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Cost analysis: methods, tools and gender-integration guidelines

CGIAR Gender Equality and Inclusion

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CGIAR Gender Equality and Inclusion is CGIAR's Accelerator designed to put gender equality at the forefront of global agricultural research for development. The Accelerator will transform the way gender research is done, both within and beyond CGIAR, to kick-start a process of genuine change toward greater gender equality and better lives for smallholder farmers everywhere. gender.cgiar.org

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Definition of terms

Cost–benefit analysis: A cost–benefit analysis (CBA) is a comparative analysis of all costs to all benefits of a program or intervention. It is a direct comparison of the monetary costs and benefits of a particular intervention where costs and benefits are measured in monetary terms.

Cost–effectiveness analysis: A cost–effectiveness analysis (CEA) compares the relative costs per unit of effectiveness of a program or intervention. It provides a measure of the resources expended per unit of effect or impact. It offers a basis for identifying which intervention achieves the same impact at a lower cost.

Cost–efficiency analysis: A cost–efficiency analysis evaluates the efficiency of a program by comparing its costs to outputs achieved. It refers to the analysis of cost per unit of output to assess resource allocation. It measures the average cost per output (for example, the intervention cost per household reached).

Discount rate: The rate at which future benefits and costs are discounted to make them comparable with benefits and costs at the present time.

Internal rate of return: Internal rate of return (IRR) is an interest rate that will cause a present-value series of costs to equal the sum of present value for a series of revenues.

Present value: Present value (PV) is the current value of a future sum of money or stream of cash flow given a specified rate of return.

Net present value: The net present value (NPV) is the present value of benefits minus the present value of costs.

Opportunity cost: Opportunity cost is the potential benefits that are lost when an individual, business or investor chooses one substitute over another.

1. Introduction

Cost analyses are essential for promoting transparency and enabling data-driven decision-making, ensuring that limited resources are allocated optimally. There are different types of cost analyses, including cost-minimization analysis (Hirst et al. 2016), cost-utility analysis (Dernovsek et al. (2007), cost-economy analysis (Srivastava et al. 2019) and budget-impact analysis (Silva et al. 2017), cost–benefit analysis (CBA), cost–effectiveness analysis (CEA) and cost–efficiency analysis. This review focuses on CBA, CEA and cost–efficiency analyses because they are among the most common methods used for assessing costs of a project or program. By providing a detailed understanding of costs versus benefits, cost analyses help policymakers allocate funds efficiently to the most effective programs. By identifying key cost drivers and variations across interventions, they enable the design of programs that optimize resource.

Cost analyses are crucial for:

- **resource allocation:** cost analyses support informed decision-making for efficient resource distribution, ensuring the highest return on investment (ROI)
- **project prioritization:** by evaluating the costs and benefits of various projects, teams can prioritize those that deliver the most value
- **operational optimization:** cost analyses help identify opportunities for improvement, enabling teams to streamline operations, reduce costs and enhance efficiency.

CEA evaluates the cost per unit of effectiveness of a program or intervention. CEA compares the costs of a program or intervention to its effectiveness, measuring resources spent per unit of impact (e.g., causal effect). It provides a comparative metric to rank similar interventions based on their efficiency in achieving the same effect.

CBA compares the monetary costs and benefits of an intervention.

It is a direct comparison of the costs and benefits of a particular intervention where costs and benefits are measured in monetary terms. It can help to determine whether a program is worth the investment and allows for comparison across different interventions, such as those in education and agriculture. However, CBA relies on strong assumptions about the monetary value of various benefits, including long-term and lifetime impacts. Estimating these values can be particularly challenging for intangible or indirect benefits, which may not have clear market prices.

Cost–efficiency analyses compare the costs of a program, or set of activities, to the outputs achieved. Cost–efficiency analyses estimate the ratio of program costs to outputs, allowing comparison of cost-per-output for programs producing the same outcome. This analysis is useful for selecting delivery models, evaluating value-for-money and guiding resource allocation. Table 1 provides an overview of the three methods.

Table 1: Types of cost analyses

Analysis type	Description	Measurement	Example
Cost–benefit analysis (CBA)	Total monetary cost versus all monetary benefits	Return expected from every monetary unit invested	The program achieved a cost–benefit ratio of 1:4*
Cost–effectiveness analysis (CEA)	Monetary cost to achieve a given effect (e.g., causal impact)	Cost per unit of effectiveness	$25 per unit of change observed (e.g., 5 percentage point increase in the likelihood of women strongly participating in agricultural production decisions)
Cost–efficiency	Monetary cost to achieve a given output	Cost per output achieved	US$55 per household reached

Source: Adapted from (Levin et al. 2023)

* *A cost–benefit ratio of 1:4 indicates that for every dollar invested, there is an expected return of four dollars in benefits. This suggests a highly favorable outcome, meaning the benefits significantly outweigh the costs.*

This document serves as a guide for CGIAR researchers interested in conducting cost analyses. It outlines the essential steps and information required for undertaking CBAs, CEAs and cost–efficiency analyses, helping users to understand the distinct objectives and insights of each methodology. This guide also offers practical examples and a collection of useful costing resources, with key considerations for integrating gender into these analyses. While designed as a valuable starting point to enhance understanding and integration of these methodologies into daily operations, this guide is not exhaustive, and we encourage readers to consult the listed references for more detailed information.

This guide is divided into three parts. The first part presents an overview of the steps required to conduct CBAs, CEAs and cost-efficiency analyses. The second part includes useful costing resources specifically designed to support various types of cost analyses. The third part provides some guidelines for integrating cost and gender in monitoring and evaluation systems.

2. Three approaches to cost analyses: cost–benefit analysis, cost–effectiveness analysis, and cost–efficiency analysis

2.1. Cost–benefit analysis

Why conduct a cost–benefit analysis

A CBA is a comparative analysis of all costs to all benefits of a program or intervention where the costs and all benefits are measured in monetary terms (Akinyi et al. 2022). CBA helps to rank and prioritize options by considering their costs and benefits to society. Subsequently, the option with the highest net benefit, which is the benefit divided by costs, is the most desirable option. A CBA can assist in communicating and justifying investment decisions to stakeholders, including researchers, policymakers and citizens (Goel & Sharma 2022). It is not a flawless method, and there are certain challenges and limitations to consider when using this approach. For example, it can be difficult to measure and monetize certain benefits, particularly those that are intangible, indirect or long-term. It is also important to balance the quantitative and qualitative aspects of the analysis; relying solely on numbers or ignoring the context of the program or intervention can lead to underestimation of the benefits (Sinden 2019).

Steps in conducting a cost–benefit analysis

1. Define the scope of the analysis

A CBA begins with a clear definition of the scope of the boundaries and parameters that will define the analysis. This definition should include the timeframe over which the costs and benefits will be assessed, specific activities or interventions being analyzed and the outcomes that will be evaluated. This step is critical for determining which benefits and costs will be included in the analysis and the relevant stakeholders that need to be included.

At this stage, clearly defining the geographic scope of the CBA—whether it applies to the overall intervention area or specific locations—is also important. When determining the costs and benefits to be analyzed, identifying all available alternatives ensures a well-informed scope. Additionally, considering broader impacts beyond the implementation of the intervention helps capture indirect and long-term benefits (Food and Agriculture Organization of the United Nations 2018).

