Jagiellonian Journal of Management
vol. 1 (2015), no. 2, pp. 77–89
doi:10.4467/2450114XJJM.15.006.4260
www.ejournals.eu/jjm

The dilemmas of optimal water resources management in Poland posed by the implementation of EU law

Krzysztof Berbeka[1]

The Jagiellonian University in Kraków, Institute of Economics, Finance and Management

Abstract

The optimisation of water resources management requires appropriate economic instruments with respect to quality and quantity. The EU-approved regulations are to a large extent political and neglectful of the principles of optimisation. With regard to the numerous types of water utility, its quality and quantity management rules call for a rather complex apparatus, which fails to find acceptance among the law-making body in the field of natural resources and environmental services. This paper aims to provide a thorough analysis of EU water policies using standard tools of environmental economics. The analysis is based on the Polish experience of implementing some of the key EU regulations concerning water resources. The paper shows the inefficiency of the prescriptive approach as well as of its unsuccessful corrections.

Paper type: methodological article

Keywords: water resources management, efficiency of EU regulations, implementation of water policy directives

[1] krzysztof.berbeka@uj.edu.pl

Introduction

On joining the European Union, Poland was obliged to implement the EU acquis, including the set of environmental regulations. Since Poland's accession to the EU, the requirements for the use of environmental goods and services have become stricter. A large part of the legislation relates to widely-understood water management. Despite the obligatory cost and benefit analyses for new regulations, the EU legislative process is largely politicised, which calls into question the maximisation of net profit from implementing certain requirements. With regard to the numerous types of water utility, its quality and quantity management rules call for a relatively complex apparatus, which fails to find acceptance among the law-making body in the field of natural resources and environmental services. This paper aims at a critical analysis of the EU water policy using standard tools of natural resources economics. It also scrutinises the fulfilment of particular goals, especially for the adopted indicators. The empirical data refer to the period between 2003 and 2013.

1. Theoretical indications of determining the optimal level of pollution and the optimal rate of resource consumption

Optimal level of pollution

The optimal level of pollution is defined on the basis of the marginal social cost curves caused by the pollution and the marginal abatement cost of the pollution. The standard version of the optimisation is depicted in Figure 1. It features in classic works on environmental economics (Pearce & Turner, 1990; Sterner, 2003).

By social cost of emissions is meant the total cost of the sum of private costs (incurred by the producer) and the external costs experienced by the whole community involved in the activity of the producer (including the pollutant emissions caused by their activity). The emission abatement cost signifies the costs (mainly abatement technologies) incurred by the producer which aim at reducing or eliminating emissions. The graph illustrates marginal values which should be interpreted as follows:

- for MAC, it is the emission abatement cost by one unit (e.g. a ton),
- for MSC, it is the monetary value of adversity caused by emission increased by one unit.

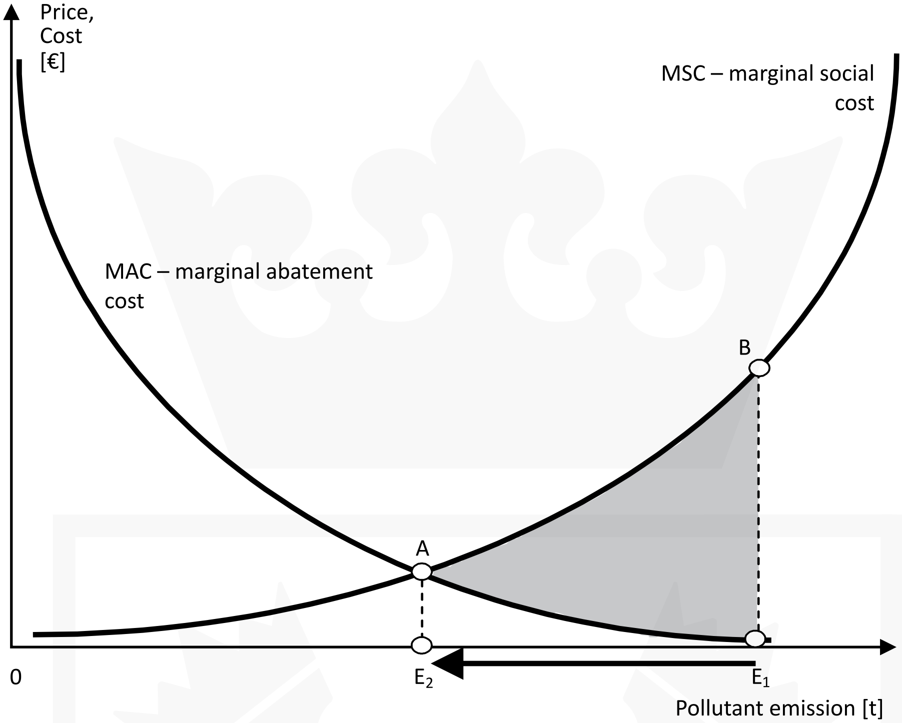

Figure 1. *Oplimal level of pollutant emission.*

Source: Pearce & Turner, 1990, p. 63.

The optimisation above also meets, at least partly, the dynamic criteria as long as the marginal social cost curve includes the discounted costs of future generations. Applying the concept on the EU regulation level and implementing a regulation which limits the acceptable amount of emissions give rise to a series of problems. Both curves – the marginal cost as well as the social cost – differ considerably from one EU member to another. With regard to price convergence, it can be assumed that there is less variation in the abatement technology costs (MAC curve). The marginal social cost curve depends greatly on the level of wealth of a given country; and here the differences are significant. Figure 2 depicts how shifting curves influence the optimum level. Moreover, the graph presents two phenomena: the decrease in MAC caused by public funding of environmental protection investment (mainly from the EU but also the national public means) and the covergence process connected with aligning the standards of living, which results in MSC_{PL} approaching MSC_{UE}.

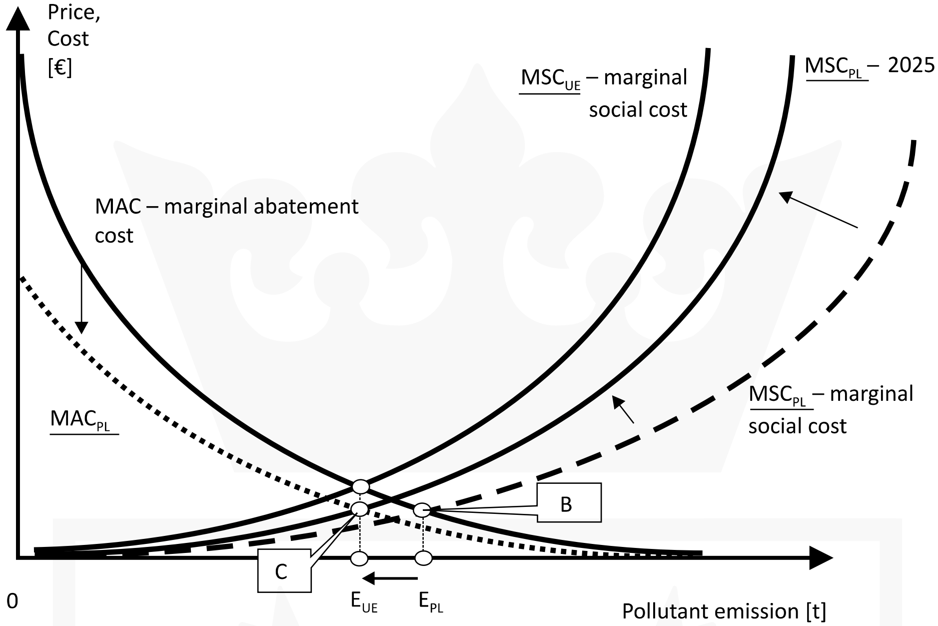

Figure 2. *The impact of shifts in marginal cost-benefit abatement curves on the optimal abatement level.*

The line of reasoning illustrated by Figure 2 allows a relatively obvious conclusion that the requirements stated in EU directives (assuming that they were founded on a solid economic basis in the first place) do not necessarily lead to the maximisation of welfare on the scale of a single country, especially if it is less wealthy than the EU average.

