



# REPORT

# Proposed Cost-effective Measures for Reducing the Pressure on the Water Bodies in the Gauja/Koiva river basin district

*prepared within the Estonian – Latvian programme's project "Towards joint management of the transboundary Gauja/Koiva river basin district – Gauja/Koiva"*

**December, 2013**

# Contents

# Introduction

Water Framework Directive (WFD) sets a common framework for the EU water policy aiming at achieving good water status for all waters. To achieve this aim, the WFD establishes a legal obligation for Member States to organise management of water within River Basin Districts (RBD) including production of a management plan for each river basin district. A programme of measures is one of the key elements of the river basin management plan (RBMP) consisting of defined regulatory provisions or so called *basic* measures and where necessary *supplementary* measures. As required in Annex III of the WFD Member States shall make judgements about the most cost-effective combination of measures in respect of water uses to be included in the programme of measures. Therefore, one of Gauja/Koiva project's specific objectives was to select cost efficient measures for improvement of water status in Gauja/Koiva river basin.

The work on the assessment of the cost-effectiveness of the measures was one of the focuses of the economic analyses implemented in the Gauja/Koiva project. The key tasks were development of methodology for cost effectiveness analysis (CEA), testing that in the Gauja/Koiva river basin district, and drawing conclusions. The work on the CEA was lead by Latvian experts, namely Kristine Pakalniete and Kristina Fedorovica, AKTiivS, Ltd who where contracted by the Latvian Ministry of the Environmental Protection and Regional Development.

A methodological approach on CEA was discussed during two cross-border Estonian-Latvian expert meetings where economists, project partners and representatives of the Ministries of the Environment were present. During these meetings, a concept of cost-efficiency analysis was reviewed in terms of applying either a "conventional" cost-effectiveness analysis (a unit of costs versus environmental effects) or widening the concept by applying multi-criteria approach for defining the best combination of measures. The latter would support planners and decision makers to see additional arguments in selection of measures for including in the 2nd RBMP.

Furthermore, differences in definitions of "basic" and "supplementary" measures between both countries were clarified. In Estonia, all measures which are set in national legislation are regarded as "basic" measures meaning that they shall be implemented regardless of the costs. Legal provisions cover wide range of the basic measures and relevant funding has been planned. Few supplementary measures which would be taken additionally to achieve good water status have also been identified, e.g., support for sewerage solutions in low density areas or compensation for restrictions in agricultural practices. However, these measures where mainly identified based on available funding mechanisms than the cost-effectiveness analysis. In Latvia, the definition of "basic" measures is also defined in the legislation – these measures are mandatory for implementation. The supplementary measures were defined and included in the 1st RBMP. However, the CEA was only conducted for the identification of the least cost measures to reduce nutrient pollution.

As a result of discussion the participants of the cross-border meetings concluded that a methodology for more comprehensive approach to the economic analysis of *supplementary* measures, covering different types of measures for different pressures, comparing their cost-effectiveness could be advantageous. The contracted economists would develop such methodology and test its applicability in the Gauja/Koiva RBD.

This report aims to bridge work of the economists on cost-effectiveness with work of scientists assessing water quality and pressures in the Gauja/Koiva RBD. The report presents the findings and recommendations related to selection of the cost-effectiveness of the measures. The findings related to cost-effectiveness analysis are based on the study implemented by the Latvian experts, as the Estonian experts were not fully implementing the approach due to lack of available data and capacity to implement the study within the frame of the Gauja/Koiva project. The full version of the Latvian study in English is available at http://gauja.balticrivers.eu/en/publications.

The Gauja/Koiva project also included work on the economic analysis elements of the RBMPs with a general aim to coordinate national approaches in Latvia and Estonia for joint RBMP for 2016-2021. The economic analysis elements covered by the work:

- Socio-economic assessment of water use,
- Development of the “baseline scenario” (for assessing likely changes in pressures),
- Assessment of the cost-recovery of water services and water pricing policies,
- Assessment of costs and cost-effectiveness analysis of measures.

We encourage you to get acquainted with all research work on economic analyses performed in the frame of the project. The relevant reports are available from the project web-site: http://gauja.balticrivers.eu/en/publications.

Kristina Veidemane

On behalf of Gauja/Koiva project

# 1. Background of CEA analyses in RBMP

The overall objective of water policy is to achieve good water status in all water bodies. The state of water bodies depends on level of pressures caused by various human activities. If pressures are significant then the water status can be deteriorated to lower quality than good (either moderate, poor, bad). Consequently, measures are to be taken to reduce pressures which would result in the improvement of the water status. The WFD requires that Members States make judgements about the most cost-effective combination of measures in respect of water uses to be included in the programme of measures based on estimates of the potential costs of such measures (WFD, Annex III, b). As basic measures are already defined by the WFD and shall be treated as mandatory regardless of their costs, the subject of the CEA is supplementary and additional measures which can be implemented to reduce pressures, thus to close a gap in achieving the good status. However, when working on the programme of measures river basin managers and planners shall also review if the foreseen basic measures are implemented as expected. It can turn out that the desired water status can be improved by making larger efforts to implement basic measures instead of pushing stakeholders to implement new supplementary measures. The causal relationships between these key elements are reflected in the Figure. 1.1.

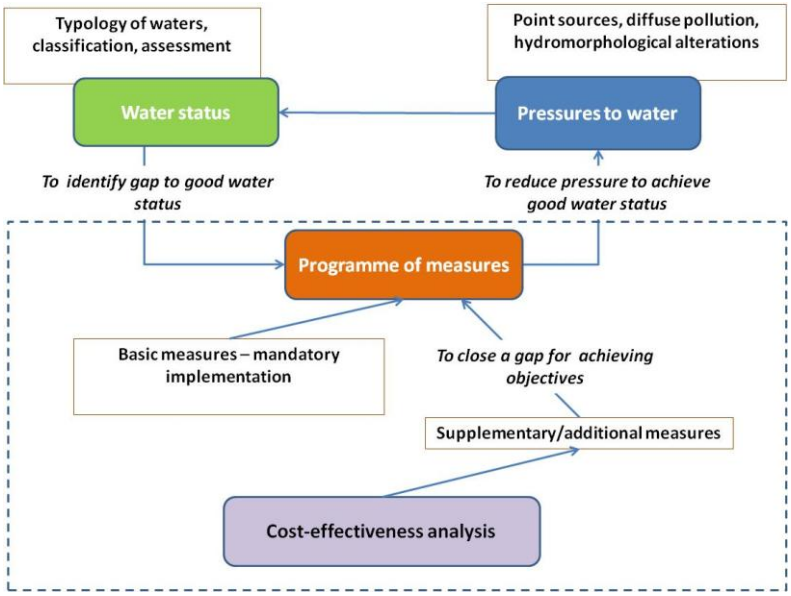


***Figure 1.1.*** *Interlinks between key components of the development of the RBMP (author: K.Veidemane)*

The Guidance[1] on Economics for implementation of the WFD suggests that the CEA is best to perform at the river basin **scale**. When undertaking the analysis at lower scale, it requires an adequate integration between analyses undertaken for sub-units of the river basin. A catalogue (or a data base) of measures where comprehensive descriptions are given usually are compiled for a country, as many aspects are not site specific.