2. Quantify and monetize benefits and costs over the duration of the project

Step 2 of the CBA entails quantifying and monetizing all project benefits and costs throughout the project's life cycle. Surveys, financial records, expert consultations, case studies and program evaluations, complemented by a desk review of relevant documents, can be used to quantify and monetize benefits and costs in a CBA (Vaessen et al. 2020).

- **Identifying costs and benefits:** to accurately identify costs and benefits, it is crucial to map inputs, activities, outputs and outcomes in a structured manner. Developing a well-defined theory of change is essential, as it clarifies the resources and actions required to achieve the intended results. A strong theory of change helps determine expected costs by outlining the necessary inputs and activities, while clearly defined outcomes provide a foundation for identifying and monetizing potential benefits.

Typically, for each intervention activity, the inputs will include some combination of personnel and volunteer time, supplies, equipment, vehicles, maintenance, travel, per diem, communication, equipment, consultants, contracted services and overheads (e.g., utilities, office space, shared services, etc.). In some cases, a category for mixed inputs may be relevant for costs that cannot be separated into individual input categories. This category may include costs related to training workshops or community events, such as the venues, accommodation and meals (Levin et al. 2023).

Either a gross- or micro-costing approach can be used. Gross costing uses financial expenditure data and is a "top down" approach that estimates the total costs of a program from existing budgets and expense reports (Špacírová et al. 2020). Micro-costing is a comprehensive estimate of the quantity and value of each resource that is constructed from the "bottom up" rather than being extracted from financial accounting systems. However, it is more labor intensive than gross-costing and not always possible or necessary, especially for a complex, multisectoral program delivered by more than one implementing partner (Xu et al. 2021). Data can be collected through a mix of retrospective and prospective data collection activities. In addition, the time horizon of the costing study must be considered. For each alternative, a list of costs should be drawn up.

Examples of costs are:

- capital expenditures
- operational and maintenance costs
- labor costs
- costs of other inputs (materials, manufactured goods, transport and storage, etc.)
- research, design and development costs
- opportunity costs associated with using land or facilities.

Examples of benefits include:

- increased yield or income
- increased diversification of farm production
- improved livelihoods

- increased land and labor productivity
- better nutrition
- increased livestock productivity.

Monetary valuation: monetizing costs and benefits in a CBA involves assigning monetary values to all relevant inputs, outputs and outcomes to create an objective comparison. Costs are typically straightforward to quantify, encompassing direct expenses such as labor, materials and operational expenditures, as well as indirect costs like administrative overheads. Benefits, however, can be more challenging to monetize, especially when they involve intangible, long-term or non-market outcomes. Common approaches for valuing benefits include using market prices (e.g., increased agricultural yields), revealed preference methods (e.g., assessing individuals' willingness to pay for improved services) and shadow pricing (e.g., assigning value to environmental enhancements or time savings). In situations where direct valuation is difficult, proxies and estimations based on similar interventions or expert consultations can be employed (Dixon 2012).

3. Quantify present values of costs and benefits

In this step, it is essential to recognize that project benefits span an extended timeframe, requiring a careful evaluation of future benefits and costs. To convert future values of the benefits and costs into present values, you need to use a discount rate. Discounting allows for an appropriate comparison of cash flows occurring at different points in time by accounting for the opportunity cost associated with resource allocation—the value of the next best alternative that is foregone (Vaessen et al. 2020), or the potential return from an alternative investment with a similar risk and duration. A higher discount rate lowers the present value of future benefits and cost.

This process accounts for the opportunity cost associated with resource allocation, which refers to the value of the best alternative use of resources forgone when allocated to a specific activity or investment. Since choosing one course of action means sacrificing potential benefits from the next best alternative, discounting helps assess the actual economic value of a project by adjusting future benefits and costs relative to present-day decision-making.

4. Quantify the net present value and the internal rate of return

The next step is to calculate the net present value (NPV), which represents the difference between the present value of benefits and the present value of costs. NPV is determined by subtracting the total discounted costs from the total discounted benefits over all years. The project is viable if the NPV is positive; when comparing mutually exclusive alternatives, the alternative with the largest NPV is selected (Williams et al. 2020).

The internal rate of return (IRR) is the discount rate at which the net present value equals zero. It corresponds to the maximum interest rate that can be earned from investing resources in a project. It is not just a return on capital investment but a return on all types of resources invested in a project. It is derived through interpolation, by changing the

discount rate until at least one positive and one negative NPV is obtained. If the IRR of a project is greater than the prevailing discount rate, then the project should proceed (Juhász 2011).

5. Describe the "with" and "without project" scenarios

Additionally, you can conduct a CBA by comparing a with-project scenario against a without-project scenario.

- The with-project scenario outlines the expected conditions if the project is implemented, including anticipated costs and benefits.
- The without-project scenario serves as a baseline, reflecting what would happen without the project. It should account for external factors like policy changes, technological advancements and market dynamics (e.g., price fluctuations and demand shifts) to avoid misleading conclusions.

Once both scenarios are established and their NPVs are calculated, the net incremental benefit can be determined by subtracting the without-project net benefit from the with-project net benefit, which will represent the additional benefit generated by the project.

6. Perform sensitivity analysis

Uncertainty surrounds predicted costs and benefits (Jenkins et al. 2018), making sensitivity analysis essential to test how variations in key assumptions affect results. This analysis should focus on the most critical parameters (e.g., costs, discount rates) and assumptions (e.g., inflation, future conditions) that influence the CBA. Since benefit and cost estimates rely on these factors, small changes—such as shifts in inflation rates—can significantly impact projections. Sensitivity analysis helps identify which assumptions have the greatest effect, highlighting areas of uncertainty that may require further examination.

Key financial metrics like NPV and IRR are particularly sensitive to changes in parameters. Assigning probability distributions to these variables allows researchers to simulate a range of possible outcomes, improving risk assessment.

Switching values indicates the thresholds at which changes in costs, benefits or discount rates impact the project's viability (e.g., shifting NPV from positive to negative). These values are essential for assessing project robustness, guiding decision-making and supporting scenario planning.

7. Provide a recommendation

The findings of a CBA play a vital role in shaping recommendations for donors, policymakers, and implementers. For instance, if a CBA reveals a positive NPV and a high IRR for a new irrigation project, policymakers may be encouraged to allocate resources toward its implementation, highlighting its financial feasibility and potential benefits. A negative NPV indicates that a project will be unprofitable, suggesting that it would be best to abandon the initiative. Conversely, a zero value implies that the project will neither generate a profit nor incur a loss, resulting in a break-even situation.

Incorporating gender into a cost–benefit analysis

To integrate gender into CBAs it is important to understand how cultural norms and gender gaps influence project outcomes and ensure that they are appropriately measured and valued. Key considerations include conducting a gender analysis to understand how costs and benefits differ across genders, engaging women and socially excluded groups in decision-making and developing gender-responsive indicators to measure benefits in outcomes such as empowerment and workload reduction. Incorporating gender analysis throughout all project phases—design, implementation and evaluation—is crucial, along with fostering institutional capacities to collect relevant data. A participatory approach helps capture diverse perspectives, while accounting for social and cultural factors ensures that norms and power dynamics influencing gender disparities are considered.

Case study 1: Cost–benefit analysis

Conservation agriculture for climate change adaptation in Zambia: A cost-benefit analysis (FAO & UNDP 2020)

Conservation agriculture has emerged as a critical strategy for climate change adaptation in Zambia's agricultural sector, aiming to enhance crop yields while simultaneously lowering production costs and preserving soil fertility. The fundamental principles of conservation agriculture include minimizing soil disturbance, maximizing soil cover, and rotating crops. Among the various practices associated with conservation agriculture, minimum tillage is a common entry point, with ripping—creating small furrows without significant soil disturbance—gaining more traction than planting basins, which involve more intensive labor and are generally used on smaller plots of land. While planting basins require farmers to hoe small pockets of soil to fill with seeds and fertilizers, ripping is favored for its efficiency and lower labor requirements. However, the primary challenge associated with minimum tillage is the increased growth of weeds, which thrive in conditions with minimal soil disturbance.

This project was collaboratively implemented by the Zambian Ministry of Agriculture and the Food and Agriculture Organization of the United Nations (FAO) and financed by the European Union through the 10th European Development Fund (EDF), running from June 2013 to December 2017.

This study aimed to

- Estimate the on-farm costs and benefits of conservation agriculture practices and, ultimately, their viability in the context of more sustainable, climate-adapted smallholder farming.
- Analyze the barriers to conservation agriculture adoption at the farm level.

The CBA followed the following steps.

Define scope of the analysis: The analysis focused on 18,183 households targeted by Conservation Agriculture Scaling-Up Project (CASU), examining agricultural practices, land use and project interventions. The dataset included information on farm management, crop types (mainly cereals like maize), livestock, and costs associated with electronic vouchers. The average land size was about 4 hectares, with less than 1 hectare applying conservation agriculture principles. While 89 percent of farmers used tillage, only 7.2 percent fully adopted conservation agriculture practices. Crop rotation was common

among conservation agriculture adopters (84 percent), but the use of minimum tillage and residue management was limited. Other practices like contour farming and agroforestry were also noted.

Quantify and monetize benefits and costs over the duration of the project	Conventional farming	Conservation agriculture
Yield	Stable at 2,000 kg per hectare	Initially stable at 2,000 kg per hectare for 3 years; increases to 2,600 kg per hectare thereafter
Gross income	ZMW800 per hectare	ZMW3,640 per hectare
Cost parameters	Maize seed: ZMW4 per kg	Maize seed: ZMW4 per kg
	Bean seed: ZMW10 per kg	Bean seed: ZMW10 per kg
	Soybean and groundnut seed: ZMW7.25 per kg	Soybean and groundnut seed: ZMW7.25 per kg
	Fertilizer: ZMW720	Fertilizer: ZMW360
	Transport costs: ZMW300	Transport costs: ZMW450
	Total labor cost: ZMW600 (40 person-days at ZMW12/day)	Labor costs not specified; includes additional hiring for agricultural development
	Total costs: ZMW1,620	Total costs: ZMW1,487 (includes hiring and lime application)
Additional costs	Not applicable	Agricultural development program hiring: ZMW281
		Lime application: ZMW200

Source: Food and Agriculture Organization of the United Nations 2020

Cost–benefit analysis – key assumptions

Conventional technology		Conservation agriculture
Description	Conventional farming practices	Conservation farming mainly; minimum tillage, crop rotation and increased land under legumes
Key assumptions	• Total land cultivated: 4 ha; 1 haper crop • Maize selling price: ZMW70 per 50 kg • Average selling prices for beans, soya beans and groundnuts: ZMW 250 per 50 kg • Person-days/year: 50 days • Labor cost at ZMW12 per person-day (family labor) • Transport cost: ZMW2/ton/km • Average distance of target grouppopulation from the market: 75 km	• Total land cultivated: 4 ha; 1 ha per crop • Increase in yields starting as of year 2 • Crop yields in years one to three are unchanged with respect to the without-project scenario and assuming full development and realization of project interventions occurring in year 4 • Maize yields from fourth year onwards remain unchanged at 2,600 kg per ha • Maize selling price: ZMW70 per 50 kg • Average selling prices for beans, soya beans and groundnuts: ZMW250 per 50 kg • Person-days/year: 40 days • Labor cost at ZMW12 per person-day (family labor) • Lime applied once every 3 years • Transport cost: ZMW2/ton/km

		• Average distance of target group population from the market: 75 km
Benefits	• Yield: 2,000 kg/ha • Gross income: ZMW800/ha	• Conservation agriculture skills improved • Conservation agriculture farmer input and output supply chain improved • Land management improved • Yield: 2,000kg/ha first to year 3 and 2,600kg/ha in subsequent years • Annual income: ZMW3,640 per ha
Breakdown ofcosts	• Maize seed: ZMW4 per kg • Bean seed: ZMW10 per kg • Soybean seed: ZMW7.25 per kg • Groundnut seed: ZMW7.25 per kg • Fertilizer: ZMW720 • 50kg bags: ZMW120 • Person-days: 40*ZMW12 = ZMW600 • Transport: ZMW300	• Maize seed: ZMW4 per kg • Bean seed: ZMW10 per kg • Soybean seed: ZMW7.25 per kg • Groundnut seed: ZMW7.25 per kg • Fertilizer: ZMW360 • Agriculture Development Program hire: ZMW281 • 50 kg bags: ZMW156 • Transport: ZMW450 • Lime: ZMW200

Source: (Food and Agriculture Organization of the United Nations 2020)

Describe the with- and without-adaptation project scenarios

In the conservation agriculture scenario, practices like minimum tillage, crop rotation, and increased legume cultivation were practiced, with 4 hectares cultivated across different crops. Key assumptions included an anticipated increase in yields starting in the second year, while yields in the first three years remained unchanged compared to a scenario without project intervention. Maize yields were expected to stabilize at 2,600 kg per hectare from the fourth year onward, with a selling price of ZMW70 per 50 kg and similar selling prices for beans, soya beans, and groundnuts at ZMW250 per 50 kg. The labor requirement was reduced to 40 person-days per year, maintaining a labor cost of ZMW12 per person-day and applying lime every three years. In contrast, the conventional farming scenario operated under the same land area and selling prices but assumed 50 person-days of labor per year, reflecting a more traditional approach to agriculture. Both scenarios included transport costs of (Zambian Kwacha) ZMW2 per ton per kilometer over an average distance of 75 km to market.

Quantify present values of costs and benefits

The annual net benefits for farmers practicing conventional agriculture (without the project) were ZMW 1,987 before labor costs and ZMW -413 after labor costs. A negative benefit means that the costs incurred exceeded the revenues generated, resulting in a financial loss. In the context of the farmer's income, a negative benefit of ZMW -413 indicates that after accounting for labor costs, the farmer spent ZMW 413 more than they earned. This situation highlights that, under conventional agriculture, the financial outcome was unfavorable after considering all expenses. After transitioning to conservation agriculture (CA), farmers' net income increased to ZMW 3,223 before labor costs and ZMW 1,723 after labor costs at full development. A comparison of scenarios indicated that farmers could expect greater net benefits from engaging in CA farming than from maintaining current conventional practices. The incremental net benefits were negative initially, as CA benefits were only realized in the third year and farmers incurred initial investment costs. However, in the following years, the incremental net benefits became positive, indicating that the net benefits in the with- project scenario (CA management) would be higher than in the 'without project' scenario (conventional management).

Researchers converted financial values into economic values using specific conversion factors after subtracting taxes, duties, and transfer payments. The economic internal rate of return (IRR) associated with the adoption of conservation agriculture (CA) was found to be 39 percent, significantly exceeding the assumed opportunity cost of capital of 7 percent. Additionally, the net present value (NPV) generated per beneficiary amounted to ZMW 25,151.

Perform sensitivity analysis with reference to changing scenarios

For this CBA, researchers focused sensitivity analysis scenarios most appropriate for climate change adaptation on the more frequent droughts and climatic weather changes that Zambia has been experiencing, as well as a varying social price of carbon. Therefore, researchers conducted sensitivity analysis assuming: (i) reduction in benefits/yields, (ii) changing the social price of carbon from ZMW 4 to ZMW 2 per ton of CO_2 equivalent, and (iii) reducing the recurrent costs of the project.

Researchers found that the project is most sensitive to reduction in benefits although it can withstand reduction of up to 17 percent and remain viable. A reduction in benefits of 18 percent led to a decrease in the economic internal rate of return (EIRR) to 6 percent and caused the NPV to turn negative. The model indicated that increases in recurrent costs of less than 27 percent would maintain a positive NPV and EIRR. For instance, a 25 percent cost increase lowered the EIRR to 8 percent and the NPV to ZMW 113,757,580. However, raising costs by 27 percent made the project economically unviable, as the EIRR fell to 6 percent (below the discount rate of 7 percent) and led to a negative NPV.

The findings also showed that the project was not affected by reductions in carbon prices; it remained economically viable even if the carbon price dropped to zero. Additionally, researchers performed econometric analyses to identify factors influencing innovation adoption at the household level. They conducted several logistic regressions focusing on practices such as crop rotations, no tillage, and mulching (both individually and in combination as full conservation agriculture), along with terracing, contour farming, and agroforestry (using fertilizer trees in fields).

2.2. Cost–effectiveness analysis

Why conduct a cost-effectiveness analysis?

A CEA compares the cost and effectiveness per unit of a given program to assess whether the value of an intervention justifies its cost. It provides metrics to rank or compare similar interventions or projects that achieve the same effect, helping to determine which option produces that effect at a lower cost.

Making a definitive statement about an intervention's cost-effectiveness requires a comparison to a similar intervention that aims to achieve the same effect. Conducting a CEA involves having access to information about the program's costs, and the magnitude of the causal effect on the outcome of interest. This means that to conduct a CEA,[1] you need to have information about the magnitude of the causal effects of an intervention (e.g., to have conducted a causal impact assessment) (DIME 2021; Mogues et al. 2019).

Making a definitive statement about an intervention's cost effectiveness necessitates comparing it to a similar intervention that aims to achieve the same effect. Conducting a CEA requires access to information about a program's costs and the magnitude of its effect (causal effect) on the outcome of interest. This means that to perform a CEA, data on the magnitude of the effect of an intervention must be available from a causal-impact assessment. It is not possible to estimate the cost effectiveness of an intervention if there is no data on the magnitude of the effect of the intervention on the desired outcome (DIME 2021; J-PAL 2020; International Rescue Committee n.d.).

Steps to conduct a cost–effectiveness analysis

1. Define scope of the analysis

   Defining the scope of a CEA requires clearly outlining the project's objectives, identifying key stakeholders and establishing the timeframe for assessment. This process involves defining interventions at both broad and specific levels. For example, a project aimed at promoting climate-smart agriculture may include both demand-side and supply-side interventions. On the demand side, advocacy efforts might focus on increasing awareness and adopting climate-smart practices. On the supply side, the intervention could involve providing inputs and training to community farmer groups to enhance sustainable agricultural practices. In the case of interventions with multiple components, it is important to narrow down and select the components that are going to be assessed in the CEA. It is also important to

[1] For more information on conducting cost-effectiveness analysis, refer to:

- https://dimewiki.worldbank.org/Cost-effectiveness_Analysis#Cost-effectiveness_analysis_(CEA)_vs._cost-benefit_analysis_(CBA)https://poverty-action.org/cost-effectiveness-analysis
- https://www.rescue.org/cost-analysis.

narrow down the outcomes where an impact or causal effect is expected to be observed or where the effectiveness will focus on (e.g., effectiveness in increasing adoption or improving yield). Since effects are typically observed across multiple outcomes along the Theory of Change, it is important to identify and select the specific outcomes the CEA will focus on. Examples include the rate of adoption of a new variety, input use, or yield; or women's input in decision-making.

To determine which intervention components will be assessed, it is essential to first clearly outline the project's Theory of Change and to identify the inputs and activities required to achieve the expected outcomes and impacts.

When defining the scope of the CEA, consider the following questions:

- What is the problem the intervention aims to address?
- What are the key components of the intervention (e.g., training, input provision, financial support)?
- What is the target population (e.g., household heads, male and female farmers)? What is the size of the population that will be targeted?
- How is each component of the intervention delivered, and what are the key inputs and activities needed?
- Who is responsible for delivering each activity? Is it the same provider for all components, or are different providers involved?
- How long will the intervention be implemented? Are all components planned for the same duration?
- When are the intended outcomes and impacts expected to be observed, and which specific outcomes or impacts will the CEA focus on?
- Are there any interdependencies between intervention components that may influence costs or the desirable effects?

2. Describe the intervention components

Once the scope of the CEA has been defined, a detailed breakdown of inputs, activities and sub-activities related to the components of the intervention being assessed is essential for a comprehensive and accurate CEA. If the intervention consists of a single component, the analysis is relatively straightforward. However, when multiple components are involved, it is important to clearly outline and distinguish the inputs, activities and sub-activities associated with each component to ensure accurate cost allocation. For example, when an intervention has supply and demand components, and the cost effectiveness of each is assessed, it is important to clearly outline the inputs and activities needed to implement each. Additionally, specifying the coverage level or project phase—such as pilot, implementation or post-scale-up—is crucial because these stages can significantly influence costs (Fermanich 2021; Rosen et al. 2019).

3. Identify all relevant costs

When the components of the intervention or program have been identified, all the associated costs need to be identified and quantified, including direct and indirect costs over the duration of implementation. Activity-cased costing is a method used to allocate a program's costs to its core activities. This approach involves asking implementing staff to identify key activities and estimate the time and resources they dedicate to each activity. The process relies on staff interviews and a thorough review of program documents, such as proposals, implementation plans and reports. The list of activities should be comprehensive (including all program activities) and mutually exclusive (not overlapping) to reflect the total program without double-counting any of the resources used (McBain et al. 2018).

It is also crucial to integrate cost data into monitoring tools to capture all implementation costs and ensure sufficient disaggregated data to identify unit costs.

Different types of costs that can be identified include:

- **Program administration:** staff hired to work throughout the implementation of the intervention, costs of facilities and any overhead costs incurred.
- **Targeting costs:** any costs incurred to target, identify and raise awareness of the program among potential participants.
- **Staff training:** the costs of training staff responsible for implementing the program.
- **User training:** any costs incurred to train participants or beneficiaries.
- **Implementation costs:** all costs directly associated with the implementation of the intervention, such as the cost of items distributed to participants, the cost of staff who worked solely on implementation activities, or the cost of creating and maintaining resources developed for the intervention.
- **User costs:** any costs incurred by program participants, such as the cost of goods users were required to purchase or the opportunity cost of participants' time.
- **Averted costs:** costs that were replaced or discontinued because of the intervention—these costs should be subtracted from the total cost of the program.
- **Monitoring costs:** any costs incurred due to oversight, monitoring or tracking of program participants and staff. These are costs that would be incurred as part of the program's ongoing monitoring and evaluation (M&E) strategy, and not as part of the evaluation (Levin et al. 2023).

4. Measure impact

A CEA compares the costs and effectiveness of a specific program or intervention. Therefore, a crucial element of the analysis is precisely quantifying the magnitude of the program's effect, which is derived from a causal impact assessment or impact evaluation. Causal inference methods are essential as they allow the true effects of an intervention to be identified, ensuring that the estimated effect can be fully attributed to the program itself. Quantitative causal impact assessment is a prerequisite for conducting a CEA; without a measurable size of the intervention's effect, a CEA cannot be undertaken. Various methodologies, including experimental and quasi-experimental approaches, can be used

to establish a reliable comparison group or reference (Glennerster & Takavarasha 2013; Gertler et al. 2016).

5. Calculating the cost-effectiveness ratio of each alternative

The cost-effectiveness ratio (CER) is calculated by dividing the total costs incurred for expenses like equipment and training by the unit of effectiveness of the intervention or program, such as the increase in crop yield or the increase in income. When researchers are testing the impact of only one intervention or program, the CER estimated can be contrasted to the CER of comparable interventions aiming at impacting the same outcomes or variables. If there are no other CEAs for comparison, the CER measured by the researcher will serve as an input for future CEAs. When more than one intervention (or variation of an intervention) is being tested, the CER of the different interventions will be compared to find the most cost-effective intervention. Additionally, sensitivity analyses could be conducted to assess how changes in input costs or assumptions might affect the CER (Jain et al. 2011).

6. Provide recommendations

Researchers can determine the most cost-effective intervention by identifying the alternative that delivers the highest impact (e.g., unit of effectiveness) at the lowest cost. This is done using metrics like the CER or the effectiveness–cost ratio (ECR). The ECR is calculated by dividing the effectiveness of the intervention or program by the total costs incurred. With this information, researchers can rank different interventions from the lowest CER to the highest (or the highest ECR to the lowest) to identify the most cost-effective intervention.

For example, consider researchers assessing the effectiveness of adoption and productivity of two different interventions: one providing vouchers for input purchases (intervention 1) and another offering vouchers combined with information campaigns on input characteristics (intervention 2). If the researchers find that intervention 2 is significantly more effective than intervention 1, but its costs disproportionately exceed the additional effectiveness gained, then it would be difficult to advocate for scaling up intervention 2 because, despite being more effective, it is not necessarily more cost-effective.

Incorporating gender into cost–effectiveness analysis

To effectively integrate gender into CEA, it is key to start by clearly defining in the Theory of Change the indicators where a differential impact between male and female participants is expected (e.g., adoption, yield) or the indicators where a specific impact is expected only among women or specifically related to women's economic empowerment and agency (e.g., control over income). Once this is completed, it is important to identify which is the main impact the intervention aims to achieve and ensure the causal impact assessment adequately (e.g. correct methodology, large enough sample size, etc.) estimates this impact. Additionally, the costs that may differ by gender, such as targeted outreach efforts for women (Peterman et. al. 2024) or specific activities only targeted to women or certain subgroups need to be accounted for.

Case study: Cost-effectiveness analysis of the Water Smart Agriculture Program (Salvadoran Foundation for Economic and Social Development 2021)

Catholic Relief Services developed Water-Smart Agriculture (WSA) as an approach to simultaneously confront the challenges of land degradation, drought and erratic rainfall, low agricultural productivity and poverty in Central America. The first phase of the WSA program was implemented between 2015 and 2020. Phase One of the program reached nearly 3,000 smallholder farmers in El Salvador, Guatemala, Honduras and Nicaragua with training on WSA practices, including on-farm, side-by-side comparison plots to produce both visual and scientific evidence. Phase Two of the program used the evidence from the Phase One to scale the WSA tools and approaches to more farmers. Scaling WSA by building partnerships, influencing public and private investment and continuing to build capacity to implement WSA through projects and programs is the strategic pathway to ensure 500,000 farmers in the region are actively implementing WSA practices by 2030. This case study evaluated the cost-effectiveness of the WSA program. The analysis focused on the program's performance from 2015, the baseline year before implementation, to 2020, the endline year for cumulative outcomes.

The following steps were followed:

1. The scope of the analysis was defined

The scope of the analysis encompassed the financial and environmental impacts of the WSA program from 2015 to 2020. The focus was on measuring the program's effectiveness in increasing farmer net income, capturing carbon dioxide (CO_2) and retaining soil moisture. Both direct and indirect costs associated with the program were considered to provide a comprehensive view of its cost-effectiveness.

2. The intervention components and effect and impact measures were described

The WSA program included several key components aimed at improving agricultural practices:

- training and education for farmers on sustainable practices
- implementation of conservation techniques that enhanced soil health and moisture retention
- monitoring and evaluation of environmental impacts, specifically CO_2 sequestration and moisture levels.

The primary impact measures included:

- **farmer net income increase:** the program's influence on farmer earnings
- **CO_2 sequestration:** the amount of carbon captured because of improved agricultural practices

- **soil moisture retention:** the cubic meters of moisture retained in the soil due to the intervention.

3. All relevant costs were identified

All relevant costs were identified, including:

- implementation costs: expenses incurred in training, materials, and support for farmers
- operational costs: ongoing costs related to program management and monitoring
- partner and administrative costs: expenditure from collaborating organizations involved in the program.

4. The CER ratio of each alternative was calculated

The CERs for the WSA program were calculated based on the average costs to achieve specific impacts:

- **Farmer net income:** the average cost of increasing farmer net income by $1.00 was $0.41 (or $0.20 when only considering direct implementation costs). Or, for every dollar invested by the WSA program, farmer income increased by $2.46.
- **CO_2 sequestration:** the program incurred an average cost of $2.69 per metric ton of CO_2 sequestered. Notably, the cost of capturing a metric ton of CO_2 ranged from $1.56 to $4.05, which was significantly lower than the market value of carbon payments, estimated at between $10 and $35.
- **Soil moisture retention:** the average cost for generating 1 m^3 of soil moisture was $0.37.

In conclusion, the WSA program demonstrated significant cost-effectiveness in enhancing agricultural practices while contributing positively to environmental sustainability.

2.3. Cost–efficiency analysis

Why conduct a cost–efficiency analysis

Cost-efficiency analysis examines the cost per unit of output for a program or activity, enabling comparisons between different programs or interventions designed to achieve the same outcome (International Rescue Committee 2019). This type of analysis is particularly valuable when selecting among alternative delivery models. Given the scarcity of resources, efficiency analysis is a crucial criterion for priority setting by decision-makers (Coelli et al. 2005). Conducting a robust cost-efficiency analysis requires collaboration among service providers, project managers, policymakers and researchers. Its ultimate goal is to

continuously identify and implement strategies that enhance overall efficiency—assessing the effective use of time, money, personnel and other resources—while maintaining or improving the quality and quantity of outputs.

Cost-efficiency analysis is useful for:

- **Performance management:** cost-efficiency helps to identify resource allocation and enhance operational efficiency. It supports benchmarking, progress tracking and alignment of financial resources with strategic goals to foster continuous improvement.
- **Learning:** cost-efficiency analysis can be applied to compare different programs, or components of a program, and see what factors drive cost-efficiency.
- **Planning:** cost-efficiency analysis ensures that planning efforts align with strategic objectives and maximize resource utilization. It also enables planners to create realistic budgets (International Rescue Committee 2019).

Steps to conduct a cost–efficiency analysis

1. Identifying strategic priorities

It is crucial to clearly specify the timeframe and geographic area covered by the analysis, avoiding periods shorter than six months unless the program was completed within that duration. It is also important to determine if the analysis is for performance management (comparing against existing benchmarks or targets) or for learning (comparing different program models or categories). The chosen goal significantly influences both data collection methods and the selection of appropriate comparators (International Rescue Committee 2019).

2. Indicator selection

The core component of this analysis is comparing the costs per unit of a specific, well-defined output, which requires identifying and standardizing the indicators used. These indicators must be comparable across different programs or delivery modalities to ensure reliability and validity, and should adhere to the SMARTA criteria: be specific, measurable, achievable, relevant, time-bound and agreeable. The selected indicators should be clearly documented and reviewed with stakeholders, including program participants and researchers, to validate their relevance and practicality. Before conducting the analysis, it is important to identify the programmatic outputs (e.g., number of households reached, amount transferred or inputs distributed) that are relevant and comparable across programs' activities. Furthermore, the document underscores that the indicators should align with the purpose of the analysis, whether for performance management or learning, and should be selected with consideration of the specific context, target population and the program's objectives. Proper indicator selection and clear definition are essential to produce valid comparisons and derive actionable insights from cost-efficiency assessments.

3. Data collection

Detailed cost data, including expenditure data disaggregated by relevant cost categories and sometimes sub-categories are required. It is important to use actual program expenses at a disaggregated level, preferably based on individual budget lines—rather than merged categories, to allow precise allocation of costs to specific outputs. When cost-efficiency analysis is used for comparing interventions, it is particularly important that the methodology for capturing and for analyzing the cost and output data are the same for all the compared interventions (International Rescue Committee 2019).

Sourcing data directly from finance systems is recommended to facilitate consistency and minimize manual errors, with analysis ideally conducted by staff involved in program implementation to provide contextual insights. Collecting comprehensive data on outputs, such as the number of households reached, transfers made, and target population characteristics is essential for meaningful comparisons. Data should also include contextual factors like market conditions and timing, which influence disbursement and purchasing power (International Rescue Committee 2019).

The main sources of data used in cost-efficiency analysis include (Barasa et al. 2021):

- Budget documents, public expenditure reviews and public expenditure tracking surveys that assess how public resources—financial, human, in-kind—are allocated and managed and how they flow across administrative levels (e.g., from central government to regional levels).
- Routine or administrative data, which is generated as part of the daily operation other than research, typically for administrative reasons or to support the intervention of interest.
- Monitoring data is essential for verifying that program outputs are achieved and for informing cost-efficiency analyses. It should encompass information on activities, beneficiary reach, market conditions and timing. Monitoring data must be aligned with the financial and activity data used for cost analysis, ensuring an accurate representation of the relationship between costs and outputs.

4. Data analysis

Cost-efficiency analysis is expressed as a unit cost ratio per unit of output generated. With cost efficiency analysis, a program's performance can be reviewed from three perspectives:

- planned milestones to actual target achievement (performance-target ratio)
- budgeted cost to actual expenditure (cost-budget ratio)
- cross-site performance to cost ratio (cost-performance ratio).

Performance-target ratio

Performance-target ratio measures the progress of a program by comparing planned milestones (log-frame indicators) with the actual milestone achieved during the implementation period. A ratio of less than 1.0 indicates underachievement. Conversely, a

ratio exceeding 1.0 highlights overachievement, implying that the program is delivering results beyond expectations, potentially justifying continued or increased investment. This analysis fosters informed decision-making about resource allocation and program adjustments, ultimately enhancing the overall value derived from investments in the program.

Performance-target ratio = actual milestone achieved or planned milestone:

- <1.0 underachieved
- >1.0 overachieved.

Cost budget and cost-performance ratios

The cost-budget ratio compares the actual expenditure with the planned budget, providing insight into whether a project is being completed within budget. It helps organizations determine how effectively they are managing their costs in comparison to their planned or allocated budget. A ratio greater than 1.0 indicates that costs are exceeding the budget, while a ratio less than 1.0 suggests that costs are below the budget. A cost-budget ratio of <1.0 is desirable as it demonstrates that the actual program expenditure was less than what was budgeted. It assumes efficient resource use during implementation. A ratio >1.0 is less desirable as it shows that the actual expenditure was higher than the planned approved budget.

Cost-budget ratio = actual expenditure or planned budget:

- <1.0 underspending
- >1.0 overspending.

A cost-performance ratio, however, gives insight into the performance and cost implications of various strategies. It combines both the cost budget and cost performance ratios to model these four scenarios:

- underspending and over-achievement-most desirable
- overachievement and overspending
- underachievement and underspending
- underachievement and overspending-least desirable.

5. Provide recommendations

Finally, a recommendation is made by highlighting the financial implications and revealing specific contextual or programmatic features that influence the cost per output. For example, it is essential to assess how the cost per dollar transferred in a cash program varies depending on whether targeting is facilitated through an existing social safety net platform or requiring direct surveys by implementers. It is essential to interpret results within their broader context by recognizing that efficiency varies across. When presenting results, it is important to include key program information such as households reached, transfer values, targeting methods and market conditions to ensure accurate interpretation. Use

comparative analysis of cost–efficiency data to inform program decisions, course corrections and performance assessments, always considering contextual limitations.

Incorporating gender into a cost–efficiency analysis

To effectively integrate gender into cost–efficiency analyses, a well-defined Theory of Change is essential for accurately identifying the output indicators of interest. This enables the identification of gender-specific or gender-sensitive output indicators, which focus on measuring results that reflect gender differences in program outputs. Proper integration requires disaggregating data by gender and analyzing how program costs and outputs differ for women and men. This involves collecting gender-specific information on targeting methods, transfer amounts, market conditions and participation rates.

Case study 3: Cost–efficiency analysis

Cost–efficiency analysis of health and nutrition emergency response in Yemen

(Save the Children 2017)

This study aimed to demonstrate how the Save the Children's actual costs incurred compared with the planned spending for this intervention. The program was implemented between June 2015 and July 2016 and aimed to address the basic need of Yemeni children and their caregivers. The program provided primary health care services through mobile teams and support to fixed facilities.

The following steps were taken:

1. Identifying strategic priorities:

Three strategic priorities were identified:

- Nutrition
    - Treatment of severe acute malnutrition (SAM) in children under 5 years of age
    - Administration of micro-nutrient supplements and deworming medicines for children under 5 years of age
- Health
    - Making essential child health services accessible to vulnerable children
    - Making essential reproductive health care services available to vulnerable mothers
- Community for development
    - Reaching caregivers of children under 5 years of age and pregnant and lactating women with effective behaviour change communication interventions.

2. Indicator selection

For each strategic priority, several indicators were identified (see Indicator selection table):

Indicator selection

Area	Short-term outputs
Nutrition	No. of sites managing SAM
	No. of children 6–59 months admitted to SAM services
	No. of healthcare providers trained on SAM
	No. of people trained on management of SAM
	Number of children 24–59 months dewormed in the last 6 months
	No. of children 6–59 months who received vitamin A
	No. of children 6–23 months who received Mineral- and vitamin-enhanced micronutrient powder (MNP)
Health	Management protocol
	No. of children under 2 vaccinated according to immunization schedule
	Short-term outputs
	Vaccinated against measles
	No. of children under 5 referred by mobile teams
	No. of pregnant women who have attended at least 2 antenatal clinic visits
	No. of pregnant women who have delivered assisted by birth attendant
	No. of women and newborns that received post-natal care within 3 days after delivery
	No. of pregnant women in their third trimester who received a clean delivery kit
	No. of health facilities/mobile teams supplied and equipped according to national standards
	Number of Ministry of Public Health and Population (MoPHP) staff trained on Integrated Management of Newborn and Childhood Illnesses (IMNCI) and Reproductive Health (RH) by sex

	Number of health facilities/mobile teams supported and/or rehabilitated
	No and percentage of health facilities/mobile teams submitting weekly surveillance reports
Communication for development	No. of community volunteers oriented and engaged by gender
	No. of caregivers reached with specific message by gender and message type
	No. of community mobilization/awareness activities conducted by pre-mobile team
	No. of people counselled during mobile team visit
	No. of mothers reached with Infant Young Children Feeding (IYCF) messages through Mother to Child Support Groups (MTMSGs)

Source: Save the Children 2017

3. Data collection

Direct program and non-direct program cost data were collected. Additionally, budget and performance data were collected to calculate the

- planned milestones to actual target achievement (performance-target ratio)
- budgeted cost to actual expenditure (cost-budget ratio)
- cross-site performance to cost ratio (cost-performance ratio).

4. Data analysis

Performance target ratio was estimated to measure the progress of a program by comparing planned milestones (log-frame indicators) with the actual milestone achieved during the implementation period (see Table 3).

Performance-target ratio = actual milestone achieved/planned milestone:

- <1.0 underachieved
- >1.0 overachieved.

Table 3: Performance-target ratio

Area	Short-term outputs	Performance-target ratio
Nutrition	No. of sites managing SAM	1.02
	No. of children 6–59 months admitted to SAM services	1.34
	No. of healthcare providers trained on SAM	1.01
	No of people trained on management of SAM	1.01
	Number of children 24–59 months dewormed in the last 6 months	2.00
	No. of children 6–59 months who received vitamin A	0.45
	No. of children 6–23 months who received MNP	0.56
Health	Management protocol	1.46
	No. of children under 2 vaccinated according to immunization schedule	2.65
	Vaccinated against measles	1.34
	No. of children under 5 referred by mobile teams	1.41
	No. of pregnant women who have attended at least 2 antenatal clinic visits	0.88
	No. of pregnant women who have delivered assisted by birth attendant	0.30
	No. of women and newborns that received post-natal care within 3 days after delivery	1.30
	No. of pregnant women in their third trimester who received a clean delivery kit	0.03
	No. of health facilities/mobile teams supplied and equipped according to national standards	1.00
	Number of MoPHP staff trained on IMNCI, RH by sex	1.25
	No. of health facilities/mobile teams supported and/or rehabilitated	0.75

	No. and percentage of health facilities/mobile teams submitting weekly surveillance reports	1.00
Communication for development	No. of community volunteers oriented and engaged by gender	1.01
	No. of caregivers reached with specific message by gender and message type	3.76
	No. of community mobilization/ awareness activities conducted by pre-mobile team	4.23
	No. of people counselled during mobile team visit	13.09
	No. of mothers reached with IYCF messages through MTMSGs	2.42

Source: (Save the Children 2017)

Cost-budget and cost-performance ratios

The cost-budget ratio compared the actual expenditure with the planned budget, providing insight into whether a project was completed within the budget (see Table 4)

Cost-budget ratio = actual expenditure/planned budget:

- <1.0 underspending
- >1.0 overspending.

Table 4: Cost-budget ratio at output level

Area	Intermediate output	Cost-budget ratio
Nutrition	No. of sites managing SAM	1.49
	No. of children 6–59 months admitted to SAM services	1.06
	No. of healthcare providers trained on SAM	0.88
	No. of people trained is management of SAM	1.72
Health	No. of pregnant women who have delivered assisted by birth attendant	0.77

	No. of women and newborns that received post-natal care within 3 days after delivery	0.77
	No. of MoPHP staff trained on IMNCI, RH by sex	0.17
	No. of health facilities/mobile teams supported and/or rehabilitated	0.99
Communication for development	No. of community volunteers oriented and engaged by gender	1.74
	No. of caregivers reached with specific message by gender and message type	0.77
	No. of community mobilization/ awareness activities conducted by pre-mobile team	0.77
	No. of people counselled during mobile team visit	0.77
	No. of mothers reached with IYCF messages through MTMSGs	0.80

Source: Save the Children 2017

A cost-performance ratio was then calculated to give an insight into the performance and cost implications of various strategies. It combined both the cost budget and cost performance ratios to model these four scenarios (see Table 5):

- under-achievement and overspending-least desirable
- overachievement and overspending
- overachievement and underspending-most desirable
- underachievement and underspending.

Table 5: Cost-performance ratio at the output indicator level

Area	Intermediate output	Performance-target ratio	Cost-budget ratio
Nutrition	No. of sites managing SAM	Overachievement	Overspending
	No. of children 6–59 months admitted to SAM services	Overachievement	Overspending
	No. of healthcare providers trained on SAM	Overachievement	Underspending

	No. of people trained on management of SAM	Overachievement	Overspending
Health	No. of pregnant women who have delivered assisted by birth attendant	Underachievement	Underspending
	No. of women and newborns that received post-natal care within 3 days after delivery	Overachievement	Underspending
	Number of Ministry of Public Health and Population (MoPHP) staff trained on Integrated Management of Newborn and Childhood Illnesses (IMNCI), reproductive health (RH) by sex	Overachievement	Underspending
	No. of health facilities/mobile teams supported and/or rehabilitated	Underachievement	Underspending
Communication for development	No. of community volunteers oriented and engaged by gender	Overachievement	Overspending
	No. of mothers reached with Infant Young Children Feeding (IYCF) messages through Mother to Child Support Groups (MTMSG).	Overachievement	Underspending

Source: Save the Children 2017

By combining the cost-budget and cost-performance ratios, the team inferred that most of the overspending happened for nutrition-related outputs, while under-expenditure was in the community for development outputs, except for community health volunteer orientation.

5. Recommendations

The most desirable interventions identified from the cost-efficiency analysis are those that achieve significant outcomes while using resources effectively. The training of healthcare providers on SAM stands out, as it demonstrates both overachievement in performance and underspending, indicating an efficient enhancement of provider capacity. Similarly, the intervention focused on post-natal care for women and newborns shows strong results, with a high number of recipients and underspending. The training of MoPHP staff on IMNCI and RH also reflects overachievement with underspending, showcasing its role in building essential skills without straining financial resources. Additionally, outreach efforts delivering IYCF messages to mothers reveal a high reach with efficient resource use, indicating a successful strategy for improving nutrition awareness in communities.

3. Tools and resources for cost analyses

3.1. Cost–benefit analysis

To effectively navigate the tools available for CBA, begin by identifying the specific focus of your project and the complexity of the analysis and the type of data available. If your project involves community engagement and benefit-sharing, the Vumelana CBA tool is useful. For projects centered around agricultural adaptation, the GIZ CBA template will help compare options and assess their economic viability. For projects that require an in-depth analysis of investment projects with extensive data, WinDASI software is ideal. Simpler tools like Vumelana CBA tool and the GIZ CBA template are better suited for initial assessments and comparisons, while more complex scenarios requiring detailed calculations will benefit from using WinDASI. Additionally, if your project involves uncertainties in cost and benefit estimations, the sensitivity analysis features in the GIZ CBA template can be particularly useful.

Vumelana cost–benefit analysis tool

Vumelana CBA tool[2] uses CBA to help assess the potential of currently unproductive community land through partnerships with investors. For example, a simplified CBA can be used to make an initial assessment of whether the proposed split of benefits between an investor and the community that owns the land is worth its value. The analysis is intended to highlight the value of different projects so that it can evaluate them from several perspectives. A more rigorous CBA can show whether projects in some sectors, such as agriculture, generate larger and more sustainable benefits than projects in other sectors.

The Vumelana CBA tool can be downloaded[3] and is designed as a Microsoft Excel spreadsheet. The tool should be adapted to the specifics of each project, and it may not be necessary to complete allthe parts of the tool for a given project. Users should consider what sections of the toolkit are relevant for each project and note that some calculations or formulas need to be changed to reflect individual projects. Table 2 also provides guidance on how to populate the Vumelana toolkit.

[2] For more information about Vumelana toolkits is at: https://www.vumelana.org.za/toolkits/
[3] Download the Vumelana CBA tool at: https://www.vumelana.org.za/toolkits/

Table 2: Overview of the Vumelana Cost–Benefit Analysis tool

Component of cost–benefit analysis tool	Instructions and comments
Project information	1. Insert project name. 2. Insert the date of analysis (DD MM YYYY). 3. Review notes and adapt or add more comments about data quality and reliability that would be important for the reader of the CBA to be aware of. 4. A discount rate indicates the time value of money according to the riskiness of the project. Currently (in 2015) the 10% discount rate is appropriate for tourism and agriculture projects. 5. Tax rate is the company income tax rate, which is currently 28% (2015). 6. Start year is Year 0 and is the year when the investment is made by the investor (and most likely also the year when Vumelana advisory fee is paid). It would typically be one year before income is earned (or longer if there is construction period).
Table 1: Revenue	7. When the investor provides financial projections for the initial five years, you are supposed to make assumptions and projections for the remainder of the 20-year period. 8. Type in revenue data for the first five years. If necessary, revenue growth can also be projected for the first five years, and then the growth (in %) can be inserted here. The formula will be = E38*(1+$F39), to be copied to Year 5. 9. Type in projected revenue growth (in %) for Years 5–20. If there is data from the investor for a longer period, override the formulas and use the data until such a time that own projections are required. 10. Revenue Year 6: This field will be populated automatically. If formula needs to be replaced, it is =I38*(1+$F40) (Year 5 revenue times percentage growth). 11. Type of revenue: if there is more than one type of income and there is a difference in that share that community receives, then it is necessary to provide the revenue data separately for each type of income.

Component of cost–benefit analysis tool	Instructions and comments
	12. If it is possible to assess the procurement of fresh produce from local community/area, insert the percentage of this procurement. If there is none or it is not confirmed, leave this cell empty. 13. Project phase: some projects are conducted in phases, for example where there is expansion after the first few years. Check if this is applicable to the project and, if so, data can be populated per phase. 14. Total revenue (A+B+C) includes all revenue from different segments, where applicable. This is the default field to be used for further calculations
Table 2: Operating costs	15. The minimum information required is operating expenses, salary costs and training costs. 16. If a detailed breakdown is not available, the row "Other" is to be used for operating expenses.
Table 3: Capital expenditure	17. Investment capital is capital provided by the investor. If investment is installed over several years, there is a provision to input the amounts accordingly and this is important for the calculation of NPV. 18. Government grants is for investment from government, which is applicable to some projects only. 19. If there is construction and local suppliers can be allocated a portion of supplies/work, record it as a distinct benefit by indicating the percentage of contract to be spent with them.
Table 4: Setting up costs	20. In some projects, the investor will charge a fee for raising funds on behalf of the Communal Property Association (CPA) and/or monetize their effort to set up the agreement. This cost can be recorded here. Insert the amount charged for Vumelana advisory fee. Vumelana advisory fee is the fee charged when structuring partnerships between land owning communities and investors. All work completed is paid for even if no agreement is reached. This fee is paid by the projects managers that seek advisory services on structuring partnerships between land owning communities and investors.
Table 5: Income statement	21. The income statement table is mostly a summary table where data from input tables is put together and the only rows for inputs would be depreciation and finance items.

Component of cost–benefit analysis tool	Instructions and comments
Table 6: Benefit flows (A) Value of enterprise	22. Value of enterprise measures the value of the business in Year 20. Typically, the enterprise is owned by the investor. The value will depend on how many years after the initial lease the investor has the right to continue running the enterprise. These inputs are to be looked for in the lease agreement. 23. If the profit after tax has been stable over the past five years, then the Year 20 income after tax can be used. If the income varies a lot, it might be useful to use a five-year average. 24. Number of years remaining insert the number of years the investor has the right to have the business after the first 20 years. 25. Earnings multiple (P/E ratio) can be used but it is more subjective, and this valuation would assume that the enterprise continues indefinitely. 26. For projects with fixed leases, it is not a useful method unless the enterprise is entirely owned by the CPA.
(B) Fees generated to investor	27. The investor typically receives benefits through profits from the business (in addition to the value of the business). 28. "Other fees" allows for other types of income that the investor might receive which can be project specific. 29. If the investor earns a management fee instead of profits, it may be necessary to change the reference to the cells in income statement and/or operating costs.
(C) Income generated to CPA	30. The structure of the CPA's income would vary depending on the agreement with the investor but typically consists of base rental and turnover share or profit share. 31. The specifics are to be checked in the lease agreement and project documents. 32. This template is set up for the model "the higher of the base rental and a percentage of turnover". If arrangements differ, the formulas must be changed accordingly. 33. Gross revenue share: insert percentage share as per the lease agreement.

Component of cost–benefit analysis tool	Instructions and comments
	34. Communal Property Institution (CPI): if the base rental increases with the CPI, insert CPI percentage.
(D) Income retained by local community	35. This part feeds through the data of local procurement and local construction that would benefit the local community.
(E) Revenues to government	36. Revenue to the government is comprised of income tax, employment taxes and other levies (e.g. tourism levy for tourism enterprises). 37. Tourism levy: insert 1% here if it is a tourism enterprise (for accommodation revenue only). 38. Employment taxes (PAYE) are applicable to earnings above the tax-free threshold, and this would be relevant to the salaries of management and technical staff only. The values are calculated automatically depending on the salary levels in the job creation section.
(F) Income/fees to other stakeholders	39. Income to other stakeholders caters for fees payable to, for example, the Parks Board. This is not applicable for every project.
Benefits (A) Employment created	40. Total jobs created: insert the total number of jobs expected to be created. If there is a range (e.g. 20 to 30 jobs), it might be more reliable to assume the middle value (25) or the lowest value (20). 41. Management jobs: insert the number of management-level jobs in the Year 1 cell. The rest of the years will populate the same number; if change is required, you can override the formula. Where you override the formula, color the digit in red to indicate the hard coded number, to remind of this and help avoid calculation errors. 42. Technical jobs: insert number of technical/supervisor positions. 43. General workers: gets calculated automatically by subtracting management and technical jobs from the total jobs. 44. Seasonal workers: insert the number of workers (persons). 45. Number of weeks: insert the number of weeks the seasonal workers will be employed per year.

Component of cost–benefit analysis tool	Instructions and comments
	46. