Case study: Cost-effectiveness analysis for realistic river basin plans in Romania (#391)

Description

The EU Water Framework Directive (WFD) requires member states to identify and implement program of measures for reaching good water status for all water bodies by 2015. Selecting the most cost-effective set of measures for reaching good water status is especially important for Romania, a country that belongs to the most economically weak and vulnerable EU member state. In addition, EU water legislation imposes high investment needs that require careful considerations regarding the nation's affordability. Romanian water sector poses the limited financial and budgetary resources available for supporting this implementation as well as the limited capacity to pay for the many water users and economic sectors. Thus, in the implementation of the EU WFD, Romania is confronted with the difficulty to choose among a wide range of measures. Hence the challenge lies on how to choose among all the available measures that can appropriately be applied and more so, how to prioritize them.

Action taken

In response to address the pressures in the Romanian river basins, a number of measures have been identified as part of EU WFD implementation. There are two categories of measures defined for removing and reducing the effects of these pressures i.e. basic measures and supplementary measures. The basic measures include concrete projects and programs to achieve the good status of all water bodies. Supplementary measures were also identified and aimed at reducing the effects of hydro-morphological alterations, application of good practices, capacity building of reformed water institutions and public awareness initiatives.

Because of the limited cost-information, the most challenging steps were to assess cost-effectiveness of the proposed measures. As a result of 5-years effort of specialists from various sectors a cost effectiveness analysis report was published. It highlights the investments and time periods the environmental objectives could be reached. The cost effectiveness analysis describes a prioritization and analyzes the criteria for measures and implementation possibility of the kinds of measures to be under taken.

Lessons learned

Identification of a single solution proved to be difficult due to costs and the probability to reach the target could only be evaluated in a qualitative way. Also uniformity of basic assumptions and proposed methods has been safeguarded by ensuring that all river basins (subunits) from Romania use the same approach. Thus, it makes possible to compare the results of individual river basins and simplifies analysis at a greater scale, for example at national scale. It has to be mentioned that the involvement of stakeholders in the CEA was needed for the development of the programme of measures. In addition, there was a need to ensure that expert judgment was used in a rigorous and transparent manner.

There are still a lot of challenges: human (and financial) resources are required to undertake such studies, how results will be translated to right political decisions, and how out-of-water sectors understand needs to provide specific information. Also, there was a lack of studies related to monetary assessment of indirect costs of supplementary measures.

Importance of the case study for IWRM

Integrated water resources management seeks to address a wide variety of water management objectives and interests which among other things many include: developing, selecting and implementing the most appropriate programme of measures related to all important water management issues. Such issues among others include organic pollution, hazardous pollution, nutrient pollution and hydro morphological alterations. The use of cost effectiveness analysis

is one of the ways of achieving IWRM objectives. Finally, having integrated basin analysis of all water management issues provides opportunities for overall improvements in management.

For Tools A3.1, C2.6, C4.2

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Full case study

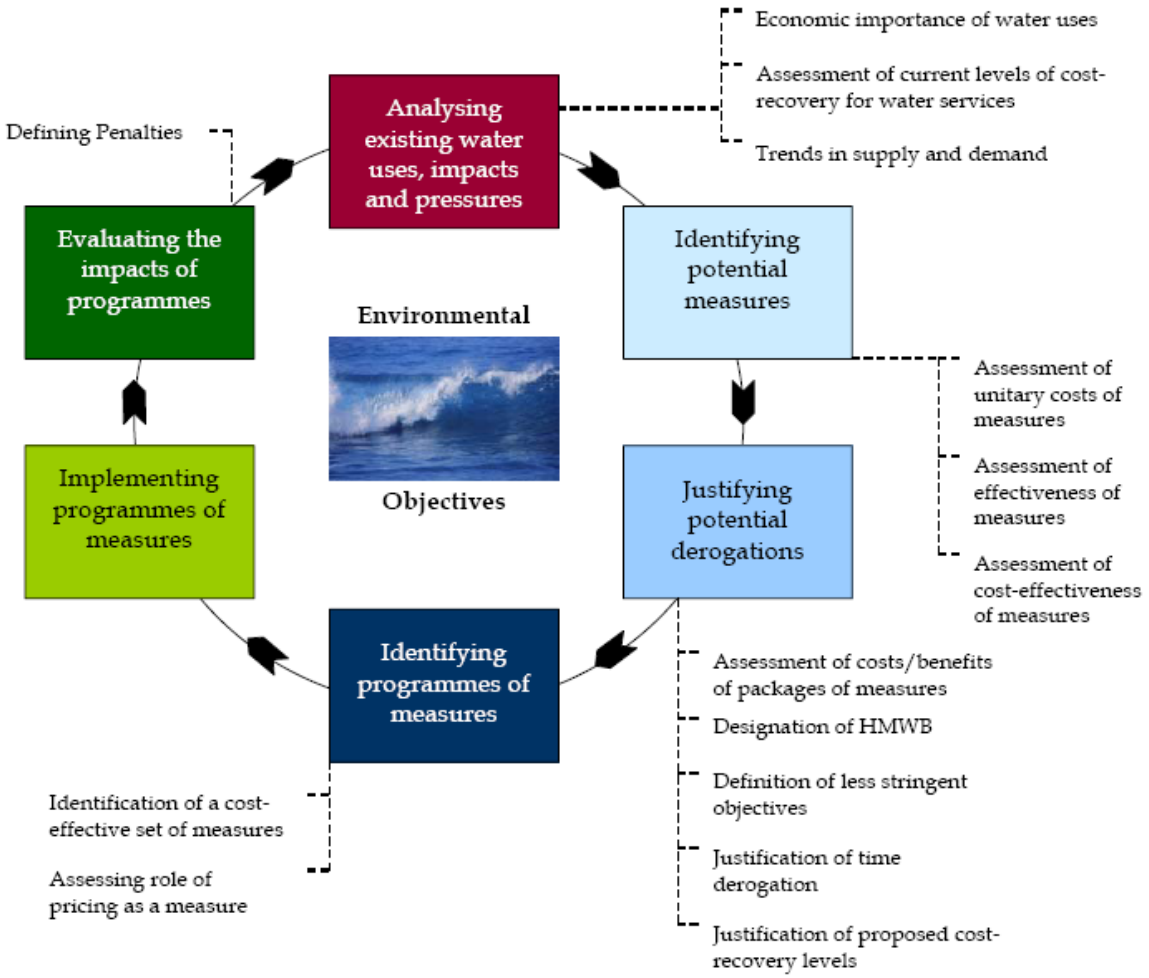
Background

Romania has committed to transpose and implement the EU Water Framework Directive. An overview on significant pressures in Romania indicates a number of 947 point significant sources (436 urban, 325 industrial, 181 agricultural, and 5 others). More than 50% of the total nitrogen discharge originates from agricultural diffuse sources; around 52% of phosphorous diffuse discharge is due to human agglomerations and agriculture. Hydro-morphological alterations impacts significantly water courses, for instance 242 reservoirs interrupt the longitudinal continuity of the river; 4689 km embankments on river bank regulations with 3460 km changing the river morphology. Also 550 km derivations and significant water abstractions produce effects on river hydrological characteristics.

The Program of Measures is a part of the River Basin Management Plan in response to address the above pressures, to improve and preserve the good status of the river with concrete results as part of WFD implementation. Setting and selecting the most cost-effective set of measures is particularly relevant to the implementation of the WFD. In particular considering the need to implement highly expensive environmental and water related legislations with the limited financial and budgetary resources as well as the limited capacity to pay for many water users and economic sectors. The EU WFD prescribes different elements that that should be integrated in the policy decision and management cycle:

- Undertaking the economic analyses of water uses (Article 5);
- Investigating the dynamics in the river basin – development of the baseline scenario (Article 5, Annex III);
- Assessing current levels of cost-recovery of water services (Annex III, Article 9);
- Preparing for the cost-effectiveness analysis (Annex III); and
- Proposing activities for enhancing the information and knowledge base (Annex III).

It is important to ensure that the economic analyses (illustrated below) are integrated with other technical analyses such as the analysis of pressures and impacts. This will ensure a common description and characterization of the river basin is obtained, basis for the identification of the program of measures and the development of the river basin management plan.



