

**Author and organism:** Broekx Steven, Meynaerts Erika, Wustenberghs Hilde, D’Heygere Tom, De Nocker Leo  
 Flemish Institute for Technological Research (VITO); Institute for Agricultural and Fisheries Research (ILVO), Flemish Environment Agency  
**Publisher or contracting body:** Flemish Environment Administration (LNE) and the Flemish Environment Agency (VMM)

**Country:** Belgium

**Geographical Area covered:**  
 Flemish region

**Themes:** Quality;

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Research paper/Academic publication following a project report

**Internet links:** /

**Key Focus:** Assessing the most cost effective measures to reduce surface water bodies pollution in flanders region using a hydro-economic model

**Relation to WFD:** Yes : The study was carried out to help designing the PoM in Flanders

**Summary of the study:** The paper describes how the Environmental Costing Model was used by administrations for the scientific underpinning of the selection of measures for the draft RBMP for the Flemish Region in Belgium. A cost-effective ranking of measures was the basis for compiling the program of cost-effective measures that has to be implemented by 2015.

### Measures

**Does the CEA analyze measures or combinations of measures?** Individual measures

**How many measures are compared in the CEA?**

Total is 17, of which 4 are basic measures and 13 supplementary

**List or type of measure compared:** 2 for industry, 2 for WWTP, 4 for households not treated by WWTP and 9 for Agriculture

**What are the main differences between measures?** The source of pollution

### Methodology

**C/E Ratio calculated?** Not shown in the paper but integrated in the model

**On which parameters?** -

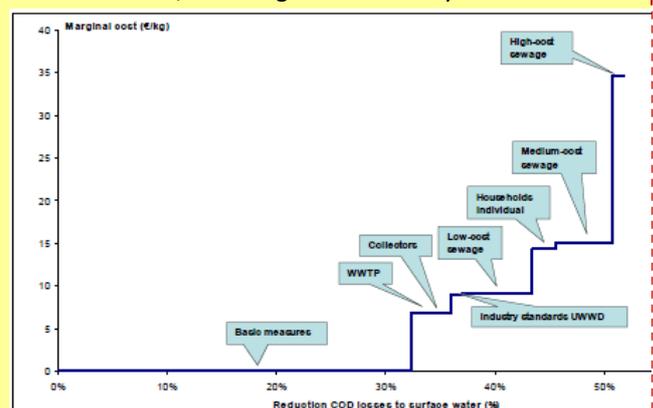
**Example of C/E indicator:** -

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E Ratio

**Generic approach and/or data sources (e.g. national databases)?** No generic approach (Costs and effectiveness data were taken from different sources of literature)

**Illustration of C/E ranking from the study:**



Which costs of the measures have been taken into account?

<b>Investment costs:</b> Not given in the publication	<b>Operation and maintenance costs:</b> Not given in the publication	<b>Indirect costs (Income losses...):</b> Income losses for farmers	<b>Environmental costs:</b> Not mentioned	<b>Others: Not mentioned</b>
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**Method for annualizing:** Discount rate of 5% is used

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**  
Reduction of mineral N and P, reduce particle runoff from fields by 51 to 94%

Tool used to measure effectiveness?

<b>Expert judgment:</b> Yes, but experts' names are not mentioned	<b>Models:</b> SENTWA model (System for the Evaluation of Nutrient Transport to Water) for nutrient losses	<b>Field experiment:</b> Not mentioned	<b>Others:</b> Literature (sources are provided in the document)
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**Are uncertainties quantified?** Not mentioned in the publication

### Process

**Who built the CEA ?** Scientists from Flemish Institute for Technological Research (VITO); Institute for Agricultural and Fisheries Research (ILVO), Flemish Environment Agency

**Which role of stakeholder consultation?** The results of the CEA were discussed with the stakeholders to build the PoM

**Are the different steps of the analysis developed in a transparent way?** Not really, as regards the publication. Moreover, the authors state themselves that: "Overall, remarks from stakeholders in the public consultation showed the need for a more clear, transparent, uniform and scientifically underpinned assessment for the selection of measures"

**Are there iterations in the implementation process?** It is planned to carry out further research for the following PoM (2015-2021 and 2021-2027)

**Which integration of the results in the decision making process?** "Based on the cost-effectiveness analysis for the Flemish region and other considerations as stakeholder acceptance and technical constraints, a package of supplementary measures to be implemented by 2015 were selected in the draft river basin management plan"

**Technical limit of the analysis:** 1-The model is only applied for surface water quality issues, whereas cost effectiveness analysis is also required for measures related to water scarcity, floods and ground water quality; 2- cost effectiveness analysis has to be made more dynamic in order to take into account the long term effects on water quality of measures taken today; 3- Results indicate that cost-effectiveness depends heavily on the geographical scale of the assessment.

**Main constraints encountered:** there is an important challenge for administrators and scientists is to develop new measures and innovative technologies to reach good status in highly urbanized and agricultural areas. The study clearly indicates that conventional measures as urban wastewater treatment and far going nutrient application abatement are not sufficient.

**General comments:** The study seems to have been used effectively in the process to build of Flemish's Programs of Measures

**Author and organism:** M. Bourouag, J.F. Delière, E. Everbecq, A. Grard, J. Smits  
Centre d'Étude et de Modélisation de l'Environnement (CEME), Université de Liège (AquaPôle)  
**Publisher or contracting body:** Ministère de la Région Wallonne

**Country:** Belgium

**Geographical Area covered:**  
Walloon region

**Themes:** Quality;

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Project report  
**Internet links:** /

**Key Focus:** To develop a cost-effectiveness module within the Pegase model which modelises water quality according to different scenarios  
**Relation to WFD:** Yes : The PIRENE programme was conducted to develop methods and tools useful for the implementation of WFD in the Walloon region

**Summary of the study:** The CEA was carried out within a research project, as one of the 12 activities of the project. The aim of this activity was to develop a cost-effectiveness module within the Pegase model which modelises water quality according to different scenarios. CEA is then conducted at water body level and then aggregated at subbasin level. Effectiveness of the measures are measured on a scale (SEQ-eau) on which good status was defined.

### Measures

**Does the CEA analyze measures or combinations of measures?** Individual measures

**How many measures are compared in the CEA?**  
11

**List or type of measure compared:** Measures to i) improve the WWT plant (5), ii) to reduce industrial pollution (4) and iii) to reduce agricultural pollution (2)

**What are the main differences between measures?** The source of pollution (target)

### Methodology

**C/E Ratio calculated?** Not shown in the paper but integrated in the model

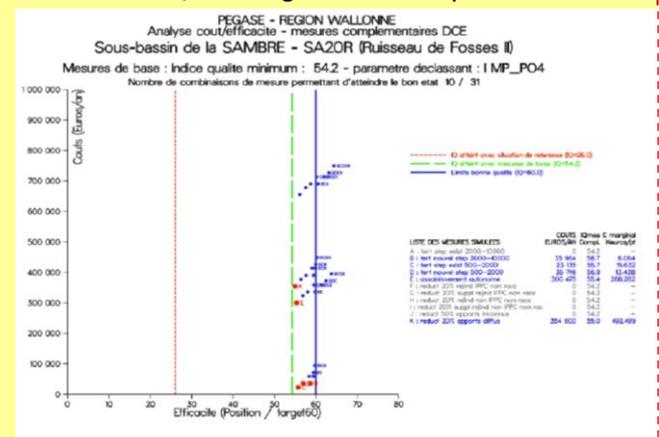
**On which parameters?** The most downgrading parameter(s) for each water body is considered

**Example of C/E indicator:** C/E indicators are expressed as indexes on the SEQ-Eau scale (threshold for good status was settled at 60 on that scale)

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E Ratio

**Generic approach and/or data sources (e.g. national databases)?** No generic approach

Illustration of C/E ranking from the study:



*Which costs of the measures have been taken into account?*

**Investment costs:**

Details are not provided in the publication

**Operation and maintenance costs:**

Details are not provided in the publication

**Indirect costs (Income losses...):**

Details are not provided in the publication

**Environmental costs:**

Not mentioned

**Others: Not mentioned**

**Method for annualizing:** Not mentioned

**Are the cost distributed among financers?** No

*How has effectiveness been taken into account?*

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** Yes, the three most downgrading parameters are considered

**Examples of indicators used:**

MOOX (O2, TXO2, DBO5, DCO, COD, NH4, Nkj), MAZ (NH4, NKj, NO2) and MP (Ptot, PO4)

*Tool used to measure effectiveness?*

**Expert judgment:** No

**Models:** Pegase model

**Field experiment:** Yes, as input in the Pegase model

**Others:** Not mentioned

**Are uncertainties quantified?** Not mentioned

**Process**

**Who built the CEA ?** Scientists from Centre d'Étude et de Modélisation de l'Environnement (CEME), Université de Liège (Aquapôle)

**Which role of stakeholder consultation?** Stakeholders were consulted for validation of the costs values

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** According to Belgian experts, the results were not really used in decision making process

**Technical limit of the analysis:** Some sensitivity analysis could have been conducted

**Main constraints encountered:** -

**General comments:**

**Author and organism:** Water Development Department - Ministry of Agriculture, Natural Resources and Environment

Water Development Department - Ministry of Agriculture, Natural Resources and Environment

**Publisher or contracting body:** Water Development Department - Ministry of Agriculture, Natural Resources and Environment

**Type of publication:** Project Report

**Internet links:**

[http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/E1A080A680981C92C2257731004187FD/\\$file/PROGRAMME%20OF%20MEASURES.pdf?openelement](http://www.moa.gov.cy/moa/wdd/wdd.nsf/all/E1A080A680981C92C2257731004187FD/$file/PROGRAMME%20OF%20MEASURES.pdf?openelement)

**Key Focus:** WFD Draft Program of Measures - Cost Effectiveness Analysis

**Relation to WFD:** Implementation Project Report

**Country:** Cyprus

**Geographical Area covered:** Cyprus

**Themes:** Scarcity; Quality; Hydromorphology; coastal water, HMWB

**Sector:** Agriculture; Industry; Households; Energy; Tourism

**Summary of the study:** For all the proposed measures whether these refer to the control of available quantities of water (supply-side measures) or to the control of the demand for water by the various uses (demand-side measures) a cost effectiveness analysis is performed as defined by the WFD, so that the combination of measures that brings about the desired target is determined, which is the achievement of the good condition until 2015, at the smaller possible cost.

### Measures

**Does the CEA analyze measures or combinations of measures?** Individual Measures

**How many measures are compared in the CEA?**

32 Supplementary Measures

**List or type of measure compared:** 2 for Control of emissions, 1 for Codes of Good Practices, 3 for effectiveness and reuse, 1 for Desalination Plants, 1 for Works for rehabilitation of existing works, 4 for Artificial Aquifer Recharge, 7 Educational Measures, 6 for Research works of development and demonstration, 3 for use of treated urban and community sewage, 1 for sediments, 2 concerning Subsidies, 1 for Information campaign

**What are the main differences between measures?** Each Type of Measure has a different Nature and Scope

### Methodology

**C/E Ratio calculated?** Assumably yes, but in the paper a ranking of measures is provided

**On which parameters?** Implementation cost over improvement of the water body status

**Example of C/E indicator:** In terms of ranking of measures

**Measures ranked based on C/E ratio and /or Expert judgment?** C/E Ratio

**Generic approach and/or data sources (e.g. national databases)?** No generic approach (Cost and effectiveness data were taken/calculated from different sources of literature)

Illustration of C/E ranking from the study:

**Table 5.6-1 Ranking on the basis of Effectiveness for the Protection of Resource (not including measures of zero cost)**

Code	Name of Measure	Ranking
S-18-2	Improvement Modifications of the Code of Good Agricultural Practices	1
S-22-5	Drafting of a Guidance Document for the development of reduced irrigation water demand household gardens	2
S-27-5	Drafting of a Guidance Document for informing and sensitizing in relation to issues of pollution originating from activities of the primary sector	3
S-27-7	Education programs in hotel units	3
S-28-2	Updating of water bodies monitoring program	5
S-22-6	Drafting of a Guidance Document of specifications for fitting new buildings with equipment of low water consumption	6
S-27-3	Development of an explicit Water Awareness Website	7
S-27-1	One-day seminars for Training and Specialization of staff on subjects of groundwater monitoring and data management	8
S-17-1	Personnel Recruitment and Staff Increase of the Pollution Division of the Environment Department	9
S-28-6	Ad hoc special program for the monitoring of surface water bodies with high uncertainty in the classification	10
S-27-2	Development of water concience in Primary Education	11

Which costs of the measures have been taken into account?

**Investment costs:**

Yes, but details are not provided in the publication

**Operation and maintenance costs:**

Yes, but details are not provided in the publication

**Indirect costs (Income losses...):**

Details are not provided in the publication

**Environmental costs:**

Not mentioned

**Others:** Design and implementation cost

**Method for annualizing:** Not mentioned - assuming effectiveness by 2015

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Quantitative and Qualitative (chemical and ecological status) - More details are not provided in the publication

**Limited to one (few) parameters of the water status:** -

**Examples of indicators used:**

Upgrading of water status (ecological and/or chemical and/or quantitatively) i.e. from bad to moderate or moderate

Tool used to measure effectiveness?

**Expert judgment:** Yes, selection of literature values best suited to Cyprus Conditions

**Models:** No

**Field experiment:** No

**Others:** Literature (sources are given)

**Are uncertainties quantified?** Not mentioned

**Process**

**Who built the CEA ?** Greek - Cypriot Expert

**Which role of stakeholder consultation?** Currently part of a consultation process for the RBMP

**Are the different steps of the analysis developed in a transparent way?** Not really. Possibly access to background work could provide more information and clarifications

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Based on the ranking of measures, stakeholder acceptance and technical constraints, a package of supplementary measures to be implemented by 2015 will be finalized in the draft river basin management plan

**Technical limit of the analysis:** The CEA is presented in a 20 page chapter in the PoM report. A more thorough analysis or private interview could provide more details

**Main constraints encountered:** Not mentioned

**General comments:** The CEA seems to have concluded in a list of cost effective measures that after the consultation process will be included in the Cyprus's Program of Measures

Publication name: WFD: Jensen, P.N., Jacobsen, B.H.; Hasler, B. Rubæk, G. og Waagepetersen, J. (2009). Cost and measures in WFD (in Danish) .. Rapport udarbejdet til Virkemiddeludvalg II for By- og Landskabsstyrelsen.

Year: 2009

**Author and organism:** Jensen, P.N., Jacobsen, B.H.; Hasler, B. Rubæk, G. and Waagepetersen, J.

Danmarks Miljøundersøgelser, Danmarks JordbrugsForskning and Fødevarøkonomisk Institut.

**Publisher or contracting body:** The report is written by representatives from Danmarks Miljøundersøgelser, Danmarks JordbrugsForskning and Fødevarøkonomisk Institut.

**Type of publication:** Report

**Internet links:**

[http://www.foi.life.ku.dk/Publikationer/FOI\\_serier/~media/Foi/docs/Publikationer/Udredninger/2009/Virkemidler%20i%20VRD%20april%202009.ashx](http://www.foi.life.ku.dk/Publikationer/FOI_serier/~media/Foi/docs/Publikationer/Udredninger/2009/Virkemidler%20i%20VRD%20april%202009.ashx)

**Key Focus:** Measures and costs of implementing WFD.

**Relation to WFD:** High

**Country:** Denmark

**Geographical Area covered:**

Three danish regions (West, Mid and East)

**Themes:** Quality;

**Sector:** Agriculture;

**Summary of the study:** CEA for three Danish regions (West, Middle and East Denmark). For each region is a regional case described by a fictional (but realistic) area of 2000 km<sup>2</sup>, which covers different farming practices, natural environments etc. Based on this fictional case are reduction needs, potential for measures, cost estimates etc analysed, and scaled up to regional level and summed at national level.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**

9 ( N reduction), 4 (P reduction)

**List or type of measure compared:** Changed farming methods, change in land use, technical measures.

**What are the main differences between measures?** 2 main groups: 1) measures relating to river valleys, 2) measures related to farming methods.

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Annual cost per reduced kg of N and P and annual cost per ha.

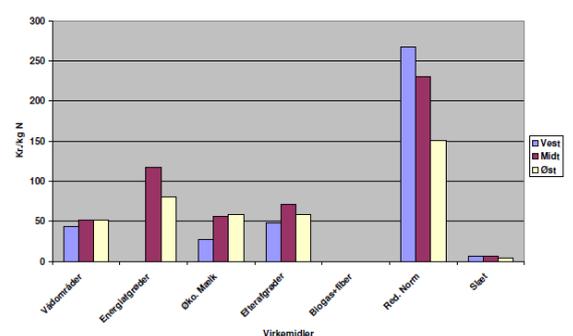
**Example of C/E indicator:** DDK/kg N and P/year + DDK/ha/year.

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E ratios

**Generic approach and/or data sources (e.g. national databases)?**

Illustration of C/E ranking from the study:



Figur 6.1. Omkostningseffektivitet (kr. pr. kg N) efter adm. omik.

*Which costs of the measures have been taken into account?*

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

Not mentioned

**Environmental costs:**

Not mentioned

**Others: Not mentioned**

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** 1) kg reduced N and P/year and, 2) ha where measures have been implemented.

**Examples of indicators used:** kg

P and N reduction

Tool used to measure effectiveness?

**Expert judgment:** Many references to other work regarding this in Denmark.

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Since the estimates presented build upon earlier Danish estimations (with various degrees of uncertainty), the uncertainties of the present report are even higher.

**Process**

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** It is noted that the results builds upon hypothetical scenarios but that they are still realistic.

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Publication name:** Schou, J.S., Kronvang, B.; Birr-Pedersen, K.; Jensen, P.L., Rubæk, G.H., Jørgensen, U og Jacobsen, B.H. (2007) Measures for achieving the WFD target. Faglig Rapport fra DMU nr. 625. Aarhus Universitet. (UK summary)

**Year:** 2007

**Author and organism:** Schou, J.S., Kronvang, B.; Birr-Pedersen, K.; Jensen, P.L., Rubæk, G.H., Jørgensen, U and Jacobsen, B.H.

Danmarks Miljøundersøgelser, Danmarks JordbrugsForskning and Fødevareøkonomisk Institut.

**Publisher or contracting body:** Danmarks Miljøundersøgelser (University of Aarhus)

**Country:** Denmark

**Geographical Area covered:**

Denmark

**Themes:** Quality; Climate gasses, ammonia, pesticides, biodiversity and landscape.

**Sector:** Agriculture;

**Type of publication:** Report

**Internet links:** [http://www2.dmu.dk/Pub/FR625\\_Final.pdf](http://www2.dmu.dk/Pub/FR625_Final.pdf)

**Key Focus:** Cost of measures in the agricultural sector to reach the WFD requirements.

**Relation to WFD:** High

**Summary of the study:** An analysis of measures that will contribute as an input to how the goals in the WFD can be cost-effectively implemented in terms of river basin management plans.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**  
22

**List or type of measure compared:** Changed farming methods, change in land use, technical measures.

**What are the main differences between measures?** 2 main groups: 1) measures relating to river valleys, 2) measures related to farming methods.

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Welfare economic cost per reduced kilogram of N and P per year

**Example of C/E indicator:** DKK/kg N/year

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E ratios are listed for the measures but there is no ranking.

**Generic approach and/or data sources (e.g. national databases)?** Yes

**Illustration of C/E ranking from the study:**

	Primary effect	N-emission	P-emission	Financial economic cost	Welfare economic cost	Welfare economic cost per unit of primary effect
<b>Changed farming methods</b>						
1. Conversion of extensive cattle production to organic production methods	N	6-41 kg/ha	-	0	0	0
2. Ammonia fertilisers in stead of NO <sub>x</sub>	N	6-8 kg/ha	-	0	0	0
3. Catch crops – current practice	N	12-55 kg/ha	-	330-660 DKK/ha	386-772 DKK/ha	7-64 DKK/kg N
4. Optimised use of catch crops	N	20-95 kg/ha	-	315-700 DKK/ha	368-820 DKK/ha	4-41 DKK/kg N

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Not mentioned	<b>Operation and maintenance costs:</b> Not mentioned. But it is mentioned that administrative costs are not included.	<b>Indirect costs (Income losses...):</b> Not mentioned	<b>Environmental costs:</b> Not mentioned	<b>Others:</b> Not mentioned
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**Method for annualizing:** C/E per year (price level of 2005)

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P and N reduction

**Examples of indicators used:** kg P and N reduction

Tool used to measure effectiveness?

<b>Expert judgment:</b> Literature studies	<b>Models:</b>	<b>Field experiment:</b> No	<b>Others:</b>
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**Are uncertainties quantified?** No, but intervals are used and the level of uncertainty regarding the presented cost estimates is indicated by the use of a 3-level grading (from "unacceptable level of uncertainty" to "acceptable level of uncertainty").

**Process**

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Issues related to the practical implementation, e.g. the process leading to preparation of the river basin management plans, are not reflected.

**Which integration of the results in the decision making process?** It is mentioned that the results from the report should contribute to future work in the local water district. They need to develop action plans that secure the cost-effectiveness of the implementation of WFD objectives.

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

Aaes, O, Andersen, J.M., Gyldenkerne, S., Hansen, A.G., Jacobsen, B. H., Kjær, H., Pedersen, P og Poulsen, H.D. (2008): Evaluering af det generelle ammoniakkrav, maj 2008. Rapport udarbejdet

**Author and organism:** Aaes, O, Andersen, J.M., Gyldenkerne, S., Hansen, A.G., Jacobsen, B. H., Kjær, H., Pedersen, P and Poulsen, H.D.

Dansk Landbrug, Dansk Svineproduktion, Landscentret, Dansk Kvæg, Fødevarøkonomisk Institut (Københavns Universitet), Danmarks Miljøundersøgelser (Aarhus Universitet), Det Jordbrugsvidenskabelige Fakultet (Aarhus Universitet) and Miljøstyrelsen.

**Publisher or contracting body:** The report is written by representatives from Dansk Landbrug, Dansk Svineproduktion, Landscentret, Dansk Kvæg, Fødevarøkonomisk Institut (Københavns Universitet), Danmarks Miljøundersøgelser (Aarhus Universitet), Det Jordbrugsvidenskabelige Fakultet (Aarhus Universitet) and Miljøstyrelsen.

**Type of publication:** Evaluation report

**Internet links:** <http://www.mim.dk/NR/rdonlyres/00287B6C-9C67-49CF-9394-73F2739051F0/0/Ammoniaevalueringrapport.pdf>

**Key Focus:** Evaluation of Danish requirements regarding ammonia.

**Relation to WFD:** Low since ammonia is not targeted by WFD (it is perceived as a side effect from measures in agriculture).

**Country:** Denmark

**Geographical Area covered:**

Denmark

**Themes:** Ammonia

**Sector:** Agriculture;

**Summary of the study:** In 2008, the general Danish requirements regarding the norm for best animal housing and reduction of ammonia were evaluated. This report is a decision support for the final evaluation.

### Measures

**Does the CEA analyze measures or combinations of measures?** Combinations of measures

**How many measures are compared in the CEA?**

4 scenarios reflecting different levels of NH3-N reductions

**List or type of measure compared:** 1) feeding, 3) air cleaning, 3) acidification.

**What are the main differences between measures?** Different levels of NH3-N reductions.

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Cost per kg reduced NH3-N and per animal unit per year.