The efficiency of the unified European water management regulations seems controversial as the cost and benefit marginal curves diverge. According to the Oats's principle (Oates, 1996), the possiblity of individual diversity of environmental objectives is limited. The principle focuses on efficient problem solving (setting goals and optima) on the lowest possible level where there are costs and benefits of the solution. It is extremely difficult to establish such a micro-scale level for water resources. In so far as the costs of regulations are ascribed to specific locations, regions (through construction of treatment plants, local water scarcity), the benefits derived from better quality resources and improved accessibility are enjoyed far away from where the costs have been allocated. This is a direct result of the fact that developed river systems generate transboundary effects. Such a considerable dispersion of cost and benefit justifies international application of regulations regardless of their local inefficiency.

Optimal rate of resource consumption

The theory of optimal rate of resource consumption is far more demanding, and yet, in some of its aspects, it still lacks satisfactory solutions. This applies to nonrenewable resources. Due to the fact that water resources are intrinsically renewable, the scope of discussion will be narrowed down to this type of resources specifically.[2] With regard to renewable resources, one determines the maximum sustainable yield which is identical with the maximum amount derived from the resource and which aims to maintain the resource at a constant level. The correlation is known as the Gordon-Schaefer model (Munro, 1979), and was formulated to provide answers to questions about obtaining resources in forestry and fishery. The model, however, does not solve all the problems, some of which are more general (independent from the type od resource), others are related to water resources specifically. There remains the question of whether the current amount of renewable resource is at a satisfactory level (also for future generations), or whether the current exploitation of the resource should not be using a lower than the maximum rate and consequently lead to expanding the renewable resource. Another shortcoming of the model in question is the assumption that the resource remains constant in time, and more specifically, that the resource variability is exclusively linked with human activity. With respect to water resources, exogenous variables, such as the seasons of the year and current precipitation must not be underestimated as their impact is much greater than human impact, which is why the applicability of the Gordon-Schaefer model in the field of water resources is dubious.

Due to inadequate theoretical solutions available, there is an approach based on a precautionary principle, which consists in using specific safety margins. Such an approach involves the use of an arbitrarily assumed percentage of discretionary resources. The percentage lacks any substantive justification and is more likely a product of political, economic and cultural decisions.

2. An overview of the main objectives in terms of water management under the existing EU regulations

One of the first attempts to improve the quality of water resources was the Council Directive 91/271/EEC concerning urban wastewater treatment. The directive concerns urban wastewater collection, treatment and discharges as well as treatment and discharges of wasterwater from some industry sectors. It refers to the various

[2] In the case of groundwater the length of the renewal cycle may vary considerably.

degrees of agglomerations with more than 2.000 population equivalent.[3] The directive imposes a number of various requirements connected with the necessity and degree of wastewater treatment in relation to the size of an agglomeration and the type of receiving waters where the treated sewage is discharged. The implementation costs of this directive are the highest among the whole of environmental directives. Its objectives mainly serve as facility standards (specify the need, scope and efficiency of wastewater treatment for specific treatment plants) and were approved without any prior cost-benefit analysis. However, such analyses were not obligatory back in 1990s. At the same time the Council Directive 91/676/EEC concerning protection of waters against pollution caused by nitrates from agricultural sources was approved. The main objective was to reduce the amount of pollutants (nitrates) from agricultural sources entering surface waters and groudwaters.

Despite the heavy costs incurred when implementing both directives, the quality of waters in EU Member States has not reached satisfactory levels, which resulted in adopting a far more comprehensive regulation known as the Water Framework Directive (WFD).[4] The directive commits the EU member states to achieve good qualitative and quantitative status of all water bodies within a specified timeframe. The good status of waters is defined by a number of indicators. The objective was again adopted without relevant prior analysis of necessary costs and benefits. It was expected that due to inadequate technical possibilities of reaching the objective, and that for the smallest computational unit, e.g. a single body of water, the costs may considerably exceed the benefits, therefore few ways of derogation from the required status were provided.

