WaterNet short course
Financing of Water Infrastructure projects

Cost benefit assessment

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Structure

- Project appraisal (PA)
- Cost benefit analysis (CBA)
- Examples

Are PAs and CBAs commonly done as part of the decision making process?

Is there enough expertise to carry out Pas and CBAA

Project appraisal (PA)

- Aims to assess:
  - Expected returns from a project prior during the project preparation phase;
  - Selecting the best project from multiple projects
  - Project feasibility
- Project appraisal provides inputs in the decision-making process
- Different types of appraisals: technical, economic and socio-environmental
- Economic appraisal compares the costs and benefits of a project and aims to maximise net benefits
- Cost Benefit Analysis (CBA) most common:
  - Financial CBA: from the investor's perspective
  - Economic CBA: from the country's perspective
  - Gap between financial and economic returns hampers private sector investments

Cost benefit analysis (CBA)

- Aims to select a project that maximises net benefits and to avoid implementing projects which do not increase welfare
- Allows for comparison of alternative project options, and make a decision on the preferred option
- Different perspectives:
  - **Social-economic** CBA needs to incorporate environmental & social costs and benefits
  - **Financial** CBA: looks at costs & benefits for the investor only. performance).
- CBA issues related to the water sector:
  - Choice of discount rate (DR)
    - Government sets DR for economic CBAs
    - Investor sets DR for financial CBAs.
  - Handling risks (political, project, sector).

Stages of CBA

- Detailed project description
- Choice of time horizon and discount rate
- Identification of costs and benefits in time (cost-benefit matrix)
- Quantification of the costs and benefits
- Valuation of costs and benefits
- Efficiency assessment: Net present Value (NPV), Cost-benefit ratio (CBR), Internal rate of return (IRR)

Example of an aggregate Cost Benefit matrix

	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr8	Yr 9	Yr 10	total
Annual costs	100.00	10.00	10.00	10.00	10.00	20.00	30.00	40.00	50.00	60.00	340.00
Annual benefits	20.00	30.00	40.00	50.00	70.00	90.00	110.00	120.00	120.00	120.00	770.00
Net benefits	-80.00	20.00	30.00	40.00	60.00	70.00	80.00	80.00	70.00	60.00	430.00
discount factor (DR 10%)	1.00	0.91	0.83	0.75	0.68	0.62	0.56	0.51	0.47	0.42	6.76
Discounted costs	100.00	9.09	8.26	7.51	6.83	12.42	16.93	20.53	23.33	25.45	230.35
Discounted benefits	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	245.00
Disc. Net benefits	**-80.00**	**11.91**	**13.74**	**15.49**	**17.17**	**12.58**	**9.07**	**6.47**	**4.67**	**3.55**	**14.65**

Efficiency indicators NPV and BC ratio

NPV	BCR	DR
430.00	*2.26*	0
-5.30	0.89	DR 5%
-29.46	0.98	DR 7.5%
14.65	*1.06*	DR 10%

Efficiency indicator	One project	Choice of projects
Net present value	NPV> 0 accept the project NPV< 0 reject the project	Select the project with the highest NPV
Benefit cost ratio	If BCR >1 accept the project If BCR< 1 reject the project	Select project with the highest BCR
Internal rate of return	If IRR > present rate or discount rate, then accept the project. Reject the project if the IRR is below the discount rate	Choose project with highest IRR

Handling of risks and limitations in CBA

- Carry out sensitivity scenarios: use other costs & benefits for various risk categories. Examples:
  - Different exchange rates to deal with exchange rate risks
  - Different discount rates
  - Different cost and benefit values to deal with costs overruns
  - Different time horizon & timing of B&C to deal with project delays

- Results need to be presented to investor – developer for a better informed decision

CBA limitations

- Handling of B&C that cannot be quantified and yet have to be considered (e.g. Equator principles). Carry out separate EIA and include where possible monetarized B&C (e.g. mitigation & compensation).
- Data intensive & time consuming. Often solved by using assumption and data from elsewhere

Project 1: Improved water and sanitation for women and girls in sub-Saharan Africa

- Source: Malloy-Good (2008). CBA of improved water and sanitation for women and girls in Sub-Saharan Africa.
- **Economic** CBA of improved water and sanitation projects in the sub-Saharan Africa using WHO studies as an entry point;
- In the WHO studies, the following criteria are used for 'improved' facilities:
  - Water supply – Piped water, standpipes, wells, rainwater harvesting & protected springs
  - Sanitation – Flush and pit latrine toilets, ventilated improved latrines, composting toilets, etc.

Methods used for measuring costs and benefits (WHO)

- Costs
  - incremental cost analysis, the costs include all resources necessary for implementation and maintenance and associated costs;
- Benefits
  - Health: Reduced incidence of water related diseases (CBA indicator used is diarrhoea) and reduced mortalities.
  - Direct economic benefits of avoiding diarrhoea disease
  - Indirect economic benefits related to health improvements
  - Non-health benefits related to water and sanitation improvements (water efficiency, time saved in accessing water points, affordable water, improved supply).
- Estimated costs and benefits (2008)
  - Benefits - $39.7 billion
  - Costs - $2.7 billion
  - Benefit-Cost ratio: 14.85: CBC rate exceeds 1: projects worthwhile to carry out.

