International Workshop on Eutrophication
Synthesis of knowledge

An analysis of international studies on the economics of eutrophication

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literature review : Sybille de Mareschal

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Outline

>> Objectives of this work

>> Methodology followed for the analysis of international studies

>> Lessons learned from studies

>> What economics can do to help reduce eutrophication ?

Economics

Object: How individuals, societies allocate scare resources between alternative uses

Objectives: To understand, to help make choices, to identify opportunities

Motivations

>> National expertise on Eutrophication

- A bibliographical search carried out on economic papers addressing this issue
- The reviewing of the selected recent international literature on the economics of eutrophication
  - Databases SCOPUS (specialized in Human and Social Sciences)
  - ECONLIT (specialized in economic literature)
  - JSTOR databases to retrieve full texts

No search in grey literature but only in scientific papers

Applied methodology

Step One: First key-words definition

Language		Key-words
F	EN	econom*
	EN	regulation
F	EN	réglementation
F		incitation
	EN	incentive
	EN	procurement
F	EN	eutrophi*
F	EN	impact + econom* + (evaluation or assessemnt)
F	EN	estimation
F	EN	evaluation
	EN	assessment

Language		Key-words
	EN	efficiency
F		efficacité
	EN	public policy
F		politique publique
F		coût
	EN	cost
	EN	cost + efficiency
	EN	cost + benefits
F		coût + bénéfice
F		coût + efficacité
	EN	cost + mitig* + eutrophi*
F		coût + (atténuation or limitation) + eutrophi*
	EN	cost + allocation
F		coût + répartition

Language		Key-words
F	EN	indicat* + eutrophi* + econom*
	EN	non point + pollution
F		diffus + pollution
	EN	resource equivalency analysis
	EN	habitat equivalency analysis
	EN	uncertainty + eutroph* + econom*
	EN	risk + eutroph* + econom*
	EN	eutrophi* + abatment
F		eutrophi* + réduction

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Problem: number of obtained results

for exemple with Scopus database: eutroph* and efficiency = 1831 papers

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Xepapadeas, conomics of non-point-source pollution. Annual Review of Resource Economics 3, 355-373
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Applied methodology

Step two: Adjustment of equations to get a manageable number of results

Query	Equation	Number of documents
R2 - Scopus	Eutroph* AND (Regulation OR incentive OR "public policy") Limit to : (SOCI") OR LIMIT-TO (SUBJAREA, "DECI") OR LIMIT-TO (SUBJAREA, "MULT") OR LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON") OR LIMIT-TO (SUBJAREA, "ARTS" = 82	82
R3 - Scopus	Eutroph* AND Procurement	10
R4 - Scopus	Eutroph* AND (impact + econom* + (evaluation or assessment)) AND (Business, Socio, economy, decision OR arts)	19
R7 - Scopus	Eutroph* AND cost* AND (LIMIT-TO (SUBJAREA , "SOCI") OR LIMIT-TO (SUBJAREA , "ECON") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "DECI")))	43
R10 - Scopus	Eutroph* + (cost + mitig* + eutrophi*+econ*)	37
R11 - Scopus	Eutroph* AND (cost + allocation)	33
R15 - Scopus	resource equivalency analysis OR habitat equivalency analysis	51
R17 - Scopus	eutroph* AND uncertainty + econom*	63
R18 - Scopus	autroph AND risk + econom*	193
R19 - Scopus	eutroph* + abatement + cost	83
R20 - Scopus	eutroph + abatement + econmy + "public policy"	4
Econlit	(eutroph* + impact) AND (eutroph* + economic)	409
	Total	**1027**

Limiting the number of results through trials and errors by retaining only the most relevant key-words

Total without duplicates

932 papers

Methodology applied

Step three: Checking

Checking that 10 papers considered as key papers have been found by following this methodology

Only 2 papers not found (added to the base)

+ 4 documents (reports, books)

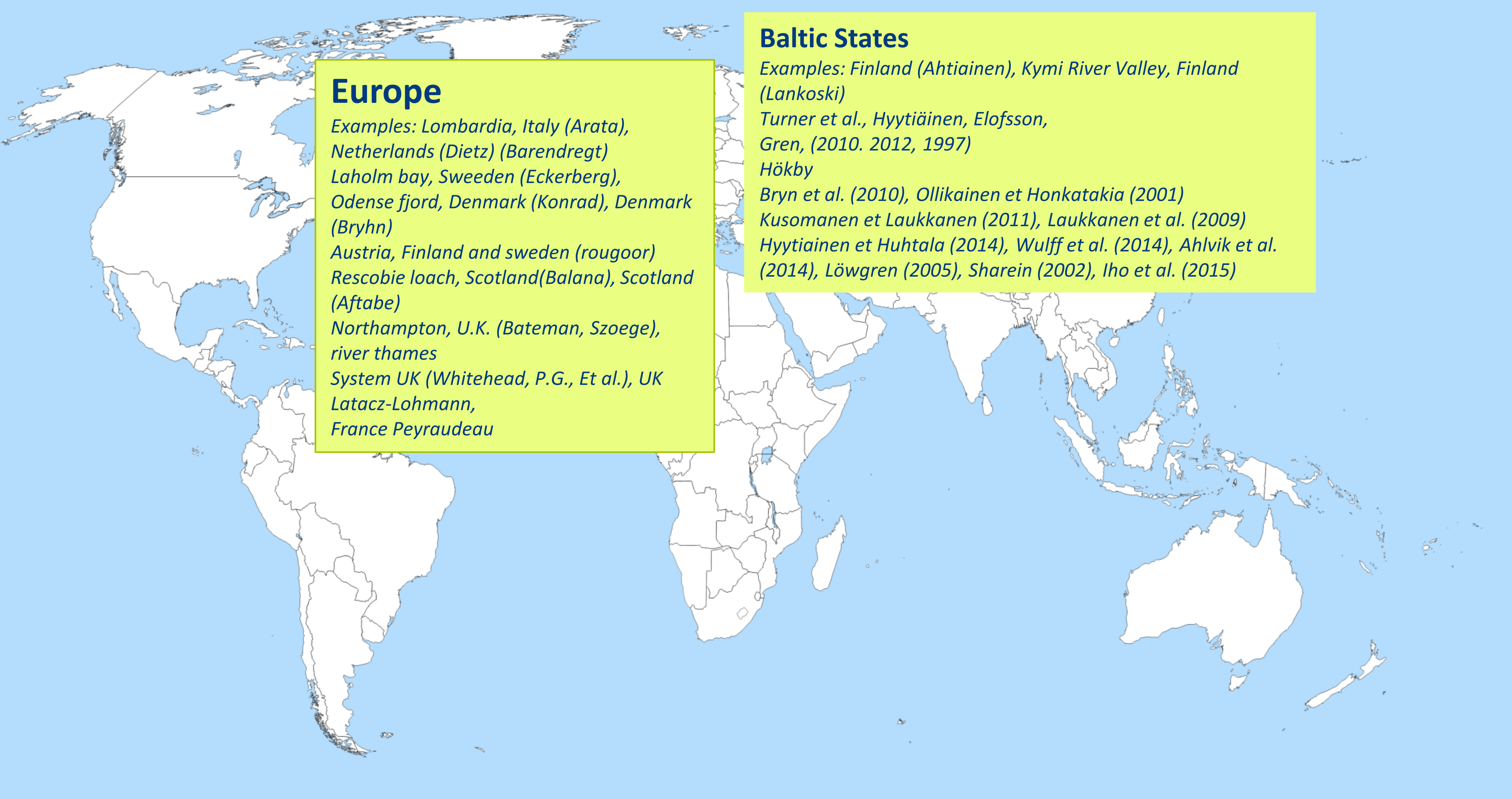
Step four: Removal

From 938 documents elimination of papers out of the scope (by reading the abstract, the whole paper)

Query group	Number
R2*	25
R3*	1
R4*	4
R7_b	12
R10_b	18
R11_b	29
R15_b	35
R17_b	23
R18_b	37
R19_b	83
R20_b	4
Econlit_b	112
Total	**383**

Without duplicates → **382 papers analyzed**

Where are the cases studies located



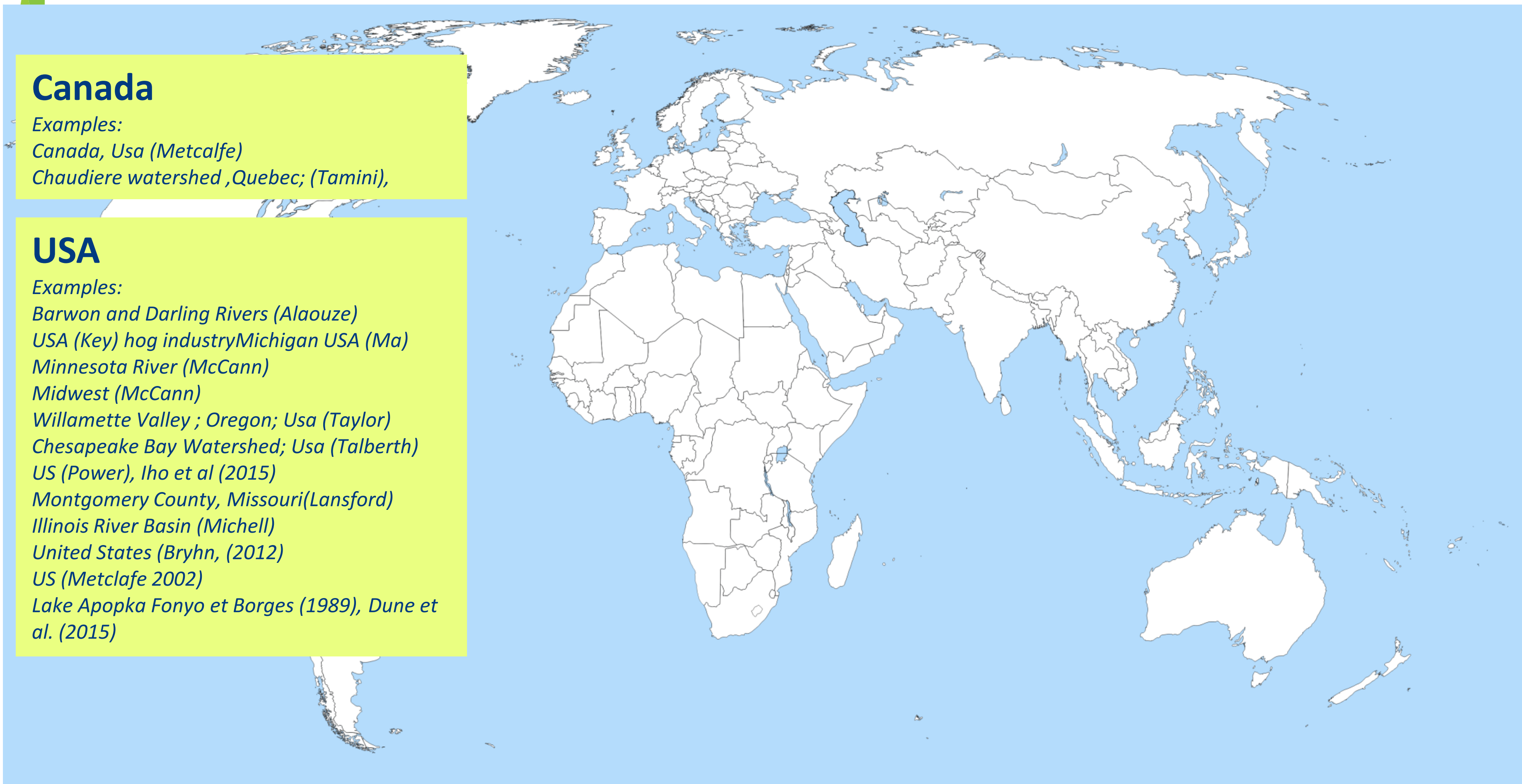
Europe

Examples: Lombardia, Italy (Arata),
Netherlands (Dietz) (Barendregt)
Laholm bay, Sweeden (Eckerberg),
Odense fjord, Denmark (Konrad), Denmark (Bryhn)
Austria, Finland and sweden (rougoor)
Rescobie loach, Scotland(Balana), Scotland (Aftabe)
Northampton, U.K. (Bateman, Szoege), river thames
System UK (Whitehead, P.G., Et al.), UK
Latacz-Lohmann,
France Peyraudeau