Source: EU WFD CIS Guidance Document No. 1 (Economics and the Environment – The Implementation Challenge of the Water Framework Directive)

In Romania, five steps to conduct the cost-effectiveness analysis were undertaken. These involved selecting the measures; cost evaluation of the measures; selecting the supplementary measures inventory related to significant pressure and prioritization of supplementary measures based on 'cost effectiveness ratio". To ensure the successful application of the cost-effectiveness analysis, it was important to identify a wide range of measures targeting the significant pressures which affect the water environment.

The total investment costs related to supplementary measures is estimated to be around 0,58 billions EURO of which 0,25 billion EURO represents the hydro morphological alterations related measures. While an estimate of 0,1 billion EURO for human agglomerations, 0,08 billions EURO for industry and 0,160 billions EURO for agriculture is needed. So from the total investment amount related to the Program of measures 2,87% represents the supplementary measures.

Problems addressed

The EU WFD requires countries to identify and implement program of measures for reaching good water status for every water body by 2015. However, reaching good water status demands looking at different economic sectors and activities affecting water status and eventually selecting a package of measures that may affect to a different level various economic sectors and water users. Majority of investments go to implement basic measures

(those mandatory provisions derived from new water legislation). The problem that arises is to determine which measures are the optimum additional or supplementary measures necessary to reach the environmental objectives.

It has been clear that the effect of the basic measures in improving good water status is positive and the investment costs have to be supported. The issues that still remain to be addressed include the following:

- The approaches to be taken for the supplementary measures in order to have a proper decision making on the Programme of Measures.
- The relationship between the cost of these measures and their effect on water status.
- The criteria to prioritize the set of pre-identified supplementary measures.

Another issue is also the extent of expert knowledge and judgment that can be used for involvement of stakeholders. Coupled with the appropriate geographical scale for applying cost effectiveness analysis (national, regional, basin, sub-basin, local and water body); the relative difficulty in assessing the effectiveness of measures, rather than the costs. The assessment of costs in this case was easier and more certain than the assessment of effectiveness of measures. The use of uncertainty as a reason for not doing anything was identified as a problem by a stakeholder. One key remaining issue is related to the effect of the measures to establish groundwater quality. Regarding the development of the cost effectiveness analysis, there is still lack of studies related to monetary assessment of indirect costs of supplementary measures. This is mainly grouped at a sub basin level and also the existence of an uncertainty regarding the evaluation of some supplementary measures for agricultural activity was a challenge.

In addition, the issue of how to estimate and compare effects when assessing the expected impact of a measure on water status may be difficult due to the diversity of dimensions considered in good water status. In some cases, there is limited knowledge on a number of basic parameters` impacts (e.g., N, P) and the impact on ecological status is a challenge. Also, it has not been easy to compare the impact of measures affecting different indicators. For instance comparison of the effects of wastewater treatment plant to reduce nitrogen and phosphorous loads with the effect of a river restoration program which directly target the functioning of the ecosystems. To express each impact as a relative change in water status would solve this problem but there is still a long way to arrive at the point.

The involvement of stakeholders in cost effectiveness analysis and the financing of measures played an important role. It helped in decision making and implementation process since stakeholders were involved in the early stage of the process. This also assisted in increasing the awareness of stakeholders in relation to their responsibilities. However, discussions and negotiations held with the stakeholders to establish supplementary measures further revealed that there is a risk in terms of achieving the above measures within the agreed deadlines. This is due to the decreased economic indicators in the current financial conditions which may influence the financial availability of economic units over the next 3-5 years.

Action taken

Two categories of measures defined for removing and reducing the effects of pressures were identified i.e. basic measures and supplementary measures. All these measures aim at addressing anthropogenic pressures which are mainly a result of human agglomerations, industrial and agricultural activity and hydro morphological alterations. The ***basic minimum compliance measures*** involve a financial investment totaling approximately 19 billions

EURO. Out of this investment only the human agglomerations represents around 15 billions Euro (78%), the industry 1,28 billions Euro (7%), agriculture 1,9 billions Euro (10%) and 0,011 billions Euro the hydro morphological related measures.

In addition to the basic measures achieving the environmental objectives, ***supplementary measures*** were identified. These measures are aimed at reducing the effect of hydro-morphological alterations (restoration of longitudinal and latitudinal river continuity), ecological restoration, measures related to decrease the effect of navigation on aquatic ecosystems and flooded areas. Also specific supplementary measures for reducing pollution from human agglomerations, industrial and agricultural activities have been identified. The identification of measures was based on review of existing strategic and planning documents for specific policies (e.g. implementation of the EU Nitrates Directive), sources of financing, and involvement of various economic sectors and other actors (e.g. environmental NGOs). This list with measures was complemented by targeted discussions with a wide range of experts and stakeholders from government, research institutes, consulting companies and NGOs. A distinction was then made between measures and ***instruments***.

The following processes were considered crucial in the implementation of the measures and the instruments:

i) Cost evaluation for each measure

The collection of basic information describing measures along with their expected costs was the second main action of the cost-effectiveness analysis. Relevant information for cost-effectiveness analysis and for fulfilling the program of measures in general included: detailed description of the measure; time-related information, duration for implementation, date of completion if specified, costs; main uncertainties with regards to time, responsible institutions for (a) deciding on the measure, (b) implementing the measure, (c) funding the measure.

The information was organized in such a way to facilitate the use of the cost-effectiveness analysis and further refinements in analyses that may be required following the collection of new information and development of new models or feedbacks from stakeholders. The information required for this step was available in the strategies and documents mentioned above for measures for which large experience in implementation already exist. More detailed information is also available in project documents; in particular those financed by external financial sources such as EU ISPA and today cohesion funds.

ii) Identify the scale of analysis and classify the effect of the selected supplementary measures of biological quality elements

From an economic point of view and more so to account for the inter-connection among the water bodies of a given river basin, cost-effectiveness analysis should best be performed at the scale of a River basin. However, to undertake the analysis at lower scales it is more manageable in cases of large numbers of water bodies, pressures and environmental problems within the sub basin scale. To achieve the 2015 water quality prognosis, 2 mathematical mass balance models (WaQ and QUAL2K) have been applied. The WaQ model was applied for all water bodies on sub-basin river scale and QUAL2K only for the water bodies on risk from the organic point sources.

The proposed supplementary measures entirely will lead to reaching the good water status or good water potential as a result of reducing the pollutants according to the WaQ, QUAL2K models. Evaluation of the ecological effect of the supplementary measures has taken into account the main essential indicator groups (algae,

macrophytes, macro-zoobenthos, and fish fauna) defined in Annex V of the WFD. A selected target group participated in establishing the ecological effect of above mentioned supplementary measures. The effectiveness of measures on the water body indicators or pressure situation has been evaluated in four stages. All specialized departments in the environmental administration have incorporated into their work the process mentioned earlier. In relation to the target group, an effect classification scheme has been developed; a low improvement effect of a measure on the biological indicator was marked with an "x" effect. Those with a medium effect were marked with "xx", and those with a high effect were marked with "xxx". If a measure is not expected to produce any effect in a biological indicator, it was marked with "0".

The effects of the supplementary measures were modified according to local characteristics, while taking into account the importance of the significant pressures. Nevertheless, an estimation reduction of the pollutants i.e. Nitrogen and Phosphorus and more so applying the WaQ mass balance model by adding "+" or by eliminating "+" to obtain the relevant quality biological elements hence effecting the hydro morphological alterations. An overall evaluation was implemented for each individual measure in the form of the sum total of "x" (x = 1, xx = 2, xxx =3). In order to derive prioritization on this basis, a classification of the overall value was needed. This classification is depicted as the function of significant indicators. Therefore, for each water body, a points system should be employed, and the individual measure should be classified. For this purpose, a four-stage classification (0, 1, 2, and 3) has proven practical. Measures which are expected to have no or only a marginal positive effect (e.g. values < 1) on the ecological status of the water body were eliminated from further consideration in subsequent stages.

iii) Prioritization of supplementary measures based on "cost effectiveness ratio"
A matrix has been realized for all supplementary measures which contain the investment value, operation and maintenance costs as "direct costs" for the ecological effect. This action combines costs and effectiveness information into cost-effectiveness indicators, i.e. computing the ratio between costs and effectiveness for each supplementary measure. A cost-effectiveness analysis was also carried out for supplementary measures, ranking the measures from the lowest to the highest cost-effectiveness ratio. Now it has been observed that these measures are the most cost-effective set of measures for reaching the environmental objectives of the WFD.

iv) Analysis of supplementary measures on sub basin river scale from reaching the environmental objectives.
A final analysis of the supplementary measures prioritized as "cost-effectiveness" ratio has been realized on the probability to implement the measures in 2012 as well as realizing indirect impact of the measures. Comparatively the direct costs (investment, operation and maintenance for example) are a significant percentage that represent the indirect costs. A quantitative and qualitative evaluation of the indirect costs has also been developed. For example, in the case of measures related to hydro morphological alteration, interruption of the river longitudinal continuity due to hydro power plant. The indirect costs were calculated by quantifying the loss energy production**.** A selected target group related to the probability of implementing the supplementary measures participated in collecting information associated to financing sources, conversation with involved stakeholders and local administrative factors. It is important to note that an expert judgment evaluation has been taken into account for some of the cases.

Outcomes

Important final outcome has been the development of the Program of Measures as part of integrated River Basin Management Plans. While to reach all the above actions, it was realized that an economic tools are important to identify the options and reach a certain pre-defined target. A report was developed to highlight the investments related to supplementary measures that are a priority to reduce ecological effects and the time period required for the objectives to be reached. Also the report describes the criteria for prioritization and analyzing the possibility of implementing the measures for the first time at a basin as well as national scale. A national overview related to the supplementary measures identified as a result of Cost Effectiveness Analysis, instruments and associated costs, necessary for reaching the environmental objectives was attained.

In this regard, 222 supplementary measures have been identified related to organic and hazardous pollution and nutrient pollution especially to the hydro morphological alterations and 261 related instruments. The total necessary costs are estimated around 584,224 million Euros. The financing of the supplementary measures is 41% from European funds, 23% from the state budget, 17% from local budgets and 18% from companies` financing sources. For the ecological effects, the highest ranking was associated with hydro morphological measures. Also other measures included structures such as fish ladders, artificial wetlands and river restoration however the probability to implement these measures in the first cycle of River Basin Management Plan (2012) is very low due to financial constraints. Only in few cases of hydro morphological related measures were registered with high certainty of implementation in 2012.

Most of the supplementary measures related to organic pollution especially those from point sources with generally a medium ecological effect were identified to be possible for implementation in 2012. This is due to the fact that these measures are a part of economic investment for actors in the planning process, for instance the extension and modernization of the sewage network. However, due to high financial investment costs related to basic measures, of the 19 billions Euros approximately 57% of the total supplementary measures are allocated to the first cycle of RBMP. Finally, in the framework of RBMP the Cost Effectiveness Analysis provides the basis for Cost Benefit Analysis. In fact for derogation of time for reaching the environmental objectives for these measures which are not eligible to be implemented in 2012 due to financial reasons.

Lessons learned and next steps

CEA is a useful tool in decision making however it is neither the only nor the ultimate selection criteria for the selection of measures. In order to have a proper and update Cost Effectiveness, approach with the Economic Guidance recommended by the European Commission, all the below questions should be assessed:

- How to organize all the information describing measures? A specific electronic database like excel can facilitate developing the cost-effectiveness analysis. Although updates and refinements are likely to be required throughout the planning process.
- Who should do the analysis? It is indeed important to ensure that cost-effectiveness analysis is performed by a selected target group so as to integrate costs and technical efficiency.
- At which scale should the analysis be performed? Whatever scale chosen, the most important thing is to ensure that the inter-relations between water bodies are adequately accounted for in the methodology and analysis.

- How should representatives from relevant economic sectors and ministries, or any other stakeholder be associated to the cost-effectiveness analysis? Different actors play a crucial role since each has relevant information for specific measures (cost of effectiveness). More so, they are likely to be interested in discussing the first results of the analysis. This is due to the fact that they may potentially in one way or the other be affected by the proposed measures. The involvement and the acceptance of stakeholders is therefore crucially in decision making.

The way forward

The current approach offers a prioritization only for supplementary measures but they are still individually analyzed depending on the pressures categories. Cost effectiveness analysis for combination of measures (basic and supplementary) could offer a more appropriate way for policy makers especially in selecting the most optimum solution for Programme of Measures.

In terms of pressures, there is need for an effective combination of measures to ensure that all pressures are adequately addressed.

Sources used in this case study

Economics and the environment. Challenge of the Water Framework Directive Accompanying document and guidance.

WFD CIS Work programme 2010-2012.
http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/implementation_documents/final_2010-2012/_EN_1.0_&a=d