**Example of C/E indicator:** DKK/kg reduced NH3-N per year.

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes

**Illustration of C/E ranking from the study:**

	Reduktion (%)	Reduktion (kg NH <sub>3</sub> -N pr. DE)	Om. (kr. pr. sl. Svin)	Budget økonomi (kr. pr. DE)	Velferds-økonomi. (kr. pr. DE)	Om. eff. (Kr. pr. kg NH <sub>3</sub> -N)
Fodring <sup>2)</sup>	0 - 24	0 - 3,5	0 - 8	0 - 280	0 - 330	0 - 94
Fodring <sup>3)</sup>	0 - 10	0 - 1,4	0 - 2	0-70	0 - 82	0 - 59
Fodring <sup>4)</sup>	10 - 20	1,4 - 2,8	2 - 5	70 -175	82 - 205	59 - 73
Luffrensning <sup>5)</sup>	60	8,7	10,5	367	386	44
- <sup>3)</sup> Drænet gulv	25 - 80	4,4 - 14	6 - 19	200 - 670	210 - 703	48 - 50
- <sup>4)</sup> Delvis spalte I	25 - 80	3,6 - 11,5	6 - 19	200 - 670	210 - 703	58 - 61
- <sup>1)</sup> Delvis spalte II	25 - 80	2,7 - 8,7	6 - 19	200 - 670	210 - 703	78 - 81
Forsuring <sup>6)</sup>	88	12,6	18,4	644	708	56
- drænet gulv <sup>1)</sup>	70	12,3	15	519	570	46
- delvis spalte II <sup>1)</sup>	70	7,6	15	519	570	75

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

Not mentioned

**Environmental costs:**

Not mentioned

**Others: Not mentioned**

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** N reduction

**Examples of indicators used:** kg NH3-N per animal unit.

Tool used to measure effectiveness?

**Expert judgment:**

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** No

### Process

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?**

**Which integration of the results in the decision making process?** The report serves as decision support for the evaluation of Danish requirements regarding ammonia.

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Publication name:** Iversen, T.M., J.S. Schou, P.N. Jensen, J. Waagepetersen og U. Jørgensen. 2007. Scenarieberegninger. Udredning for Udvalg under Finansministeriet vedr. "Langsigtet indsats for bedre vandmiljø".

**Year:** 2007

**Author and organism:** Torben Moth Iversen, Jesper S. Schou and Poul Nordemann Jensen (DMU), Jesper Waagepetersen and Uffe Jørgensen (DJF).

Danmarks Miljøundersøgelser (DMU) and Jordbrugsvidenskabelige Fakultet (DJF), both are at University of Aarhus.

**Publisher or contracting body:** University of Aarhus

**Country:** Denmark

**Geographical Area covered:**

Denmark

**Themes:** Quality;

**Sector:** Agriculture; Fishery, aquaculture and households are only partly included.

**Type of publication:** Report

**Internet links:**

[http://www2.dmu.dk/pub/UDR\\_Scenariebergninger\\_endelig\\_10\\_04\\_07.pdf](http://www2.dmu.dk/pub/UDR_Scenariebergninger_endelig_10_04_07.pdf)

**Key Focus:** Cost of measures in the agricultural sector (primarily) to reach the WFD requirements.

**Relation to WFD:** High

**Summary of the study:** The purpose of this report is to estimate the national costs that can be expected as a consequence of the WFD requirements regarding good ecological status in surface water. The choice of measures is guided by a demand for lowest possible welfare economic costs, i.e. cost-effectiveness. In the analyses it is not taken into account how the measures should be implemented in practice. 3 scenarios reflecting different levels of ambition regarding measures in watercourses, lakes and coastal areas are compared.

### Measures

**Does the CEA analyze measures or combinations of measures?** Scenarios reflecting different levels of ambition regarding measures in watercourses are compared.

**How many measures are compared in the CEA?** 22

**List or type of measure compared:** Changed farming methods, change in land use, technical measures.

**What are the main differences between measures?** 2 main groups: 1) measures relating to river valleys, 2) measures related to farming methods.

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Cost per kilometer and ha maintained watercourse, cost per reduced tonne of P and N.

**Example of C/E indicator:** DKK/ha/year and DDK/km/year (watercourse maintenance). DKK/kg reduced N per year.

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes

Illustration of C/E ranking from the study:

**Tabel 13a. Søer: Scenarie 1**

	Infoga	Tabeller	Bilder	Lænker	Til	Filer
Søer						Velfærdsøkonomisk
Scenarie #1: 60.000 kg P/år						
			kg P/ha			kr/ha
Nr.	Virkemiddel	MIN	MAX	MIN	MAX	
5a	Krav om nedfældning frem til 1/4	0,01	0,125			60 175
5b	Forbud mod jordbearbejdning frem til 1/4	0,025	0,25			300 880
11	Udelukke vintersæd på erosionstruede arealer	0,06	0,25			300 880
12	Udergøds m P	0,003	0,1			30 60
15	Vedr. græs på erosionstruede arealer	0,06	0,25			3.600 6.800
16	Udyrkede randzoner langs søer og vandløb	1	3			3.600 6.800

*Which costs of the measures have been taken into account?*

**Investment costs:**

Not mentioned

**Operation and**

**maintenance costs:**

Administrative costs (and some other costs as well) are not included.

**Indirect costs (Income losses...):**

Not mentioned

**Environmental costs:**

Not mentioned

**Others: Not mentioned**

**Method for annualizing:**

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Scenarios (DVFI index) for watercourses, chlorofyl/phosphorus for seas, eelgrass/nitrogen for marine areas.

**Examples of indicators used:** t

N/year

Tool used to measure effectiveness?

**Expert judgment:** Literature studies

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Use of intervals.

**Process**

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Partly

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** The results are technical in nature and there is no discussion regarding how the measures should be implemented in practice.

**Technical limit of the analysis:** This analysis is carried out using available data. Therefore, a number of assumptions and adjustment are made in order to scale up from single water areas to the national level. The resulting uncertainties are tackled by the use of intervals.

**Main constraints encountered:**

**General comments:**

**Author and organism:** E.F.L.M. de Bruin, F.J.L. Vliegenthart, P. Schipper, T. Pallo, P. Antons, T. Botterweg, K.J. Reincke, R. van den Boomen, J. Kotta, A. Vassiljev, R. Perens, L. Vallner, A. Kivinukk  
Grontmij, Ecorys, Witteveen+Bos, ELLE, REC  
**Publisher or contracting body:** Ministry of Environment of the Republic of Estonia

**Country:** Estonia

**Geographical Area covered:**  
Harju

**Themes:** Quality; Wastewater

**Sector:** Agriculture; Industry; Households;

**Type of publication:** RBMP

**Internet links:** <https://www.etis.ee/ShowFile.aspx?FileVID=19208>

**Key Focus:** Pilot Study, conducted by Dutch experts

**Relation to WFD:** Yes

**Summary of the study:** CEA undertaken as part of a technical assistance of Dutch consultancies for the Harju sub-River Basin District Water Management Plan. In the CEA, the costs (both investment and operational costs) and their projected effects are taken and organised into a ranking. This process is well elaborated, yet actually displays a Cost Benefit Analysis (measuring "net operating effect") including the 'Internal Rate of Return'(=CEA).

### Measures

**Does the CEA analyze measures or combinations of measures?** both

**How many measures are compared in the CEA?**

12 local measures, 4 overall generic measures and 4 measure packages

**List or type of measure compared:** Local measures different actions regarding various waste water treatment plants: Generic measures 1. overall generic measures; 2. agricultural measures 3. groundwater measures 4. radionuclide-related measures. Packages 1. All measures taken together. 2. Only local measures. 3. Only generic measures. 4. All measures together, but with adjustment of water quality norms.

**What are the main differences between measures?** Scale, Geography, Sectors, Level, Outreach,

### Methodology

**C/E Ratio calculated?** Internal Rate of Return, showing the relative values of the different measures.

**On which parameters?** The IRR is calculated by analysing at which discount rate the NPV would be zero.

**Example of C/E indicator:** relative reduction of excess concentrations (average over the 3 main pollutant types) in a water body per hundred thousand Kroon (equivalent to %/€)

**Measures ranked based on C/E ratio and /or Expert judgment?**

Internal Rate of Return (if the data situation allows a CEA).

**Illustration of C/E ranking from the study:**

**Table 8.1 Results and ranking of CEA for local measures**

Measure (short description)	Water body	IRR
L11. renovating and connecting Maardu WWTP direct to existing sea outlet	Kroodi	206.0%
L1. reconstruction of Ääsmäe waste water treatment plant	Maidla	126.0%
L5. renovation and building waste water pumping stations in Kose-Uuemõisa	Pirita-2	78.9%
L6. install of compact waste water treatment plant in Ravila	Pirita-2	54.1%
L3. install of compact waste water treatment plant in Vardja	Pirita-2	19.0%
L4. renovation and building new WW pumping station, cleaning oxidation ponds in Kose	Pirita-2	18.2%
L2. renovation of water and sewerage systems and WWTP in Ardu village	Pirita-1	7.0%
L8. construction and reconstruction of sewage system in Porkuni village	Valgejõgi 1	n.a.**
L7. reconstruction of sewage systems in Paunküla	Pirita-2	n.a.*
L9. reconstruction of Rummu WWTP, install of new waste water treatment plant	Metsapere	n.a.*
L10. connect Klooga waste water treatment plant with perspective	Klooga	n.a.*

*Which costs of the measures have been taken into account?*

**Investment costs:**

taken from over-views presented by municipalities in the Harju sub-river basin area

**Operation and**

**maintenance costs:**

Operating costs, have been estimated assuming a value of 2,5% of the investment costs per year

**Indirect costs (Income losses...):**

No

**Environmental costs:**

No

**Others: No**

**Method for annualizing:** 5% discount factor to deflate both costs and effects, 10-year calculation period

**Are the cost distributed among financers?** Not mentioned

*How has effectiveness been taken into account?*

**Global in terms of general impact on the water body status:** This cost-effectiveness analysis does not take into account any economic, social or other (i.e. non-water quality related) environmental effects.

**Limited to one (few) parameters of the water status:** limited to one (few) parameters of the water status : to express the effects of measures in the share of excess pollutant concentrations

**Examples of indicators used:**

reduction (in %) of N, P-Gen and P-LF

*Tool used to measure effectiveness?*

**Expert judgment:** Not elaborated

**Models:** No

**Field experiment:** No

**Others:** No

**Are uncertainties quantified?** No

**Process**

**Who built the CEA ?** Dutch experts

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** Not addressed

**Technical limit of the analysis:** Quote: measures are very different and will always remain different, so that their comparison in terms of effects and costs will be subject to sometimes far-reaching assumptions. Limited information/data on costs, effectiveness of measures and pollution level available. Thus CEA for Coastal waters (e.g.) is not possible.

**Main constraints encountered:** Not mentioned but local capacities seem to have lacked, therefore the technical assistance from the Dutch consultancy.

**General comments:** The study estimates the Net Present Value (NPV, sum of net operating effect for each year corrected by the discount rate; in %, not monetary) and the Internal Rate of return. The NPV indicates how much of the problems encountered the measure solves; the IRR indicates how efficiently the measure does this. A distinctive way of describing a CEA.

**Author and organism:** Aulong S., J-D. Rinaudo, C Hérivaux et L. Maton  
BRGM  
**Publisher or contracting body:** Agence de l'eau Seine Normandie

**Country:** France

**Geographical Area covered:** Seine Aval (Seine Normandie RBD)

**Themes:** Quality; Hydromorphology;

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Project Report  
**Internet links:** /

**Key Focus:** The study consist mainly of an economic analysis of the 2010-2015 PoM focussing on calculating costs and their distribution between users and environmental issues

**Relation to WFD:** In regard to WFD (economic evaluation of the PoM)

**Summary of the study:** The report presents the economic analysis of the PoM for Seine aval river basin. The analysis consist in calculating costs of the program of measures per sub-basin, per environmental issue and per financier. Rough CEA were carried for some issues presenting different possible combination of measures to achieve the objective.

### Measures

**Does the CEA analyze measures or combinations of measures?** Combination of measures

**How many measures are compared in the CEA?**

A CEA was carried out for 3 different environmental issues (organic pollution, drinking water resource protection and hydromorphological issues)

**List or type of measure compared:** Measure to restore the hydromorphology of the rivers (30 measure), measures to address agricultural pollution (17 measures),

**What are the main differences between measures?**

### Methodology

**C/E Ratio calculated?** Yes, for hydromorphological issues

**On which parameters?** Cost was divided by the estimated effectiveness "score" of the combination of measures

**Example of C/E indicator:** -

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Cost were taken from different sources : a generic data base (unitary costs data base of the Rhin Meuse water agency), the SPEP and data from the literature

**Illustration of C/E ranking from the study:**

	Gestion des ouvrages	Effacement arasement	Aménagement	Efficacité (score)	Coût	Coût / efficacité
Scénario 1		oui		4	118 680 €	29 670
Scénario 2	Oui	oui		3	109 146 €	36 382
Scénario 3	Oui		oui	1	197 193 €	197 193
Scénario 4	Oui	oui	oui	2	248 540 €	124 270

Tableau 6 : Comparaison du coût-efficacité des variantes d'actions visant à restaurer la qualité biologique et hydromorphologique des cours d'eau

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

not mentioned

**Environmental costs:**

not mentioned

**Others: -**

**Method for annualizing:** Usual formula using a 4% discount rate

**Are the cost distributed among financiers?** Yes, for each issue

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Yes

**Examples of indicators used:**

score (1 to 4)

**Limited to one (few) parameters of the water status:** No

Tool used to measure effectiveness?

**Expert judgment:** Yes, effectiveness was entirely assess relying on experts judgement

**Models:** No

**Field experiment:** No

**Others:** No

**Are uncertainties quantified?** Not mentioned

### Process

**Who built the CEA ?** Economists from the BRGM

**Which role of stakeholder consultation?** Stakeholders were consulted to define combination of measures, assess effectiveness, etc.

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** CEA was used to select the scenario proposed for the programme of measures

**Technical limit of the analysis:** Effectiveness was defined using a "score" which make the calculation of the C/E ratio very uncertain

**Main constraints encountered:**

**General comments:**

**Author and organism:** Sebastien Loubier, Guy Gleyses, Marielle Montginoul, Patrice Garin et Fabien Christin  
Cemagref UMR G-eau  
**Publisher or contracting body:** LA HOUILLE BLANCHE

**Country:** France

**Geographical Area covered:**  
Charente river basin

**Themes:** Scarcity;

**Sector:** Agriculture;

**Type of publication:** Research paper/Academic publication  
**Internet links:** /

**Key Focus:** Scientific approach to analyse the impacts and effectiveness of different options to reduce irrigation

**Relation to WFD:** Indirect : based on the Water Framework Directive requirement on programs of measures, namely that they should include a combination of the most cost-efficient measures.

**Summary of the study:** The article compares the costs and effectiveness of 3 water management measures for the irrigated agriculture sector, in order to address water flow deficits in the Charente river basin. The objective of the authors was to demonstrate the interest for the water manager that is to use an alternative water pricing system.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**  
3

**List or type of measure compared:** Alternative water pricing system, creation of new water resources, volumetric management tools

**What are the main differences between measures?** They are 3 different ways of addressing water flow deficit in the river

### Methodology

**C/E Ratio calculated?** No - Effectiveness is assumed to be identical for all three measures

**On which parameters?** -

**Example of C/E indicator:** -

**Measures ranked based on C/E ratio and /or Expert judgment?**

Not really. It was calculated the maximum cost for the alternative water pricing system that would make it less costly than the two other measures.

**Generic approach and/or data sources (e.g. national databases)?** No generic approach

Illustration of C/E ranking from the study:

*Which costs of the measures have been taken into account?*

**Investment costs:**

Yes (a range of investment cost and of life-times were considered)

**Operation and maintenance costs:**

Yes (as a percentage of the investment cost)

**Indirect costs (Income losses...):**

Yes (for the volumetric management measure, the only cost considered is the loss of income for the farmers)

**Environmental costs:**

NO

**Others: NO**

**Method for annualizing:** Not mentioned

**Are the cost distributed among financers?** No

**How has effectiveness been taken into account?**

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**

m3 saved

**Tool used to measure effectiveness?**

**Expert judgment:** No

**Models:** No

**Field experiment:** No

**Others:** Effectiveness for alternative water pricing was calculated based on the behaviour of the

**Are uncertainties quantified?** No

**Process**

**Who built the CEA ?** Scientist from the Cemagref

**Which role of stakeholder consultation?** None

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** -

**Main constraints encountered:** -

**General comments:** The CEA was carried out more to demonstrate the benefits of implementing an alternative water pricing system rather than really exploring the most cost effective measure

Publication name: Etude économique SAGE estuaire Gironde

Year:

**Author and organism:** Eaucéa /Ecodécision  
**Publisher or contracting body:** CLE SAGE Estuaire Gironde

**Country:** France

**Geographical Area covered:**  
SAGE Estuaire

**Themes:** Ecology (fish mobility)

**Sector:**

**Type of publication:** SAGE report  
**Internet links:** A analyser

**Key Focus:** Ecological CEA assessment for fish mobility  
**Relation to WFD:**

**Summary of the study:** CEA on an Ecologic Issue, which was rare so far. The authors describe that the results are quite vague.

### Measures

**Does the CEA analyze measures or combinations of measures?** measures

**How many measures are compared in the CEA?**  
2,3 or more, not clear..

**List or type of measure compared:** Different types of river doors/barriers

**What are the main differences between measures?** not clear

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** cost/km of canal that enable fish mobility

**Example of C/E indicator:** €/km

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER

**Generic approach and/or data sources (e.g. national databases)?** No

Illustration of C/E ranking from the study:

Priorité bassin	Bassin versant	Portes à flot			Vannes et autres obstacles			Ratio 3	Techn. Coût (10 ans)	Ratio 4
		Coût max	Linéaire gagné	Ratio 1	Coût max + études	Linéaire gagné	Ratio 2			
		(1)	(2)	(1)/(2)	(3)	(4)	(3)/(4)	(5a)	(5b)	(2a)
1	Chenal de Guy	15 000	180	83	7 000	13	538	114	150 000	891
	Chenal du Gua	30 000	1 122	27	0	28	0	26	150 000	157
	Liverme	15 000	899	17	87 000	25	3 480	110	300 000	435
	Jaille Breuil et Calupeyre	45 000	192	234	116 000	11	10 545	793	150 000	1 532
	Jailles horre et Berle	30 000	83	361	86 000	19	3 474	941	150 000	2 412
	<b>Total Priorité 1</b>	<b>135 000</b>	<b>2 477</b>	<b>54</b>	<b>277 000</b>	<b>96</b>	<b>2 885</b>	<b>160</b>	<b>900 000</b>	<b>510</b>
2	Eau Bourde	0	0		50 000	17	3 471	3 471	150 000	12 294
	Maqueline et Despartin	60 000	316	190	66 000	20	3 300	375	150 000	821
	Jaille Castelneau et Cartillon	30 000	109	275	106 000	9	11 778	1153	150 000	2 424
	<b>Total Priorité 2</b>	<b>90 000</b>	<b>425</b>	<b>212</b>	<b>230 000</b>	<b>46</b>	<b>5 000</b>	<b>879</b>	<b>450 000</b>	<b>1 635</b>
	Brouillon	0	0		7 000	3	2 333	2 333	60 000	22 333
3	Elier de Maubert	15 000	189	79	17 000	13	1 308	158	150 000	901
	Ferrat	15 000	365	41	0	11	0	40	150 000	439
	Jaille de Blanquefort	30 000	133	225	96 000	27	3 630	800	150 000	1 738
	Moron	15 000	112	134	66 000	17	3 862	626	150 000	1 791
	Gua	15 000	16	940	0	10	0	577	150 000	6 346
	<b>Total Priorité 3</b>	<b>90 000</b>	<b>816</b>	<b>110</b>	<b>188 000</b>	<b>81</b>	<b>2 321</b>	<b>310</b>	<b>810 000</b>	<b>1 213</b>
	<b>Total SAGE</b>	<b>315 000</b>	<b>3 718</b>	<b>85</b>	<b>694 000</b>	<b>223</b>	<b>3 112</b>	<b>256</b>	<b>2 160 000</b>	<b>804</b>

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

**Environmental costs:**

**Others:**

**Method for annualizing:** Technical costs are spread over 10 year but no discount rate

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Examples of indicators used:**

km

**Limited to one (few) parameters of the water status:** Ability of fish to traverse the hindrances in the canals (km)

Tool used to measure effectiveness?

**Expert judgment:** Yes

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Not specifically, the issues of uncertainty is dealt with the setup of a multi criteria analysis

### Process

**Who built the CEA ?**

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Quite short

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** confirms plan and thus is incorporated

**Technical limit of the analysis:** vague estimations

**Main constraints encountered:**

**General comments:** The solution to the vagueness of assessing CEA in a ecological context (fish movement) is to embed the CEA in a multi criteria analysis

**Author and organism:** Setec/Asconit/hydratec/teleperformance consultancies  
Water agency Loire Bretagne

**Publisher or contracting body:** Water Agency Loire Bretagne

**Country:** France

**Geographical Area covered:**  
Loire Bretagne

**Themes:** Scarcity;

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Evaluation report of the water agency

**Internet links:** A analyser

**Key Focus:** Evaluation of intervention of the water agency incl. some sort of general CEA

**Relation to WFD:** No direct relation

**Summary of the study:** Evaluation of the water agencies investments in water saving measures including a general qualitative CEA.

### Measures

**Does the CEA analyze measures or combinations of measures?** measures

**How many measures are compared in the CEA?**  
10

**List or type of measure compared:** Water saving measures (irrigation, sensibilisation, studies, water recycling, domestic water saving, sector measurement tools etc)

**What are the main differences between measures?** technical, social, sectoral

### Methodology

**C/E Ratio calculated?** No

**On which parameters?**

**Example of C/E indicator:**

**Measures ranked based on C/E ratio and /or Expert judgment?**

Yes, based on the results of the relation of approx costs (high, medium, low) and qualitative effectiveness measurements, sustainability effect and eco potential

**Generic approach and/or data sources (e.g. national databases)?** No

Illustration of C/E ranking from the study:

	Coût	Efficacité	Durabilité	Eco potentielle (volume)
MAE (simulation)	€€€	++++	++	
Retenues	€€€€	+++	++++	++++
Optimisation de l'irrigation	€€	+	++	
Changement d'assolement volontaire	0/€	+++	+	
Etudes diagnostics et patrimoniales	€€	+++	+++	
Compteurs sectoriels	€€ / €€€	+++	++++	++
Sensibilisation	€	+	+++	
Travaux d'économies d'eau (bâtiments)	€€€	+++	+++	
Recyclage des eaux usées	€€	++	+++	
Récupération de l'eau pluviale	€€	+	++	+

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

**Indirect costs (Income losses...):**

**Environmental costs:**

**Others:**

**Method for annualizing:** No

**Are the cost distributed among financers?** Yes, as the investment is evaluated, it is outlined who paid for what measures

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Water quantity

**Examples of indicators used:**

plus plus/plus/minus/minus  
minus

Tool used to measure effectiveness?

**Expert judgment:** Yes

**Models:** No

**Field experiment:** No

**Others:**

**Are uncertainties quantified?** Qualitative

### Process

**Who built the CEA ?**

**Which role of stakeholder consultation?**

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Recommendations

**Technical limit of the analysis:** Effectiveness measurement

**Main constraints encountered:** Not mentioned

**General comments:** Quite broad water saving measures effectiveness assessment, unlike most other studies here, no relation to the WFD

**Author and organism:** Londong, J., Geiger, W.F., Meusel, S., Meyer, P., Werbeck, N., Hecht, D., Karl, H  
University Duisburg  
**Publisher or contracting body:** Environmental Ministry NRW

**Country:** Germany

**Geographical Area covered:**  
Lippe

**Themes:** Quality; temperature

**Sector:** Industry;

**Type of publication:** Case Study

**Internet links:**

<http://www.flussgebiete.nrw.de/Pilotprojekte/Lippeprojekt/Pilotprojekt-Lippe-Endfassungf.pdf>

**Key Focus:** CEA for measure to limit temperature increase and salt discharge

**Relation to WFD:** high

**Summary of the study:** CEA which focuses on water temperature and salt content

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures and Combination

**How many measures are compared in the CEA?**  
13

**List or type of measure compared:** Technical measures and measures related to green infrastructure

**What are the main differences between measures?** Different types of technologies

### Methodology

**C/E Ratio calculated?** yes

**On which parameters?** Euro/temp-reduced and Euro per load reduced

**Example of C/E indicator:** Euro/temp-reduced and Euro per load reduced

**Measures ranked based on C/E ratio and /or Expert judgment?**  
Based on CEA

**Generic approach and/or data sources (e.g. national databases)?** Research results, modeling, monitoring results

**Illustration of C/E ranking from the study:**

Tabelle 7-3: Kosteneffiziente Maßnahmenkombinationen für den Parameter „Temperatur“ an „Auguste Victoria“

Maßnahmen (kombination)	ZEG <sub>T</sub> [%] im SLF	ZEG <sub>T</sub> [%] im WLF	Projektkostenbarwerte [€]
12	110	100	4,86 Mio
12 + 5.2	90 / 10	90 / 10	5,14 Mio
12 + 1.1	90 / 10	80 / 40	5,01 Mio
12 + 5.2 + 1.1	80 / 10 / 10	70 / 0 / 40	5,00 Mio
10	110	100	20,81 Mio
10 + 5.2	90 / 10	90 / 10	21,13 Mio
10 + 1.1	90 / 10	80 / 40	21,01 Mio
10 + 5.2 + 1.1	50 / 20 / 30	40 / 10 / 120	20,19 Mio
10 + 5.2 + 1.1	50 / 30 / 20	40 / 20 / 80	20,94 Mio

Which costs of the measures have been taken into account?

