



Economic Benefits of Acid Rain Abatement

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Contents

- Environmental Valuation theory & approach
- Acid Rain impacts (direct & indirect)
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Environmental Valuation (EV)

- EV is a method of estimating the value that people place on the environment (or certain parts of the environment) using a common unit (dollars, Euros, yen, etc).
- The use of a common unit facilitates comparison of the value of different environmental goods and services.
- The things that people value are not limited to the things they spend money on. EV tries to capture all sources of value, not simply direct market values.

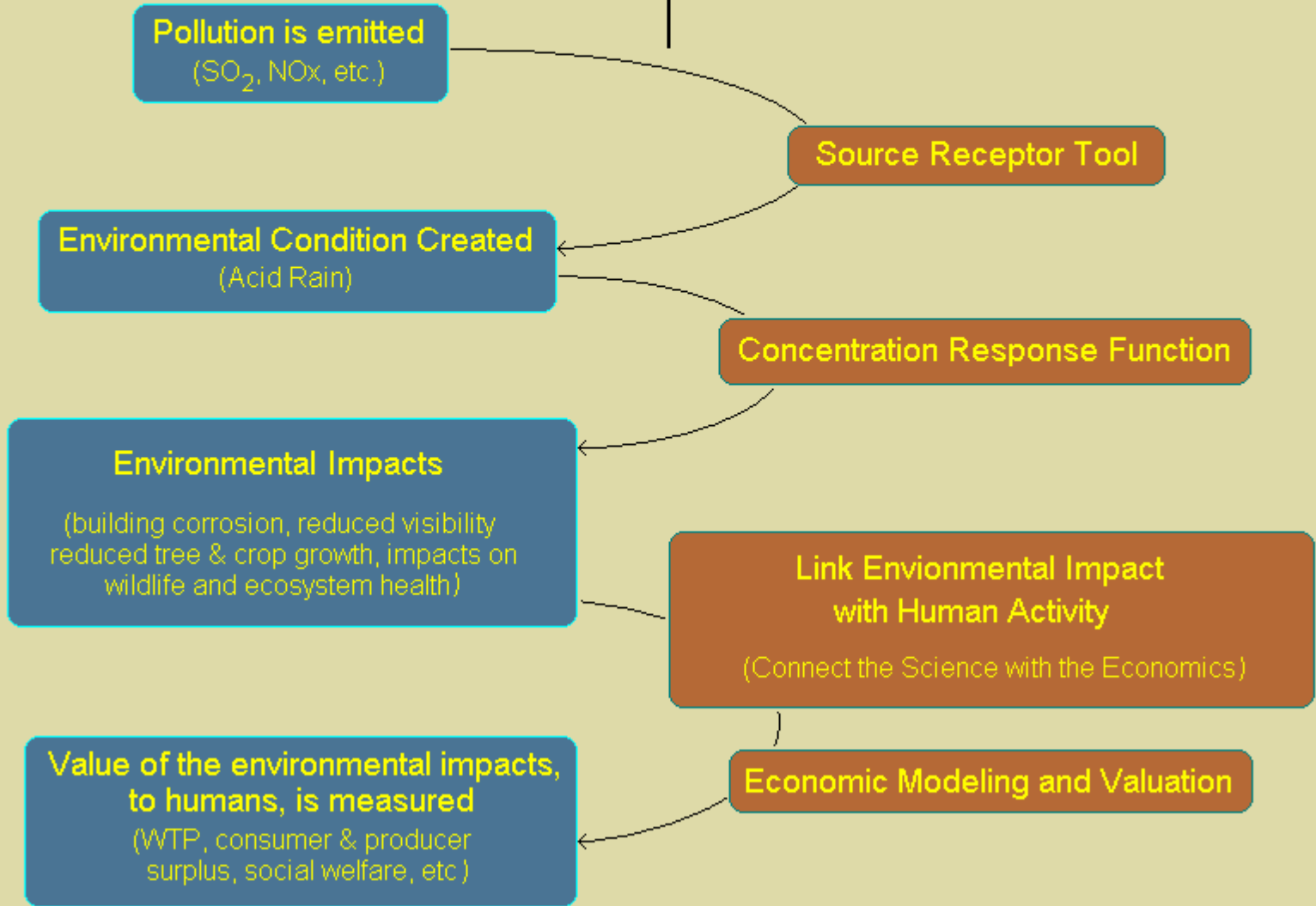
Valuation Theory

- Emissions
 - Environmental Condition(s)
 - Environment & Human Impacts
 - Valuation
- Each step must be linked with previous step and relationship quantified.
- For policy purposes, we are interested in marginal impacts.
- We measure the change in values, resulting from changes in environmental conditions.