In so far as the main objective was adopted without a solid economic ground, in certain critical situations it still was employed. For the first time too prices of services were to include charges for environmental and resource depletion (the so-called environmental and resource costs).

What is worthy of notice among the specific objectives of the directive is the need for sustainable water management, which aims at reducing water consumption in specific sectors.

---

[3] Population equivalent means the organic biodegradable load having a five-day biochemical oxygen demand (BOD_5) of 60 g of oxygen per day. The unit is arbitrary as it does not specify the source of pollution, and so it expresses idustrial polution in population equivalent. To establish one common standard, industrial and individual waste can be combined.

[4] Directive 2000/60/EC of 23 October 2000 establishing a framework for community action in the field of water policy.

3. Measurement method

When it comes to the directives concerning facility standards (such as the urban wastewater treatment directive), their implementation process is reduced to verifying if technological installations meet appropriate requirements and to whether the entities concerned are in possession of installations required by law.[5] So implementation measurement is relatively straighforward and consists in an uncomplicated specification of entities or pollution load covered/not covered by correct collection and treatment. Such an approach, however, does not provide any possibility of optimisation of cost or environmental effects. The directive under discussion does facilitate cost optimisation under Article 5.4, which allows for deviation from facility standards, provided that the cumulative effect of all the activities in required facilities will result in effective nutrient reduction not lower than 75%. Such a delegation enables, on the one hand, the use of the so-called economies of scale, i.e. a greater reduction of pollution on large industrial sites (where the unit cost is lower) and, on the other, establishing less stringent requirements in the case of smaller sites. Implementation measurement is then carried out on the basis of generated, treated and discharged pollution loads.

The main objective of the Water Framework Directive is the accomplishment of good water status. Simple reporting refers to the number of bodies of water, which have reached the required level or the remaining range (the number of bodies of water which have yet to reach the required status). It is quite surprising, however, that the basic implementation measurement of the directive which refers to the economic and price mechanisms analyses on several occasions is the number of separate units, without consideration for either the beneficiaries of the good status or the lack of it, or for other irregularities of basic computational units. From the perspective of water management on a national level, the directive creates requirements of considerable variability. On the one hand, good environmental status creates requirements for maintaining minimum acceptable flow in rivers, and so establishes hierarchical resource consumption. Therefore, there emerges, at least potentially, the phenomenon of resource scarcity or – more precisely – deficit. In the hydrological context the term is interpreted differently than in environmental sciences since, when considering "good water status", a "deficit" takes place when the demand is met not only from water withdrawal, but necessitates tapping into the minimum acceptable flow. The reflections focus on the two categories: water withdrawal and actual abstraction of waters. In economic terms, a situation where supply meets demand does not qualify as a deficit. Moreover, the actual abstraction of water is not identical with demand for water due to the existing system of the Water Act Permit for abstraction. In the event of a potential user's expectations ex-

[5] In practice, it is the number of agglomerations with treatment plants plus the population number assigned to these agglomerations.

ceeding water withdrawal, they do not get permission for abstracting the whole of the required amount. Hence, unsatisfied demand – or an economic deficit – arises without a hydrological deficit. This divergence is depicted in Figure 3, where curve C illustrates the actual abstraction of water whereas curve D presents the demand for water. Starting from value P_1, the demand may be limited by water intake permits, therefore an economic deficit is likely to appear before a hydrological deficit.