Baltic States

Examples: Finland (Ahtiainen), Kymi River Valley, Finland (Lankoski)
Turner et al., Hyytiäinen, Elofsson,
Gren, (2010. 2012, 1997)
Hökby
Bryn et al. (2010), Ollikainen et Honkatakia (2001)
Kusomanen et Laukkanen (2011), Laukkanen et al. (2009)
Hyytiainen et Huhtala (2014), Wulff et al. (2014), Ahlvik et al. (2014), Löwgren (2005), Sharein (2002), Iho et al. (2015)

Where are the cases studies located



Canada

Examples:
Canada, Usa (Metcalfe)
Chaudiere watershed ,Quebec; (Tamini),

USA

Examples:
Barwon and Darling Rivers (Alaouze)
USA (Key) hog industryMichigan USA (Ma)
Minnesota River (McCann)
Midwest (McCann)
Willamette Valley ; Oregon; Usa (Taylor)
Chesapeake Bay Watershed; Usa (Talberth)
US (Power), Iho et al (2015)
Montgomery County, Missouri(Lansford)
Illinois River Basin (Michell)
United States (Bryhn, (2012)
US (Metclafe 2002)
Lake Apopka Fonyo et Borges (1989), Dune et al. (2015)

Where are the cases studies located

Environmental policies

>> Three types of environmental policies

- Structural actions or activities undertaken directly by public authorities (1)
- Non-structural actions managed by public authorities (e.g. education, taxes, subsidies, etc.) (2)
- Regulation of private activities: licenses, codes, standards,..(3)

>> Two main methods (2)+(3)

- Command and Control (generally not very efficient in terms of cost effectiveness)
- Incentives and/or constraints

>> Two important problems

- Free-rider problem
- Taking into account the time dimension (discounting, technological progress) and uncertainties

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Policy strategies

- Three types of policy strategies*

  >> Regulation strategy

  with associated instruments: permits, standards, rules, interdictions, sanctions

  >> Market strategy

  with associated instruments: incentives, taxes

  >> Communication strategy

  Information, advices, education, negotiation

* Combination of political instruments (defined as an authoritarian choice of means to reach a particular objective)

Objectives of a policy need to be clearly defined

>> Too ambitious objectives are not applicable and lead to programs that are not Cost-Effective

- They are inefficient because they are not implemented at the relevant scale and costly because nevertheless partly implemented

>> If allocated budgets cannot satisfy the full implementation of a policy then it is better to have a limited and targeted budget with a relatively higher efficiency

>> Interest in coordinating actions (between different geographical sectors, different sources of pollution), even if this can lead to complicated dynamics (especially when intervention of stakeholders)

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Assessment methods

>> Costs should be compared with the effectiveness of advocated actions

>> If Cost-Benefit analysis wants to be a correct assessment tool then we need to give attention to cost and benefit assessment methods

>> Consider the spatial and temporal variability of costs and benefits

- *The variability of water quality (also dependent on climatic conditions) must be taken into account in assessing the effectiveness of remediation measures*

Examples:

-Effects of different approaches of quantification on cost-effectiveness analysis (Gren et Destouni;2012)

-Use of high resolution data to identify cost-effective and targeted N leaching reduction by optimizing measures implementation and location (Konrad et al.,2014)

- Integrated assessment of land use changes for reducing P transfers to lakes Roberts (2012)

- Effects of policies based on inputs and direct restrictions on Nitrogen leaching Doole, Romera (2013)

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Assessment methods

>> Discount rate in cost-benefit analyses

Example: Ludwig, (2005)

- The choice of the discount rate in the process of weighting costs and benefits over time should take into account uncertainties over long-term rates

What types of costs?

Direct private costs, indirect costs, public costs, opportunity costs …

>> Transaction costs

taking them into account

- Could help prevent distorting assessment of alternatives policies for reducing at least costs
- Could help identify factors affecting these costs in environmental policies
- Could help manage and design policies to reduce these costs
- Relevant in time of budgetary restrictions and aversion of programs with increased bureaucracy
- Taxes have the lowest transaction costs

Examples:
Transaction costs of policies and scale returns (McCann, 2009)
Calculation of transaction costs (McCann et Easter, 1999)

What types of benefits?