Generic Approach to Environmental Valuation for Acid Rain

Steps for Valuation

Linking Techniques



Types of Value

- People value the environment for many different reasons:
 - They use it to make a living; They enjoy being close to nature; They just like knowing it is there; etc.
- When the condition of the resource changes, it's value to people increases or decreases.
- For policy purposes, we want to measure this change in value.

Total Economic Value of the Environment

Decreasing Tangibility



TEV

Use Values

Non-Use/Passive Values

Consumptive

Non Consumptive

Option Value

Vicarious Consumption

Bequest Value

Pure Existence

-Timber
-Agriculture
-Fishing
-Hunting
-Buildings

-Visibility
-Tourism
-Birding
-Research

Save for later
-Biodiversity
-Eco health
-Species survival

Like other people to be able to benefit

Leave value for future generations
-Sustainable Development

Like nature for its own sake
"warm glow"

Measuring Values

- For marketed commodities (timber, agriculture, building materials) we measure value based upon market changes: prices, producer profits, consumer surplus (benefit).
- For non market use values (tourism, visibility, fishing) we can use secondary market observations, travel costs, hedonic pricing.
- To capture non use values, we must typically use stated preference approaches (contingent valuation, choice experiments).

Impacts of Acid Rain

Direct Damages of Acid Rain

- Corrosion of buildings & infrastructure
- Damages to forests & forest soil
 - Timber industry impacts
 - Tourism & recreation impacts
 - Non use value impacts
- Acidification of lakes & rivers
 - Commercial & recreational fishing losses
 - Non use value impacts
- Other environmental & ecosystem damages
 - Diminished natural capital/capacity & biodiversity

Direct Vs Indirect Benefits

- What is it we want to value?
 - Acid rain reductions, *ceterus parabus* ?
 - NO_x and SO_x reductions ?
 - AD reduction policies ?
- The primary pollutants responsible for acid deposition (NO_x & SO_x) also contribute to smog formation.
- Reducing smog will result in significant benefits.
- These benefits are the direct result of NO_x and SO_x reductions. They are the indirect benefits (or “co-benefits”) of AD reduction.

Other Damages of NO_x & SO_x

- Significant health impacts of PM & Ozone
- Poor visibility due to PM
- Material soiling due to PM
- Agriculture and forestry impacts of ozone
- Wildlife & ecosystem impacts of ozone

Acid Rain reduction policies (ie policies to reduce NO_x & SO_x emissions) will create co-benefits in all these areas.

Direct impacts of acid rain

- Numeric Examples

Forest Impacts

- At current deposition levels, over half a million cubic meters of wood is being lost each year from forests in NB and NS due to soil nutrient & base cation leaching.
- The market value of this wood is about \$159 million per year.
- Numbers are probably much higher for Ontario & Quebec (though exact numbers are unknown).

Source: Arp, 2004

Recreational Fishing Impacts

- Canadians spent \$1.9 billion on recreational fishing in 1996.
- Recreational fisherman spent an average of \$40 per day of fishing.
- Acid rain has seriously reduced fish populations in many lakes and rivers.
- This could have serious impacts on both the enjoyment of fishermen, and their financial contribution to the Canadian economy.

Source: Nature Survey, 1996

Commercial fishing

- Acid deposition has reduced many commercial fish populations in inland lakes and rivers, including ocean species who spawn inland (ie atlantic salmon).
- Fishing of these species represents a hundred million dollar per year industry.
- Exact impact of acid is unknown, but is potentially resulting the loss of millions of dollars worth of commercial fishing revenue annually.

Infrastructure & Building Corrosion

- Impacts are most significant for older buildings & highly exposed infrastructure.
- Corrosion repair costs for cultural and historic buildings can cost millions (ie, parliament).
- For electrical transmission towers, life expectancy is reduced by 50% or more in areas of high acid deposition.
- Each of these towers costs thousands to repair and hundreds of thousands to replace.

Other environmental damages

- Canadians spent over \$12 billion on nature related activities in 1996.
- These expenditures likely represent only a part of the environment's use value, and capture little, if any, of the environment's non use value.
- Thus observed expenditures may only be the tip of the iceberg for the value Canadians place on the Environment.
- Damages from acid deposition could seriously reduce environmental quality and the benefits the environment provides to Canadians.

Knowledge gaps

- The most difficult task for valuation is to link physical impacts to human values (link the science with the economics).
- For example, scientific models can predict impacts on fish populations.
- On the economics side, we know how much fishermen spend, and how much they value fishing.
- What we don't know, is the relationship between fish availability and the enjoyment or expenditures of fishermen.

Challenges & Opportunities

- On the science side, great progress is being made on identification and quantification of the physical impacts of air pollution.
- Economic valuation can be used to value effects on humans, once these are identified.
- Our challenge is to identify the link between physical impacts, and the human effect.
- This will require continuing collaboration between the scientific and economic communities.

For questions or comments please contact

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