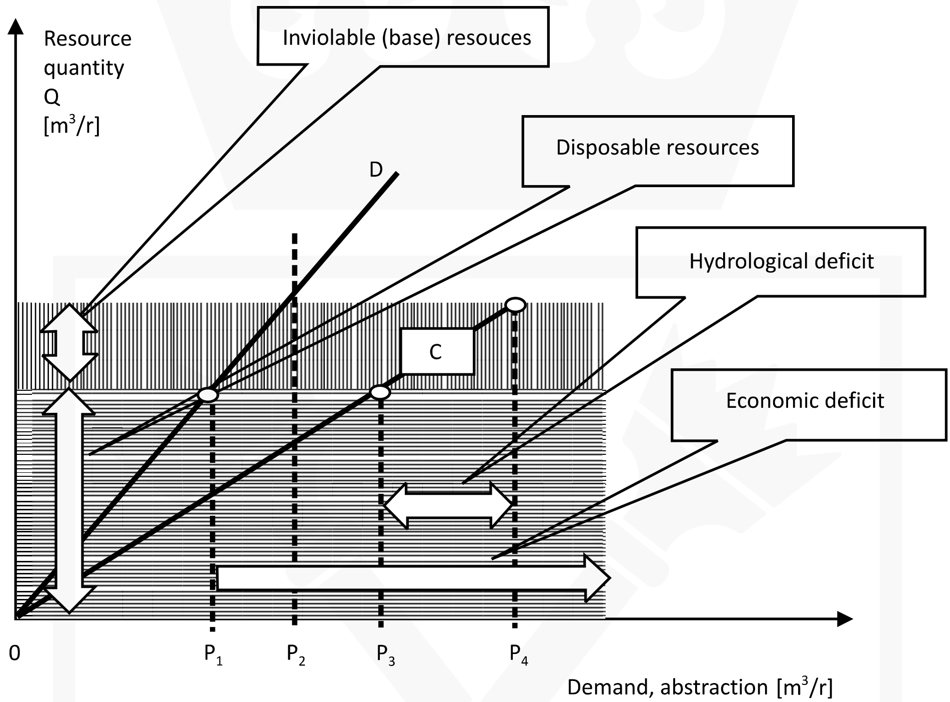

Figure 3. *Differences between a hydrological deficit and an economic deficit.*

On the other hand, if the demand does not exeed the P_2 value and is not limited by water permits, the deficit will not occur. Depending on by how much the demand curve is higher than the abstraction curve, there are different relations between the sizes of hydrological and economic deficits possible. Lack of comparability between the two indicators generates problems in water management. The WFD refers to good environmental status, which necessitates respect for the minimum annual flow, however, the very same directive requires the cost accounting to include the so-called resource costs which refer to opportunity costs. This approach calls for appropriate economic instruments.

The need for sustainable consumption of water resources, which is expressed in numerous directives calls for establishing a sustainability rate by quantifying the process. For this, the aggregated measure of water absorption of economy, which captures the amount of consumed water in relation to the intensity of economic processes. It can take the form of:

- General water intensity (general water use/GDP), units: thousand m^3/ PLN million (calculated as the ratio of water consumption for the economy and population to the level of GDP).
- Industrial water intensity (industrial water use/GDP generated by the inustrial sector), units: thousand m^3/ PLN million (calculated as the ratio of industrial water use to the level of GDP).

Furthermore, the specificity of water intake for cooling purposes – the key purpose in Polish economy – needs to be taken into account. Disabling the use of return cooling water stems from:

- water intake and return with limited qualitative differences (temperature), which does not prevent re-using the water in economic processes,
- large intake of water which makes all the other purposes marginal. The changes in the amount of cooling waters do not affect the intensity of water management in other locations.

4. Analysis results according to adopted indicators

It is beyond doubt that meeting specific EU directives aims at improving water quality. What remains controversial, however, is the question whether the imposed ways of meeting the objectives are cost-effective and whether they maximise general social well-being. The research concerning excluding Poland from the possibility of optimising the concept of implementation of urban wastewater treatment directive indicates a highly inefficient implementation path. Transferring the requirements for efficient treatment from large industrial sites onto small ones generates both an increase in the treatment unit costs and in the investment outlays. In view of the necessary condition, i.e. a comparable environmental effect which makes optimisation possible, deteriorating cost effectiveness can be observed, which is a result of the rendering Article 5.4 of the urban wastewater treatment directive inapplicable in Poland. According to the data concerning the optimisation programme resignation cost (Krajowy Zarząd Gospodarki Wodnej, 2012), the derogation from the optimisation programme concerns 239 agglomerations (8.4 million inhabitants) with 327 treatment plants. The additional investment outlay is estimated at PLN 1387.8 million. Having to sustain such an investment outlay and later the operating costs in the target group will lead to an increase in waste collection and treatment costs by PLN 2.88 with the current price of PLN 5.71/m^3. The environmental effects of such an action brought down to enhanced nutrients reduction discharged into rivers will improve treatment efficiency by less than 1 percentage point. The cost effectiveness of such measures is three times lower than in the case of large facilities. From the perspective of water management, the statistics of agglomerations complying/not complying with the requirements set out in the directive are of less importance. There is no doubt that the percentage of agglomerations complying with the requirements decreases after rejecting the efficiency mechanisms.

The process analysis of the Water Framework Directive allows the hypothesis that the most significant indicator for the European Commission is the number of single water bodies which have reached good status. The other assessment criterion is a thorough justification of diversions from the requirement to reach such good status agains the proposed water bodies exempt from this requirement. This formal approach has nothing to do with sustainable water management. There are no reports of the aggregated costs of reaching the status with the possibility of sustaining such costs, and, more importantly, no reports of aggregated benefits from reaching the status. Giving the EU Member States the freedom to shape their own programmes of measures aiming at good status is hardly satisfactory. This discretion is more apparent than real as there are still the facility standards from previous directives in force, which lead to obligatory implementation of environmental protection investments, also in facilities where it is extremely expensive and inefficient. In fact, there is very little scope for optimisation in individual programmes of measures as the older facility standards directives are not subject to negotiation.

To undermine the purely statistical approach, the example of the current state of the Vistula river basin can serve as an argument: the good status has been reached by 499 out of 2.649 bodies of water (Hobot, 2013). This puts on the same level the bodies of water with a surrounding population of tens of thousands with a flow of over a dozen m^3 per second, as well as those uninhabited ones with a flow of $0.001m^3$ per second. Such reporting is and should be obligatory, but it should not serve as a basis for water management assessment in a given country.

Managing the available water resources in compliance with the Water Framework Directive is not devoid of dilemmas either. Differences in defining a deficit hinder or prevent establishing a common apprach. The priority of preserving the minimum annual flow seems unquestionable with regard to long-term sustainability of resources. However, subjecting all the remaining dimensions of sustainable development, such social and economic development, to environmental issues fails to meet the declared priorities. In practice, every body of water in Poland has its designated discretionary resources and a minimum annual flow in compliance with hydrological criteria. There is no evaluation of the total demand for water or opportunity costs related to the decreasing demand. The few attempts to pinpoint the lack of balance between demand and supply in terms of economics have not been fully successful (Krajowy Zarząd Gospodarki Wodnej, 2013). Therefore it is not possible to compare the correction costs of deficits in the hydrological sense by means of estimation and valuation of economic deficits.

It is undeniable, however, that the existing price mechanisms encourage better water management. The trend analysis of GDP water intensity in all variants of the measurement shows increasingly efficient water resources consumption (Figure 4).

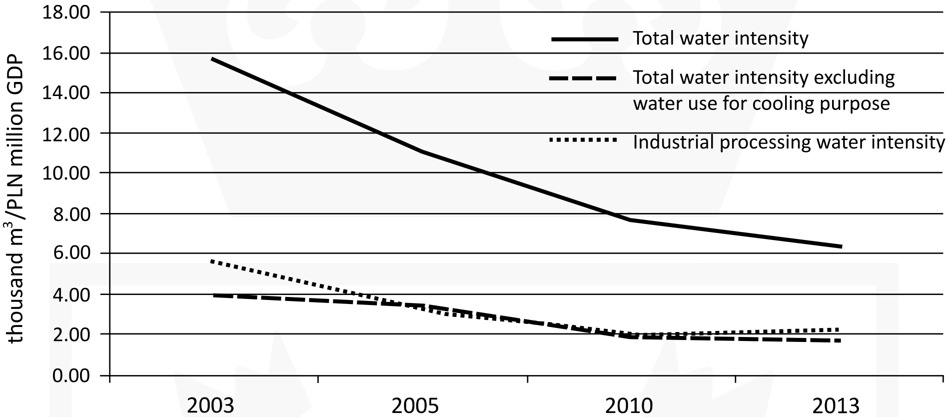

Figure 4. *Shifts in GDP water absorption indicator over the period 2003–2013.*

Source: This figure is the author's own elaboration on the basis of the data of the GUS: *Produkt Krajowy Brutto – Rachunki regionalne* and *Ochrona Środowiska,* the following yearbooks for 2003–2013.