Integration of ‘overlooked’ benefits

- Time savings;
  - 2.5 hours against WHO’s estimate of 0.5 hour. The result is 912 hours of savings p.a;
- Education impacts on:
  - Productivity and life expectancy up

- Total benefits generated increased from $39.7 to 91.6 billion while the costs remained constant.
- CBAs must therefore comprehensively integrate all aspects of related costs and benefits for improved sanitation;
- Non-CBA factors to consider:
  - Non-monetised benefits should also not be sidelined in decision making process;
  - Community ownership of projects and women empowerment are necessary

INCREASED LIFE EXPECTANCY VALUE

A 10% Increase In Literacy Rate Leads to a 10% Increase In Life Expectancy for Future Generation

Determining the Change In Life Expectancy

10% Increase x Current Life Expectancy in Sub-Saharan Africa = (.1) x (47. 2) =

4.72 Years Increase in Life Expectancy for Future Generation (Per Capita)

Determining Number of Children in Next Generation

Current Population in Sub-Saharan Africa x Population Growth Rate in Sub-Saharan Africa =

752.6 million x 0.023 =

17,309,800 Children In Next Generation

Determining the Total Number of Years Gained

Years Gained Per Capita x Children In Next Generation = (4.72) x (17,309,800) =

81,702,256 Total Years Gained

Determining the Monetary Value of Total Years Gained

Total Years Gained x GNI Per Capita in Sub-Saharan Africa = (81,702,256) x ($742.90) =

$60,696,605,980 Value Gained From Increased Life Expectancy

2.Economic CBA framework for regional infrastructure projects

- Identify costs & benefits
- Conversion to shadow prices where appropriate
- Quantification of non-market impacts (e.g. externalities)
- Social discounting of the C&B
- Efficiency assessment
- Sensitivity analysis to deal with uncertainties & risks

Economic Commission for Africa (2012). Cost-Benefit Analysis for Regional Infrastructure in Water and Power Sectors in Southern Africa.

Box 1: CBA Framework

Step 1: Setting the stage
- Specify the project to be undertaken.
- Identify any constraints that must be satisfied and any other factors to consider in the analysis (e.g. the effects of a project proposal on small businesses and the socially disadvantaged).

Step 2: Determine the scope of the analysis
- Determine the stakeholders to be considered.

Step 3: Assess the costs and benefits
- Direct costs – the costs of implementing and maintaining the project
- Quantity and quality of the goods to be supplied.
- Efficiency of competition.

Step 4: Output
- Provide a baseline statement of the problem that the project is designed to address.
- Present the main option(s) considered.
- Provide an appraisal setting out the costs and benefits of those options, quantifying them or (if quantification is not possible) being explicit about the trade-offs involved. The appraisal should also set out key assumptions on which the analysis is based.

Examples of common C&B by type of water project

Type of project	Details
Transboundary river basin projects	• The costs include: ✓ Expected capital and operational expenditures; ✓ Opportunity costs reflected in the net benefits foregone from available independent alternatives. • Benefits relate to the expected contribution of the planned project and have to be greater than the costs.
Increasing quantity and reliability of water supply	• The benefit is assessed according to expected demand for water that the project will fulfil; • Use shadow price for water based on consumers' WTP for the water service. Can use the market prices of alternative services; • If the WTP is difficult to determine, then apply a conversion factor to the revenues derived from the water service: calculate the mean value between WTP and the long-term marginal cost of the service and adjust the result to take advantage the distributive effects into account.
Leakage prevention projects	• The benefits relate to the reduced volume of water used for supplying the networks. Therefore, these are determined by the water preserved for other uses.
Water quality projects	• Benefits can be assessed by valuing the deaths and illnesses that can be avoided through an efficient water supply service; • For the illnesses, use the total cost of hospital or out-patient treatments and to the income loss due to possible absence from work; • For deaths, quantify the value of life based on the average income and residual life expectancy.
Sewer projects	• For the benefits, assess the demand for sewage that will be fulfilled; • Direct valuation of benefits such as deaths and illness avoided due to efficient sewer systems, or the value generated from improving the quality of the environment where the waste water is discharged.

Some literature

- Economic text books and guides on project appraisal. E.g.
- EC (2014). Guide to Cost-Benefit Analysis of Investment Projects
- Malloy-Good & Smith (2008). Cost-Benefit Analysis of Improved Water and Sanitation for Women and Girls in Sub-Saharan Africa.
- ECA (2012). Cost-Benefit Analysis for Regional Infrastructure in Water and Power Sectors in Southern Africa

THANK YOU

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