**Investment costs:**

yes

**Operation and maintenance costs:**

yes

**Indirect costs (Income losses...):**

**Environmental costs:**

partly

**Others: ressource costs partly**

**Method for annualizing:** According to DE-Lawa Guidelines (3% discounting)

**Are the cost distributed among financers?** The issue is addressed but only theoretical

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Per water body

**Limited to one (few) parameters of the water status:** Temperature and chlorid

**Examples of indicators used:**

Reduction of temp.

Tool used to measure effectiveness?

**Expert judgment:** x

**Models:** x

**Field experiment:** no

**Others:** no

**Are uncertainties quantified?** Yes the issue is discussed in relation the methodology and the costs

### Process

**Who built the CEA ?** University

**Which role of stakeholder consultation?** not mentioned

**Are the different steps of the analysis developed in a transparent way?** yes

**Are there iterations in the implementation process?** yes

**Which integration of the results in the decision making process?** not mentioned

**Technical limit of the analysis:** assessment of environmental and ressourcecosts

**Main constraints encountered:** not mentioned

**General comments:**



Which costs of the measures have been taken into account?

**Investment costs:**  
yes

**Operation and maintenance costs:**  
yes

**Indirect costs (Income losses...):**  
no, only qualitative discription

**Environmental costs:**  
no

**Others:** no

**Method for annualizing:** not specified but 3% discounting is mentioned

**Are the cost distributed among financers?** no

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** water body

**Limited to one (few) parameters of the water status:** hdromorph QE and N

**Examples of indicators used:**  
distance to target in % or mg/l

Tool used to measure effectiveness?

**Expert judgment:** Unclear

**Models:** Unclear

**Field experiment:** Unclear

**Others:** Unclear

**Are uncertainties quantified?** No

### Process

**Who built the CEA ?** Planning office

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Partly

**Are there iterations in the implementation process?** Unclear

**Which integration of the results in the decision making process?** not mentioned

**Technical limit of the analysis:** Assessment of environmental and resource costs

**Main constraints encountered:** not mentioned

**General comments:**

**Author and organism:**  
**Publisher or contracting body:**

**Country:** Germany

**Type of publication:** Part of the RBMP

**Internet links:**

[http://www.flussgebiete.nrw.de/Dokumente/NRW/Bewirtschaftungsplan\\_2010\\_2015/Ma\\_\\_nahmenprogramm/10\\_MP\\_Kosteneffizienteste\\_Ma\\_\\_nahmenkombinationen.pdf](http://www.flussgebiete.nrw.de/Dokumente/NRW/Bewirtschaftungsplan_2010_2015/Ma__nahmenprogramm/10_MP_Kosteneffizienteste_Ma__nahmenkombinationen.pdf)

**Geographical Area covered:**  
 North-Rhinr-Westfalia (NRW)

**Themes:** Quality;  
 Hydromorphology;

**Sector:** Agriculture; Industry;  
 Households;Energy;

**Key Focus:** Methdology on CEA under the WFD

**Relation to WFD:** high

**Summary of the study:** chapter in the RBMP on CEA

**Measures**

**Does the CEA analyze measures or combinations of measures?** combination

**How many measures are compared in the CEA?**

Unclear, the methodology just refers to the general RBMP, but it is unclear if the approach was chosen for all measures

**List or type of measure compared:** Technical measures and instruments

**What are the main differences between measures?** Scale, Geography, Sectors, Level, Outreach,

**Methodology**

**C/E Ratio calculated?** no

**On which parameters?** Unclear

**Example of C/E indicator:** Unclear

Illustration of C/E ranking from the study: Not available

**Measures ranked based on C/E ratio and /or Expert judgment?**

Unclear

**Generic approach and/or data sources (e.g. national databases)?** Unclear

Which costs of the measures have been taken into account?

**Investment costs:**  
Yes, but no details

**Operation and maintenance costs:**  
Yes, but no details

**Indirect costs (Income losses...):**  
Unclear

**Environmental costs:**  
Yes, but no details

**Others: Resource costs**

**Method for annualizing:** unclear

**Are the cost distributed among financers?** Partly, references to existing funding schemes are made

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Water body

**Limited to one (few) parameters of the water status:** Full set of QE

**Examples of indicators used:**  
Not provided

Tool used to measure effectiveness?

**Expert judgment:** Unclear

**Models:** Unclear

**Field experiment:** Unclear

**Others:** Unclear

**Are uncertainties quantified?** Yes, there are mostly related to impacts of measures

### Process

**Who built the CEA ?** Ministry with the help of consultants

**Which role of stakeholder consultation?** According to the Art 14 WFD

**Are the different steps of the analysis developed in a transparent way?** Partly

**Are there iterations in the implementation process?** Unclear

**Which integration of the results in the decision making process?** Full integration

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:** I still would look in a step 3 on the issues, interviewing people and asking for background information. I know that they have done quite more than what is stated in the report which was the basis for my assessment. NRW has done quite more than other Länder in Germany

**Author and organism:** Niedersächsisches Ministerium für Umwelt und Klimaschutz  
**Publisher or contracting body:** Niedersächsisches Ministerium für Umwelt und Klimaschutz

**Country:** Germany

**Geographical Area covered:**  
Lower Saxony

**Themes:** Quality;  
Hydomorphology;

**Sector:** Agriculture; Industry;  
Households;Energy;

**Type of publication:** Part of the RBMP

**Internet links:**

[http://www.nlwkn.niedersachsen.de/live/live.php?navigation\\_id=7990&article\\_id=45644&\\_psmand=26](http://www.nlwkn.niedersachsen.de/live/live.php?navigation_id=7990&article_id=45644&_psmand=26)

**Key Focus:** Methodology on CEA under the WFD

**Relation to WFD:** high

**Summary of the study:** Report to the RBMP outlining the approach taken for the CEA and the selection of measures

### Measures

**Does the CEA analyze measures or combinations of measures?** Both

**How many measures are compared in the CEA?**

Unclear as the report only refers to case studies as examples

**List or type of measure compared:** In both the case study four hydromorphological measures are compared

**What are the main differences between measures?** Different technical options

### Methodology

**C/E Ratio calculated?** No, only the different parameters are listed and judged

**On which parameters?** Different types of costs, time, fish movement, Benthos but also administrative issues

**Example of C/E indicator:** Ranges from 0 to + or cost numbers

**Measures ranked based on C/E ratio and /or Expert judgment?**

Based on the judgement of the different parameters

**Generic approach and/or data sources (e.g. national databases)?** Unclear

Illustration of C/E ranking from the study:

Tabelle 2: Kosten-Wirksamkeits-Matrix für die Fallstudie Dinkel-Wehr

Maßnahme	Pastierbarkeit Fischfauna	Pastierbarkeit Benthos	Gestaltung	Kanugleite	Zeithorizont	Mittlere bwl. Kosten [€]	VwL Kosten
I: Störsteinbauweise	-	+	o	-	Kurzfristig	ohne Kostenanschlag	gering
II: Riegelbauweise	-	+	o	-	Kurzfristig	ohne Kostenanschlag	gering
III: Raugerinne-Beckenpass	+	+	o	-	Kurzfristig	~ 177.000	gering
IV: Umgehungsgerinne	+	+	+	-	Kurzfristig	~ 193.000	gering

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> yes	<b>Operation and maintenance costs:</b> yes	<b>Indirect costs (Income losses...):</b> no	<b>Environmental costs:</b> no	<b>Others:</b> Administrative costs
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**Method for annualizing:** Unclear

**Are the cost distributed among financers?** No

*How has effectiveness been taken into account?*

**Global in terms of general impact on the water body status:** Water body in teh case studies

**Limited to one (few) parameters of the water status:** No, different QE related to Hymo

**Examples of indicators used:** In one case study a semi-qualitative approach is used in the other just a number is presented but it remains unclear how this number was developed

**Tool used to measure effectiveness?**

**Expert judgment:** Yes, based on a case study

**Models:** No

**Field experiment:** No

**Others:** No

**Are uncertainties quantified?** Yes, effectiveness is mentioned as an area of uncertiantes

*Process*

**Who built the CEA ?** Unclear

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** Full integration

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:** The methodology is clear but the transfer into practice leaves several questions

**Author and organism:** Prof. Dr. H. Karl,  
 Prof. Dr.-Ing. J. Londong  
 Prof. Dr.-Ing. W. F. Geiger  
 Dipl.-Ing. P. Meyer  
 Dipl.-Ing. S. Meusel  
 Ruhr Universität Bochum  
**Publisher or contracting body:** Ruhr Universität Bochum

**Country:** Germany  
**Geographical Area covered:** Rur  
**Themes:** Quality;  
**Sector:** Agriculture; Industry;

**Type of publication:** Case Study  
**Internet links:**  
[http://www.lanuv.nrw.de/wasser/abwasser/forschung/pdf/Abschlussbericht\\_EG-WRRRL.pdf](http://www.lanuv.nrw.de/wasser/abwasser/forschung/pdf/Abschlussbericht_EG-WRRRL.pdf)

**Key Focus:** Testing of a methodology on CEA under the WFD  
**Relation to WFD:** high

**Summary of the study:** Case study on pollution

### Measures

**Does the CEA analyze measures or combinations of measures?** both

**How many measures are compared in the CEA?**  
 34

**List or type of measure compared:** Technical and administrative measures

**What are the main differences between measures?** Scale, Geography, Sectors, Level, Outreach,

### Methodology

**C/E Ratio calculated?** yes

**On which parameters?** Euro per load reduced and area

**Example of C/E indicator:** €/(kg N·a)

**Measures ranked based on C/E ratio and /or Expert judgment?**  
 CEA

**Generic approach and/or data sources (e.g. national databases)?** Use of various sources

**Illustration of C/E ranking from the study:**

Tabelle 6-6: Kosten und Wirksamkeiten der Maßnahmen im Inde-EZG

Gewässer	Mögliche Maßnahmen	Mittlere Kosten pro Jahr [C/a]	$f_k / f_w$	N [t/a]	P [t/a]	Cd [kg/a]	Pb [kg/a]	Zn [t/a]	Kosten-träger
Vicht-bach und Inde	Abtragung von Altlasten	436,7 Mio.	4,3	-		574,7	7183,2	38,3	
Inde	N-Reduktion KA Aachen-Süd	7,3 Mio.	1,2	36,5	-				Wasser-verband
Itebach	Stoff-Reduktion KKA	1,5 Mio.	1,5	1,1	0,3				Private, Kommunen (B)
<b>Gesamtkosten</b>		<b>445,5 Mio.</b>							

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Unclear	<b>Operation and maintenance costs:</b> Unclear	<b>Indirect costs (Income losses...):</b> No	<b>Environmental costs:</b> No	<b>Others: unclear</b>
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**Method for annualizing:** Unclear

**Are the cost distributed among financers?** Yes

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Global as load reduction

**Limited to one (few) parameters of the water status:** Limited to load related parameters

**Examples of indicators used:** N-educed

Tool used to measure effectiveness?

**Expert judgment:** Yes, based on a case study

**Models:** Yes

**Field experiment:** No

**Others:** Historical data and research

**Are uncertainties quantified?** Yes

*Process*

**Who built the CEA ?** University

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Author and organism:** Clement, Adrienne, Kovács, Ádám, Rákosi, Judit and Ungvári, Gábor  
 Budapest University of Technology and Economics, Department of Sanitary and Environmental Engineering,  
 ÖKO Co.Ltd.,  
 Corvinus University of Budapest, REKK Water Economics Unit  
**Publisher or contracting body:**

**Country:** Hungary

**Geographical Area covered:**  
 Upper Tisza

**Themes:** Quality; Erosion

**Sector:** Agriculture; Industry; Households; Wastewater

**Type of publication:** Research Paper

**Internet links:**

**Key Focus:** CEA, phosphorus reduction

**Relation to WFD:** In regard to WFD

**Summary of the study:** The aim of this paper is to evaluate the impacts of different load reduction measures on the water quality improvement, including (i) supplementary P removal applied at WWTPs, (ii) reduction of P load with change of land use and cultivation techniques (e.g. forestation, erosion control); (iii) floodplain rehabilitation and establishment of riparian buffer zones along the riverbed, (iv) location of constructed wetlands. It is a research paper, written quite short.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**  
 17 altogether, 6 for lowlands, 11 for hilly areas

**List or type of measure compared:** Transport control of Pollutant, Erosion prevention, Land use change

**What are the main differences between measures?** Different types of pollutant mitigation (land use, pollutant influx,

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Load reduction total phosphorus/ annualized specific costs

**Example of C/E indicator:** €/kg P

**Measures ranked based on C/E ratio and /or Expert judgment?**  
 CER

**Generic approach and/or data sources (e.g. national databases)?** No

Illustration of C/E ranking from the study:

Measure	Average load reduction for TP	Annualised specific cost, €/ha	Cost-efficiency indicator, €/kg P
<b>Land use change</b>			
Conversion of arable land to grassland/pasture (without grazing)	70 %	22	13
Conversion of arable land to forest	75 %	112-180	60-100
<b>Erosion prevention- soil conservation</b>			
Vegetation buffer strips along the arable land (6 m width in 1 ha arable land)	50 %	36	30
Mulching, conservation tillage	65 %	56	35
Crop rotation	45 %	13	120
Complex erosion control including strip cropping and contouring	65%	210	130
Trench, terrace	35 %	1720	1900
<b>Transport control</b>			
Riparian buffer strip with 2x6=12m grassland, for a length of 100 m (assuming that 1 ha belongs to the 100 m river stretch)	50 %	3.6	5.6

Which costs of the measures have been taken into account?

**Investment costs:**

Yes, but not specified

**Operation and**

**maintenance costs:**

Yes, but not specified

**Indirect costs (Income losses...):**

Not mentioned

**Environmental costs:**

Not mentioned

**Others:**

Agricultural subsidy cost, wetland construction

**Method for annualizing:** The life-span and real discount rate

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Examples of indicators used:** P load

**Limited to one (few) parameters of the water status:** Yes

Tool used to measure effectiveness?

**Expert judgment:** Wetland construction and introduction of additional P removal at wastewater treatment plants were derived from the experiences of the designer engineers

**Models:** PhosFate

**Field experiment:** not mentioned

**Others:** computed travel time dependent coefficient, Literature data

**Are uncertainties quantified?** Not mentioned

### Process

**Who built the CEA ?** Not mentioned

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes, relatively, but too short

**Are there iterations in the implementation process?** It is outlined in such a brief way that it is not clear, the emphasis is rather on the phosphate reduction model, not so much on the detailed process description

**Which integration of the results in the decision making process?** Application of some measures is rather decided by the land use ratio and not the costs

**Technical limit of the analysis:** Too short

**Main constraints encountered:** The difficulties were not addressed in the research paper

**General comments:** Solid study but it would be interesting to get more procedural and methodological information

**Author and organism:** Ministry of Environment, Heritage and Local Government  
Ministry, County Councils, CDM Environmental Consultants  
**Publisher or contracting body:** ERBD Ireland

**Country:** Ireland

**Geographical Area covered:**  
Blackwater North

**Type of publication:** River Basin Management Plan  
**Internet links:**  
[http://www.erbd.ie/Docs/RBMP\\_2010/DG223%20RBMP%20Status%20V25+Minister\\_Iss.pdf](http://www.erbd.ie/Docs/RBMP_2010/DG223%20RBMP%20Status%20V25+Minister_Iss.pdf)

**Themes:** Quality;

**Sector:** Agriculture; Households;

**Key Focus:** RBMP  
**Relation to WFD:** In regard to WFD

**Summary of the study:** This Plan has been produced jointly by the local authorities and a project team for the Eastern River Basin District. The plan and the generic approach of the CEA are supported by the River Basin Management System (developed by the Eastern River Basin) which contains all data sets describing the District, a detailed analysis of pressures, the recommended actions to address those pressures, and all of the reasoning for that selection, including the costs and effectiveness of each measure in each location. The information derived from the CEA pilot study has informed the selection of measures in the Eastern River Basin District and allowed to select both individual and sets of actions for the different types of catchments which offer a cost effective approach to water management. The more cost effective measures have been used widely in similar catchments throughout the Eastern River Basin District, whilst still taking account of pressures in each locality.

**Measures**

**Does the CEA analyze measures or combinations of measures?** Set of measures. Each measure has a C/E Ratio yet the total sum of the package is relevant for choice.

**How many measures are compared in the CEA?**  
For each water management unit, two sets of supplementary measures were identified for comparative analysis. Each set consists of several measures that were selected to deal with the specific pressure in the catchment.

**List or type of measure compared:** Types of Measures: Septic system/Wastewater System/Cattle access

**What are the main differences between measures?** Different aspects/locations of the same types of measures

**Methodology**

**C/E Ratio calculated?** Yes  
**On which parameters?** Cost/ benefit in terms of achieving improvements in water status  
**Example of C/E indicator:** Not outlined  
**Measures ranked based on C/E ratio and /or Expert judgment?** CER, but EJ plays a role as supplementary measures chosen for both alternatives already include a strong element of expert judgment and they are generally less expensive than basic measures.  
**Generic approach and/or data sources (e.g. national databases)?** Yes, a river basin management system exists that allows to estimate costs and effectiveness for measures in the eastern river basin district with the computer programme. The dynamic system assists authorities in designing equitable and cost-effective water quality improvement programs to comply with the WFD's requirements for good ecological status in all natural surface waters. The system's transparency supports stakeholder involvement, resulting in effective information sharing and decision making.

**Illustration of C/E ranking from the study:**

Table 10.3. Alternative 1 - Supplementary Measures			Table 10.4. Alternative 2 - Supplementary Measures		
Sub-catchment	Supplementary Measure	C/E Effectiveness Ratio	Sub-catchment	Supplementary Measure	C/E Effectiveness Ratio
Mouth	Blackwater North		Blackwater North		
	Enhance Regulation on Septic Systems	0.15	Install sewage system in road area with 100% on road treatment	0.51	
	Upgrade WWTP - 2000 PE	0.27	Introduce Integrated Constructed Wetlands where practical to treat pollution from discharge	0.11	
	Upgrade WWTP and Collecting Systems - 2000 PE	0.65	Introduce Agri-Related Bye-Laws Through Water Pollution Act 1977 to address animal access to water courses. Reduce water type law	0.05	
	Install Cattle Access to rivers - Cattle Cattle Drinking points	0.01	Farm Specific Constructed Wetland (Requires Regulatory Site Assessment)	0.29	
	Implement System Programmes of Measures	0.00	Install additional WWTP - 2000 PE	0.30	
	Tertiary Treatment	0.81		Digester for nutrient capture	0.79
	TOTAL	1.99		TOTAL	2.00
Cavan	Enhance Regulation on Septic Systems	0.01	Cavan	Provide a grant system for the maintenance and upgrading of septic tanks	1.82
	Shangaragh		Shangaragh		
	GDSD Compliance - CSOs	5.47	GDSD Compliance & Storm Sewer Separation	0.00	
	Investigate and eliminate microcontaminants	0.49	Site Specific Riparian Buffer Requirement on Residential Developments	0.54	
	Investigate Fats, Oils and Grease Issues	0.03	Site Specific Remedial Fund for Residential Developments (Requires Regulatory Site Assessment) (per cubic metre capacity)	0.05	
	River Pollution - Road Act	0.01		Cattle Management	0.53
	TOTAL	5.99		TOTAL	4.90
Dun Loughan Ballymore	Varry		Varry		
	Diffuse Runoff Mitigation - Implement SUDS	0.01	Install buffer zones and collection systems	0.04	
	Inspect and Upgrade Microcontaminants	0.01	Provide a grant system for the maintenance and upgrading of septic tanks	0.91	
	Investigate Fats, Oils and Grease Issues	0.00	Introduce Agri-Related Bye-Laws Through Water Pollution Act 1977 to address animal access to water courses. Reduce water type law	0.00	
	Upgrade WWTP and Collecting Systems - 2000 PE	1.96	Install 2 additional WWTP - 2000 PE & Collecting system	2.57	
	TOTAL	2.00		TOTAL	2.61
Mouth	Blackwater North		Blackwater North		
	Enhance Regulation on Septic Systems	0.63	Introduce Agri-Related Bye-Laws Through Water Pollution Act 1977 to ban animal access to water courses. Reduce water type law	0.08	
	Upgrade WWTP and Collecting Systems - 2000 PE	0.26	Install wastewater treatment systems with 100% on facility treatment	2.57	
	Install Cattle Access to rivers - Cattle	0.01	Install wastewater treatment systems with 100% on facility treatment	2.57	
		Tertiary Treatment	1.90	Reinstatement of WWTP - 2000 PE	1.80
	TOTAL	2.80		TOTAL	5.03

Which costs of the measures have been taken into account?

**Investment costs:**

Capital

**Operation and**

**maintenance costs:**

Operations, maintenance  
and staff

**Indirect costs (Income**

**losses...):**

Not mentioned

**Environmental**

**costs:**

Not mentioned

**Others:**

Non capital  
measures (like  
restricting cattle  
access)

**Method for annualizing:** 30 year span, methodology not outlined

**Are the cost distributed among financiers?** The plan says that it cannot address resource allocation

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**

Benefit in terms of achieving P  
level improvements in water  
status

Tool used to measure effectiveness?

**Expert judgment:** Not  
specified

**Models:** Phosphorus  
modelling, Water quality  
models

**Field experiment:**

**Others:** Past experience of  
similar measures

**Are uncertainties quantified?** Not mentioned

### Process

**Who built the CEA ?** CIS oriented, build by Eastern River  
Basin District in cooperation with CIS (EU)

**Which role of stakeholder consultation?** Not mentioned in  
regard to CEA but the RBMP has been developed in  
cooperation with stakeholders

**Are the different steps of the analysis developed in a transparent way?** No

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Already the preselection was influenced by expert  
judgement, then the results were of course also involved in the decision making.

**Technical limit of the analysis:** Too short, not elaborated, not transparent, lack of reliable data

**Main constraints encountered:** Not mentioned

**General comments:** This is an example of how CEA is conducted in Ireland, relying on generic information and incorporating  
local contributions. In this case the District has an elaborate database system which has helped. However, the CEA is rather  
brief.

**Author and organism:** S Blacklocke, A Hooper, M Rosenberg and R Earle  
CDM Ireland  
**Publisher or contracting body:** SAC and SEPA, International Water Agency

**Country:** Ireland

**Geographical Area covered:**  
Athbury Pilot Study in the Eastern  
River Basin

**Type of publication:** Project Outline in Conference Report 'Managing Rural Diffuse  
Pollution  
International  
Water Association'  
**Internet links:** <http://www.sac.ac.uk/mainrep/pdfs/sacsepaproceedings.pdf>

**Themes:** Quality;

**Sector:** Agriculture; Industry;  
Households;Wastewater

**Key Focus:** A generic online tool that will allow the Eastern river Basin  
management officials to conduct their own constrained cost-effectiveness analysis  
**Relation to WFD:** In regard to WFD

**Summary of the study:** This short conference report shows the Eastern River Basin District project decision support system, which is a web-based POM selection tool. This generic instrument is exemplified with a CEA for P-reduction in Athboy Catchment displaying basic cost-effectiveness analysis methodology.

