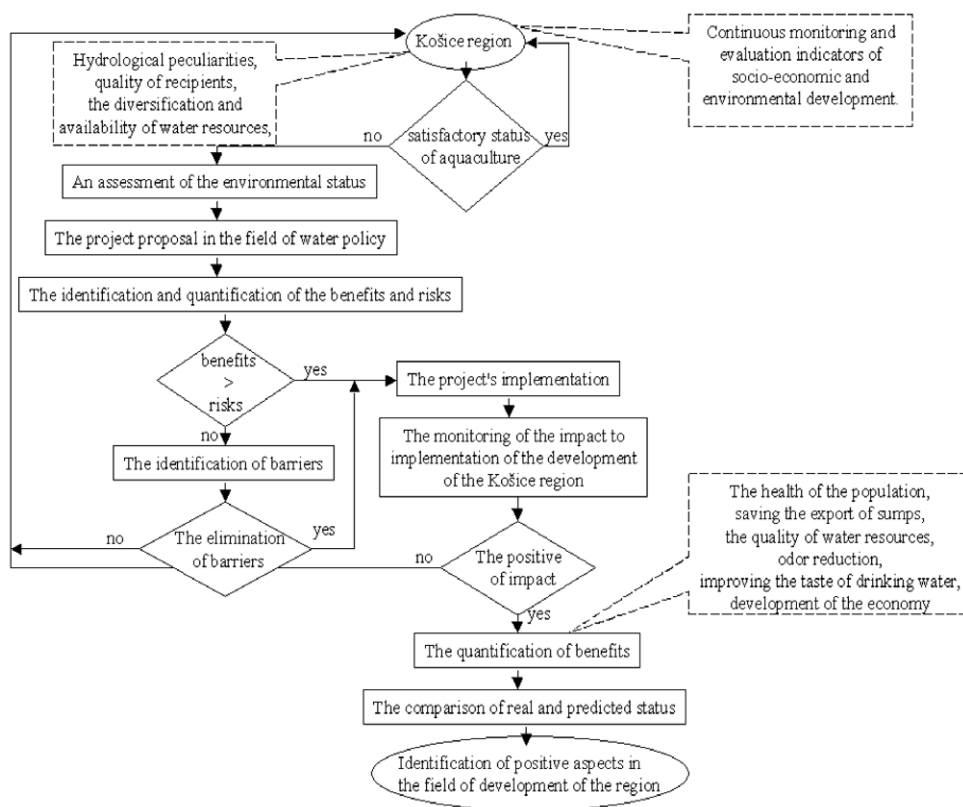


Fig. 11. Management of regional development through the implementation of environmental projects in the field of water policy. Source: Prepared by authors.

Conclusion

Environmental projects in the field of water management represent a response to the initiative of the bad state of water, which occurs in the transforming of an unacceptable condition for an acceptable condition, thus corresponding to the conditions of existing EU environmental standards accepting the specificities of the projected areas of the region. With the help of the identification of the fundamental problem of the unfavourable state of water management, a strategy for the improvement can be determined and identified the predicted benefits and potential risks in the process of implementing an environmental project in field of water management in relation to regional development. By determine the appropriate strategies and possible gradual elimination of barriers, we can provide an appropriate and positive-oriented implementation of environmental projects in relation to regional development.

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