The expert work on programme of measures including CEA is closely linked with work of environmental experts estimating pressures and impacts on water bodies. The key issue is not only about costs which are calculated by economists but environmental effect which are measured or calculated by environmental experts. In its turn environmental experts shall work with biologists assessing the status of fauna and flora. Therefore all work for river basin management planning is very interdependent – result of one expert group is strongly dependent on the outcomes of other expert groups. It requires a lot of coordination and communication.

[1] *Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 1. Economics and the Environment – The Implementation Challenge of the Water Framework Directive, 2003.*

# 2. Overview of status and pressures in the transboundary water bodies in the Gauja/Koiva RBD.

## 2.1. Water status assessment in the transboundary water bodies

During Gauja/Koiva project the Estonian and Latvian scientists investigated ecological status of the transboundary water bodies[2]. The scientists assessed the ecological status according to the following biological elements: diatoms, phytoplankton, benthic macroinvertebrates, macrophytes and fish fauna. Physico-chemical elements such as temperature and the level of nutrients were measured and taken into account just for explaining the results.

Estonian scientists from Tallinn University of Technology also investigated physico-chemical status of the rivers in Koiva RBD by taking monthly samples during a year. The key conclusion was that physico-chemical status of the monitored rivers is good or high (see figure 2.1.). This indicates that the existing pressures has not deteriorated the physico-chemical quality status of rivers there is no a gap to be covered by supplementary measures.

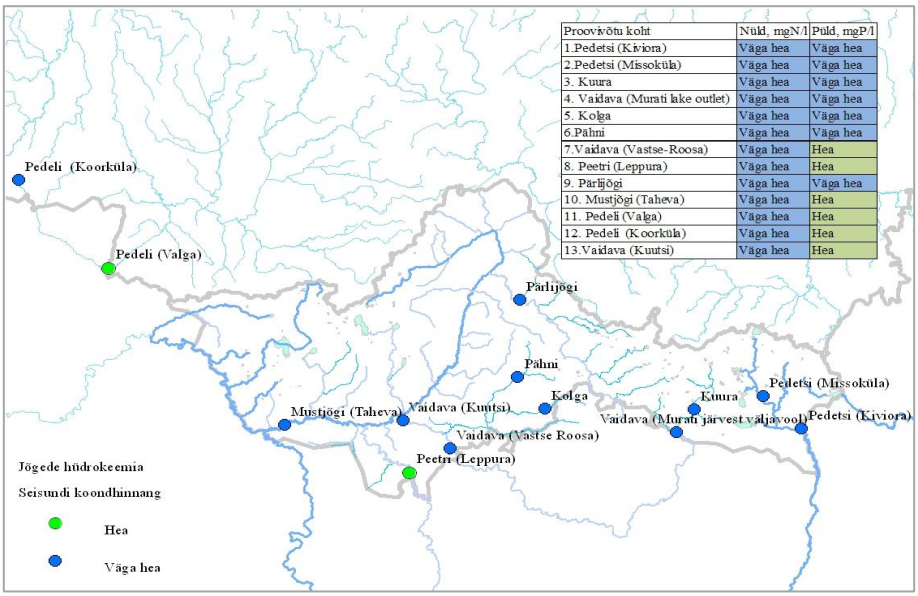


***Figure 2.1.*** *Rivers physico-chemical status in Koiva RBD (hea – good; väga hea – high). (author: K.Pachel)*

The Latvian experts mainly applied the Estonian methods for sampling and analysis while the assessment schemes to derive the final status were different. Consequently, the final status assessment results also indicate some differences (see table 2.1.). A reason for assessment of the river Pärlijõgi as *poor* at the upper course in Estonia was due to fish fauna indicators. The main stressors to the fish of the river Pärlijõgi are dams. The river is separated from the Mustjõgi and Koiva River by several dams. Three of them are situated at 4, 7, and 22 km from the river mouth. Fish catches were performed in summer 2012 and this time fish could not surpass these dams. In autumn 2012 the fish passes were constructed to the first two dams from the river mouth. Probably now the ecological state of the river has improved. The same reason was when status was assessed of the river Pedele, where fish fauna has been impacted by dams at town Valga.

In addition to the transboundary rivers, biological elements were investigated also in other rivers. The situation showed that in several rivers (Ahelo, Hargla, Mustjõgi) do not achieve good status due to fish fauna. Damming

[2] *Kalvane I. and Veidemane K. (eds.). 2013. Final report on assessment of the quality status of the transboundary water bodies (coastal, lakes, rivers) in Gauja/Koiva river basin district.*

by beavers resulting in impoundments might have impacted fish fauna in the river Ahelo and Hargla, however additional investigation of the source of pressure is needed.

Similarly to Estonia, Latvian experts also investigated other rivers in Gauja/Koiva basin. As the methods for the assessment are still new and not fully validated, the experts are rather reserved in presenting the final water status assessment. For example, for fish fauna assessment, the expert has admitted that the reason for lower assessment of some rivers can be due to lack of final typology of rivers according to fish communities in Latvia. Therefore the Latvian experts still choose to apply the expert judgement approach.

***Table 2.1.*** *Final assessment of the status of the transboundary water bodies monitored in the Gauja/Koiva Project*[3]

| Ecological status | Vaidava | | Peetri/ Melnupe | | Pedeli/Pedele | | Pedetsi/Pededze | | Pärlijõgi/ Pērļupīte | | Ujuste/Kaičupe | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | in LV | in EE | in LV | in EE | in LV | in EE | in LV | in EE | in LV | in EE | in LV | in EE |
| Estonian scheme | Good | Good | Good | Good | Moderate | Moderate | - | Good | - | Poor | | Good |
| Latvian scheme | Good | Good | Good | Good | Moderate | Good | Good | - | High | | Moderate | |

| | **Kikkajärv/ Ilgājs** | **Murati / Muratu** | **Väike Palkna / Mazais Baltiņš** |
|---|---|---|---|
| Assessment by the Estonian scheme: scoring system; | Good | Moderate | Good |
| one out -all out principle | Moderate | Moderate | Good |
| Assessment by the Latvian scheme: one out -all out principle; | Moderate | Moderate | Good |
| based on expert judgement | Good | Moderate | High |

The lake experts involved in Gauja/Koiva project support on use of the variety of quality indicators but the final assessment shall be based the integrated approach, not just on technical scoring. As the lakes are not investigated annually then the preferred approach is that the final assessment is defined by the expert judgment instead of the “one out – all out” principle. Lakes can be sensitive to the conditions of the particular year, thus technical evaluation might not reflect true status.

