THE ECONOMICS OF LAND DEGRADATION

ELD CAMPUS

Module: Cost-benefit analysis

In this module you will learn about:

- *The logic and basic elements of a cost-benefit analysis (CBA) and the importance of a sound context analysis*
- *"With project" and "without project" scenarios*
- *Time preference and discounting (choice of social discount rate or factor)*
- *Economic indicators to conclude on a project's worth*
  - *- net present value (NPV)*
  - *- internal rate of return (IRR)*
  - *- benefit-to-cost-ratio (BCR)*
- *Derivation of economic costs and benefits from financial values*
- *Uncertainty and sensitivity analysis*

If you want to deepen your know-how on CBA, further information is provided in the script on this module and links are provided at the end of this presentation. The self-study module on CBA also offers more explanations as well as an application example!

Basics about cost-benefit analysis

- Cost-benefit analysis is a form of analysis derived from accounting
- Policy-makers and project managers use CBAs to assess whether an action, planned change or project is worth undertaking
- Whereas a **financial cost-benefit analysis** builds on actual (financial) prices, an **economic cost-benefit analysis** integrates the viewpoint of society as a whole
- Economic costs-benefit analysis is also called social cost-benefit analysis

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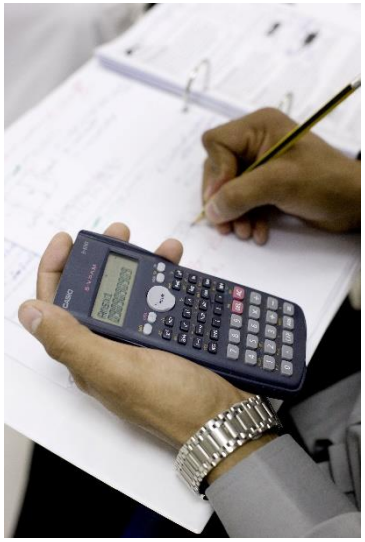

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Key steps of a CBA

- Definition of the target group
- Definition of parameters of the analysis:
  - timeframe
  - categories of benefits and costs
  - discount rate
  - indicators of a project worth
- Estimating economic benefits and costs under alternative scenarios
- Comparing net benefits of action to net benefits from business-as-usual to estimate the 'added value' of action
- Computing indicators of viability
- Sensitivity analysis

Source: adapted from Snell 2011

Cost-benefit analysis – ELD‘s 6+1 step approach

- Step 5 leads to the business-as-usual scenario within the CBA!

1. ***Inception***
2. ***Geographical characteristics***
3. ***Types of ecosystem services***
4. ***Role of ecosystem services and economic valuation***
5. ***Patterns and pressures***
6. ***Cost-benefit analysis and decision-making***

+1 step: ***Take action!***

Structure of a CBA

	Year 1	2	3	4
Revenues (+)		$$$	$$$	$$$$
Costs (-)	$$$	$$	$$	$
Net revenue (balance)				
Discount factor (%)				
Discounted additional revenue				
Discounted additional operating and investment costs				
Discounted additional net revenue				
Discounted net value				
Internal rate of return (%)				
Benefits-costs ratio (discounted)				

„Benefits“ is used instead of „revenues“ for total value CBA

Context analysis for CBA

- A CBA needs to match real-life conditions and derive salient results for informed decision-making
- Participation of local stakeholders in the process is essential
- The constraints faced by stakeholders, the area of interest and the chosen timeframe impact the amounts and variation of costs and benefits across stakeholders, space and time
- Cost-benefit analysis can also be undertaken separately for each stakeholder or group of stakeholder if deemed necessary

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With project and without project scenarios

- Net benefit: Benefits-costs

With project net benefits =
With project benefits - With project costs

Without project net benefits =
Without project benefits - Without project costs

- A cost-benefit analysis compares the net benefit derived from implementing the project to the without project net benefits for each stakeholder:

Incremental net benefit =
With project net benefits - Without project net benefits

Costs and benefits related to land use

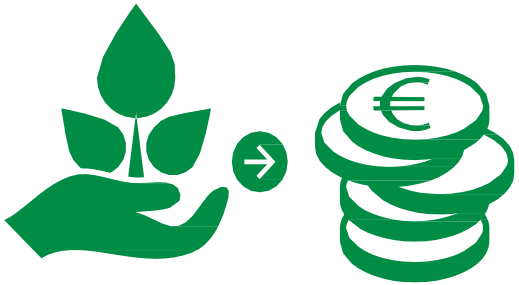
- There is need to identify unit costs and prices for each benefit and each cost, for example:

benefits from agricultural yields =

N° of hectares cropped x price per tonne of crop

benefits from carbon storage =

N° of tonnes of carbon stored x price for each tonne of carbon



- All costs and benefits need to be comparable in how they are measured (price system), their currency as well as across time!

