Evaluation of additional measures for significant pressures – results from Latvia

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Economic analysis for developing measures

Policy principles and requirements

- Program of measures for achieving GES
- Cost-effective additional measures
- Socioeconomic impacts of the measures
- Possible additional measures for achieving environmental objectives of WBs
- For water uses creating significant pressures (failing GES).

Included water uses

Users	Water uses and their created pressures	WBs failing GES
Agriculture	Diffuse nutrient pollution from AGR lands	13 WBs
	Hydro-morphological pressures from drainage	7 WBs
Forestry	Diffuse nutrient pollution from clear-cutting and drained FOR lands	5 WBs
	Hydro-morphological pressures from drainage	4 WBs
Various/no users	Hydro-morphological pressures from dams/ obstacles on rivers with various or no use	3 WBs (with 8 significant obstacles)
Small HPPs	Hydro-morphological pressures from water use for electricity production	3 WB (due to 5 HPPs)
No users (historical)	Accumulated (past) nutrient pollution in sediments	1WB (Burtnieku lake)
Households, Industry, Other	Point source nutrient pollution from centralised sewage systems	1 WB (due to Aluksne city)
Industry	Point source nutrient pollution from individual sewage systems	1 WB (due to 1 company)

Socioeconomic assessment approach

Diffuse nutrient pollution from AGRICULTURE and FORESTRY	Cost-effectiveness analysis (CEA) of possible additional measures
Hydro-morphological pressures from drainage in AGRICULTURE and FORESTRY	
Hydro-morphological pressures from water use for electricity production in small HPPs	**Multi-criteria analysis (MCA) of possible additional measures**
Hydro-morphological pressures from dams/obstacles on rivers with various/no users	
Accumulated (past) nutrient pollution in sediments	

- **(1) Assessment of measures on general scale.** (2) Evaluation and selection of measures on WB scale (for each WBs failing GES).
- Results in the presentation – general scale MCA results.

MCA- criteria

Criteria cover important impacts of the measures

- Assessment with categories
- Scores
- For each measures summary score => the higher, the better – the measures has higher priority

CRITERIA	Categories	Scores
1. Effectiveness of a measure	No effect	0
	Low effect	1
	Moderate effect	2
	High effect	3
2. Certainty of the Effectiveness assessment	-	0
	Low certainty	1
	Moderate certainty	2
	High certainty	3
3. Negative adverse environmental impacts from implementing a measure	High impact	0
	Moderate impact	1
	Low impacts	2
	No impact	3
4. Costs of a measure	-	0
	High costs	1
	Moderate costs	2
	Low costs	3
5. Constraints/ obstacles of implementation of a measure (institutional, legal, financial)	High constraints	0
	Moderate constraints	1
	Low constraints	2
	No constraints	3

MCA: Evaluated possible measures

Additional measures for dams used by small HPPs creating hydro-morphological pressures
M1 Building of a fish pass
M2 Reconstruction or improvement of an existing fish pass
M3 Maintenance of an existing fish pass
M4 Environmentally friendly turbine
M5 Implementation of ecological flow
M6 Demolishing a dam
M7 Permanently lowering a dam
M8 Opening migration way during spawning period
Additional measures for obstacles with other/no use creating hydro-morphological pressures
M1 Building of a fish pass
M2 Demolishing a dam
M3 Opening migration way during spawning period (if a dam with sluice)
Additional measures for lakes with accumulated past nutrient pollution in sediments
M1 Sediment dredging
M2 Removal of macrophytes
M3 Immobilization of phosphorus using chemical treatment
M4 Artificial aeration and mixing
M5 Biomanipulation
M6 Hypolimnetic withdrawal
M7 Artificial floating wetlands

MCA: Assessment of costs of measures

Types of the costs

- Direct financial costs for implementer (investment costs, yearly operation and maintenance costs, costs of studies, monitoring)
- «costs of lost opportunities» due to foregone revenues for implementer
- "induced costs" – costs to other water users than implementer due to implementing a measure

Developing quantitative cost estimates

- Average (annualised) costs per year
- Costs as % of revenues (HPPs) or yearly budget (municipalities)
- Cost intervals (variation in the costs and size of implementers)

MCA: Assessment of costs of measures

!!! Interpretation of the cost categories

HPP revenues, municipal budgets – data for project area.

Categories	Interpretation of the cost categories	Costs as % of HPP yearly revenues	Costs as % of municipal yearly budget
Low (3)	The costs are affordable, an actor could cover the costs with own funding.	**< 1 %** of yearly revenues	**< 0.5 %** of yearly budget
Moderate (2)	The costs are hardly affordable, some public financial support would be recommended to facilitate implementation of a measure.	**1-1.5 %** of yearly revenues	**0.5-1 %** of yearly budget
High (1)	The costs are not affordable, public funding would be needed for financing implementation of a measure.	**> 1.5 %** of yearly revenues	**> 1 %** of yearly budget

MCA: Constraints of implementation

Types of obstacles/constraints

- **Institutional** (acceptance by implementers, other affected society groups; complexity/procedures for coordination of the implementation).
- **Legal** (official/local importance cultural heritage site; impact on Natura; compensations for damage to private properties; regulatory procedures (e.g. EIA, permitting); lack of mandatory regulatory requirements (as incentives) for implementing a measure).
- **Financial** (lack of public financial support instruments if necessary due to high costs).

Assessment

- For each measure – identifying relevant types of obstacles/ constraints; assessment with categories (scores) based on project experts' judgement.