### Measures

**Does the CEA analyze measures or combinations of measures?** In this case study measures

**How many measures are compared in the CEA?**  
15

**List or type of measure compared:** Fertiliser, Septic tanks, Wastewater Plants

**What are the main differences between measures?** Type of mitigation

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** €/kg Phosphor reduction

**Example of C/E indicator:** €/kg P reduction

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER

**Generic approach and/or data sources (e.g. national databases)?** Yes, computer tool for selection of C/E measures was developed

### Illustration of C/E ranking from the study:

Table 2: Cost-effective measures for phosphorous for Athboy Catchment (preliminary)

P Sources	Management measures	Effectiveness (kg/year P red)	Costs(€/year – 10 years)	Cost-Effective (€/kg P red)	CE Rank
Manure fertilised land	Manure management plans	437	250,000	572	6
	25% stocking reduction	546	22,800,000	41,758	15
	Sheltered manure storage	218	150,000	688	7
	1.5 km <sup>2</sup> riparian buffers	328	580,000	1,768	9
	Faed optimisation plans	219	3,200	15	1
	500 m <sup>3</sup> retention ponds	164	60,000	366	5
Chemical fertilised land	Fertiliser management plans	564	82,500	146	3
	50% grassland conversion	1,128	408,500	362	4
	1.5 km <sup>2</sup> riparian buffers	338	580,000	1,715	8
	500 m <sup>3</sup> retention ponds	451	60,000	133	2
Septic systems	Inspections and upgrades	32	652,408	20,388	14
	Treatment plant tie-ins	35	244,678	6,991	12
	Education programme	9	75,000	8,333	13
WWTPs	MLE without filtration	561	2,649,000	4,722	10

Which costs of the measures have been taken into account?

**Investment costs:**

Additional cost Info from literature review but not specified

**Operation and maintenance costs:**

Costs are not specified

**Indirect costs (Income losses...):**

Costs are not specified

**Environmental costs:**

Costs are not specified

**Others:**

**Method for annualizing:** Costs are annualised

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P reduction

**Examples of indicators used:**

kg/year P reduction

Tool used to measure effectiveness?

**Expert judgment:** Literature review, no further specification

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Not mentioned

**Process**

**Who built the CEA ?** Model build by the authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** No, but the information system is described as transparent.

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Not mentioned

**Main constraints encountered:** Input data need to be refined over time.

**General comments:** Example for a generic approach.

**Author and organism:** PWC, Ecologic  
PWC, Ecologic  
**Publisher or contracting body:** Administration de la gestion de l'eau

**Country:** Luxembourg

**Geographical Area covered:**  
Luxembourg

**Type of publication:** Part of the RBMP  
**Internet links:**  
[http://www.eau.public.lu/actualites/2010/03/plan\\_de\\_gestion\\_fr/wirtschaftliche\\_Analyse.pdf](http://www.eau.public.lu/actualites/2010/03/plan_de_gestion_fr/wirtschaftliche_Analyse.pdf)

**Themes:** Quality;  
Hydomorphology;

**Sector:** Agriculture; Industry;  
Households;Energy;

**Key Focus:** Methdology on CEA under the WFD  
**Relation to WFD:** high

**Summary of the study:** The CEA was part of the development of the RBMP development and covers all pressures found in LUX

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**  
34 main measures which have submeasures

**List or type of measure compared:** Full POM

**What are the main differences between measures?** Scale, Geography, Sectors, Level, Outreach,

### Methodology

**C/E Ratio calculated?** No, semiquantitativ  
**On which parameters?** Costs and the different QE stated in the Directive  
**Example of C/E indicator:** No combined C/E was used  
**Measures ranked based on C/E ratio and /or Expert judgment?**  
Ranking was made measures which will applied mostly (that was based on CEA, Acceptance and alternative options available)  
**Generic approach and/or data sources (e.g. national databases)?** Use of historic data and catalogues of measures from other MS

Illustration of C/E ranking from the study:

LISTE DER MASSNAHMEN MIT KOSTENPUNKTEN UND VERGLEICHENDE QUALITÄTSWIRKUNGEN

M-Nr.	Beschreibung	Kostenpunkte	Wirkung QE	Ratio
<b>Durchgängigkeit</b>				
HY 1.1	Entfernen Querbauwerk Fallhöhe bis 1 m; EZG < 100	1	4	4
HY 2.1	Fischaufstiegshilfe Fallhöhe bis 1 m; EZG < 100	1	3	3
HY 1.2	Entfernen Querbauwerk Fallhöhe bis 1 m; EZG 100 bis 500	1	4	4
HY 2.2	Fischaufstiegshilfe Fallhöhe bis 1 m; EZG 100 bis 500	2	3	1,5
HY 1.3	Entfernen Querbauwerk Fallhöhe bis 1 m; EZG > 500	2	4	2
HY 2.3	Fischaufstiegshilfe Fallhöhe bis 1 m; EZG > 500	2	3	1,5
HY 1.4	Entfernen Querbauwerk Fallhöhe 1 bis 2 m; EZG < 100	1	4	4
HY 2.4	Fischaufstiegshilfe Fallhöhe 1 bis 2 m; EZG < 100	1	3	3
HY 1.5	Entfernen Querbauwerk Fallhöhe 1 bis 2 m; EZG 100 bis 500	2	4	2
HY 2.5	Fischaufstiegshilfe Fallhöhe 1 bis 2 m; EZG 100 bis 500	2	3	1,5
HY 1.6	Entfernen Querbauwerk Fallhöhe 1 bis 2 m; EZG > 500	2	4	2
HY 2.6	Fischaufstiegshilfe Fallhöhe 1 bis 2 m; EZG > 500	2	3	1,5
HY 1.7	Entfernen Querbauwerk Fallhöhe höher als 2 m; EZG < 100	2	4	2
HY 2.7	Fischaufstiegshilfe Fallhöhe höher als 2 m; EZG < 100	2	3	1,5
Entfernen Querbauwerk Fallhöhe höher als 2 m; EZG 100 bis 500				
HY 1.8		2	4	2
HY 2.8	Fischaufstiegshilfe Fallhöhe höher als 2 m; EZG 100 bis 500	3	3	1
HY 1.9	Entfernen Querbauwerk Fallhöhe höher als 2 m; EZG > 500	3	4	1,33
HY 2.9	Fischaufstiegshilfe Fallhöhe höher als 2 m; EZG > 500	3	3	1
<b>Restwasser</b>				
Biologie				
HY 5.1	Erhöhung des Mindestrestwassers auf 30% von MNQ im Hauptfluss	N.A. <sup>1</sup>	2	N.A.
HY 5.2	Erhöhung des Mindestrestwassers auf 50% von MNQ im Hauptfluss	N.A.	3	N.A.
HY 6	Volle Wasserführung	N.A.	4	N.A.
<b>Reduktion von N-P Emissionen im Ackerland (Oberflächenwasser)</b>				
LWS-OW				

*Which costs of the measures have been taken into account?*

**Investment costs:**

Taken from historic data

**Operation and**

**maintenance costs:**

Taken from historic data

**Indirect costs (Income losses...):**

Only qualitative

**Environmental costs:**

Only qualitative

**Others: No**

**Method for annualizing:** DE- LAWA Guidelines for annualizing available at

**Are the cost distributed among financers?** Yes

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Impact on each water body (change in status)

**Limited to one (few) parameters of the water status:** No impact on all QE has been assessed

**Examples of indicators used:**

Impact on QE have been ranked from + to +++

Tool used to measure effectiveness?

**Expert judgment:** Based on expert judgement and assessment of existing measures

**Models:** No

**Field experiment:** No

**Others:** No

**Are uncertainties quantified?** Partly (such as uptake of measures by a farmer)

**Process**

**Who built the CEA ?** Administration with support by consultant

**Which role of stakeholder consultation?** Stakeholders where invited to review and to provide input

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** Full integration

**Technical limit of the analysis:** Uncertainty related to effectiveness

**Main constraints encountered:**

**General comments:**

**Author and organism:** Twinning Light Project  
Office International de l'Eau (OIEau)  
**Publisher or contracting body:** Twinning Light Project Report

**Country:** Malta

**Geographical Area covered:**  
Maltese Water Catchment  
District

**Type of publication:** Project Report  
**Internet links:**

**Themes:** Scarcity; Quality;

**Sector:** Agriculture; Industry;  
Households;Energy;Tourism

**Key Focus:** Groundwater  
**Relation to WFD:** In regard to WFD

**Summary of the study:** The study, carried out within a Twinning light project between French and Maltese experts, aimed to help building the Program of Measures for Malta. Two CEA were actually carried out, one related to water quality issues and the other to water quantity issues. Regulatory, knowledge and awareness measures were also considered in the study but not in the CEA.

### Measures

**Does the CEA analyze measures or combinations of measures?** Individual measures

**How many measures are compared in the CEA?**  
26 in the water quantity CEA and 18 in the water quality CEA

**List or type of measure compared:** Measures targeting all sectors (in order of importance) : Agriculture, industry, households, the national water supply company, other users (hotels, bowsers, etc.)

**What are the main differences between measures?** Environmental target (quantity and quality) and water user targeted

### Methodology

**C/E Ratio calculated?** Yes

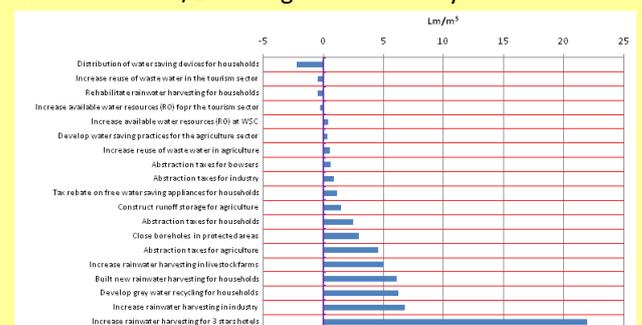
**On which parameters?** Total annualised cost per kg of N or per m3 saved

**Example of C/E indicator:** €/m3

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** No generic approach

Illustration of C/E ranking from the study:



Which costs of the measures have been taken into account?

**Investment costs:**

Yes (cost of infrastructure development, equipment purchase and installation, land acquisition, etc)

**Operation and**

**maintenance costs:**  
Yes (include all annual costs which are directly related to the measure )

**Indirect costs**

**(Income losses...):**  
Yes (costs incurred to third parties by the measure

**Environmental costs:**

Yes (for instance, energy demanding solutions such as Reverse Osmosis generate additional CO2 emission, an environmental damage which can be valued in monetary terms)

**Others:**

Administrative costs, which include cost of administrative staff (salary, overheads, functioning costs)

**Method for annualizing:** Use of the usual formula. Some sensitivity analysis were carried out on the discount rate (4%, 2% and 9%)

**Are the cost distributed among financers?** Yes. The cost were compared to the current expenses by water users and the capacity to pay of the water users

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Examples of indicators used:**

kg of N and m3

**Limited to one (few) parameters of the water status:** Yes

Tool used to measure effectiveness?

**Expert judgment:**

Yes, including from foreign experts (mostly French)

**Models:** No

**Field experiment:** No

**Others:** Literature

**Are uncertainties quantified?** Yes - Consultation with stakeholders and sensitivity analysis were carried out to reduce uncertainty

**Process**

**Who built the CEA ?** The twinning light project group of experts (French experts and Maltese experts from different institutions)

**Which role of stakeholder consultation?** Stakeholders were associated at different steps of the project and their knowledge of "the field" was used

**Are the different steps of the analysis developed in a transparent way?** Yes. The reports is very detailed on the method, sources of data, etc.

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** The results were used to help building the PoM for Malta

**Technical limit of the analysis:** Some unitary costs and effectiveness used were believed by some stakeholders and policy makers not to be robust enough for building the PoM entirely relying on the CEA results

**Main constraints encountered:** Some water related issues are very political in Malta (ex : charging water for agriculture, etc.). Therefore, some measures that were proven to be technically cost-effective and feasible were not chosen because of political decision.

**General comments:** Very detailed and serious study which shows in a transparent manner how CEA is built from the first to the last step

**Author and organism:** Rob van der Veeren  
Rijkswaterstat  
**Publisher or contracting body:** Ministrie van Verkeer en Waterstraat

**Country:** Netherlands

**Geographical Area covered:**  
General Guideline exemplified in the case of the Meuse

**Type of publication:** Guidance Report  
**Internet links:**  
<http://www.mra.org.mt/Downloads/Twinning%20Light%20Water/Dutch%20handbook%20on%20cost%20effectiveness%20analysis.pdf>

**Themes:** Quality;  
Hydomorphology; Fauna, Fish

**Key Focus:** Explaining CEA  
**Relation to WFD:** In regard to WFD

**Sector:**

**Summary of the study:** This is a report on hydromorphological changes in the Meuse. It has a qualitative approach without proper CER. It states that there are uncertainties in the effectiveness measurement and certain cost estimations, thus this has more of a pre-study character to determine the measure package.

**Measures**

**Does the CEA analyze measures or combinations of measures?** first single measures out of which the measure parcel is derived.

**How many measures are compared in the CEA?**  
18

**List or type of measure compared:** River bank measures/river measures/linking ponds measures/dike measures/fish measures

**What are the main differences between measures?** measures that deal with hydromorphology/measures that improve ecology

**Methodology**

**C/E Ratio calculated?** NO  
**On which parameters?**  
**Example of C/E indicator:**

**Measures ranked based on C/E ratio and /or Expert judgment?**  
Expert Judgement as costs are compared to Effectiveness using classification ++/+/-/-- Ranking of various measures on the basis of costeffectiveness only becomes interesting when different measures need to be weighed against each other to determine which are potentially useful for inclusion in the package of measures.

**Generic approach and/or data sources (e.g. national databases)?** No

**Illustration of C/E ranking from the study:**

Ecologically targeted measures	effect on point of reference				Costs (Cash Value in EUR 1000)			Comments / Negative consequences
	fish	waterplants	macrofauna	Bird and Habitat directive	Investments	Management and maintenance	Total	
Cut through/remove summer dike	+	-	+	o	160	0	160	Possibly at the cost of low-dynamic ecotopes in the flood plain: selective application
Lowering of flood plains	++	+	++	+	5,160	0	5,160	score in combination with cutting through summer dikes and design with water and gradual land-water transition, assuming that no valuable ecotopes are lost
Removal of levee reinforcement	+	+	++	-	60	0	60	danger of significant erosion
Ecologically friendly banks with protective restraints	++	++	++	o	600-900	50	650 - 950	cost depends on size, large waters cost more than small waters
Jointly flowing secondary channel: recently dug	+++	+	++	-	60,000	1,000	61,000	
Jointly flowing secondary channel: existing isolated water linked	++	-	+	o	24,000	1,000	25,000	
Channel along water	++	o	++	n/a	24,000	0	24,000	sections of permanent flowing water in almost stagnant system
Connected oxbow/pool: recently dug	++	++	++	o	40,000	0	40,000	
Connected oxbow/pool: existing isolated water linked	+	-	+	-	18,000	0	18,000	
Widening of summer bed	+	+	+	+	1,500	0	1,500	when the space created is used for ecological river-bank layouts
In-line dams	++	+	++	-	6,000	0	6,000	when combined with ecological river-bank layouts
Expand river-bank vegetation	+	o	++	o	360	0	360	in combination with ecological river-bank layouts
Introduce wood into the river	o/c	o	++	o	10	0	10	Good score does not concern all macrofauna, but specific species. Not for application in main channel.
Regulation of shipping (speed/locks)	o/c	+	+	+	n/a	0	n/a	When combined with ecological river-bank layouts
Disengage hydro-electric power stations during downstream peak operation of fish	+	o	o	n/a	21,000	0	21,000	
Improve fish ladder/fish bypasses	++	o	o	n/a	15,000	0	15,000	
Fish-friendly lock management	+	o	o	o	0	0	0	not weirs and sea-defence dams
Improve link to regional waters	++	o	o	o/c	2,000	0	2,000	

Which costs of the measures have been taken into account?

**Investment costs:**

Due to the significant uncertainties relating to the costs of management and maintenance, only the costs of construction have been included in the considerations.

**Operation and maintenance costs:**

**Indirect costs (Income losses...):**

**Environmental costs:**

**Others:**

Method for annualizing: No

Are the cost distributed among financers? Not mentioned

How has effectiveness been taken into account?

Global in terms of general impact on the water body status: Yes

Limited to one (few) parameters of the water status:

**Examples of indicators used:**

Plus or minus symbols

Tool used to measure effectiveness?

Expert judgment: Yes

Models:

Field experiment:

Others:

Are uncertainties quantified? No

**Process**

Who built the CEA ? Not mentioned

Which role of stakeholder consultation? Not mentioned

Are the different steps of the analysis developed in a transparent way? Yes

Are there iterations in the implementation process? Not mentioned

Which integration of the results in the decision making process? Not mentioned

**Technical limit of the analysis:** Uncertain Data. Quote: The analysis is therefore no more than an illustration of the type of results that are possible when further, more detailed information becomes available.

**Main constraints encountered:** Not mentioned

**General comments:** Well explained case study. However, the study can be only partly representative (data situation). What is interesting to note that hydromorphological effectiveness is hard to measure and that this is however one of the main water problems in the Netherlands.

**Author and organism:** J. Ebregt, C.J.J. Eijgenraam en H.J.J. Stolwijk  
 Centraal Planbureau

**Publisher or contracting body:** Centraal Planbureau

**Type of publication:** part 2 of the economic analysis of the project 'Space for the Rivers'

**Internet links:** <http://www.cpb.nl/eng/pub/cpbreeksen/document/83/doc83.pdf>

**Key Focus:** CEA of proposed measures and packages. A method has been developed for evaluating measures and packages with more than one effect at the same time. Progress in safety, growth of the number of hectares with desired nature, and value judgements on spatial and recreational quality are the elements in the CEA.

**Relation to WFD:** No

**Country:** Netherlands

**Geographical Area covered:**  
 Rhine

**Themes:** Excess of water;  
 Hydromorphology;Ecology

**Sector:**

**Summary of the study:** This report is an economic analysis of the project 'Space for the Rivers', which aims at improving the safety against flooding along the river Rhine. It is a Cost-Effectiveness Analysis (CEA) of proposed measures and packages. A method has been developed for evaluating measures and packages with more than one effect at the same time. Progress in safety, growth of the number of hectares with desired nature, and value judgements on spatial and recreational quality are the elements in the CEA.

### Measures

**Does the CEA analyze measures or combinations of measures?** Both, measures and packages - with more than one effect at the same time.

**How many measures are compared in the CEA?**

Different CEAs are undertaken for various water bodies in the river district, usually about 5 measure packet variations

**List or type of measure compared:** different versions: nature version/current version

**What are the main differences between measures?** location, scope and level of ecology

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Investmentcost per unit effectivity

**Example of C/E indicator:** € per unit flood safety

**Measures ranked based on C/E ratio and /or Expert judgment?**

CER but Effectiveness is build on Expert Judgement

**Generic approach and/or data sources (e.g. national databases)?** Generic Databank

Illustration of C/E ranking from the study:

Measures	% encountered	Cumulative costs (€/year)	Cumulative reductions				
			Nitrogen Reduction (ton/ya)	Phosphate Reduction (kg/ya)	Copper Reduction (kg/ya)	Nickel Reduction (kg/ya)	Zinc Reduction (kg/ya)
Reduction of fertilizer security	100%	0	87.2	2.0	0.0	0.0	0.0
No measure (concerns Streef conclusion), very limited	100%	0	87.2	2.0	0.0	0.0	0.0
Advice to prevent use of copper-bearing anti-fouling	100%	7,354	87.2	2.0	15.4	0.0	0.0
Reduce-Ni industry filter to STP	100%	11,198	88.1	2.1	16.9	1.3	22.7
Optimize fertilizer security	100%	11,198	81.6	2.5	16.9	1.3	22.7
Eliminate dredging and plants	100%	421,152	100.0	7.2	16.9	1.3	22.7
Reduce surface run-off	100%	1,316,498	156.1	9.7	16.9	1.3	22.7
Dry buffer zones (impoverished)	100%	1,756,744	176.8	10.6	16.9	1.3	22.7
4 <sup>th</sup> stage by STP	100%	1,886,313	176.3	10.7	20.8	2.7	56.6

Which costs of the measures have been taken into account?

**Investment costs:**  
Called Standard costs

**Operation and maintenance costs:**  
Yes, especially relevant because of flood destruction

**Indirect costs (Income losses...):**  
Not mentioned

**Environmental costs:**  
Stated preference/hedonic pricing

**Others:** Not mentioned

**Method for annualizing:** Incorporated in costs but not outlined

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Landscape value, flood control

**Limited to one (few) parameters of the water status:**

**Examples of indicators used:**  
Non Monetary but physical units (safety benefit measured by reduction of flood danger per area)

Tool used to measure effectiveness?

**Expert judgment:**

**Models:**

**Field experiment:** Not mentioned

**Others:**

**Are uncertainties quantified?**

### Process

**Who built the CEA ?** Own Methodology of the Authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:** Dutch CEA, detailed and embedded in a CBA using generic cost effect

**Author and organism:** Morselt, T., te Grotenhuis, R., Schomaker, T.  
Rebel Group Rotterdam, Royal Haskoning

**Publisher or contracting body:**

**Country:** Netherlands

**Geographical Area covered:**  
Rhine

**Themes:** Quality;

**Sector:** Agriculture; Industry;  
Households;

**Type of publication:** Endreport for the WFD

**Internet links:**

**Key Focus:** Quantitative CEA conducted for a pilot project

**Relation to WFD:** In regard to WFD

**Summary of the study:** Dutch pilot study to test the CEA of the Rijkswaterstaat RIZA method using a generic approach with various databases for annualised costs and effectiveness. The study has a quantitative approach and quantifies everything relevant. The study looks at the chemical potential for reduction of 5 pollutants and the costs. This study was also mentioned in the Dutch CEA guidelines. It explains the steps quite precisely.

### Measures

**Does the CEA analyze measures or combinations of measures?** the individual effect of measures and the the accumulation of measures in order to solve the aimed pollutants reductions 23 Combinations of measures

**How many measures are compared in the CEA?**

there are 50 measures and, out of that, 23 measure packages

**List or type of measure compared:** farming measures and measures in other sectors

**What are the main differences between measures?** sectoral

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Total annual costs per Kg of substance reduced per year (N, P, Cu, Zn en Ni.)

**Example of C/E indicator:** €/Kg

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER

**Generic approach and/or data sources (e.g. national databases)?** Generic approach provided by the Rijkswaterstaat-RIZA method. Costs and Effectiveness for Measures are mainly taken from various databases (LEI etc).

Illustration of C/E ranking from the study:

1	2	3	4	5
	MHW-winst	Kosteneffectiviteit: MHW-winst per geldeenheid	Kosteneffectiviteit: Geld per eenheid MHW-winst	Rangorde
	m <sup>2</sup>	m <sup>2</sup> per miljoen euro	duizend euro per m <sup>2</sup>	
Groene rivier Deventer-Wapenveld: variant 'natuur'	25 963	9	108	5
Groene rivier Deventer-Wapenveld: variant 'huidig landgebruik'	29 842	77	13	2
Groene rivier Veessen-Wapenveld: variant 'natuur'	13 066	24	42	3
Groene rivier Veessen-Wapenveld: variant 'huidig landgebruik'	14 101	134	7	1
Dijkverlegging bypass Deventer	4 623	17	58	4

*Which costs of the measures have been taken into account?*

<p><b>Investment costs:</b> Calculated on the basis of investments, economic life expectancy (depreciation period) and interest</p>	<p><b>Operation and maintenance costs:</b> Were calculated on the basis of information relating to the annual operation and maintenance costs</p>	<p><b>Indirect costs (Income losses...):</b> Indirect costs were sometimes known quantitatively but most often qualitatively (classification of the information about indirect effects into a qualitative scale: 0, +, ++, +++.)</p>	<p><b>Environmental costs:</b> Not mentioned</p>	<p><b>Others:</b> Not mentioned</p>
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**Method for annualizing:** Calculation of costs was based on the total annual costs

**Are the cost distributed among financiers?** Cost bearing is estimated for sectors

*How has effectiveness been taken into account?*

<p><b>Global in terms of general impact on the water body status:</b></p>	<p><b>Examples of indicators used:</b> ton/pa</p>
<p><b>Limited to one (few) parameters of the water status:</b> Yes, the potential reduction of emissions for N P Zn Ni Cu</p>	

*Tool used to measure effectiveness?*

<p><b>Expert judgment:</b></p>	<p><b>Models:</b> RWS-RIZA</p>	<p><b>Field experiment:</b> Not mentioned</p>	<p><b>Others:</b> Not mentioned</p>
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**Are uncertainties quantified?** Uncertainty analysis based on (1) 'baseline scenario' and (2) the estimate of costs and effects of possible measures.