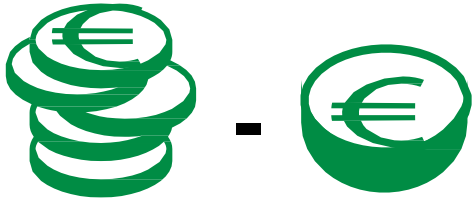
Graph: SV BoDeN: Soil conservation works. Paper for BMZ

Costs and benefits related to land use

- Costs can be decomposed into variable costs and fixed costs.
- Variable costs vary with the quantity used (the higher the quantity used, the higher the cost). Fixed costs do not vary with the level of utilisation (e.g., insurance, building depreciation…).
- Real prices can be derived from observed nominal prices by correcting for inflation.
- The gross margin and net income can then be computed for a given year as follows:

Gross Margin = Benefits - Variable costs

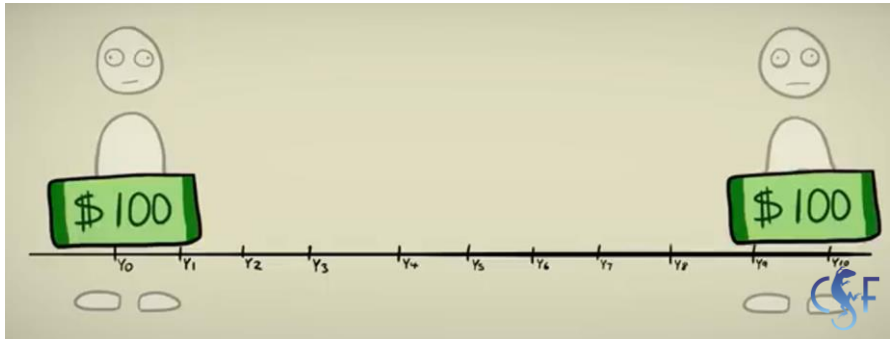
Net income = Gross Margin - Fixed costs



Graph: SV BoDeN: Soil conservation works. Paper for BMZ

Time preference and discounting

- People often show a preference for receiving money now rather than later (time preference). It is the same principle behind earning interest on savings in a bank account
- To assess whether a project is worth doing, the incremental net benefits need to be made comparable in time before they are summed up
- **Discounting is the technique used to express equivalent economic or financial values at a chosen point in time**. Costs and benefits occurring in the future are discounted to obtain the value they would have if they were occurring today = present value



Graph: Conservation Strategy Fund

Time preference and discounting

- The current value of future benefits and costs is computed as follows:

  Present Value = Discount Factor x Value

- The discount factor directly reflects on time preferences. One of the most common formulas for the discount factor is:

  Discount Factor = 1/(1+r)^(t-1)

  r:discount rate t:the year

- The further in the future the cost and/or benefit occurs, the less it is worth today.
- **The higher the rate of discount is, the quicker an amount of money loses value in time**!

Graph: SV BoDeN: Soil conservation works. Paper for BMZ

Time preference and discounting

- The choice of a discount rate is not neutral and can influence the decision to undertake a project or not!
- The discount rate is generally higher in less developed countries
- Future generations are not yet here to signal their time preference and their influence tends to be ignored when choosing a discount rate.
- By design, a lower discount rate assumes more intergenerational equity than a higher rate.
- Stern Review on the Economics of Climate Change: 1,4% discount rate!
- A good cost-benefit analysis should include a discussion on the consequences that the chosen discount rate has on the result of the CBA

Economic indicators to conclude on a project worth

Net present value:

- The NPV is the sum of the present value across all years. When computed from incremental net benefits, it gives an indication of whether the project will add to business as usual.
- The project is considered worth undertaking for a NPV greater than 0 (positive) and not worth undertaking for a NPV less than 0 (negative).