The final ecological water quality assessment for the **Lake Murati/Muratu is moderate** regardless which assessment system is used. However, the sampling results of physico-chemical parameters indicate that the river water quality which outflows of the lake Murati via the river Vaidava is in high quality. The experts did not have information documented about the history of this lake, but probably it has suffered from agriculture during Soviet period and now the **residual pollution** plays a role.

Estonian experts investigate also the following lakes during the Gauja/Koiva project and the final assessment indicated water quality problems. The lake Ruusmäe has poor quality; lakes Pullijärv, Köstrijärv, Kiiviti and Ahitsõ have moderate quality, while lakes Maiori, Mikeli, Preeksa, Sõdaalonõ have good status.

[3] *Kalvane I. and Veidemane K. (eds.). 2013. Final report on assessment of the quality status of the transboundary water bodies (coastal, lakes, rivers) in Gauja/Koiva river basin district.*

## 2.2. Assessment of significant pressures and impacts in the transboundary water bodies

The WFD requires significant pressures to be identified. The Guidance[4] prepared to help Member States to implement the WFD has interpreted the term "significant" as meaning that the pressure contributes to an impact that may result in the failing of an objective.

The WFD requires information to be collected and maintained on the type and magnitude of significant anthropogenic pressures, and indicates a broad categorisation of the pressures to the surface waters into:

- Point sources of pollution;
- Diffuse sources of pollution;
- Morphological alterations.

During the development of the 1st RBMP the significant pressures were characterised and water bodies which might fail to achieve the good environmental status by 2015 identified. The pressures and the selected criteria for the significance were also reviewed in the Gauja/Koiva project. The work on improving of methodology in identification and estimating the pressures were also implemented by subcontractors and conclusions presented in the separate Reports (http://gauja.balticrivers.eu/en/publications).

The impact assessment should use both information from the review of pressures, and any other information, for example environmental monitoring data, to determine the likelihood that the surface water body will fail to meet its environmental quality objectives. Monitoring data may indicate that there are no current impacts. This information itself reveals that none of the pressures identified in the initial screening process is significant, or that the time lag required for a pressure to give rise to an impact has not yet passed. For bodies at risk of failing their specified objectives, it will be necessary to consider the implementation of additional monitoring and a programme of measures.

**Point sources of pollution**

During Gauja/Koiva project, impact on water quality from the three (Hargla, Saru and Rõuge) municipal waste water treatment plants (WWTP) in Estonia was investigated. The results are that the outlet figures from Saru WWTP to Mustjõgi are quite high while the situation in the river is good. BOD was the first parameter reacting to pollution. Saru WWTPs of this type are not working properly in Estonia. Situation is now improving because investments are already allocated. In Hargla there is a quite well functioning bio-pond, thus the discharge water to the river Hargla was not so polluting. In Rõuge the higher N concentrations in outlet were observed, while the concentrations in rivers very not high. In summary, it was concluded that the pressure from these WWTP are insignificant.

As such type of sampling and analysis in Latvia were not taken place then it is rather difficult to draw direct conclusions on significance of the impacts of small WWTP on the Gauja RBD. Nevertheless, the experts assessing the significance of the pollution load of small WWTP (below 2000 population equivalent) in Gauja RBD concluded that their role is comparatively small.[5] The Estonian experts also have concluded the minor role of point source pollution to the total load in Gauja/Koiva RB. In the Mustjõgi sub-basin where there are no

[4] *Common Implementation Strategy for the Water Framework Directive (2000/60/EC). Guidance Document No. 3. Analysis of Pressures and Impacts, European Communities, 2003.*

[5] *Loreta Urtāne, Ģirts Karss. 2013. Gaujas upes piemēra izpētes ziņojums izstrādāto nozīmīguma kritēriju pārbaudīšanai un parādīšanai. Punktveida piesārņojuma avotu radīto slodžu un to ietekmes analīze. http://gauja.balticrivers.eu/en/publications.*

large settlements WWTPs account for 1% or less of the phosphorus load and for even less of the nitrogen load to water bodies.[6]

**Morphological alterations**

As indicated above in the chapter on water status assessment, the main pressure which results in impact to river water bodies in Estonia are related to morphological alterations caused by artificial or beaver dams thus making obstacles for free fish migration. This also means that the measures shall be taken to remove these dams or construct fish ladders to achieve good status in the respective rivers.

The experts assessing the ecological water status also pointed out a need for further investigation of the impacts from drainage activities on biological elements. Renovation and maintenance of the drainage and land reclamation systems has been financially supported in recent years, however, comprehensive studies of their impacts of the water quality are missing.

**Diffuse sources of pollution**

During the Gauja/Koiva project, the experts were evaluating the existing approaches to calculate diffuse pollution in Estonia and Latvia. Pollution load from diffuse sources are estimated by modelling in both countries, however, the applied runoff factors/coefficients are different. This is particularly relevant for factors for natural background load calculations from forests and wetlands, as well as antrophogenic diffuse loads from agriculture and scattered dwellings areas. It was also pointed out that the issue of the nutrient retention in water bodies requires additional discussion. According to Latvian calculations, nutrient retention represents 30-45%, which is very significant. The figures on pollution loads from different models examined by the experts deliver different results. Therefore one of the recommendations was that the additional investigations and intercalibration exercise are needed to obtain acceptable and more reliable coefficients and thus pollution loads from diffuse sources.

As estimations of diffuse pollution load vary depending on used models, it is also rather scientifically ambiguous to come up with precise demands towards reduction of the pollution load from the diffuse sources. Nonetheless, the project experts have identified that diffuse pollution of both nitrogen and phosphorus contributes more than half of the total pollution load in the Gauja RBD. Whereas a part of that is background or natural origin like forests, meadows, wetlands or bogs, the diffuse pollution load from human activities is also seen as relevant source to be examined during the development of the 2$^{nd}$ RBMP.

Unfortunately impacts from diffuse sources on water bodies in the Gauja/Koiva RBD could not be assessed explicitly as monitoring data are not set up for that purpose and the existing methods to estimate diffuse pollution load are uncertain and incredible. In that situation, the water status of the water bodies can indicate if there could possibly be a problem with diffuse sources (current or relict). As described in the chapter 2.1., this might be a case in a number of water bodies in Gauja/Koiva RBD. Thus, identification and selection of supplementary measures related to reduction of agricultural and forestry pollution are relevant.