**Process**

<p><b>Who built the CEA ?</b> RWS-RIZA</p>	<p><b>Which role of stakeholder consultation?</b> The results of the cost-effectiveness analysis offer some handles to water managers to make adjustments in the package of measures based on a calculation of the costs for the various causer categories.</p>
<p><b>Are the different steps of the analysis developed in a transparent way?</b> Yes</p>	
<p><b>Are there iterations in the implementation process?</b> Yes</p>	
<p><b>Which integration of the results in the decision making process?</b> Fairness and proportionality to sectors more important the CE</p>	
<p><b>Technical limit of the analysis:</b> An important question that arises when packages of measures are being defined is to what extent measures are divisible</p>	
<p><b>Main constraints encountered:</b> Very work intense method</p>	
<p><b>General comments:</b> This dutch pilot project is not so representative for the CEAs conducted later (2009) for the RBMP as they tend to have a more qualitative approach contrary to this quantitative approach. Transfer of measures is being considered. The most important difference with the analysis without transfer lies in the fact that it is assumed that the objectives are attained upstream (instead of assuming that the regions situated upstream continue their current emission levels). This therefore means that, in the analyses with transfer, the influx from upstream regions is clearly less than in the analysis without transfer.</p>	

**Author and organism:** Kieron Callaghan, EHS (NI)  
Seamus O’Hare,  
EHS, DRD  
**Publisher or contracting body:** Environment and Heritage Service

**Country:** Northern Ireland (UK)

**Geographical Area covered:**  
Upper Bann catchment

**Themes:** Quality;  
Hydomorphology;

**Sector:** Agriculture; Industry;  
Households;Wastewater

**Type of publication:** Pilot Project  
**Internet links:** <http://www.ni-environment.gov.uk/crpcosteffect.pdf>

**Key Focus:** CEA methodology  
**Relation to WFD:** In regard to WFD

**Summary of the study:** A methodology was supplied to Northern Irelands (UK) Environment and Heritage Service from an environmental consultant via DEFRA to enable the calculation of cost and effectiveness of a range of various measures chosen to deal with a pilot catchment. For this purpose, a pilot programme was initiated under the auspices of the Collaborative Research Programme (CRP) to establish whether the methodology supplied to EHS was appropriate for this task. Thus, this case tests the methodology as a tool for the calculation of cost and effectiveness leading towards an indication for the programme of measures (POM) for Northern Ireland. The environmental parameter in this case is Soluble Reactive Phosphorous.

**Measures**

**Does the CEA analyze measures or combinations of measures?** Measures.

**How many measures are compared in the CEA?**  
There were twenty seven measures chosen from the list available in the worksheets to deal with the pressures identified. From these, the eight major measures were chosen to be carried over to the effectiveness calculation

**List or type of measure compared:** Mainly Agricultural measures.

**What are the main differences between measures?**  
Nutrient reduction, Wastewater plant, prevent nutrient rich run-off

**Methodology**

**C/E Ratio calculated?** Yes  
**On which parameters?** Costs per  $\mu$  Soluable Reactive Phosphorous per liter removed  
**Example of C/E indicator:** £/ $\mu$ g/l

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E Ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes, in most cases, the costs used were generic and taken from the costs database. On certain occasions, individually resourced costs were used.UK Generic Effectiveness database (e.g. 20%-80% effectiveness for Buffer strips, mean 50%).

Illustration of C/E ranking from the study:

**Table showing the cost and effectiveness of measures**

Examining this table it is suggested that measures 3, 4, 6 and 7 are given further consideration from a costing perspective to check their validity.

Measure	1	2	3	4	5	6	7	8
Effect ( $\mu$ g/l removed)	1.6	4	0.3	1.1	6.48	7.2	7.2	6.72
Cost (£)	8688	12071	13942	86642	21238	215560	12071	37270
Effectiveness (£/ $\mu$ g/l)	5430	3018	46474	78765	3277	29939	1676	5546

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

Mentioned but not measured monetary

**Environmental costs:**

Not mentioned

**Others:**

Not mentioned

**Method for annualizing:** Incorporated in the generic cost database

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**

µg / l removed

Tool used to measure effectiveness?

**Expert judgment:** Yes, estimated in regard to the Generic Database

**Models:** Simcat model

**Field experiment:** Not mentioned

**Others:** Not mentioned

**Are uncertainties quantified?** Probability analysis is conducted

### Process

**Who built the CEA ?** Environmental Consultancy/DEFRA

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Pilot test thus not mentioned

**Technical limit of the analysis:** Generic Database not 100% accurate for local setting

**Main constraints encountered:**

**General comments:** Pilot case testing the CEA in N Ireland, exemplary for UK

Publication name: Refsgaard, K., Bechmann, M., Blankenberg, A.G.B., Skøien, S., Veidal, A. (2010). *Kostnadseffektivitet for tiltak mot fosfortap fra jordbruksarealer i Østfold og Akershus. Rapport 2010-2. Norsk institutt for landbruksøkonomisk forskning.*

Year: 2010

**Author and organism:** Refsgaard, K., Bechmann, M., Blankenberg, A.G.B., Skøien, S., Veidal, A.

NILF (The Norwegian Agricultural Economics Research Institute) and Bioforsk (Norwegian Institute for Agricultural and Environmental Research)

**Publisher or contracting body:** NILF (The Norwegian Agricultural Economics Research Institute)

**Country:** Norway

**Geographical Area covered:** The Norwegian counties Østfold and Akershus

**Themes:** Quality; Measures in the agricultural sector.

**Sector:** Agriculture;

**Type of publication:** Project report

**Internet links:**

<http://www.nilf.no/Publikasjoner/Rapporter/Bm/2010/R201002Hele.pdf>

**Key Focus:** Phosphate run-off

**Relation to WFD:** High

**Summary of the study:** The study aims to gain more knowledge and data on the cost effectiveness of alternative measures to reduce phosphorus loss from agriculture. The analysis was carried out for cereal production in the two counties Akershus and Østfold.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures as well as combinations of measures

**How many measures are compared in the CEA?**

5

**List or type of measure compared:** Different farming techniques (sowing, ploughing, harvesting in spring or autumn), reduced phosphorus fertilisation, construction of sedimentation ponds and wetlands, vegetation buffers.

**What are the main differences between measures?** Season for measures, different technical solutions

### Methodology

**C/E Ratio calculated?** Y

**On which parameters?** Marginal cost per daa (NOK/daa) (1 daa= 1/10 ha) for the farmer relative to the reduced loss of phosphorus (kg/daa).

**Example of C/E indicator:** NOK/kg P

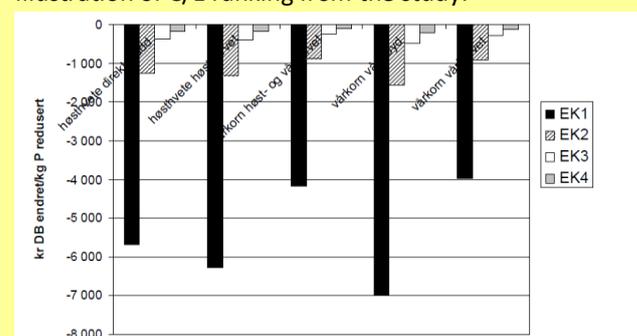
**Measures ranked based on C/E ratio and /or Expert judgment?**

C/E ratio (the most cost-effective measures can be found in areas where the risk of erosion is high)

**Generic approach and/or data sources (e.g. national databases)?**

Data found in various Norwegian studies and also gathered by the use of focus groups and telephone interviews.

Illustration of C/E ranking from the study:



Figur 5.1 Kostnadseffektivitet (endret DB/kg fosfor) av jordarbeidingstiltak i gjennomsnitt for hver erosjonsklasse for Haldenvassdraget.

Which costs of the measures have been taken into account?

**Investment costs:**

Yes (e.g. costs for seeds, manure, seed sowers, ploughs and other machines)

**Operation and**

**maintenance costs:**  
Cost of labour

**Indirect costs (Income losses...):**

**Environmental costs:**

**Others:**

**Method for annualizing:**

**Are the cost distributed among financers?** Focus is on the farmer's costs

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P reduction

**Examples of indicators used:** kg

P reduction

Tool used to measure effectiveness?

**Expert judgment:**

**Models:** AgriCat-model

**Field experiment:**

**Others:**

**Are uncertainties quantified?** No

### Process

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Focus groups were arranged and farmers were interviewed

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?**

**Which integration of the results in the decision making process?** The analysis shows that it is important to aim for action in areas with a high risk of erosion to find the most cost-effective means. This implies generally a much lower cost than taking action in the areas with low erosion.

**Technical limit of the analysis:** The analysis builds upon experimental economics. This approach implies strengths as well as weaknesses. One potential risk of the chosen approach is that farmers have incentives to exaggerate their costs when interviewed in order to increase their contribution margins.

**Main constraints encountered:**

**General comments:**

**Publication name:** Magnussen, K., E. Romstad og D. Barton (2003). Eksempler på tiltaksanalyser og tiltakskostnader knyttet til vannforekomster – Forberedende arbeid i forbindelse med EUs rammedirektiv for vann. KM Miljøutredning, rapport 2003-01.

**Year:** 2003

**Author and organism:** "Kristin Magnussen (KM Miljøutredning), Eirik Romstad (Inst. for økonomi og samfunnsfag, Norges landbrukshøgskole), David Barton (NIVA).

**"Publisher or contracting body:** KM Miljøutredning (Norway)

**Country:** Norway

**Geographical Area covered:**

Examples from different parts of Norway

**Themes:** Quality;

**Sector:** Agriculture; Households; Energy

**Type of publication:** Project report

**Internet links:**

[http://www.niva.no/symfoni/infoportal/publikasjon.nsf/9418bc4d7e98a727c1256f2a002f3ede/550bc5772fab9bd7c12572a0003768fd/\\$FILE/vanndirektivet\\_tiltaksanalyser.pdf](http://www.niva.no/symfoni/infoportal/publikasjon.nsf/9418bc4d7e98a727c1256f2a002f3ede/550bc5772fab9bd7c12572a0003768fd/$FILE/vanndirektivet_tiltaksanalyser.pdf)

**Key Focus:** Examples of Norwegian studies where costs of measures and/or CEA are studied.

**Relation to WFD:** High

**Summary of the study:** The report gives a good overview of what has been done in the CEA field in Norway, i.e. for which environmental problems and sectors. The CEAs carried out in Norway have mainly focused on eutrophication. The pre-study character of the report means that the main purpose of it is to serve as a basis for future CEA analyses.

### Measures

**How many measures are compared in the CEA?** 10

**List or type of measure compared:** Measures in agriculture and sewage treatment plants

**What are the main differences between measures?** Sectors

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Cost per kg reduced kg of phosphorus and cost per reduced kg bio phosphorus

**Example of C/E indicator:** kr/kg P, kr/kg bio P

**Measures ranked based on C/E ratio and /or Expert judgment?** C/E Ratio

**Generic approach and/or data sources (e.g. national databases)?** National databases

**Illustration of C/E ranking from the study:**

Tabell 3.7. Kostnadseffektivitet i hht. Lyché et al. (2001).  $\beta$  = biotilgjengelighetsfaktor (KE i 2)

Tiltak	$\beta$	KE-P (kr/kg P)	KE-bioP (kr/kg bioP)	Merknader
Endret jordarbeiding	0,2	90-250	450- 1250	Biotilgjengelighetsfaktor: 0,2
Vegetasjonssoner	0,2	270	1350	Ved beregning av effekt er samspilleff lagt til grunn, dvs. beregning basert på nettoeffekt etter at tiltaket endret jorda er gjennomført
Fangdammer	0,2	490-1130	2440-5670	Ved beregning av effekt er samspilleff lagt til grunn, dvs. beregning basert på nettoeffekt etter at tiltaket endret jorda er gjennomført
Grasdekte vannveier	-	-	-	KE ikke mulig å beregne i en samlet tiltakspakke fordi det ikke er mulig å ta tiltakets nettoeffekt etter at tiltaket endret jordarbeiding er gjennomført
Spredt avløp	0,7	6800	9700	
Kommunalt avløp:				
Utbedring av feilkoplinger	0,6	1000-1900	1600-3200	
Redusert overløp	0,6	-	-	

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Not mentioned in Mangnussen et al.	<b>Operation and maintenance costs:</b> Not mentioned in Mangnussen et al.	<b>Indirect costs (Income losses...):</b> Not mentioned in Mangnussen et al.	<b>Environmental costs:</b> Not mentioned in Mangnussen et al.	<b>Others:</b> Not mentioned in Mangnussen et al.
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**Method for annualizing:** Not mentioned in Mangnussen et al.

**Are the cost distributed among financers?** Not mentioned in Mangnussen et al.

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Yes (to reach environmental objectives regarding drinking water, swimming, fishing etc)

**Limited to one (few) parameters of the water status:** P reduction

**Examples of indicators used:**

Kg P

Tool used to measure effectiveness?

<b>Expert judgment:</b> Not mentioned in Mangnussen et al.	<b>Models:</b> Not mentioned in Mangnussen et al.	<b>Field experiment:</b> Not mentioned in Mangnussen et al.	<b>Others:</b> Not mentioned in Mangnussen et al.
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**Are uncertainties quantified?** No

**Process**

**Who built the CEA ?** Lyche et al. 2001

**Which role of stakeholder consultation?** Not mentioned in Mangnussen et al.

**Are the different steps of the analysis developed in a transparent way?** No (at least not in Magnussen et al)

**Are there iterations in the implementation process?** Not mentioned in Mangnussen et al.

**Which integration of the results in the decision making process?** Not mentioned in Mangnussen et al.

**Technical limit of the analysis:** Not mentioned in Mangnussen et al.

**Main constraints encountered:** Not mentioned in Mangnussen et al.

**General comments:** Not mentioned in Mangnussen et al.

**Author and organism:** Janusz Krupanek, Mohammed Belhaj, John Munthe, Eva Brorström-Lundén,  
Willy van Tangeren, Jaap van der Vlies, Ruud Baartmans, Urszula Zielonka  
IETU, IVL, TNO  
**Publisher or contracting body:** EU

**Type of publication:** Project Case study on Source Control of Priority Substances in Europe

**Internet links:**

[http://www.socopse.se/download/18.764bd915124e8f2573d80008891/Klodnica-case\\_D52\\_final.pdf](http://www.socopse.se/download/18.764bd915124e8f2573d80008891/Klodnica-case_D52_final.pdf)

**Key Focus:** Pollutant mitigation

**Relation to WFD:** Yes

**Country:** Poland

**Geographical Area covered:**

Klodnica

**Themes:** Quality; Wastewater, Contaminated Land, Landfill

**Sector:** Industry; Households;

**Summary of the study:** This is a case report of the SOCOPSE project, aiming at reducing the level of priority toxins in water. The report on the Polish case states that evaluation of the effects of the measures is not possible in a reliable way. It can be based only on the potential to reduction of emissions from point and diffuse sources where the latter are the most elusive in assessment.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures from different sectors

**How many measures are compared in the CEA?**

7

**List or type of measure compared:** Wastewater treatment plant

Mining

Industrial waste Landfills    Municipal waste landfills    Contaminated Land

Air deposition    Sediments

**What are the main differences between measures?** Sectors

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Cost/ Efficiency on source category scale

compared to unabated impacts

**Example of C/E indicator:** Not given because qualitative judgment based on expert assessment, reports, literature, tests etc

**Measures ranked based on C/E ratio and /or Expert judgment?**

C/R ratio is derived from Expert Judgment

**Illustration of C/E ranking from the study:**

Table 19. Additional measures to be applied as the results of already existing plans and requirements in the subcatchment Klodnica from Kozłowka including Kozłowka

	Possible measures	Costs		Costs/effects ratio for source category scale	
		mil. Euro	Hg	Cd	PAH
1. WWTP	Additional treatment techniques (precipitation)	50**	moderate	Low	Moderate
	Sedimentation/filtration underground unit	10**	Moderate	Moderate	Low
2. Mining	On ground units	10**	Moderate	Moderate	Low
	Desalination (reverse osmosis, ultra filtration)	30-100***	Moderate	Moderate	Low
	Close down/restructurisation	High social costs	Low	Low	Low
3. Industrial waste landfills	Capping and leachate treatment	50***	Low	Moderate	Low
4. Municipal waste landfills	Capping and leachate treatment	50***	Low	Moderate	Low
5. Contaminated land	Industrial sites recultivation	100-400**	Low	Moderate	Low
	Phytoremediation	50-200**	Low	Low	Low
6. Air deposition	Technological improvement/fuel change for individual heating systems	10****	Moderate	Low	Moderate
	Dredging	No data	Low	Low	Low
7. Sediments					

\* expert assessment

\*\* - estimation based on literature studies and pilot projects

\*\*\*-Silesia Voivodships Program for revitalization of post-industrial and degraded land

\*\*\*\*- expert assessment including data concerning local programs for individual heating environmental improvements implemented for the counties located in Klodnica catchment

Which costs of the measures have been taken into account?

**Investment costs:**

Estimated on expert judgement, projects, literature, tests etc.  
Costs are not differentiated

**Operation and maintenance costs:**

Costs are not differentiated

**Indirect costs (Income losses...):**

**Environmental costs:**

Contingent valuation willingness to pay amongst stakeholders

**Others:**

**Method for annualizing:** Not mentioned

**Are the cost distributed among financers?** EU structural funds, national funding schemes, municipal funds, industry funds,

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Yes, Hg Cd PAH

**Examples of indicators used:**

Qualitative judgement (low, high, medium)

Tool used to measure effectiveness?

**Expert judgment:** Use of contaminant load characteristics and concentrations, seasonal

**Models:** At this point it is not recommended to apply advanced modelling for the catchment due to lack of

**Field experiment:** No

**Others:** WP3 substance report Inventory DATABASE

**Are uncertainties quantified?** No, Qualitative approach

**Process**

**Who built the CEA ?** Not mentioned

**Which role of stakeholder consultation?** Embedded in CBA with stakeholder participation

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Institutional issues were described as the most important management aspect, thus the results might only have a limited effect on decision making

**Technical limit of the analysis:** Lack of Data

**Main constraints encountered:** Governance issues in this Polish region

**General comments:** Dutch Swedish Polish Cooperation

**Author and organism:** S. Costa, L. Coutinho, A.G. Brito, R. Nogueira, A.P. Machado, J.J. Salas, C. Póvoa

University of Minho, Portugal

**Publisher or contracting body:** Desalination and Water Treatment

**Type of publication:** Academic research paper

**Internet links:** <http://www.deswater.com/articoli/350.pdf>

**Key Focus:** WWT location and design for WFD

**Relation to WFD:** In regard to WFD

**Country:** Portugal

**Geographical Area covered:**

Minho–Lima river basins (Portugal)

**Themes:** Quality;

**Sector:** Industry; Households;

**Summary of the study:** Selection of complementary decentralized WWTPs based on priorities using caused-effect assessment matrix

### Measures

**Does the CEA analyze measures or combinations of measures?** Both

**How many measures are compared in the CEA?**

PM (20 measures) compared to 10 added complementary actions

**List or type of measure compared:** Very broad range. But in the study, they focus on WWTP

**What are the main differences between measures?** WW treatment in rural areas vs. centralized WWTP

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Removal of organic matter and cost per inhabitant

**Example of C/E indicator:** €/kg of BOD5 removed

**Measures ranked based on C/E ratio and /or Expert judgment?**

Expert judgment

**Generic approach and/or data sources (e.g. national databases)?** Approach from the German handbook (Interwies et al., 2004). Data from RBMP

**Illustration of C/E ranking from the study:**

Cost-effectiveness indicators (2015)	(PM)	(PM+CA)
Removal of wastewater organic matter (€/kg BOD <sub>5</sub> removed)	€3.22/kg <sup>-1</sup>	€3.17/kg <sup>-1</sup>
WWTP service upgrade (1000€ per each new inhabitant served)	€1540/inhab <sup>-1</sup>	€1510/inhab <sup>-1</sup>

PM: programme of measures; PM + CA: programme of measures plus complementary action.

*Which costs of the measures have been taken into account?*

**Investment costs:**  
Yes. Using cost functions

**Operation and maintenance costs:**  
Yes. Using cost functions

**Indirect costs (Income losses...):**  
No

**Environmental costs:**  
No

**Others:** no

**Method for annualizing:** Not mentioned

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Examples of indicators used:** kg of BOD removed

**Limited to one (few) parameters of the water status:** yes. BOD

Tool used to measure effectiveness?

**Expert judgment:** Priorities based on stakeholders and experts consultation caused-effect assessment matrix

**Models:** No

**Field experiment:** No

**Others:**

**Are uncertainties quantified?** No

**Process**

**Who built the CEA ?** University

**Which role of stakeholder consultation?** Used to prioritize alternatives

**Are the different steps of the analysis developed in a transparent way?** No

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Selection of measures based on priorities instead of simulated effectiveness at the water bodies and CEI

**Main constraints encountered:** -

**General comments:**

**Author and organism:** Maia, R., Schumann, A.H.  
Universidade do Porto, Portugal  
**Publisher or contracting body:** Water Resources Management

**Country:** Portugal

**Geographical Area covered:**  
Ribeiras do Algarve River Basin  
(Portugal)

**Themes:** Scarcity;

**Sector:** Agriculture; Industry;  
Households;

**Type of publication:** Academic research paper  
**Internet links:**

**Key Focus:** GIS model for water management decisions / including water pricing  
and cost assessment

**Relation to WFD:** In regard to WFD

**Summary of the study:** Evaluation of alternative management scenarios using WSM DSS

### Measures

**Does the CEA analyze measures or combinations of measures?** Combinations

**How many measures are compared in the CEA?**

2 strategies: 1 or structural measures vs 2 ( nonstructural + small scale + conjunctive use measures). 10 measures

**List or type of measure compared:** Structural options (dam, network enhancements, desalination, etc.), Demand management (reuse, irrigation improvement), SocioEconomic measures (pricing)

**What are the main differences between measures?** Measured grouped into 2 different strategies (see previous response)

### Methodology

**C/E Ratio calculated?** No

**On which parameters?** -

**Example of C/E indicator:** -

**Measures ranked based on C/E ratio and /or Expert judgment?**

Not ranked, but evaluation table showing effectiveness, Ec Efficiency and benefits

**Generic approach and/or data sources (e.g. national databases)?** Main source: RBMP

**Illustration of C/E ranking from the study:**

Option	Effectiveness (relative performance index for demand coverage)	Environmental cost (PV, million €)	Direct cost (PV, million €)
BAU+Normal			
Strategy 1	0.703 (0.572)	647 (700)	2,137 (2,361)
Strategy 2	0.704 (0.638)	628 (667)	2,079 (2,252)
BAU+HD			
Strategy 1	0.701 (0.566)	647 (699)	2,136 (2,360)
Strategy 2	0.701 (0.638)	627 (667)	2,076 (2,245)

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes (invest + OM grouped into Direct Cost)

**Indirect costs (Income losses...):**

No

**Environmental costs:**

Yes. Related to effluent disposal and surface-GW abstractions

**Others: -**

**Method for annualizing:** Present Value. Discount rate 3.33%

**Are the cost distributed among financers?** Yes. Cost recovery strategy analyzed

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** Only quantity

**Examples of indicators used:**

Relative index for demand coverage

Tool used to measure effectiveness?