Economic indicators to conclude on a project worth

Internal rate of return

- The Internal Rate of Return (IRR) is the discount rate at which the net present value equals zero.
- In other words, it corresponds to the maximum interest rate that can be earned from investing resources in a project

Economic indicators to conclude on a project worth

Cost-to-benefit ratio or Benefit-to-cost ratio

- Comparison of the present value of an investment decision or project with its initial cost
- It is the ratio obtained by dividing the present value of the benefit stream by the present value of the cost stream.
- Present values are derived using the opportunity cost of capital as the discount rate.
- A project is accepted if the BCR is greater than or equal to 1.

Economic indicators to conclude on a project worth

- All three indicators are complementary and when possible should be computed to assess a project's worth.
- They do not necessarily always lead to the same conclusion, in which case a further formal discussion on whether the project is worth undertaking needs to be included with the cost-benefit analysis.
- The indicators can be computed in a financial as well as in an economic setting

Derivation of economic costs and benefits from financial values

- A financial analysis is based on the financial costs and benefits to participants whereas an economic analysis is based on the costs and benefits to society as a whole
- Financial costs and benefits are typically observed through market prices, user fees or the like
- In case of ELD studies, **the interest is in both economic and financial values**
- Economic values are referred to as **shadow prices**, as they are "in the shadow" of the financial values that can be observed in real-life
- Economic values correspond to opportunity costs and/or willingness to pay for the goods and services considered from the point of view of society as a whole

Derivation of economic costs and benefits from financial values

- One of the easiest ways to undertake an economic cost-benefit analysis is to first perform a financial analysis and then adjust each financial value to derive its economic equivalent
- Adjustments between financial and economic values are needed because of market price distortions that arise when markets are not perfectly competitive.
- The type of adjustment varies with:

  - the type of value being considered (transfer payments, traded good, non-traded tradable good, non-traded non-tradable goods);
  - the reference system adopted for measuring the costs and benefits (world or domestic price system); and
  - the currency (domestic or foreign) in which benefits and costs are expressed.

Derivation of economic costs and benefits from financial values

- Economic values can be derived or estimated from financial values in 3 steps:
  - Step 1 – Adjust for transfer payments (taxes and subsidies)
  - Step 2 – Adjust for price distortions in traded goods
  - Step 3 – Adjust for price distortions in non-traded goods (tradables not traded in practice and non-tradables).
- Ultimately, the decision to undertake the project or not when indicators are contradictory between the financial and economic analyses will depend on how much priority is given to actual financial flows over the value to society as a whole.
- It may be socially acceptable to go ahead with a development project that leads to small losses for society as a whole (negative NPV in the economic analysis) but that allows poor stakeholders to benefit from it (positive NPV in the financial analysis).

Uncertainty and sensitivity analysis

- A sensitivity analysis aims to assess consequences on the project's economic worth for risks arising from the project itself or external forces.
- A good sensitivity analysis helps assess the resilience of the consequences of project implementation and its social consequences. This is particularly critical to assess whether livelihoods of already fragile populations can be sustained even under extreme events or not.

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Uncertainty and sensitivity analysis

- For a sensitivity analysis the main quantities and/or prices that are likely to change, e.g. because of droughts, floods, changes in inputs or fluctuations in commodity prices are identified
- This can be done in consultation with the relevant stakeholders and/or based on local or international expert opinion
- The **average values** originally used in the CBA **are changed to the new "extreme" values** and the economic indicators of a project's worth are recalculated
- If the project is worth doing on average but not under extreme events, a policy-maker might want to consider either not undertaking this project or providing some form of safety net
- Alternatively, the values of quantities and prices of inputs can be changed to obtain "switching values"

Further information and reading:

Script for this module

Further resources:

Snell, Michael. 2011. Cost-benefit analysis. A practical guide. London, UK

Gollier, Christian. 2012. Pricing the Planet's Future. The Economics of Discounting in an Uncertain World. Princeton University Press: https://press.princeton.edu/titles/9894.html

Curry, Steve and Weiss, John. 1993. Project analysis in developing countries

Potts, David. 2002. Project planning and analysis for development

Belli, Pedro et al. 2001. Economic Analysis of Investment Operations World Bank Institute. WBI Development Studies

OECD, 2018. Cost-Benefit Analysis and the Environment: Further Developments and Policy Use, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264085169-en

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