MCA results for dams used by small HPPs

The analysed additional measures	C1 Effect SUM (AVER)	C2 Certainty	C3 Negative impact	C4 Costs	C5 Constraints	Total SumEffec (AverEffect)
M6 Demolishing a dam	9 (3)	High (3)	Moderate-High (0.5)	Low-High (2)	High (0)	**14.5 (8.5)**
M5 Implementation of ecological flow	6 (2)	Moderate (2)	No impact (3)	Moderate-High (1.5)	Low-Moderate (1.5)	**14.0 (10)**
M4 Environmentally friendly turbine	1.5 (0.5)	Moderate-High (2.5)	No impact (3)	High (1)	Moderate (1)	**9.0 (8.0)**
M1 Building of a fish pass	4.5 (1.5)	Moderate (2)	Moderate (1)	High (1)	High (0)	**8.5 (5.5)**
M7 Permanently lowering a dam	2 (0.7)	Low-Moderate (1.5)	Low-Moderate (1.5)	High (1)	High (0)	**6.0 (4.7)**
M8 Opening migration way during spawning period	3 (1)	Low-Moderate (1.5)	Moderate (1)	High (1)	High (0)	**6.5 (4.5)**
M3 Maintenance of an existing fish pass	*4.5 (1.5)*	*Moderate (2)*	*No impact (3)*	*Moderate-High (1.5)*	*Low/No (2.5)*	**13.5 (10.5)**
M2 Reconstruction or improvement of an existing fish pass	*4.5 (1.5)*	*Moderate (2)*	*Moderate (1)*	*High (1)*	*Moderate (1)*	**9.5 (6.5)**

MCA results for dams used by small HPPs

- The measures M7 and M8 are not proposed further as options due to their low effectiveness, uncertainty in the effectiveness assessment and high costs. Possible options include the measures M1, M4, M5, M6.
- The only measure which fully eliminates the problem for all state parameters is the measure *M6 Demolishing a dam*, it has also high certainty of the effectiveness assessment, and the negative environmental effect is expected to be temporal.
- Demolishing a dam could be low cost option if the opportunity costs need to be compensated based on cadastral value of properties or reasonable compensation of foregone revenues.
- Removing a dam is the highest priority option where it is suitable and no large energy production is involved/possible. Otherwise a set of measures is needed for achievement of GES (high costs).
- The assessments were used (adjusted for concrete WBs) for selecting measures for the WBs failing GES.

MCA results for obstacles with other/no use

The analysed additional measures	C1 Effect AVER	C2 Certainty	C3 Negative impact	C4 Costs	C5 Constraints	Total (AverEffec)
M2 Demolishing a dam	3	High (3)	Moderate (1)	Low-High (2)	High (0)	**9.0**
M1 Building of a fish pass	2	Moderate (2)	Moderate (1)	Low-Moderate (2.5)	Moderate (1)	**8.5**
M3 Opening migration way during spawning period	1.75	Low-Moderate (1.5)	Moderate (1)	Low (3)	Moderate (1)	**8.3**

- The only measure which fully eliminates the problem for both relevant state parameters is the measure *M6 Demolishing a dam.*
- The costs of all measures could be affordable overall even for small budget counties. Demolishing a dam could be low cost option if the opportunity costs need to be compensated based on cadastral value or reasonable compensation of foregone revenues.
- Removing obstacle is the highest priority option and should be applied where technically suitable.
- Using the assessments for selection of measures on WB scale.

MCA results for lakes with accumulated nutrient pollution in sediments

The analysed additional measures	C1 Effectiveness	C2 Certainty	C3 Negative impact	C4 Costs	C5 Constraints	Summary score
M2 Removal of macrophytes	Low (1)	High (3)	Low (2)	Low (3)	No-Low (2.5)	**11.5**
M5 Biomanipulation	Moderate (2)	Moderate-High (2.5)	Low-Moderate (1.5)	Moderate-High (1.5)	Moderate (1)	**8.5**
M7 Artificial floating wetlands	Low (1)	Moderate (2)	No impact (3)	High (1)	Low-Moderate (1.5)	**8.5**
M1 Sediment dredging	High (3)	High (3)	Moderate (1)	High (1)	High (0)	**8**
M3 Immobilization of phosphorus using chemical treatment	Moderate-High (2.5)	Moderate (2)	Moderate (1)	High (1)	High (0)	**6.5**
M6 Hypolimnetic withdrawal	Moderate (2)	Moderate (2)	Moderate (1)	High (1)	High (0)	**6**
M4 Artificial aeration and mixing	Low-Moderate (1.5)	Low-Moderate (1.5)	Moderate (1)	High (1)	High (0)	**5**

MCA results for lakes

- Measures M3, M4, M6 and M7 are not proposed as options due to their limited effectiveness in combination with uncertainty in the effectiveness assessment and high costs.
- Only M1 could ensure achievement of GES (besides with high certainty). But it has very high costs.
- Assuming the Burtnieku lake with its large size, the costs for the highly effective measure M1 would be too high. The measure M5 could be to some extent affordable but there is uncertainty whether it alone would provide achievement of GES. The measure M2 can be considered due to its low costs but the achieved state improvement would be very limited.

MCA results for lakes

- The measures, which should be investigated further, are *M5 Biomanipulation*, *M1 Sediment dredging* and *M2 Macrophyte removal* **in combination**, as there is no single measure that would provide achievement of GES with affordable costs.
- The main criteria which need further investigation are effectiveness (whether the measures would ensure achievement of GES), and costs (the prepared assessments are rather rough). Further investigations are needed to assess possible combined effect of measures.
- The costs are expected to be high, in particular for such large lake as the Burtnieku lake, and financial support would be needed for implementing measures.
- Hence, also further studies could be suggested to look for additional (not considered in this study) possible measures for addressing the given environmental problem.