**Expert judgment:** No

**Models:** Yes

**Field experiment:** No

**Others:** No

**Are uncertainties quantified?** No

### Process

**Who built the CEA ?** University / WaterStrategyMan

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** No

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** No quality. Not sufficient for WFD

**Main constraints encountered:** -

**General comments:**

**Author and organism:** Beumer, L., Erzen; N., Gobec, S., Gole, A., Hehenkamp, M., Ignjatovic, M., Marvot, L., Hozjan, U., Prestor, J., Drapal, D., Strosser, P., Umek, T., Terpin, S.

Ecorys, hidroinzeniring, IEI, EU

**Publisher or contracting body:** EU

**Country:** Slovenia

**Geographical Area covered:** Krka

**Themes:** Quality;

**Sector:** Agriculture; Industry; Households; Wastewater

**Type of publication:** Technical Assistance

**Internet links:** ftp://212.18.43.13/public/KrkaWEB/100\_Deliverable\_6.1\_final.pdf

**Key Focus:** Pilot study for exemplary RBMP incl. Economic analysis

**Relation to WFD:** In regard to WFD

**Summary of the study:** This pilot project report presents elements of a river basin management plan for the Krka river sub basin. In this CEA two different water quality improvement objectives were investigated (equilibrium concentration of just below 50mg/l of nitrates/equilibrium concentration for nitrates in groundwater of around 37,5 mg/l) for identifying the most appropriate programme of measures aimed at restoring good water quality for groundwater. For surface water there was a CEA conducted to reduce the pollution level (N,P).

**Measures**

**Does the CEA analyze measures or combinations of measures?** Both - there are actually two CEA for ground and surface water where the cost and measures are partly interlinked. Only measures are considered for surface waters but all basic and supplementary measures are needed to reduce the pollution level in the surface water. Groundwater uses different packages of measures based on 1) first basic measures and then supplementary measures 2) just measures according to the CEA ranking.

**How many measures are compared in the CEA?**

13 measures

**List or type of measure compared:** Wastewater Treatment, Wastewater Protection Areas, Buffer Zone, Winter Green Cover, Ecological Farming for groundwater / overspill protection, technology for industry, instalation of manure storage, wastewater treatment, buffer strips, constructed wetland

**What are the main differences between measures?** Sectors

**Methodology**

**C/E Ratio calculated?** Yes

**On which parameters?** Cost/Expected effectiveness of individual measures with regards to reduction in pollution to groundwater.

**Example of C/E indicator:** SIT slovenian currency/Kg reduction N&P per ha

**Measures ranked based on C/E ratio and /or Expert judgment?** CER

**Generic approach and/or data sources (e.g. national databases)?** No

**Illustration of C/E ranking from the study:**

Table 17. Main results of the cost-effectiveness analysis for selecting measures for protecting groundwater from nitrate pollution

Nr.	Potential measures	Status of potential measures	Ranking based on effectiveness ratio	Reduction by 10 mg/l in nitrate concentration (reaching 50 mg/l in groundwater)		Reduction by 22.5 mg/l in nitrate concentration (reaching 37.5 mg/l in groundwater)	
				Coverage	Annualized costs (SEK)	Coverage	Annualized costs (SEK)
1	WPA 1	Basic	0	70 ha	50 370 150	70 ha	50 370 150
2	WPA 2, 3	Basic	3	732 ha	53 8476	732 ha	538 476
3	Ecological Farming	Basic	4	2 400 ha	2 098 400	2 400 ha	2 098 400
4	Winter Green Cover	Supplem.	6	2 292 ha	27 854 294	2 292 ha	27 854 294
5	Buffer Zones	Supplem.	2	99 ha	380 042	99 ha	380 042
6	Ecological Farming	Supplem.	5	106 ha	13 309 158	106 ha	13 309 158
7	WPA 4, 5, 6 additional Green	Supplem.	10	-	-	-	-
8	WPA 4, 5, 6 additional Green	Supplem.	1	50 ha	65 700	50 ha	65 700
9	Wastewater Treatment - Sewerage	Basic	12	-	-	7 446 962	122 400 962
10	Wastewater Treatment - plants	Supplem.	11	-	-	-	-
11	Wastewater Treatment - plants (NO <sub>3</sub> -N<200)	Supplem.	8	1 010 ha	10 945 430	-	-
12	Wastewater Treatment - plants (NO <sub>3</sub> -N<200)	Basic	7	8 113 ha	127 876 178	8 113 ha	127 876 178
13	WPA 1 applied to WPA 2, 3, 4, 5, 6	Supplementary	9	-	-	-	-
<b>Total</b>				12 410 ha	340 Million SEK	4 800 ha	620 Million SEK
<b>Annualized costs per ha</b>				9 134 SEK	1,4 Million €	15 741 SEK	2,4 Million €
				200 €/ha	369 €/ha	2 147 €/ha	

\* replaced by WPA 1 measure that provides significantly stricter protection.

Which costs of the measures have been taken into account?

<b>Investment costs:</b> Yes, but not specified	<b>Operation and maintenance costs:</b> Yes, but not specified	<b>Indirect costs (Income losses...):</b> Socio economic impacts are dealt with separately and in Net Present Value, these are not included in CEA	<b>Environmental costs:</b> Env benefits are dealt with separately and not included in CEA	<b>Others:</b> Administrative costs
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**Method for annualizing:** Annualised costs

**Are the cost distributed among financiers?** Yes, the possible financiers are listed

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**

mg/l

Tool used to measure effectiveness?

**Expert judgment:** Yes, but not outlined

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Not discussed in the document

### Process

**Who built the CEA ?** Dutch consultancy

**Which role of stakeholder consultation?** Is considered important in the implementation of the measures

**Are the different steps of the analysis developed in a transparent way?** No information on source of cost and effectiveness estimation

**Are there iterations in the implementation process?** Not mentioned but unlikely due to time constraints

**Which integration of the results in the decision making process?** Integration in decision making through stakeholder involvement and implementation planning

**Technical limit of the analysis:** Not mentioned

**Main constraints encountered:** Not mentioned

**General comments:** For groundwater two scenario choices with different level of pollution reduction and cost have been developed using CEA. All measures are required for the surface water, thus the CEA can only help with the order of implementation. The whole report is thorough and considers the socio-economic context, although not in the CEA itself. It is a bit confusing to analyse two interlinked CEA together.

**Author and organism:** Ahamer, G., Bizak, A. et al  
 Bayerisches Staatsministerium für Umwelt, Gesundheit und Verbraucherschutz,  
 Ministry of the Environment and Spatial Planning, Bundesministerium für Umwelt,  
 Naturschutz und Reaktorsicherheit, Federal Environment Agency Austria  
**Publisher or contracting body:** European Twinning Project SI06/IB/EN/01

**Country:** Slovenia

**Geographical Area covered:**  
 Polskava River

**Themes:** Hydromorphology;

**Sector:**

**Type of publication:** Guideline incl Pilot case studies

**Internet links:**

[http://twinning.izvrs.si/index.php?option=com\\_content&task=view&id=7&Itemid=21](http://twinning.izvrs.si/index.php?option=com_content&task=view&id=7&Itemid=21)

**Key Focus:** Twinning Project Advice

**Relation to WFD:** In regard to WFD

**Summary of the study:** The chosen operational goal for this water body is to improve the habitat conditions for the reference fish species. Significant deficits have been identified in the ecological status of the river. This International twinning project aims at identifying the most cost effective measure combination to achieve good status. Unit costs from a Bavarian database are used. However, the CEA seems improper as effectiveness is not measured.

### Measures

**Does the CEA analyze measures or combinations of measures?** 3 combination of measures

**How many measures are compared in the CEA?**

3 measure combinations

**List or type of measure compared:** Combination A: Hard structures are removed on 12 km length on one side of Polskava River. In addition to the 5 m zone, another strip of land with a width of 5 m (now used for agriculture) will be acquired in order to allow dynamic processes like river bank erosion and deposition of eroded material in the river. Combination B: The water body profile is redesigned close to nature by engineering-biological measures within the existing profile plus the 5m riparian zones on both sides. Combination C: Insertion of massive stone blocks to reestablish variable flow velocities and insertion of dead timber to improve habitat conditions within the existing profile of the river.

**What are the main differences between measures?** No substantial difference, all address hydromorphological issues

### Methodology

**C/E Ratio calculated?** No

**On which parameters?**

**Example of C/E indicator:** Net present value

**Measures ranked based on C/E ratio and /or Expert judgment?**

On Cost, 2 Measures are supposed to have the same effectiveness on ecosystem status, thus no Effectiveness is specified

**Generic approach and/or data sources (e.g. national databases)?** Bavarian, Austrian and Hessian generic catalogues are used

**Illustration of C/E ranking from the study:**

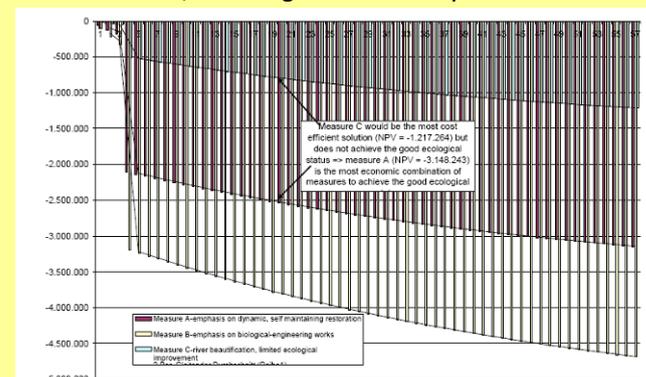


Figure 11: Polskava River annual Net Present Value of proposed combination of measures (without opportunity costs)

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Unit costs from Bavaria were used to establish investment costs	<b>Operation and maintenance costs:</b> Unit costs from Bavaria were used to establish maintenance costs	<b>Indirect costs (Income losses...):</b> Opportunity costs are taken into account	<b>Environmental costs:</b>	<b>Others:</b>
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**Method for annualizing:** Net Present Value and annuity method. The time preference is incorporated into CBA through the application of discounting future costs and benefits and through accumulating costs and benefits that occurred in the past.

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Good status for the river ecosystem through good hydromorphological status in 50% of the river

**Limited to one (few) parameters of the water status:**

**Examples of indicators used:**  
Not given and not measured

Tool used to measure effectiveness?

<b>Expert judgment:</b> Yes but not specified	<b>Models:</b> Not mentioned	<b>Field experiment:</b> Not mentioned	<b>Others:</b> Not mentioned
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**Are uncertainties quantified?** Uncertainty about the opportunity is the only relevant factor that is considered and addressed with expert opinion.

*Process*

**Who built the CEA ?** Twinning Project where German/Austrian methodology was used

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes, but the methodology seems improper as benefits are not measured

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Not mentioned

**Main constraints encountered:** Not mentioned

**General comments:** The effectiveness is not measured. This is based on the (Slovenian) approach that good status is ensured when 50% of the water body has good hydromorphological status. This is not quite precise and convincing.

**Author and organism:** Pulido-Velázquez, M., Hernandez-Sancho, F., Ferrer-Polo, J., Latorre, J.I.  
Univ. Politecnica de Valencia / Univ. De Valencia / Jucar River Basin Authority  
**Publisher or contracting body:** 2nd International Conference on Water Economics, Statistics, and Finance. Alexandroupolis, Greece

**Country:** Spain

**Geographical Area covered:** Serpis basin (Jucar RBD)

**Themes:** Scarcity; Quality; simulation of water quality on water bodies

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Conference paper  
**Internet links:**

**Key Focus:** CEA for selecting programme of measures, followed by CBA for assessing cost disproportionality and affordability

**Relation to WFD:** In regard to WFD

**Summary of the study:** Integrated approach for CEA the basin scale and CBA for cost disproportionality. Affordability also tested.

### Measures

**Does the CEA analyze measures or combinations of measures?** Both

**How many measures are compared in the CEA?**  
12 measures

**List or type of measure compared:** Improvement of WWTP and wastewater reuse

**What are the main differences between measures?** In the case of WWTPs, type of treatment, % of influent treated and effluent pollutant concentration. For reuse, volume reused.

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** BOD and phosphorus

**Example of C/E indicator:** Parameter Effect. Index for each parameter (% of gap reduction) and Measure Effect. Index (average for all parameters)

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER

**Generic approach and/or data sources (e.g. national databases)?** Follows the Guidelines from the Spanish Instruction for RBMPs

Illustration of C/E ranking from the study:

n.	MEASURES	Annual cost (€)	PEI BOD	PEI phosphorus	MEI	MCEI	Ranki
1	Improvement secondary treatment in WWTP Alcoy. BOD = 20 mg/l	476,385	41%	0%	20%	23,302	9
2	Improvement secondary treatment in WWTP Alcoy. BOD = 0.9 mg/l	47,389	0%	28%	14%	3,399	1
3	Tertiary 10,000 m <sup>3</sup> /day in WWTP Alcoy [BOD 15 mg/l; P 0.8 mg/l]	330,666	65%	46%	56%	5,947	2
4	Tertiary 13,000 m <sup>3</sup> /day in WWTP Alcoy [BOD 15 mg/l; P 0.8 mg/l]	427,551	71%	50%	61%	7,049	6
5	Tertiary 15,000 m <sup>3</sup> /day in WWTP Alcoy [BOD 15 mg/l; P 0.8 mg/l]	489,908	77%	53%	65%	7,559	7
6	Tertiary 17,000 m <sup>3</sup> /day in WWTP Alcoy [BOD 15 mg/l; P 0.8 mg/l]	551,353	82%	55%	69%	8,046	8
7	Industrial wastewater reuse 1700 m <sup>3</sup> /day in WWTP Alcoy	171,961	23%	29%	26%	6,604	3
8	Industrial wastewater reuse 3400 m <sup>3</sup> /day in WWTP Alcoy	345,882	46%	58%	52%	6,637	4
9	Industrial wastewater reuse 5100 m <sup>3</sup> /day in WWTP Alcoy	490,377	67%	77%	72%	6,792	5
10	Industrial wastewater reuse 1350 m <sup>3</sup> /day in WWTP Font de la Pedra	120,587	2%	3%	3%	45,346	10
11	Industrial wastewater reuse 2700 m <sup>3</sup> /day in WWTP Font de la Pedra	223,933	4%	6%	5%	46,194	11
12	Industrial wastewater reuse 4000 m <sup>3</sup> /day in WWTP Font de la Pedra	349,310	5%	8%	7%	52,694	12

Which costs of the measures have been taken into account?

**Investment costs:**

Yes. Using cost functions

**Operation and**

**maintenance costs:**

Yes. Using cost functions

**Indirect costs (Income losses...):**

No

**Environmental costs:**

No

**Others:** No

**Method for annualizing:** Equivalent annual cost

**Are the cost distributed among financers?** Yes. Affordability is tested.

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Yes

**Limited to one (few) parameters of the water status:** BOD and P

**Examples of indicators used:** % of reduction of projected gap in BOD concentration

Tool used to measure effectiveness?

**Expert judgment:** For the catalogue of measures

**Models:** Yes

**Field experiment:** No

**Others:**

**Are uncertainties quantified?** Sentitivity analysis for the discount rate

### Process

**Who built the CEA ?** UPVLC + Jucar Water Agency

**Which role of stakeholder consultation?** No consultation

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** Pilot study for the Jucar RB (former pilot basin in Spain for the CIS)

**Technical limit of the analysis:** No optimization. Limited to a not too high number of measures

**Main constraints encountered:**

**General comments:** Pilot study for the Jucar RB (former pilot basin in Spain for the CIS)

**Author and organism:** Gómez, C.M. , Garrido, A.  
Univ. Alcalá de Henares / Univ. Politéc. Madrid (Spain)  
**Publisher or contracting body:** Int. Workshop on Hydro-economic models and tools for the implementation of the EU WFD. Valencia, Spain.

**Type of publication:** Book chapter  
**Internet links:** submitted to Pulido-Velazquez et al. (eds), Hydro-economic Models for Water Management: Applications to the EU Water Framework Directi. Springer. In press.

**Key Focus:** CEA at the basin scale based on indicators. Consideration of avoided costs depending on the scale.

**Relation to WFD:** In regard to WFD

**Country:** Spain

**Geographical Area covered:** Cidacos basin (Ebro RBD)

**Themes:** Scarcity; Quality;

**Sector:** Agriculture; Industry; Households;

**Summary of the study:** "Virtual" study for CEA and CBA

### Measures

**Does the CEA analyze measures or combinations of measures?** Both

**How many measures are compared in the CEA?**  
50 measures

**List or type of measure compared:** Measures on quantity (in urban & irrigation), on quality and restoration

**What are the main differences between measures?** The focus effect (focus on flow augmentation of quality improvement)

### Methodology

**C/E Ratio calculated?** Yes

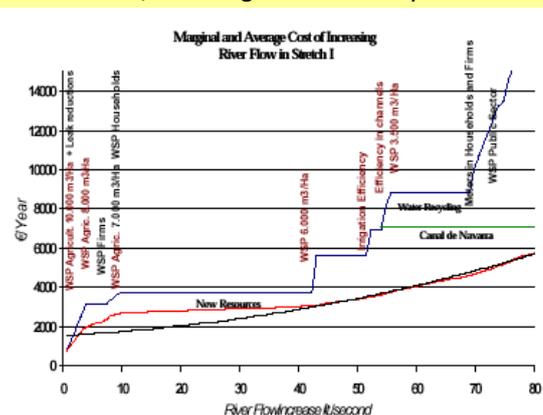
**On which parameters?** NO3, NO2, NH4 (depending on the reach)

**Example of C/E indicator:** For quantity, cost/water saved; for quality, cost/pollutant concentration reduction

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER

**Generic approach and/or data sources (e.g. national databases)?** No

Illustration of C/E ranking from the study:



Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**

Yes

**Indirect costs (Income losses...):**

Yes. Income losses of measures affecting irrigated agriculture

**Environmental costs:**

Yes

**Others: no**

**Method for annualizing:** Equivalent annual cost

**Are the cost distributed among financers?** Yes. Affordability is tested.

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** Yes

**Limited to one (few) parameters of the water status:**

**Examples of indicators used:**

mg/l reduction of pollutant concentration / m3 of water saved

Tool used to measure effectiveness?

**Expert judgment:** Yes. For effectiveness of the measures.

**Models:** No

**Field experiment:** No

**Others:**

**Are uncertainties quantified?** No

### Process

**Who built the CEA ?** A team of experts for the Spanish Ministry of environment

**Which role of stakeholder consultation?** Use for analysis of disproportionate costs

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** Conceived as a methodological pilot study by the Spanish Ministry of Env. for CEA

**Technical limit of the analysis:** No optimization. Limited to a not too high number of measures

**Main constraints encountered:**

**General comments:**

**Author and organism:** Pulido-Velázquez, M., López, A., Andreu, J., Ferrer-Polo, J. Univ. Politecnica de Valencia / Jucar River Basin Authority  
**Publisher or contracting body:** Report for the Jucar RB Authority

**Country:** Spain

**Geographical Area covered:** Jucar river basin

**Themes:** Scarcity; Quality; Opt + simulation of water quality on water bodies

**Sector:** Agriculture; Industry; Households;

**Type of publication:** Project Report  
**Internet links:**

**Key Focus:** Optimization model to select program of measures at large complex basin, embedding water quality simulation  
**Relation to WFD:** In regard to WFD

**Summary of the study:** Integrated optimization including simulation of water quality on surface water bodies

### Measures

**Does the CEA analyze measures or combinations of measures?** Both. The effect of combinations of measures is implicitly simulated within the optimization

**How many measures are compared in the CEA?**  
 54 measures (including basic and supplementary measures)

**List or type of measure compared:** Mainly improvement of WWTPs and reclaimed wastewater reuse

**What are the main differences between measures?** Location, type of treatment, effluent pollutant concentration, quantity of reclaimed wastewater reuse

### Methodology

**C/E Ratio calculated?** yes. Comparison with least cost solution by optimization

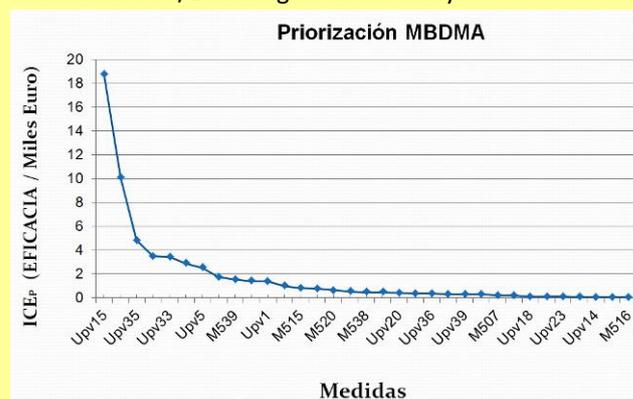
**On which parameters?** BOD, total phosphorus

**Example of C/E indicator:** % gap reduction of pollutant concentration at the water body

**Measures ranked based on C/E ratio and /or Expert judgment?**  
 CER

**Generic approach and/or data sources (e.g. national databases)?** General procedure: Spanish Guidelines "Instrucción" for RBMP; cost and technical effectiveness of measures from "Technical Guidance of characterization of measures" (Spanish Ministry of Environment)

Illustration of C/E ranking from the study:



Which costs of the measures have been taken into account?

**Investment costs:**

Yes. Using cost functions

**Operation and**

**maintenance costs:**

Yes. Using cost functions

**Indirect costs (Income losses...):**

No

**Environmental costs:**

No

**Others:**

No

**Method for annualizing:** Equivalent annual cost

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** BOD and P

**Examples of indicators used:** % of reduction of projected gap in BOD concentration

Tool used to measure effectiveness?

**Expert judgment:** For the catalogue of measures

**Models:** Yes

**Field experiment:** no

**Others:**

**Are uncertainties quantified?** Sentitivity analysis for the discount rate

### Process

**Who built the CEA ?** Technical Univ of Valencia (UPVLC) for the Jucar Water Agency

**Which role of stakeholder consultation?** No consultation

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Yes

**Which integration of the results in the decision making process?** For developing the PM for the RBMP

**Technical limit of the analysis:** Only surface water

**Main constraints encountered:**

**General comments:** Basin scale opt + simulation of water quality

**Author and organism:** Peña-Haro, S., Pulido-Velázquez, M., Sahuquillo, A., Univ. Politecnica de Valencia

**Publisher or contracting body:** Journal of Hydrology

**Country:** Spain

**Geographical Area covered:**  
General methodology (synthetic case)

**Themes:** Quality; integrates agronomic simulation, economics, nitrate leaching, and nitrate transport in groundwater

**Sector:** Agriculture;

**Type of publication:** Academic research paper

**Internet links:** <http://www.sciencedirect.com/>

**Key Focus:** Optimization model to select fertilizer standards to meet groundwater nitrate concentration limits

**Relation to WFD:** In regard to WFD-GWD

**Summary of the study:** Optimization of measure to meet groundwater nitrate pollution standards

### Measures

**Does the CEA analyze measures or combinations of measures?** Both. Simulation of measures embedded in the opt

**How many measures are compared in the CEA?**

2 alternatives: fertilizer standards & fert. Taxes. The opt model determines spatial and temporal allocation of standards, and optimal fertilizer price

**List or type of measure compared:** 2 alternatives: fertilizer standards & fert. Taxes. The opt model determines spatial and temporal allocation of standards, and optimal fertilizer price

**What are the main differences between measures?** Fertilizer standards

### Methodology

**C/E Ratio calculated?** No

**On which parameters?**

**Example of C/E indicator:**

**Measures ranked based on C/E ratio and /or Expert judgment?**

Least-cost optimization (constrained to water quality objectives)

**Generic approach and/or data sources (e.g. national databases)?** No

**Illustration of C/E ranking from the study:**

Fertilizer application and benefit for different planning horizons. Scenario 1.

Planning horizon (years)	Total annual fertilizer application (ton/year)	Total benefit (M€/year)
10	3731	20.96
20	3660	20.93
30	3533	20.83
40	3429	20.76

Which costs of the measures have been taken into account?