[6] *Peeter Marksoo. 2013. Case study report. Analysis of point sources of pollution in the Estonian part of the Gauja/Koiva River Basin District. Http://gauja.balticrivers.eu/en/publications*

# 3. Data base on the supplementary measures for reducing diffuse pollution from agriculture and forestry

Developing and filling a data base of supplementary measures was an essential step in demonstrating the multi-criteria assessment (MCA) approach for cost-effectiveness analyses (CEA). At the same time the data base is an information pool which can be exploited further during development of the 2nd Gauja/Koiva RBMP.

The database (xls file) is not scale or area-specific. The selected supplementary measures are applicable at any scale for any area, however, the effectiveness of them might differ of local geographical and technical conditions. Furthermore, the database structure allows that information can be renewed and new additional measures inserted if needed. The data base is structured to provide all relevant information which is needed to implement multi-criteria assessment for CEA (see also chapter 4)[7].

## 3.1. The structure of data base

The database structure consists of several thematic **sections**:

- General characteristics of measures include information on the pressure addressed: environmental problem and type of issue (nutrients / hydro-morphology), human activity causing the pressure (agriculture / forestry); brief characterisation of a measure.
- Application and implementation of measures include rather detailed information on specific terms of application, its scale, link to other policies or basic measures; related and accompanying measures, "instruments" which may be a part of the measure;; current status/practice in implementation of the measure in the country; implementation bodies/institutions; enforcement scheme/practice; relevant stakeholders and their acceptance towards measure.
- Effect and costs include information on "targeted" effect (physicochemical, hydro-morphological, ecological effects) and their quantification; primary and multiple effects of a measure; positive environment-related side effects (biodiversity; groundwater; soil quality / Air emissions, etc.); time until effect after making a measure operational; knowledge gaps for estimating the effect; uncertainty in the effect estimate; financial costs per unit;
- Financial and socioeconomic implications of measures include indirect costs and wider (incl. distributional) impacts; socio economic benefits; funding sources and instruments; certainty in funding availability.

## 3.2. The categories of measures

The measures are divided in commonly applied categories:

- Regulatory and administrative measures – includes setting the standards, bans, permits as well ensuring their enforcement by controls and supervision activities. The adoption and implementation of different economic instruments, such as taxes, subsidies or the incentives are can also be attributed to this group of measures. It also covers the coordination with other plans and strategies to promote the integrated river basin management approach.
- Technical measures - any physical measures having a direct impact on the environment (reducing or mitigating pressures, e.g. WWTP, buffer zones, wetlands, remediation of water ecosystems e.g. re-meandering of a straightened river). The technical measures are those which are implemented at selected water bodies where particular environmental pressure needs to be reduced.

[7] *Pakalniete K., Fedorovica K. (2013) A tool for economic evaluation of the measures for the WFD River Basin Managament Planning. Project "Towards joint management of the transboundary Gauja/Koiva river basin district". AKTiiVS Ltd.*

- Information and public participation measures – includes different educational and information activities to increase capacities of stakeholders and awareness of the public. It also regular consultation with stakeholders on progress in the implementation of the WFD.
- Research - all measures that are related to research, incl. when research/studies/monitoring is proposed for water bodies with unclear reasons for environmental problem, effect of possible measures etc.

The project team has agreed to focus the CEA work in context reducing significant pressure from agriculture and forestry. Therefore, the proposed measures aim at reducing the diffuse pollution loads and morphological alteration due these human activities. Although measures have the primary target on reduction on nutrient load or hydromorphological pressures, many of the proposed measures can provide multiple effects.

Detailed descriptions of the measures were prepared for the 'technical' measures only since they require more profound technical specification and explanation of terms of application. Initially the supplementary measures were extracted from the 1st Gauja RBMP, their definitions reviewed with actual information and research results published in literature. Few new measures were proposed additionally.

**Table 3.2. A list of 'supplementary' technical measures included in the study.** (*AD*- means that a measure has been newly proposed by the Gauja/Koiva project)

| ID of M | Name of Measure | Brief description | Targeted envir. problem |
|---|---|---|---|
| LV1 | Arranging environmentally safe manure storage facilities | Environmentally safe manure storage facilities are installed in farms with more than 5 animal units outside the Nutrient Vulnerable Zone (NVZ). | Nutrient load |
| LV2 | Construction of biological WWTP in dairies | Construction of biological WWTP in dairies in all farms with more than 230 dairy cows. | Nutrient load |
| LV3 | Crop fertilisation planning | In farms whose land borders with watercourse or water body and who spread fertilisers on the agricultural land of an area more than 20 ha, as well as growing vegetables, fruit trees and fruit brushes in an area more than 3 ha, crop fertilisation is planned. | Nutrient load |
| LV4 | Winter green areas and stubble fields | Winter green areas' or stubble fields' means that a field is not ploughed after harvest. The measure reduces soil erosion and leaching of nutrients to waters (P in particular) during the winter period. Plant cover in winter can consist of growing plants like green fallows, perennial horticultural plants, catch crops, winter cereals and oil seed plants, or stubble of crops. | Nutrient load |
| LV5 | Green manure | The measure means that after harvest residues of plants or specially cultivated plants are used instead of fertilizers or manure. One-year or perennial plants may be used such as winter rye (in particular, together with vetch) can be used as the green manure, if crushed by mill at time of flowering and ploughed into soil. Commonly used green manure is clover and vetch together with different kind of grass. Green part of plants is mowed down 1-2 times and cultivated into soil. | Nutrient load |
| LV6 | Buffer zones in agricultural land: | | |
| LV6.1 | Agricultural land buffer zones for water courses and bodies | • buffer zones of 3 m on banks of all water courses and water bodies must be maintained;<br>• buffer zones of 5 m on banks of all water courses (excluding those mentioned in point 3 below) and on banks of water bodies, the area of which is less than 50 ha, are maintained if possible;<br>• buffer zones of 10 m on the banks of the Gauja River, its first order tributaries and water bodies, the area of which is more than 50 ha, are maintained if possible.<br>The measure is referred to areas between river or lake and intensively used agricultural lands, to be as not intensively used zones with maintained natural or sown perennial grasses are left. | Nutrient load<br>Morphological alterations (sediment control and erosion management) |
| LV6.2 | Agricultural land buffer zones for drainage systems | In intensively used agricultural lands buffer zones of 2 m on banks of drainage ditches, excluding contour ditches are maintained. | Nutrient load<br>Morphological alterations |