The systematic downward trend of the GDP water absorption indicator is a sign of the right direction of changes that are taking place in out economy. In view of the visible differences in water absorption in specific economy sectors, there are not any reliable benchmarks in foreign research at such a highly aggregated level available.

Conclusions

EU legislation in terms of broadly defined water management has been evolving: from emission standards required for specific facilities to more comprehensive solutions. Inasmuch as the very direction of changes does not breed constroversy and potentially creates cost optimisation possibilities for achieving the objective, potential cost savings are eliminated due to the existing facility standards. In the field of water management, objectives are set arbitrarily and certainly without a prior economic cost-benefit analysis. Despite declarations to conduct such analyses, they seem of little importance, whereas the selection of targets is subjected to the primacy of environmental quality.

Water management in terms of quality and quantity which simultaneously meets the EU regulations is highly ineffective. The positive aspect of such regulations is an enforced improvement of water quality, however, the social costs of such measures are neglected. In this way, the opportunity to considerably improve general social well-being resulting form cleaner environment is largely wasted.

References

1. Generalna Dyrekcja Ochrony Środowiska (2012). *Ocena skutków zmiany założeń do KPOŚK oraz rozporządzenia Ministra Środowiska z dnia 24 lipca 2006 r. w sprawie warunków, jakie należy spełnić przy wprowadzaniu ścieków do wód lub do ziemi oraz w sprawie substancji szczególnie szkodliwych dla środowiska wodnego* by Pectore-Eco, Kraków-Gliwice (unpublished report).
2. Hobot, A. et al. (a collective work) (2013). *Ustalenie celów środowiskowych dla jednolitych części wód powierzchniowych (JCWP), podziemnych (JCWPd) i obszarów chronionych,* Gliwice, retrieved from: https://www.nfosigw.gov.pl/download/gfx/nfosigw/pl/.../2012-120.pdf [accessed: 10.01.2015].
3. Krajowy Zarząd Gospodarki Wodnej (2013). *Opracowanie analizy zwrotu kosztów za usługi wodne z uwzględnieniem prognozy rozwoju na obszarach dorzeczy*. Gliwice (unpublished report).
4. Munro, G.R. (1979). The optimal management of transboundary renewable resources. *Canadian Journal of Economics*, *12*(3), 355–376.
5. Oates, W.E. (ed.). (1996). *The Economics of Environmental Regulation*. Cheltenham, UK: Edward Elgar Publishing.
6. Ochrona środowiska (2003–2013, following yearbooks). Central Statistical Office of Poland, Warszawa.
7. Pearce, D., & Turner, R. (1990). *Economics of Natural Resources and the Environment*. New York, London, Sydney, Tokyo: Harvester Wheatsheaf.
8. *Produkt krajowy brutto – Rachunki regionalne* (2003–2013 following yearbooks). Central Statistical Office of Poland, Warszawa.
9. Sterner, T. (2003). *Policy instruments for environmental and natural resource management*. Washington DC: Resources for the Future.

Note about the Author

Krzysztof Berbeka graduated from the University of Technology in Kraków (the Faculty of Engineering and Environmental Protection). He was awarded the doctoral and postdoctoral degrees in economics by the Cracow University of Economics. He is currently employed as a full professor at the Jagiellonian University. His scientific work focuses on environmental protection investments as well as the financial aspects of implementing environmental programmes and policies. The scope of his work also includes models of the economic impact of implementing EU environmental directives in Central and Eastern Europe. During the process of Poland's accession to the EU, he was involved in evaluating the implementation costs in the environmental domains of air protection, wastewater management and water protection

for the Polish Ministry of the Environment, the Office of the Committe for European Integration, the World Bank and the European Commission. He is a member of the National Environmental Protection Council established by the Polish Minister of the Environment and also a member of the Civic Council for Sustainable Development of Energetics established by the Polish Minister of Economy.