**Investment costs:**

No

**Operation and maintenance costs:**

No

**Indirect costs (Income losses...):**

Yes. Cost of fertilizer standards = forgone benefits (income losses)

**Environmental costs:**

No

**Others:**

No

**Method for annualizing:** Present value

**Are the cost distributed among financers?** No

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** NO3

Tool used to measure effectiveness?

**Expert judgment:**

For calibration

**Models:** Yes

**Field experiment:** yes

**Others:**

**Examples of indicators used:**

The reduction in fertilizer use is translated into reduction on groundwater nitrate load by agronomic model (nitrate leaching functions) and finally into groundwater nitrate concentration (groundwater mass transport model)

**Are uncertainties quantified?** Yes. In another paper under review, Stochastic hydro-economic modelling for optimal management of groundwater nitrate pollution from agriculture under hydraulic conductivity uncertainty

### Process

**Who built the CEA ?** Technical Univ of Valencia (UPVLC) for EU GENESIS project

**Which role of stakeholder consultation?** No consultation

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** No integration

**Technical limit of the analysis:** Practical issues of controlling fertilizer standards

**Main constraints encountered:**

**General comments:** Diffuse groundwater nitrate pollution control

**Author and organism:** Berbel, J., Mesa, P., Martin-Ortega, J.,  
 Universidad de Córdoba / Basque  
 Centre for Climate Change  
**Publisher or contracting body:** Fundación Cajamar

**Country:** Spain

**Geographical Area covered:**  
 Guadalquivir basin, Spain

**Themes:** Scarcity;

**Sector:** Agriculture;

**Type of publication:** Book chapter

**Internet links:** <http://www.fundacioncajamar.com/files/publicaciones/215.pdf>

**Key Focus:** Water saving measures in agriculture

**Relation to WFD:** In regard to WFD

**Summary of the study:** CEA of water saving measures in the Guadalquivir basin

### Measures

**Does the CEA analyze measures or combinations of measures?** Only individual measures

**How many measures are compared in the CEA?**  
 6

**List or type of measure compared:** Upgrading urban water supply network, urban water cost recovery, farmers advisory, irrigation upgrading, irrigation cost recovery, volumetric water pricing

**What are the main differences between measures?** Sector involved; technical effectiveness

### Methodology

**C/E Ratio calculated?** Yes

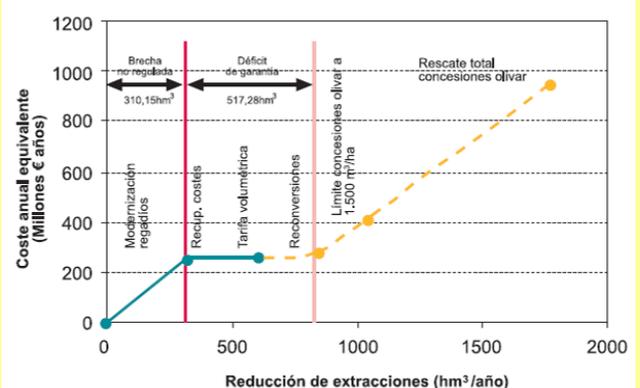
**On which parameters?** Water saving

**Example of C/E indicator:** € / m<sup>3</sup> water saving

**Measures ranked based on C/E ratio and /or Expert judgment?**  
 CER

**Generic approach and/or data sources (e.g. national databases)?** Yes. SICMACE (database, Spanish Ministry of Environment)

Illustration of C/E ranking from the study:



*Which costs of the measures have been taken into account?*

**Investment costs:**  
Only aggregated cost

**Operation and maintenance costs:**  
Only aggregated cost

**Indirect costs (Income losses...):**  
No

**Environmental costs:**  
No

**Others:** No

**Method for annualizing:** Equivalent annual cost

**Are the cost distributed among financers?** No

*How has effectiveness been taken into account?*

**Global in terms of general impact on the water body status:** No

**Limited to one (few) parameters of the water status:** Water quantity

**Examples of indicators used:**

Water saving

*Tool used to measure effectiveness?*

**Expert judgment:** No

**Models:** Unclear

**Field experiment:**

**Others:**

**Are uncertainties quantified?** 3 SCENARIOS: optimistic, pesimistic, realistic

*Process*

**Who built the CEA ?** Univ Cordoba

**Which role of stakeholder consultation?** No consultation

**Are the different steps of the analysis developed in a transparent way?** No

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** No integration

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Author and organism:** The Swedish Water Authority (North Baltic river basin district)  
The county administrative board of Västmanland  
**Publisher or contracting body:** The county administrative board of Västmanland

**Country:** Sweden

**Geographical Area covered:**  
North Baltic river basin district  
(Norra Östersjön), Sweden

**Themes:** Quality; acidification, eutrophication, hazardous substances, alien species, physical change, water outlet, protection of drinking water, chemical status of groundwater, climate change.

**Type of publication:** River Basin Action Plan

**Internet links:** <http://www.vattenmyndigheterna.se/NR/rdonlyres/8B036D16-5E91-4196-8538-2F796EA33D63/0/Atgardsprogram.pdf>

**Key Focus:** Costs (and benefits) of implementing the action plan.

**Relation to WFD:** High

**Summary of the study:** Costs and benefits of implementing the North Baltic river basin action plan, i.e. 37 measures aimed at Swedish authorities and municipalities.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures

**How many measures are compared in the CEA?**

5

**List or type of measure compared:** Construction of sedimentation ponds for separation of P, increased cleaning in sewage treatment plants, construction of wetlands, increased cleaning in private sewars, grassy buffer zones.

**What are the main differences between measures?** Measures in agriculture, sewage treatment plants, industry and private sewars, i.e. different sectors.

### Methodology

**C/E Ratio calculated?** Y

**On which parameters?** Cost per reduced kilogram of N and P.

**Example of C/E indicator:** SEK/kg P and SEK/kg N

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes, costs were taken from Swedish authorities etc.

**Illustration of C/E ranking from the study:**

Tabell B17. Kostnadseffektivitet för åtgärder för minskad tillförsel av fosfor till vatten

Åtgärd	Kostnad (kr/ kg P)	
Dammar för fosforavskiljning	820	(350 – 10 000)
Utökad rening vid reningsverk och industri	3100	(150 – 6 600)
Våtmarker	6 700	(1 700 – 37 000)
Utökad rening för enskilda avlopp	7 000	(3 500 – 12 000)
Gräsbevuxna skydds-zoner på åkermark	7 400	(4 200 – 11 000)

Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**  
Administrative costs

**Indirect costs (Income losses...):**  
Not specified.

**Environmental costs:**  
Not specified.

**Others:**  
Not specified.

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** Yes

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P and N reduction

**Examples of indicators used:** kg P and N reduction

Tool used to measure effectiveness?

**Expert judgment:**

Literature survey

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Use of cost Intervals

### Process

**Who built the CEA ?** Swedish research institute (IVL)

**Which role of stakeholder consultation?** It is noted that implementing the measures will have to involve stakeholder consultation.

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** The choice of which measures to implement in practice is decided locally by the responsible authorities. It is concluded that the result may guide prioritisation and choice of focus for investments in the district.

**Technical limit of the analysis:** Lack of data and of knowledge regarding the effects of measures, model uncertainties etc.

**Main constraints encountered:**

**General comments:**

**Author and organism:** The Swedish Water Authority (South Baltic river basin district)

The county administrative board of Kalmar

**Publisher or contracting body:** The county administrative board of Kalmar

**Country:** Sweden

**Geographical Area covered:**  
South Baltic river basin district (Södra Östersjön), Sweden

**Themes:** Quality; Acidification, eutrophication, hazardous substances, alien species, physical change, water outlet, protection of drinking water, chemical status of groundwater, climate change.

**Type of publication:** River Basin Action Plan

**Internet links:** [http://www.vattenmyndigheterna.se/NR/rdonlyres/7C1CFA52-63E1-467B-A0BB-454AC4B485E4/162887/AP\\_SO\\_webb.pdf](http://www.vattenmyndigheterna.se/NR/rdonlyres/7C1CFA52-63E1-467B-A0BB-454AC4B485E4/162887/AP_SO_webb.pdf)

**Key Focus:** Costs (and benefits) of implementing the action plan.

**Relation to WFD:** High

**Summary of the study:** Costs and benefits of implementing the South Baltic river basin action plan, i.e. 38 measures aimed at Swedish authorities and municipalities.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures as well as combinations of measures.

**How many measures are compared in the CEA?**

6

**List or type of measure compared:** Measures in agriculture, sewage treatment plants, industry and private sewers. Construction of wetlands, buffer zones, combination of the measures catch crops and spring cultivation, increased phosphorus purification by chemical deposit and sand filters, refurbishment of technical installations in private sewers.

**What are the main differences between measures?** Measures in agriculture, sewage treatment plants, industry and private sewers, i.e. different sectors.

### Methodology

**C/E Ratio calculated?** Y

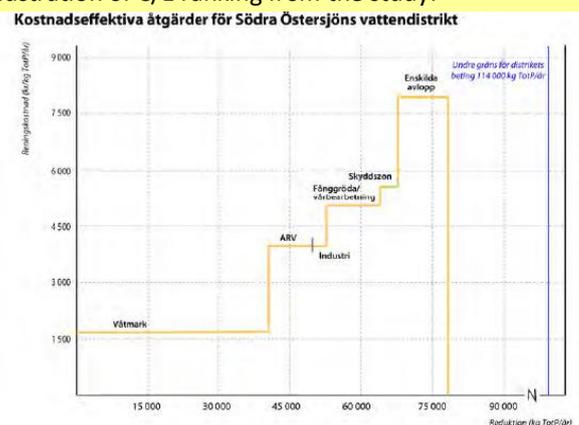
**On which parameters?** Cost per reduced kilogram of N and P per year

**Example of C/E indicator:** SEK/kg P/year and SEK/kg N/year

**Measures ranked based on C/E ratio and /or Expert judgment?**  
C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes, costs were taken from Swedish authorities etc.

Illustration of C/E ranking from the study:



Figur 14. En kostnadseffektiv åtgärds kombination mot övergödning i Södra

Which costs of the measures have been taken into account?

**Investment costs:** Yes

**Operation and maintenance costs:**  
Administrative costs

**Indirect costs (Income losses...):**  
Not specified

**Environmental costs:**  
Not specified

**Others:**  
Not specified

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** Yes

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Examples of indicators used:**  
kg/year P and N reduction

**Limited to one (few) parameters of the water status:** P and N reduction

Tool used to measure effectiveness?

**Expert judgment:**

Literature survey

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Use of cost intervals

### Process

**Who built the CEA ?** Swedish research institute (IVL)

**Which role of stakeholder consultation?** It is noted that implementing the measures will have to involve stakeholder consultation.

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** The choice of which measures to implement in practice is decided locally by the responsible authorities. It is concluded that the result may guide prioritisation and choice of focus for investments in the district.

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Author and organism:** The Swedish Water Authority (West coast river basin district)

The county administrative board of Västra Götaland

**Publisher or contracting body:** The county administrative board of Västra Götaland

**Country:** Sweden

**Geographical Area covered:** The Swedish West coast river basin district (Västerhavet), Sweden

**Type of publication:** River Basin Action Plan

**Internet links:** [http://www.vattenmyndigheterna.se/NR/rdonlyres/D21FE02A-11AA-4A04-B368-BE4B489F507F/0/ÅP\\_VH\\_webb.pdf](http://www.vattenmyndigheterna.se/NR/rdonlyres/D21FE02A-11AA-4A04-B368-BE4B489F507F/0/ÅP_VH_webb.pdf)

**Themes:** Quality; acidification, eutrophication, hazardous substances, alien species, physical change, water outlet, protection of drinking water, chemical status of groundwater, climate change.

**Key Focus:** Costs (and benefits) of implementing the action plan.

**Relation to WFD:** High

**Summary of the study:** Costs and benefits of implementing the Swedish West coast river basin action plan, i.e. 38 measures aimed at Swedish authorities and municipalities.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures as well as combinations of measures.

**How many measures are compared in the CEA?**

8

**List or type of measure compared:** Construction of wetlands, buffer zones, combination of the measures catch crops and spring cultivation, increased phosphorus purification by chemical deposit and sand filters, refurbishment of technical installations in private sewers.

**What are the main differences between measures?** Measures in agriculture, sewage treatment plants, industry and private sewers, i.e. different sectors.

### Methodology

**C/E Ratio calculated?** Y

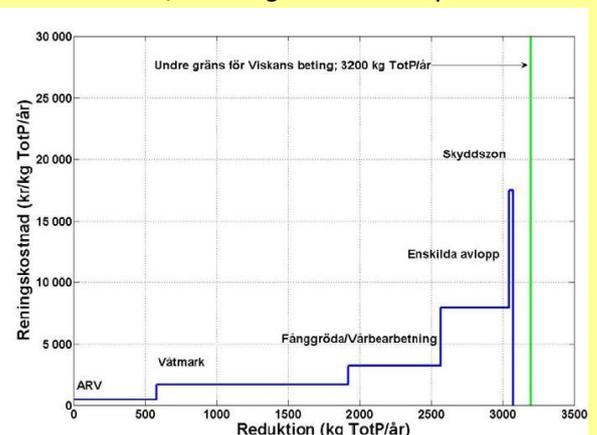
**On which parameters?** Cost per reduced kilogram of N and P per year

**Example of C/E indicator:** SEK/kg P/year and SEK/kg N/year

**Measures ranked based on C/E ratio and /or Expert judgment?** C/E ratio

**Generic approach and/or data sources (e.g. national databases)?** Yes, costs were taken from Swedish authorities etc.

Illustration of C/E ranking from the study:



Which costs of the measures have been taken into account?

**Investment costs:**

Yes

**Operation and maintenance costs:**  
Administrative costs

**Indirect costs (Income losses...):**  
Not specified

**Environmental costs:**  
Not specified

**Others:**  
Not specified

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** Yes

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P and N reduction

**Examples of indicators used:**

kg/year P and N reduction

Tool used to measure effectiveness?

**Expert judgment:**

Literature survey

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Use of cost intervals

### Process

**Who built the CEA ?** Swedish research institute (IVL)

**Which role of stakeholder consultation?** It is noted that implementing the measures will have to involve stakeholder consultation.

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No

**Which integration of the results in the decision making process?** The choice of which measures to implement in practice is decided locally by the responsible authorities. It is concluded that the result may guide prioritisation and choice of focus for investments in the district.

**Technical limit of the analysis:**

**Main constraints encountered:**

**General comments:**

**Author and organism:** Stout, Lisa and Fenn, Teresa  
RPA, Environment Agency  
**Publisher or contracting body:** RPA, Environment Agency

**Country:** United Kingdom

**Geographical Area covered:**  
River Ribble (River Darwen)

**Themes:** Quality;  
Hydomorphology;

**Type of publication:** Pilot Study on CEA use  
**Internet links:** <http://www.wfdcrp.co.uk/pdf%5Cp2a-2b-annex1.pdf>

**Sector:** Agriculture; Industry;

**Key Focus:** Pilot Study  
**Relation to WFD:** In regard to WFD

**Summary of the study:** The Ribble pilot project is part of testing the CEA methodology developed by the Collaborative Research Programme On River Basin Management Planning Economics. It is a cooperation of Environment Agency and RPA consultancy. It displays only partly the characteristics of the British approach to CEA (e.g. generic databases for measures with inbuild cost effectiveness analysis).

**Measures**

**Does the CEA analyze measures or combinations of measures?** Combinations

**How many measures are compared in the CEA?**  
27 measures, two measure parcels with 8 measures each

**List or type of measure compared:** Phosphorus, morphological pressures, urban runoff, combined sewer overflows, runoff agriculture

**What are the main differences between measures?** Pollutants measures and morphological measures, combined in parcels

**Methodology**

**C/E Ratio calculated?** No  
**On which parameters?**  
**Example of C/E indicator:** Costs/effectiveness as a range (% Gap addressed, % geographic addressed)  
**Measures ranked based on C/E ratio and /or Expert judgment?** Pair wise comparisons  
**Generic approach and/or data sources (e.g. national databases)?** Partly, as this is a test CEA and the generic databanks were still in construction there is only some use of such sources. It is also emphasised that it is actually not possible measures to give generic costs as the local situation varies too much.

Illustration of C/E ranking from the study:

Combination of Measures	Delivery Mechanism and Level of Effort	Pressure(s) Addressed	Effectiveness (as a range) % Gap Addressed	% Geog. Scale where Gap is Reduced	Time for the Measure to be Effective	Certainty of Outcome	Costs (£) (as a range)	Non-Monetary Costs	Other Key Factors, including those that may result in low sustainability
1	At maximum level of effort	P morphological urban runoff	C/SO spills and urban runoff <100% of gap due to coping spills Morphology: uncertain - but will increase habitat diversity Agriculture national and local measure should reduce PFP considerably (% not known)	Measures across whole geographical scale, 100% or 43km	Varies according to measure - immediate to 5+ years so should meet 2011 timetable	0.5 to 0.8, morphology not known	Local measure costs only: PV (financial) £1.2m to £4.8m EAV: £0.75m to £1.8m =100%	Potential for habitat benefit alongside river (21a of buffer strip)	Assumes there are no technical constraints on size of sewage tank Additional carbon emissions, although the damage costs are accounted for in direct cost estimates
2	At maximum level of effort	P morphological urban runoff	C/SO spills and urban runoff <100% of gap due to coping spills Morphology: uncertain - but will increase habitat diversity Agriculture national and local measure should reduce PFP considerably (% not known)	Measures across whole geographical scale, 100% or 43km	Varies according to measure - immediate to 5+ years so should meet 2011 timetable	0.5 to 0.8, morphology not known	Local measure costs only: PV (financial) £1.2m to £4.8m EAV (financial): £0.75m to £1.8m (economic): £0.75m to £1.8m =100%		Assumes there are no technical constraints on size of sewage tank Additional carbon emissions, although the damage costs are accounted for in direct cost estimates

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Yes, but not described	<b>Operation and maintenance costs:</b> Yes, but not described	<b>Indirect costs (Income losses...):</b> Listed non monetary (job loss etc)	<b>Environmental costs:</b> Yes, but not in monetary values	<b>Others:</b>
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**Method for annualizing:** There are Present Value Costs and Equivalent Annual Value

**Are the cost distributed among financers?** not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P, habitat diversity etc.

**Examples of indicators used:** % Gap addressed, % geographic scale, time for measure to be effective, certainty of outcome and non-monetised costs

Tool used to measure effectiveness?

<b>Expert judgment:</b> Environment Agency Local Staff, UKTAG	<b>Models:</b>	<b>Field experiment:</b> Testing	<b>Others:</b>
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**Are uncertainties quantified?** Reliability and accuracy and confidence bands for each measure were identified

**Process**

**Who built the CEA ?** Effectiveness Methodology by UK Collaborative Research Programme

**Which role of stakeholder consultation?** Theoretically yes, this testing of the methodology did not have time to do that

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** No, because of time constraints

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Probably not very precise, lack of data. Assumptions had to be made to assess costs and effectiveness, particularly for morphological measures.

**Main constraints encountered:** CEA needs time

**General comments:** Open report discussing weaknesses and difficulties

**Author and organism:** Ian J. Bateman, Amelie Deflandre-Vlandas, Carlo Fezzi, David Hadley, Michael Hutchins, Andrew Lovett, Paulette Posen, Dan Rigby  
Centre for Social and Economic Research on the Global Environment (CSERGE), School of Environmental Sciences, University of East Anglia, Centre for Ecology and Hydrology, Economics, School of Social Sciences, University of Manchester  
**Publisher or contracting body:** work was part of the interdisciplinary research programme of the ESRC

**Country:** United Kingdom

**Geographical Area covered:** Derwent catchment

**Themes:** Quality;

**Sector:** Agriculture;

**Type of publication:** Research paper/Academic publication

**Internet links:** [http://www.uea.ac.uk/env/cserge/pub/wp/ecm/ecm\\_2007\\_03.pdf](http://www.uea.ac.uk/env/cserge/pub/wp/ecm/ecm_2007_03.pdf)

**Key Focus:** Combining an economic model for farms (linear programming) and an hydrologic model to assess the most cost-effective measure to reduce nitrate pollution

**Relation to WFD:** In regard to WFD

**Summary of the study:** This study is an assessment of various policy options proposed to Defra to achieve the standards required by the WFD. It shows how the economic impact of selected nitrate leaching reduction policies on UK farms is characterised by significant variability.

### Measures

**Does the CEA analyze measures or combinations of measures?** measures

**How many measures are compared in the CEA?**

5

**List or type of measure compared:** A = fertiliser reduction by 20%; B = livestock reduction by 20%; C1 = evenly spread 20% arable to grassland; C2 = arable switching to grassland in the lowland area; C3 = arable switching to grassland in the upland area.

**What are the main differences between measures?** fertiliser reduction, livestock reduction, arable to grass conversion

### Methodology

**C/E Ratio calculated?** Yes

**On which parameters?** Changes in annual diffuse N loads and in mean nitrate concentration /total annual economic impact (IFGM)

**Example of C/E indicator:** £m/ L /mg or £m/kg/ha

**Measures ranked based on C/E ratio and /or Expert judgment?** CER

**Generic approach and/or data sources (e.g. national databases)?** Yes, national databases are used (Environment Agency, changes in farm gross margins are estimated for a large dataset derived from the Farm Business Survey, rates from the British Fertiliser Practice Survey) but this work also criticises the generalised data approach as not tight enough and shows the differentiation in results.

**Illustration of C/E ranking from the study:**

	Reference <sup>a</sup>	A	B	C1	C2	C3
Site 1	19.0	-1.1	-2.0	-2.8	--	-11.4
		-6%	-11%	-15%	--	-60%
	3.70	-0.21	-0.38	-0.54	--	-2.19
		-6%	-10%	-15%	--	-59%
Site 2	16.1	-1.1	-2.1	-2.1	--	-8.5
		-7%	-13%	-13%	--	-53%
	2.89	-0.19	-0.37	-0.40	--	-1.51
		-7%	-13%	-14%	--	-52%
Site 3	18.4	-0.8	-1.6	-3.0	--	-12.1
		-4%	-9%	-16%	--	-66%
	4.49	-0.19	-0.34	-0.71	--	-2.88
		-4%	-8%	-16%	--	-64%
Site 4	24.7	-0.8	-1.0	-6.6	-14.2	--
		-3%	-4%	-27%	-57%	--
	6.28	-0.19	-0.25	-1.47	-3.25	--
		-3%	-4%	-23%	-52%	--
Site 5	24.9	-1.1	-1.5	-5.5	-4.1	-5.0
		-4%	-6%	-22%	-16%	-20%
	5.40	-0.21	-0.30	-1.14	-0.81	-0.85
		-4%	-6%	-21%	-15%	-16%
□FGM <sup>b</sup>	--	-2.39	-1.89	-5.53	-5.53	-5.35
		[-2.50;-2.27]	[-2.00;-1.79]	[-5.84;-5.23]	[-5.84;-5.23]	[-5.68;-5.02]
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Which costs of the measures have been taken into account?

**Investment costs:**

Reduction of Fertiliser, Livestock and Change of Land use doesn't require high investment

**Operation and maintenance costs:**

Reduction of Fertiliser, Livestock and Change of Land use doesn't require operation and maintenance

**Indirect costs (Income losses...):**

This is at the heart of the document, as the costs for agriculture are measured for each measure, therefore

**Environmental costs:**

Not mentioned

**Others: Not mentioned**

**Method for annualizing:** Cost are annualised but no explanation

**Are the cost distributed among financiers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** % reduction of the main pollutants

**Examples of indicators used:**

Changes in annual diffuse N loads (kg/ha and percentages) and in mean nitrate concentration (mg/L and

Tool used to measure effectiveness?

**Expert judgment:**

**Models:** CASCADE and QUESTOR models are used

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Not mentioned

**Process**

**Who built the CEA ?** Not mentioned but it is suggested that the researchers follow the DEFRA model

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** The main limitation of the analysis is that it does not include any behavioural element but implements the effects of the various policies in a rather mechanical fashion. Furthermore, only gross margins are analysed, thereby providing no indication about profits and long run investment costs.