| ID of M | Name of Measure | Brief description | Targeted envir. problem |
|---|---|---|---|
| | | | (sediment control and erosion management) |
| LV7 | Good felling practice | The use of special equipment (for cutting, logging, etc.) in order to avoid too much soil compaction. Good felling practice includes leaving the greatest possible percentage of non-felled trees in the felling area and using special equipment for forestry activities. | Nutrient load Morphological alterations (sediment control) |
| LV8 | Forest buffer zones | The forestry activities are limited by leaving larger tree density when conducting thinning. The exception is forest stands with spruces of one age. | Nutrient load Morphological alterations (sediment control) |
| LV11 (AD) | Nutrients' retention ponds in AGR drainage systems | The nutrients' retention ponds are constructed on drainage ditches before its entering into surface water body where high nutrient loads are estimated. | Nutrient load |
| LV12 (AD) | Sedimentation ponds to reduce impact of soil erosion from FOR activities | In order to reduce soil erosion impacts from forestry areas the sedimentation ponds are constructed on drainage ditches downstream the areas with forestry activities where clear-cutting is foreseen in considerable areas. | Morphological alterations |
| LV13 (AD) | Sedimentation ponds to reduce impact of soil erosion from AGR lands | The sedimentation ponds are constructed on drainage ditches downstream the areas of agricultural lands where soil erosion is recorded locating them either close to area with soil erosion or before collected drainage water enters into surface water body depending on characteristics of drainage system. | Morphological alterations |
| LV14 (AD) | Sedimentation ponds as part of environment friendly management of FOR drainage systems | when constructing, renovating or reconstructing forest drainage systems the sedimentation ponds are constructed to reduce impacts of large-scale areas not only particular places of forestry activities locating them before collected drainage water enters into surface water body. | Morphological alterations |
| LV15 | Improving ecological functionality of lakes | The measure is focused on limitation of overgrowth with macrophytes in aquatic part of lake and/or with bushes in riparian part of lake. By cutting and removal of water plants, self-purification capacity achieved by strengthening of wind and wave induced washout of material of organic origin (remnants of water plants, fallen leaves and twigs, sediment particles etc.). | Nutrient load |
| LV20 | Environment friendly management of FOR drainage systems | The measure covers specific activities when maintaining, constructing, renovating or reconstructing forest drainage systems. During construction and renovation of forest drainage systems the installation of specific hydro-technical structures – sedimentations ponds (LV14) is foreseen. Maintenance of drainage system in "environment friendly" way includes:<br>• Cleaning of drainage system from bushes and trees rooting in channel bed, wooden debris and fallen trees.<br>• Limitation of beaver activities by destruction of beaver dams. | Nutrient load Morphological alterations |
| LV21 | Environment friendly management of AGR drainage systems | The measure covers specific activities when maintaining, constructing, renovating or reconstructing agricultural drainage systems. During construction and renovation of agricultural drainage systems the installation of nutrients' retention ponds is foreseen (LV11). Maintenance of drainage system in "environment friendly" way, should include:<br>• Limitation of overgrowth with vegetation by regular cutting and removal of water plants.<br>• Limitation of total overgrowth with bushes by regular cutting of bushes on banks of drainage systems creating mosaic bank vegetation.<br>• Naturalization of channel bed by installing separate stones or their assemblages. | Nutrient load |
| LV26 (AD) | Improving ecological processes when maintaining regulations | The conventional practice of cleaning of regulated rivers should only be undertaken where it is necessary to clear drainage outfalls. The maintenance should be undertaken in rotation to avoid excessive lengths | Nutrient load |

| ID of M | Name of Measure | Brief description | Targeted envir. problem |
|---|---|---|---|
| | of rivers | of cleared vegetation and allow natural re-growth. The maintenance works are:<br>• Limitation of overgrowth with vegetation by regular cutting and removal of water plants.<br>• Limitation of total overgrowth with bushes by management of protected belts creating mosaic bank vegetation.<br>• Naturalization of river bed by installing separate stones or their assemblages. | |
| LV27 (AD) | Improving ecological functionality of regulated rivers by naturalisation of river bed | The activities are site specific to be determined after investigating each case. They may include the activities:<br>• Improvement of in-stream structures to improve functionality of aquatic habitats by cleaning of river from excessive wooden debris and fallen trees and/or by the placement of single stones and/or development of riffle areas.<br>• Restoration of banks by bank re-profiling, the creation of aquatic ledges and the re-establishment of natural vegetation.<br>• Gravel replenishment is used to compensate for altered sediment and flow regimes in regulated rivers by importing sediment. Typical practice is dumping clean spawning gravels into piles along the edges of a river at locations upstream of degraded spawning habitat reaches (usually just downstream of a dam). It is assumed that augmented gravels will be entrained during high flows with the competence to transport them downstream. The technique relies on an adequate supply of gravel from upstream and an active bed load transport regime to deliver it.<br>• Sand traps are used to remove excess sediment from streams. A sand trap can consist of a depression dug into the stream channel where suspended sand settles. The deposited sediment must subsequently be removed which requires machinery. | Morphological alterations |
| LV28 (AD) | Management of Protected Belts of water courses/bodies | Measure addresses pressure to water bodies caused by lack of appropriate management of the Protected Belts.<br>• Creation of mosaic overgrowth by selected cutting of bushes.<br>• Limitation of potential blocking of river channel by removal of over-aged Grey alder (*Alnus incana*) stands within 1–2 m wide zone along the river.<br>• Reduction of nutrients' load originated within riparian part of river by selected cutting of bushes within 1-2 m wide riparian part of river. | Morphological alterations<br>Nutrient load |

# 4. Methodological approach developed for the cost-effectiveness analysis

The methodology was developed by Latvian economists – Kristine Pakalniete and Kristina Fedorovica, Aktiivs Ltd. The full description is presented in the report: *Pakalniete K., Fedorovica K. (2013). Economic evaluation of 'supplementary' measures for the WFD programs of measures in Latvia. Latvian Study Report*, available at http://gauja.balticrivers.eu/en/publications. This chapter presents a brief overview on the methodology to understand the approach and conclusions from the Latvian expert work which in turn also determine the potential of applicability of the elaborated approach in practice.

Experience from the 1st WFD cycle on implementation of the 'supplementary' measures shows that there are relevant socioeconomic and implementation aspects of measures that can hinder their implementation and that were not taken into account in the evaluation and selection of measures using the "conventional" CEA. Stakeholders' acceptance and funding availability could be noted among such aspects. Assessment of relevant socioeconomic and implementation aspects for measures and taking them into account in the evaluation would support discussions with stakeholders and decision-making to ensure that such measures are selected

that could be effectively implemented. It was concluded that more comprehensive assessment of measures is needed and their evaluation should take into account, besides the cost-effectiveness of measures, other relevant socioeconomic and institutional aspects that can facilitate or hinder implementation of the measures.