>> Take into account the full benefits

>> Benefits to be analyzed for a range of long term hypothesis

Taxes to discourage polluting activities

>> Input-based mechanisms are generally inadequate because of the substitution between inputs and in general the weak correlation between inputs and transfers

Examples:
- Taxes on N fertilizers (experiences from Austria, Finland, and Sweden) (Rougoor) (2001)
- Taxes on the use and transport of different types of farm effluents, model simulation of policies scenarios (Keplinger)(2006)

>> Policies targeting Nitrogen or Phosphorus
Effect of effluent control policies, limited if their modes of application are not also taken into account

Grants / subsidies

>> To encourage environmental friendly behaviors

provided that the implementation of measures is effective so as not to be unnecessarily costly

>> Can improve the effectiveness of policies by offsetting high taxes required for

>> Uncertainty on biophysical processes, farm incomes, LT markets, production functions and attitude towards risks: keys to understand participation in programs and adoption of practices

Non regulatory methods based on the market

>>Markets more efficient than constraints on quantities

>> Markets for effluents

- Improved nutrient balance at the regional (national) Level
- foster the redistribution of effluents from surplus areas to deficit areas
- Relative value of effluents relating to transport costs may limit the geographic scope of these markets

>> Efficient market development requires regulatory incentives (restrictions on the application of surplus nutrients) and public investments in market development

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Non regulatory methods based on the market

>>Exchangeable permits are more effective than instruments based on regulation and constraints

>> The effectiveness of markets for permits

very variable according to the heterogeneity of the sources of pollution, polluting activities and the heterogeneity of the media

Examples:

- Role of spatial heterogeneity when polluting permits NPsource pollution and PS pollution (Lankovski 2008)

- Consequences of permit system (maximum loads) at the regional scale (Michell 2012)

>>The definition of the price of these licenses remains an important parameter for the success of this instrument

Example: -Markets for permits to spray farm litters exchangeable with WWTP (Mitchell 2001)

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Regulation (quotas/standards)

>> Preferable to have simultaneous and coherent regulation on inputs (N & P)

>> Explicit consideration of the heterogeneity of farms

Differentiated policy towards regulation

>> The severity of standards (although effective) may also have a detrimental effect on the economic efficiency and output of some farms

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Multiplicity of the pollution causes

>> Do not seek uniform reduction

>> Considering N and P simultaneously is

- economically efficient
- would reduce costs
- would ignore different trade-offs, including those between pollutants

>> Policy targeting different goals

Examples:

- Cost-effective policies for reducing N and P (Szoege et Edwards, 1996; (Hökby et Soderqvist, 2003)

- Cross effect of policies for managing N and irrigation water (Knapp; 2008);

- Simultaneous management of phosphorus et de sediments transfers (Doole et al.; 2013)

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Coupling models: adaptive management strategies

>> A two stage approach not effective

- Avoid to set a goal for biophysical considerations which would then be sought to be achieved at a the lowest cost
- Consider economics from the beginning to take into account complicated biophysical phenomena

>> The coupling of economic models to biophysical models could help

- improve the effectiveness of public policies or to reduce its cost compared to first 'biophysical' and then 'economic‘ approaches

Example: Use of hydro-ecological modeling and costs options for cost-benefit analysis Barendregt et al. (1992)

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Mixing economic instruments

>> Mixing economic instruments based on relevant trade-offs can be much more cost effective than instruments taken separately

Examples:

- Analysis of livestock effluent policy in the Netherlands; Dietz (1991)

- Polity based on quotas/ha + reduction of quantities applied+ ad valorem tax for N and P differentiated between nutrient SWAT modelling Burkart, (2012)

- Strategy policy (Eckerberg et Forsberg, 1996) implementation strategy

>> The coupling of economic models to biophysical models could help

- improve the effectiveness of public policies or to reduce its cost compared to first 'biophysical' and then 'economic‘ approaches

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Key factors for problem analysis

>> Temporal dimension and irreversibility

>> Imposing a maximum level of pollution as a constraint may be ineffective

>> Problem of crossing pollution thresholds

>> Pollution has often several causes and often multiple effects

>> Heterogeneous nature of the sources of pollution, of the concerned agents

>> Random nature of pollution

Criteria for successful reduction policies

>> Interest in coupling different economic instruments

>> Do not seek to achieve a pre-established goal, but gradually improve the situation,

>> Consider irreversibility in a changing world

>> Climatic changes and eutrophication

>> Take into account spatial heterogeneity

>> Have a big picture of Costs and Benefits associated to pollution reduction

Thank you for your attention