**Main constraints encountered:**

**General comments:** Thorough study, showing how much work and detail is required to get a realistic CEA. Without proper databanks or expensive collection of data it will be very difficult to get good results.

**Author and organism:** Rachel Cave, Roy Brouwer, Emma Coombes, David Hadley, Kerry Turner and Irene Lorenzoni  
University of East Anglia  
**Publisher or contracting body:** Eurocat

**Type of publication:** Final Project Report  
**Internet links:** <http://www.uea.ac.uk/env/cserge/pub/ext/354.htm>

**Key Focus:** CEA  
**Relation to WFD:** In regard to WFD

**Country:** United Kingdom

**Geographical Area covered:**  
Humber

**Themes:** Quality;

**Sector:** Agriculture; Industry; Households; Wastewater, Storm Overflow

**Summary of the study:** As part of the EUROCAT programme, the HUMCAT team scrutinises three scenarios (meta approach) for the future development of the Humber Estuary, ranging from a scenario with minimum environmental improvement to one with intense management to achieve the best possible environmental conditions. The report might be exemplary of what an expert told me: CEA is in the shadow of Cost Benefit Analysis. Contrary to what the title suggests the document extensively conducts a CBA and just at the end adds a CEA. In particular the value of increasing wetland habitats within the estuarine by managed realignment of coastal defence as a contribution to retaining nutrients and metals is identified. However, as the realignment is anyhow planned in the basin this measure is already pre-included in the measure list. A cost benefit analysis is undertaken to assess the realignment. A cost-effectiveness analysis is undertaken for nutrient reduction measures in agriculture, wastewater treatment and spillover.

**Measures**

**Does the CEA analyze measures or combinations of measures?** Compares three scenarios (reduction in nutrient inputs from the freshwater rivers, a reduction in inputs from point sources and managed realignment), however the only display of CEA is in the comparison of 2 big measure packages (designation of nitrate sensitive zones, upgrading of sewage treatment facilities) that reduce pollutants.

**How many measures are compared in the CEA?**  
2 Measure packets

**List or type of measure compared:** Type of measures are in the agricultural sector, wastewater plants and overspill construction as well as hydromorphological measures (this one only CBA).

**What are the main differences between measures?** Solution that creates env. protection zones with socio-economic implications, Technical solution

**Methodology**

**C/E Ratio calculated?** Yes, Average Cost Effectiveness Ratio was calculated for designation of Nitrate Vulnerable Zone and upgrading of Sewage Treatment Works. However, the results "should be interpreted (..) as providing an indication of the rank ordering of costs associated with these measures rather than as a precise guide". The net present value of realignment was calculated for each scenario, used for CBA.

**On which parameters?** Implementation cost by the average reduction in load

**Example of C/E indicator:** £1000 per T yr<sup>-1</sup>

**Measures ranked based on C/E ratio and /or Expert judgment?**  
CER but choice is only between 2 big measures

**Illustration of C/E ranking from the study:**

Measure	Target sector	Implementation costs (£ million)	Effectiveness (Load reduction in T yr <sup>-1</sup> )	Average cost-effectiveness (£1000 per T yr <sup>-1</sup> )
Upgrading of STWs to tertiary treatment (indicative costs for a 100,000 population equivalent STW)	STW	N: 3.9 P: 3.4 – 9.5	N: 83 P: 17	N: 47.14 P: 202.35 – 559.24
NVZ designation across Humber catchment under the Nitrates (91/676/EEC) Directive	Agriculture	74.3	N: 4696 P: 417	N: 15.82 P: 178.13

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Only indicative costs could be used, probably because of the scale of the measure packets. Capital cost for CBA were estimated using data from DEFRA/Environment Agency DEFRA/Environment Agency	<b>Operation and maintenance costs:</b> Are considered but not mentioned explicitly in the CEA.	<b>Indirect costs (Income losses...):</b> not mentioned	<b>Environmental costs:</b> Benefits were considered in the CBA	<b>Others:</b> Record keeping costs, Storage costs, Transport costs were included in the CEA (to transport surplus manure to areas where loading limits are not breached).
<b>Method for annualizing:</b> Annualising capital costs and discounting operating costs over 25 years at 3.5 per cent				
<b>Are the cost distributed among financiers?</b> Financing is mentioned but not explicitly the distribution				

How has effectiveness been taken into account?

<b>Global in terms of general impact on the water body status:</b>	<b>Examples of indicators used:</b> Reduction of pollutants mg/l
<b>Limited to one (few) parameters of the water status:</b> Nitrogen (N) and phosphorus (P) and the metal elements Arsenic (As), Copper (Cu), Lead (Pb) and Zinc (Zn)	

Tool used to measure effectiveness?

<b>Expert judgment:</b> Yes, literature and database use	<b>Models:</b> Yes, e.g. Boorman's (2003) simulation results	<b>Field experiment:</b>	<b>Others:</b>
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**Are uncertainties quantified?** Based on the D-P-S-I-R framework expected developments are estimated. Because of lack of data and information, it is considered impossible to quantify all these driving forces in terms of the pressures they are expected to exert on the water system.

*Process*

<b>Who built the CEA ?</b> Not mentioned	<b>Which role of stakeholder consultation?</b> Not mentioned
<b>Are the different steps of the analysis developed in a transparent way?</b> The CEA is too short, the CBA is fully elaborated	
<b>Are there iterations in the implementation process?</b> Not mentioned	
<b>Which integration of the results in the decision making process?</b> Not mentioned	
<b>Technical limit of the analysis:</b> Data "may be subject to a wide margin of error"	
<b>Main constraints encountered:</b> Not mentioned	
<b>General comments:</b> CEA was dissappointing given the title of the document. In effect the three scenarios underwent a Cost Benefit Analysis.	

**Author and organism:** M Shepherd, S Anthony, P Haygarth, D Harris, P Newell-Price, S Cuttle, B Chambers and D Chadwick  
ADAS  
**Publisher or contracting body:** Scottish Agricultural College, Scottish Environment Protection Agency, International Water Association

**Country:** United Kingdom

**Geographical Area covered:** general

**Themes:** Quality;

**Sector:** Agriculture;

**Type of publication:** Conference presentation

**Internet links:** <http://www.sac.ac.uk/mainrep/pdfs/sacsepaproceedings.pdf>

**Key Focus:** introducing toolkit for determining C/E measures

**Relation to WFD:** In regard to WFD

**Summary of the study:** This paper presents preliminary results from a toolkit for assessing the cost-effectiveness of combinations of mitigation methods invoked by a range of policy options. It is a mix of simplified diffuse pollution models (to determine baseline losses of nitrate, phosphorus and faecal indicator organisms), best available information on cost-effectiveness drawn from other projects and, using these building blocks, a cost-curve approach. The approach relies on expert judgement.

### Measures

**Does the CEA analyze measures or combinations of measures?** The researchers developed a model for analysing combinations of measures

**How many measures are compared in the CEA?**

Two combinations of measures; a Nutrient Management Plan and a Farm Assurance Scheme

**List or type of measure compared:** a

Nutrient Management Plan and a Farm Assurance Scheme

**What are the main differences between measures?** Different Schemes

### Methodology

**C/E Ratio calculated?** Not explicitly but cost and effectiveness are given and visualised in a graph so the most C/E option becomes evident

**On which parameters?**

**Example of C/E indicator:**

**Measures ranked based on C/E ratio and /or Expert judgment?**

Cost and reduction of nitrate-N and phosphorus (kg) and FIO (relative units) for two representative farm types and two soil textures.

**Generic approach and/or data sources (e.g. national databases)?** Data was taken from previous research databases

Illustration of C/E ranking from the study:

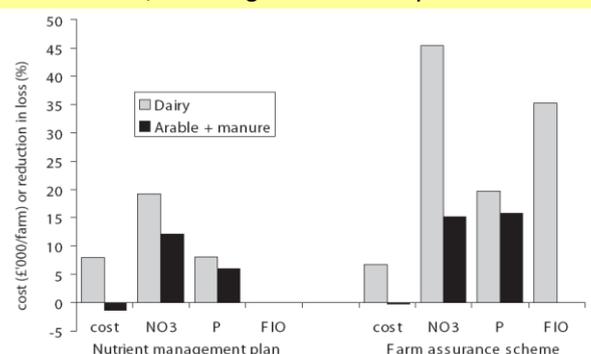


Figure 1: The estimated efficiency (% reduction against baseline) and cost (£'000/farm) of two example policy options applied to two representative farm types

*Which costs of the measures have been taken into account?*

**Investment costs:**

Not outlined in detailed, the data was taken from previous research data banks

**Operation and maintenance costs:**

**Indirect costs (Income losses...):**

**Environmental costs:**

**Others:**

**Method for annualizing:**

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Yes

**Examples of indicators used:**

Tool used to measure effectiveness?

**Expert judgment:** Data was taken from previous research databases

**Models:**

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Not mentioned

**Process**

**Who built the CEA ?** The authors

**Which role of stakeholder consultation?** Not mentioned

**Are the different steps of the analysis developed in a transparent way?** No

**Are there iterations in the implementation process?** For this work, a pragmatic approach was adapted in which the tool iteratively selects and implements the method with the least cost-benefit ratio at each cost step

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Not mentioned

**Main constraints encountered:** Not mentioned

**General comments:**

**Author and organism:** Claire Handley

Mike Holland

Chris Dore

Tim Murrells

AEA Technology plc

**Publisher of contracting body:** UK's Department for the Environment, Transport and the Regions

**Type of publication:** Final report to assess the abatement of non-agricultural sources of ammonia

**Internet links:** <http://www.airquality.co.uk/reports/empire/NH3-abatement.pdf>

**Key Focus:** The study was undertaken to improve guidance available to the UK government on meeting emission ceilings for ammonia agreed under the UNECE's Gothenburg Protocol and the EU's National Emission Ceilings Directive

**Relation to WFD:** No

**Country:** United Kingdom

**Geographical Area covered:** general

**Themes:**

**Sector:** Industry; Households; Transport, Waste

**Summary of the study:** Assessment of the abatement of non-agricultural sources of ammonia in the UK. Improved the non-agricultural emission inventory for ammonia in 2010 and beyond, identifying and estimating likely trends in emissions, and correcting projections using some updated emissions information; Identified options and costs for abatement of emissions; Integrated these data into a cost-curve for non-agricultural ammonia, taking specific account of uncertainty in emission and costs; Assessed the completeness of ammonia inventory data for other European countries.

### Measures

**Does the CEA analyze measures or combinations of measures?** Measures and effect in different sectors

**How many measures are compared in the CEA?**

6

**List or type of measure compared:** Venturi Scrubber

• Dilute acid packed tile scrubber

• Regenerative thermal oxidiser

• Biofilter

• Non-evaporative cooling system

• Silage treatment of horse manure

**What are the main differences between measures?** different technologies

### Methodology

**C/E Ratio calculated?** Marginal cost of options for reducing emissions of ammonia

**On which parameters?** Cost per Tonne abatement

**Example of C/E indicator:** £/t

**Measures ranked based on C/E ratio and /or Expert judgment?**

Marginal cost of abatement measure

**Generic approach and/or data sources (e.g. national databases)?** No, this is not a WFD analysis therefore no database etc exists

**Illustration of C/E ranking from the study:**

Table 13. Input data for @RISK estimation of the cost-effectiveness of options for non-agricultural ammonia abatement. Projections of emissions and percentage technology penetration to 2010 and calculated emission reductions for 2010.

Sector title	Fertiliser	Fertiliser	Mineral fibre processes	Mineral fibre processes	Chem industry organic chemicals	Chem industry organic chemicals	Inorganic chemical processes	Inorganic chemical processes
Sector	large emission plant > 500t	small emission plant < 500t	50 - 100 t	10 - 50 t	2 - 50 t	0.1 - 2 t	50 - 300 t	2 - 50 t
2010 Emission by sector best estimate (t)	1,500	15	332	15	30	1	359	166
2010 Emission by sector range (t)	500 - 2,000	10 - 20	150 - 350	12 - 18	10 - 100	0.1 - 8	200 - 550	100 - 250
Number of plant in UK best estimate	2	4	4	1	17	5	2	14
Number of plant in UK range	1 - 2	4 - 5	4 - 8	1	1 - 20	3 - 9	2 - 3	12 - 16
Technology	venturi scrubber	dilute acid scrubber	dilute acid scrubber	regenerative thermal oxidation	regenerative thermal oxidation	biofilter	dilute acid scrubber	regenerative thermal oxidation
Annualised Cost / plant (£ per plant) best estimate	706,698	16,839	16,839	15,197	15,198	1,291	16,839	15,198
Annualised Cost / plant (£ per plant) Range	606,500 - 868,100	14,223 - 22,070	14,223 - 22,070	10,600 - 20,000	10000 - 20,000	800 - 2,000	14,223 - 22,070	10,000 - 20,000
Effectiveness best estimate (%)	90	90	90	90	90	97	90	90
Effectiveness range (%)	85 - 92	94 - 99.9	94 - 99.9	70 - 99	71 - 99	90 - 97.5	94 - 99.9	71 - 99
Technology penetration (% of plants)	100%	80%	70%	50%	50%	50%	100%	50%
Range of technology penetration	0 - 100%	20% - 90%	20 - 90%	10 - 70%	10 - 70%	10 - 70%	50 - 100%	10 - 70%
Emission abated (kt) Best estimate	890	9	194	6	12	0	292	65

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Yes, technology installation, efficiency of abatement measure	<b>Operation and maintenance costs:</b> Yes	<b>Indirect costs (Income losses...):</b> Not mentioned	<b>Environmental costs:</b> Not mentioned	<b>Others:</b> Not mentioned
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**Method for annualizing:** The analysis of the costs of abatement follows the UK Government methodology as defined in the Treasury's Green Book. The cost curve was constructed using the annualised cost of abatement technology and the efficiency of the resulting abatement.

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** Showing estimated cost-effectiveness of abatement

**Examples of indicators used:**  
Cumul. Emissions abated and % NH3 abated

Tool used to measure effectiveness?

<b>Expert judgment:</b> Yes	<b>Models:</b> catchment systems in terms of diffuse and point source pollution and in-river processes	<b>Field experiment:</b> No	<b>Others:</b> possible technology penetration and emission by sector
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**Are uncertainties quantified?** Uncertainty in emission data for present and future emissions is a major consideration throughout the analysis of potential ammonia abatement. In this study, the magnitude of the uncertainty has been included in every stage, indicating the best and worst case scenarios possible and allowing a best estimate to be given for each sector's emissions. Uncertainties are characterised partly from estimates of statistical error made in (e.g.) emission factors, and partly from the views of sector experts. It is clear that reported error is an insufficient basis for looking at the uncertainties present in this analysis when considering the relevance of some emissions data to current and future emissions. The @RISK software package has been used to bring uncertainties together in a way that reflects overall uncertainty, in a suitably transparent and intelligible manner.

**Process**

<b>Who built the CEA ?</b> Methodology according to Treasuries Green book	<b>Which role of stakeholder consultation?</b> Important role for data
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**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Implements the effects of the various policies in a rather mechanical fashion.

**Main constraints encountered:** Not mentioned

**General comments:** Interesting study that places emphasis on uncertainty minimisation

**Author and organism:** Bedru B. Balana, Manuel Lago, Andy Vinten, Bill Slee, Nikki Baggaley, Marie Castellazzi, Eleonore Guillem, Martyn Futter, Marc Stutter MacCaulay, Scottish Agricultural College

**Publisher or contracting body:** Conference Paper ISEE International Society for Ecological Economics

**Type of publication:** Conference report

**Internet links:** <http://www.knowledgescotland.org/briefings.php?id=160>

**Key Focus:** Agricultural sediments and diffuse phosphorus (P) pollution Abatement

**Relation to WFD:** In regard to WFD

**Country:** United Kingdom (Scotland)

**Geographical Area covered:** Lunan Catchment

**Themes:** Quality;

**Sector:** Agriculture;

**Summary of the study:** Taking the case study of Rescobie Loch in Lunan catchment, this study aims to investigate the optimal targeting of buffer strips for P mitigation and how placement of buffers influences costs and effectiveness. An integrated economic, hydrologic, and GIS modelling framework is employed. The underlying economic rationale behind this exercise is that financial incentives to farmers for adopting agri-environmental measures should be at least equivalent to the forgone financial costs to the farmer in order to induce “voluntary” participation.

### Measures

**Does the CEA analyze measures or combinations of measures?** Only one measure is analysed, the bufferstrip separating fields of env. production from the loch (water). However the aim here is to find out the width of the buffer strip, the potential P reduction it effects and the compensation payment for the farmer.

**How many measures are compared in the CEA?**

Widths of one measure

**List or type of measure compared:**

**What are the main differences between measures?**

### Methodology

**C/E Ratio calculated?** average and marginal abatement costs

**On which parameters?** cost/kg reduction of P/year

**Example of C/E indicator:** £/kg P/yr

**Measures ranked based on C/E ratio and /or Expert judgment?**

The optimal width for decision makers can be established by this model, depending on the required P level reduction. Thus the C/E Ratio helps to do that.

**Generic approach and/or data sources (e.g. national databases)?** No, although this study uses national databases it

also relies heavily on expert judgement and the model it set up.

It has to be seen as a research approach.

**Illustration of C/E ranking from the study:**

Table 1. Example of results of cost and effectiveness for targeting of P reduction

P reduction goal (%)	P reduced (kg/yr)	land area in buffers(ha)	Abatement costs (£)		
			total abatement cost(£k/yr)	average abatement cost (£/kg P/yr)	marginal abatement cost (£/kg P/yr)
10	34	5	1.5	44	44
20	68	13	4.0	59	73
30	102	24	7.9	77	115
40	136	49	15.4	113	222
50	170	107	33.4	197	529
60	204	209	66.5	326	972
70	238	395	129.0	542	1838
73	248	519	176.4	711	4741

Which costs of the measures have been taken into account?

**Investment costs:**

Scottish Agricultural Census dataset of various years was used to establish the costs. The investment costs for bufferstrips are very low but it is rather the (indirect) compensation cost that matter

**Operation and maintenance costs:**

Not mentioned

**Indirect costs (Income losses...):** Very important in this study, an optimization modelling framework seeks to minimize the forgone value of economic returns of crop production as a result of land allocation for buffer strips subject to achieving a certain percentage of P reduction target in Rescobie Loch

**Environmental costs:**  
Not mentioned

**Others:**

**Method for annualizing:** C/E per year

**Are the cost distributed among financers?** Not mentioned, this is also a research that is not implemented (yet)

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Limited to one (few) parameters of the water status:** P level reduction

**Examples of indicators used:**

Tool used to measure effectiveness?

**Expert judgment:** Literature survey was carried out of buffer strip effectiveness as well as expert judgement, for removal of total P

**Models:** Model was developed to calculate P reduction in the loch through buffer strips

**Field experiment:**

**Others:**

**Are uncertainties quantified?** Everything relevant is quantified, uncertain data (relying on expert judgement) has to be improved

**Process**

**Who built the CEA ?** Researchers from Scottish Institutes build the model, using a regular (not specified) approach

**Which role of stakeholder consultation?** Not explicitly dealt with, Farmers have to be compensated in order to voluntarily cooperate and allow buffer strips

**Are the different steps of the analysis developed in a transparent way?** Short but transparent

**Are there iterations in the implementation process?** Not mentioned and unlikely due to time constraints

**Which integration of the results in the decision making process?** This is a research study on model development for c/E abatement of P, therefore is not written in regard to inform decision making

**Technical limit of the analysis:** The phosphorus export coefficient, delivery ratio, and buffer P trapping efficiency estimates were based on expert judgements, the results reported in this study are only indicative.

**Main constraints encountered:**

**General comments:** Interesting research yet not exemplary for Scottish approach in the RBMP

**Author and organism:** Stout, Lisa and Fenn, Teresa  
 RPA, Environment Agency  
**Publisher or contracting body:** RPA, Environment Agency

**Country:** United Kingdom (Scotland)

**Geographical Area covered:** River Leven and Loch Leven

**Type of publication:** Pilot Study on CEA use  
**Internet links:** <http://www.wfdcrp.co.uk/pdf%5Cp2a-2b-annex1.pdf>

**Themes:** Quality; Hydromorphology;

**Key Focus:** Pilot Study  
**Relation to WFD:** In regard to WFD

**Sector:** Agriculture; Industry; Households;

**Summary of the study:** Pilot study to test the methodology establish by the Collaborative Research Programme On River Basin Management Planning/SEPA. It was conducted by Scottish agency SEPA and SISTech consultancy.

**Measures**

**Does the CEA analyze measures or combinations of measures?** measures, for each pressure there were 3 measures to remediate, reduce and remove. Later combinations of measures were analysed.

**How many measures are compared in the CEA?**  
 24

**List or type of measure compared:** phosphor, hydromorphological, 2 measures for national level

**What are the main differences between measures?** Local vs national, load vs hydromorphological

**Methodology**

**C/E Ratio calculated?** Not quantified  
**On which parameters?**  
**Example of C/E indicator:** £/reduction in gap to good status

**Measures ranked based on C/E ratio and /or Expert judgment?**  
 Qualitative

**Generic approach and/or data sources (e.g. national databases)?** Generic approach insofar as it followed the methodology given yet the data on cost and effectiveness were not compiled yet, thus the testing relied mainly on local data provided.

Illustration of C/E ranking from the study:

Combination of Measures	Delivery Mechanism and Level of Effect	Pressure(s) Addressed	Effectiveness (as a range)		Time for the Measure to be Effective	Certainty of Outcome	Cost (£) (as a range)	Non-Monetary Costs	Other Key Factors, including those that may result in low sustainability
			% Gap Addressed	% Gavg Scale where Gap is Reduced					
1	Legislation and economic instrument (national). QAS for STW's, best practice, criteria of licence, review of consent	Phosphorus, nitrate, morphological	Morphological measures require research, other measures addressed to some extent but not well known	Whole length of river and loch	Within 5 years	High because P is sediment is removed	Local measures (P): £100m to £150m (P/A): £14m to £27m to 100%	Assumes there is a beneficial use for sediments, if not will be disposal requirements Emissions from dredging. Temporary disruption to fisheries.	Assumes 1 000 000 m <sup>3</sup> dredged per year
2	Including removal of sediments	Phosphorus, nitrate, morphological	Morphological measures require research, other measures addressed to some extent but not well known	Whole length of river and loch	Reducing inputs but not control of P so likely to be >5 years	Low because P is sediments is not removed	Local measures (P): £14m to £35m (P/A): £7.7m to £4.3m to 100%		

*Which costs of the measures have been taken into account?*

<b>Investment costs:</b> Yes, but not specified	<b>Operation and maintenance costs:</b> Yes, but not specified	<b>Indirect costs (Income losses...):</b> Listed non monetary	<b>Environmental costs:</b> Non water environmental costs and benefits are listed non monetarily	<b>Others:</b>
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**Method for annualizing:** There are Present Value Costs and Equivalent Annual Value, time horizon is given for costs

**Are the cost distributed among financers?** Not mentioned

How has effectiveness been taken into account?

**Global in terms of general impact on the water body status:**

**Examples of indicators used:** %

Gap addressed

**Limited to one (few) parameters of the water status:** Qualitative reduction in gap to good status (P)

Tool used to measure effectiveness?

<b>Expert judgment:</b> Yes, in the absence of reliable data	<b>Models:</b> No	<b>Field experiment:</b> No	<b>Others:</b>
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**Are uncertainties quantified?** Yes, confidence band around cost estimates, reliability and accuracy bands

**Process**

**Who built the CEA ?** Collaborative Research Programme On River Basin Management Planning Economics

**Which role of stakeholder consultation?** Insufficient time to involve stakeholders

**Are the different steps of the analysis developed in a transparent way?** Yes

**Are there iterations in the implementation process?** Not mentioned but unlikely due to time constraints

**Which integration of the results in the decision making process?** Not mentioned

**Technical limit of the analysis:** Lack of data and the ability to specify measures and general insufficient data on cost and effectiveness, considerable assumptions had to be made

**Main constraints encountered:** Time limits

**General comments:** Study is representative for the approach but the measure selection/data situation is hopefully much better now due to the development of databases etc. With the lack of data envisaged the study faced serious shortcomings.