The approach is based on the Multi-Criteria Analysis (MCA) methodology, which commonly aims to combine positive and negative impacts of policy options (e.g. measures) into a single framework to allow their comparison based on multiple criteria. An important feature of the MCA is that it allows comparing options where the impacts are expressed by various, e.g. qualitative, quantitative and monetary data/assessments, and with varying degrees of certainty.

The following scheme outlines the key steps and tasks implemented to develop and test the MCA methodology in the frame of the Gauja/Koiva project.


***Figure 4.1.*** *Task flow for implementing MCA approach in the Gauja/Koiva project.*

**Selecting MC and assessing their relevance**

The multiple criteria were identified based on experience from the 1st WFD implementation cycle in Latvia, literature review and expert knowledge. Those seen as potentially relevant for the evaluation and selection of measures were included in a list (in total 11 criteria) and given to Estonian and Latvian stakeholders for assessing their significance. There were no criteria that are seen commonly as not relevant, however, higher relevance was assigned to criteria related to costs (C1 and C8) as well as acceptance of stakeholders (C10) and multiple effects (C3) (see table 4.1.). The lower relevance was assigned to two criteria (2. Time until effect after making a measure operational and 5. Administration costs). When assessing the measures, it turned out that the information was also not available for the adequate assessment according to these two latter criteria.

The average relevance scores of the criteria obtained from the inquiry of specialists were used as "weights" to incorporate relevance of each criterion when evaluating measures (by multiplying the measure's assessment score for a criterion by the "weight" of that criterion, thus giving higher total score for criteria with higher relevance).

The stakeholders were also asked to rank the top 5 criteria. They were: C1, C3, C8, C10, C11. This group of criteria was also used as one of the methods to compute the overall evaluation of the measures.

***Table 4.1.*** *Criteria for the MCA and their relevance for stakeholders (a scale from 1 "low relevance" to 5 "high relevance")*

| Criteria | Brief description of the criteria | Average score on relevance of the criteria for stakeholders |
|---|---|---|
| 1. Cost-effectiveness | Annual direct financial costs of a measure divided by its effect on the "targeted" water quality parameter / pressure (e.g. nutrients pollution) (e.g. EUR / 1 kg of reduced N) | **4.3** |
| 2. Time until effect | Time period after implementing a measure within which the environmental improvement takes place. Unfortunately, information is not available to apply this criteria in practice | 2.75 |
| 3. Multiple effects | Effects on various WFD water quality elements, e.g. on various physico-chemical quality and/or hydro-morphological quality elements | **4.1** |
| 4. Economic costs and | Direct financial costs measures may create other costs to those who | 3.6 |

| Criteria | Brief description of the criteria | Average score on relevance of the criteria for stakeholders |
|---|---|---|
| gains | implement them, for instance, as foregone income due to yield loss when converting arable land to other land use type. It should be note that some measures may create also economic gains (e.g. saved costs on fertilisers thanks to more efficient fertilisation planning and application). Both are considered under this criterion. | |
| 5. Administrative costs | Costs of administrations for monitoring, control, enforcement etc | 3.1 |
| 6. Indirect costs and wider negative socioeconomic impacts | Negative "secondary"/wider impacts on the sectors who implement the measures and the related sectors, distributional impacts in terms of geographical and social distribution of the costs (e.g. impact on vulnerable groups of the society) | 3.5 |
| 7. Certainty of the effectiveness and costs' assessments | Certainty is low in cases when the assessments are very rough and is high in cases when there is good information & knowledge about what the actual costs and effects of measures are. | 3.75 |
| 8. Socioeconomic benefits from environmental improvements | Benefits to society and economy from improved water and environmental quality achieved by implementing a measure. "Environment-related side effects" create benefits if a measure gives also improvements besides those directly related to the water environment, e.g. has a positive impact also on biodiversity, soil quality, air emissions etc. | **4.3** |
| 9. Availability of enforcement scheme(s) | Enforcement requires various instruments and institutional structures to make a measure "operational". Including, instruments for implementation of a measure (e.g. setting a measure as "cross-compliance" requirement for the CAP, setting a compensation payment covering the costs of a measure), institutions and schemes for administration, control, penalties. | 3.5 |
| 10. Acceptance by stakeholders | The acceptance may be different for various measures, for instance, due to lack of knowledge about effects and/or costs of a measure, distrust to the positive environmental effect, different socioeconomic interests of various stakeholders etc. | **4.17** |
| 11. Certainty in funding availability | Certainty is "low" if possible funding is unclear, and high if a funding instrument/source is known and there is confidence that the funding will be allocated from there. | **4** |

**Identification and description of measures**

In order to test possible application of the selected criteria, information collection was conducted to gather available data and assessments for the measures (listed in the table 3.2). The information was collected from available studies in Latvia and literature review. The information was stored in the xls data base. Even with rather profound inventory of available information, it turned out insufficient for developing the assessments for all the criteria and measures.

**Assessment of the measures according to the MC**

To apply the criteria for the assessment of measures a common 5-category assessment scale was used for all the criteria, with common general interpretation of the scores from "1" being "very low" to "5" being "very high". For one of the criteria (6. Indirect costs and wider negative socioeconomic impacts) the three degree scale was used (low, moderate, high). The Table 4.2 indicates major data and information gaps with regard to proposed supplementary measures and selected criteria. The situation with empiric and scientifically sound information is rather poor in Latvia, thus a lot of expert judgment was used to demonstrate the assessment approach.

The information gaps to develop credible assessment were identified for the following criteria:

- Cost-effectiveness (C1) - data on the effectiveness are based on experiences from other countries for almost all measures. For such measures national data should be obtained from monitoring in future research.
- Time until effect after making a measure operational (C2) – information was not available at all.

- Multiple effects of measures (C3) - Since the assessment of the multiple effects builds on individual effectiveness assessments in relation to each water quality element for each measure, the same information gaps as noted for the effectiveness' assessment are important also here – see the chapter 4.4.2.3 for more information.
- Economic costs and gains (C4) - due to the lack of information they are very rough and uncertain
- Administrative costs of implementing measures (C5) - lack of information on the 'administrative costs' of the measures doesn't allow developing even qualitative assessment on magnitude of these costs.
- Indirect costs and wider negative socioeconomic impacts (C6) – information is rather rough and the experts recommend to improve robustness of the assessment.
- Certainty of effectiveness and costs' assessments (C7) -This criterion is seen in connection to the assessment of cost-effectiveness of measure (C1). Thus, the certainty was assessed for the effectiveness' assessment in relation to the "targeted effect" and for the assessment of 'financial costs'.
- Socioeconomic benefits from environmental improvements (C8) – the current assessment reflects rather relative magnitude of the benefits of the measures against each other than absolute magnitude of the benefits, since available information base doesn't allow assessing the latter.
- Availability of enforcement schemes for implementing measures (C9) – the assessment is specific for Latvia based on expert knowledge and judgment.
- Acceptance by stakeholders (C10) - the information availability for assessing the acceptance of measures is insufficient overall. More profound investigation on stakeholders' acceptance in Latvia is needed that this criterion could be applied for evaluation and selection of measures.
- Certainty in funding availability (C11) - certain specifications on funding sources and/or financial commitments for the next WFD cycle are needed for all the measures. These issues should be addressed when working on the next RBMPs.

To overcome the identified incompleteness, roughness and uncertainty of the information, the expert judgment was introduced to deliver assessment scores for the development of the methodology. However, for the 2nd Gauja/Koiva RBMP more empiric and reliable information needs to be obtained to ensure the credibility of the whole evaluation of the MCA.

***Table 4.2.*** *Information availability for the assessment of the measures according to defined criteria (x – information is available; - information is missing and additional research is needed; ? information is uncertain or incomplete, or clarification needed; ir - irrelevant)*

| Name of measure | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LV1 Arranging environmentally safe manure storage facilities | ? | - | ? | ir | - | ? | x | ? | x | ? | ? |
| LV2 Construction of biological WWTP in dairies | | - | ? | ir | - | ? | x | ? | x | ? | ? |
| LV3 Crop fertilisation planning | ? | - | ? | - | - | ? | x | ? | x | ? | ? |
| LV4 Winter green areas and stubble fields | ? | - | ? | - | - | ? | x | ? | x | ? | ? |
| LV5 Green manure | ? | - | ? | - | - | ? | x | ? | x | ? | ? |
| LV6.1 Agricultural land buffer zones for water courses and bodies | - | - | ? | - | - | ? | x | ? | x | - | ? |
| LV6.2 Agricultural land buffer zones for drainage systems | - | - | ? | - | - | ? | x | ? | x | - | ? |
| LV7 Good felling practice | - | - | ? | - | - | ? | x | ? | x | - | ? |
| LV8 Forest buffer zones | ? | - | ? | - | - | ? | x | ? | x | - | ? |
| LV11 (AD) Nutrients' retention ponds in AGR drainage systems | ? | - | ? | ? | - | ? | x | ? | x | - | ? |
| LV12 (AD) Sedimentation ponds to reduce impact of soil erosion from FOR activities | ? | - | ? | - | - | ? | x | ? | x | - | ? |
| LV13 (AD) Sedimentation ponds to reduce impact of soil erosion from AGR lands | ? | - | ? | - | - | ? | x | ? | x | - | ? |
| LV14 (AD) Sedimentation ponds as part of environment friendly management of FOR drainage systems | ? | - | ? | - | - | ? | x | ? | x | - | ? |
| LV15 Improving ecological functionality of lakes | - | - | ? | ir | - | - | - | ? | x | x | ? |

| Name of measure | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LV20 Environment friendly management of FOR drainage systems | - | - | ? | - | - | - | - | ? | x | - | ? |
| LV21 Environment friendly management of AGR drainage systems | - | - | ? | - | - | - | - | ? | x | - | ? |
| LV 26 (AD) Improving ecological processes when maintaining regulations of rivers | - | - | ? | - | - | - | - | ? | x | - | ? |
| LV27 (AD) Improving ecological functionality of regulated rivers by naturalisation of river bed | - | - | ? | - | - | - | - | ? | x | - | ? |
| LV28 (AD) Management of Protected Belts of water courses/bodies | - | - | x | - | - | - | - | ? | x | - | ? |

**Evaluation and prioritisation of the measures based on MC values**

The developed assessments were used for the economic evaluation and prioritisation of the measures. It was carried out separately for the nutrients' pollution and the hydro-morphological pressures. Two MC evaluation methods were tested – semi-quantitative and quantitative.

**The semi-quantitative** method is a simpler approach which evaluates measure based on average score of the all assessments of the criteria. The measures are assessed according to three "socioeconomic efficiency" categories:

- If the score is < 3.0, then evaluation is that the proposed measure has "low efficiency"
- If the score is 3.0-3.5, then evaluation is that the proposed measure has "neutral efficiency"
- If the score is 3.6-5.0, then evaluation is that the proposed measure has "high efficiency"

**The quantitative** method combines sum of all assessment scores for each measure which is multiplied with the value of the relevance criteria assigned by the stakeholders to the particular measure. The measures are afterwards ranked based on these total scores where the most efficient is the measure with the highest score and the least efficient is the one with the lowest score.

Such total scores and ranks were calculated for three combinations of the assessments: (i) the conventional cost-effectiveness assessment (C1), (ii) the "priority" criteria according to the relevance (C1, C3, C8, C10, C11), (iii) all the criteria. For the latter case, due to information gaps the individual scores could not be developed for the C5 and C6 (on administrative costs and indirect costs and wider negative socioeconomic impacts). These criteria were considered in the evaluation in a qualitative way, where "-" (minus) is accounted in case a measure has high administrative costs or potential negative distributional impact.

The three ranks are compared to analyse differences in prioritisation of the measures when including various criteria in their evaluation (e.g. the cost-effectiveness assessment versus assessment using all criteria).

# 5. Results of the cost-effectiveness assessment of supplementary measures

In order to demonstrate the MCA approach, the project experts assessed the identified and described supplementary measures according to the proposed criteria and evaluated according to the semi-quantitative and quantitative methods. Depending on the chosen evaluation method, obtained results show that **ranking of the measures for the cost-effectiveness analysis actually depends on the number and type of criteria selected for the assessment** (see table 5.1).

Comparing the ranks obtained by **quantitative evaluation method** based on all criteria (R3) and based on the "priority" criteria (R2) shows that the rank values often differ for the same measure. The result also demonstrates impact of other than the "priority" criteria (C7, C9 and C4) on prioritisation of measures. Thus, river basin planners and decision makers shall consider which criteria are important to be used for the cost-effectiveness assessment based on MCA approach.

When **semi-quantitative method** is applied, it shows that almost all measures are classified as neutral or with low efficiency and only one measure (LV14) has slightly higher value. The advantage of the semi-quantitative approach is that the scores show the efficiency of measures in "absolute" terms – according to the scale used for the assessment (from 1 meaning "very low" to 5 meaning "very high"). The main disadvantage is that it gives limited possibilities for prioritisation (ranking) of measures, since the measures have very similar categories and scores. In case with many alternative measures the quantitative approach allows better comparison and prioritisation (ranking) of the measures. It also allows incorporating the relevance of the various criteria (by using the weights). At the same time it might require better information base for developing more reliable assessments if the scores are used for ranking of measures.

***Table 5.1*** *Evaluation of the measures for reducing nutrients' pollution*

*R3 – ranks of the measures based on the quantitative approach using all criteria.*
*R2 – ranks of the measures based on the quantitative approach using the "priority" criteria (C1, C3, C8, C10, C11).*
*R1 – ranks of the measures based on the quantitative approach using the CE (C1) as only criterion.*
*Ch – Changes in the rank of a measure comparing R3 to R1.*
*EffCat_All and EffCat_Prior – semi-quantitative assessment with "efficiency categories" based on using all criteria or "priority" criteria.*

| Name of measure | Targ. Activ. | R3 | R2 | R1 | Ch | EffCat_ All | EffCat_ Prior |
|---|---|---|---|---|---|---|---|
| LV14 (AD) Sedimentation ponds as part of environment friendly management of FOR drainage systems | FOR | 1 | 3 | 8 | ↑ | 3.6 high | 3.3 |
| LV4 Winter green areas and stubble fields | AGR | 2 | 10 | 3 | → | 3.2 | 3 |
| LV13 (AD) Sedimentation ponds to reduce impact of soil erosion from AGR lands | AGR | 3 | 6 | 6 | ↗ | 3.3 | 3.2 |
| LV21 Environment friendly management of AGR drainage systems [LV21.2] | AGR | 4 | 1 | 12 | ↑ | 3.2 | 3.4 |
| LV8 Forest buffer zones | FOR | 5 | 11 | 2 | ↓ | 3.2 | 2.9 |
| LV27 (AD) Improving ecological functionality of regulated rivers by naturalisation of river bed | AGR | 6 | 8 | 14 | ↑ | 3.1 | 3.2 |
| LV12 (AD) Sedimentation ponds to reduce impact of soil erosion from FOR activities | FOR | 7 | 5 | 5 | → | 3.1 | 3.2 |
| LV3 Crop fertilisation planning | AGR | 8 | 14 | 10 | → | 3.1 | 2.8 |
| LV6.1 Agricultural land buffer zones for water courses and bodies | AGR | 9 | 4 | 4 | ↓ | 3.1 | 3.2 |
| LV 26 (AD) Improving ecological processes when maintaining regulations of rivers | AGR | 10 | 7 | 13 | ↗ | 3.1 | 3.2 |
| LV1 Arranging environmentally safe manure storage facilities | AGR | 11 | 15 | 9 | → | 3.0 | 2.6 |
| LV7 Good felling practice | FOR | 12 | 2 | 1 | ↓ | 3.0 | 3.4 |
| LV5 Green manure | AGR | 13 | 16 | 16 | ↗ | 3.0 | 2.4 |
| LV20 Environment friendly management of FOR drainage systems [LV20.2] | FOR | 14 | 13 | 15 | → | 2.9 | 2.8 |
| LV2 Construction of biological WWTP in dairies | AGR | 15 | 17 | 7 | ↓ | 2.8 | 2.3 |
| LV6.2 Agricultural land buffer zones for drainage | AGR | 16 | 9 | 11 | ↓ | 2.8 | 3.0 |

| Name of measure | Targ. Activ. | R3 | R2 | R1 | Ch | EffCat_ All | EffCat_ Prior |
|---|---|---|---|---|---|---|---|
| systems | | | | | | | |
| LV11 (AD) Nutrients' retention ponds in AGR drainage systems | AGR | 17 | 12 | 17 | → | 2.5 | 2.8 |

Although results of the Latvian study presented above (table 5.1.) were calculated based on best available information and expert judgment, the results should be treated carefully due to the poor information base for developing assessments of measures. This study aimed to gather available information and test the proposed (multi-criteria) assessment approach. It also provides relevant messages concerning the results for economic evaluation and prioritisation of the measures (as discussed above), however the exact scores and rankings should be taken as rough overall. In order to obtain more reliable evaluation results the information base needs to be improved considerably first of all, but also the methodological approach needs to be applied in more refined manner (for instance, by refining used assumptions and testing interval values for calculating various summary scores and categories and performing sensitivity analysis of the results).

Due to lack of the assessments for many measures for range of the criteria, the multi-criteria assessment approach couldn't be tested fully for the assessment of hydromorphological pressures. In particularly, the criteria on economic assessments (e.g. various types of the costs) couldn't be taken into account.

# Key conclusions and proposals for the development of the 2nd Gauja/Koiva RBMP

The work of multi-disciplinary experts (biologists, environmentalists, economists) from Estonia and Latvia has highlighted a number of problems which needs to be solved in further development of river basin planning and management to make them credible thus acceptable for stakeholders not only in the Gauja/Koiva RBD but in the countries in general. At first, additional field works and investigations to obtain empiric data and information is much needed for all tasks in river basin management planning. Secondly, research and modeling related to pressure and impact quantification needs to be strengthened. Thirdly, the coordination of different types of the assessment between both countries needs to be continued.

Despite of limited knowledge, uncertainties and shortcomings in ecological, pressure and economic assessments, the potential supplementary measures which could bring benefits for improving water quality in those water bodies which have been assessed in quality lower than good. Mainly these measures are already practiced and supported during the 1st RBMP or have been implemented recently in the frame of projects. Thus, they have evidence to be valued higher as others.

**Supplementary measures for nutrient load reduction**

Based on the existing information and knowledge, the most socioeconomically efficient measures for reducing nutrients' pollution, according to the used quantitative evaluation and prioritisation of measures using all the criteria turned out to be the sedimentation ponds for forest and agricultural lands (LV14 (AD) and LV13 (AD)), environment friendly management of agriculture drainage systems (LV21.2), winter green areas and stubble field (LV4), as well as forest buffer zones (LV8). Therefore it would be justifiable that these measures are particularly reviewed when the new programme of measures will be prepared for the 2nd RBMP.

**Supplementary measures for reducing hydromorphological pressures**

The experts carrying out ecological status assessment in the Gauja/Koiva river basin have identified a need for measures to reduce hydromorphological pressure caused by artificial or natural (created by beavers) damming impacting fish fauna. Several supplementary measures including activities removing fallen tries were selected for MCA assessment to support the reduction hydromorphological pressures. However, due huge information gaps in particularly related to costs, the MCA test results are not practically applicable in terms of the evaluation of the proposed measures.

Finally, this Report as well as other Reports prepared in the frame of the Gauja/Koiva project strongly highlights and calls for necessity to allocate resources to the research and studies relevant for the river basin management planning. In that way, the sound and credible decision making will be supported.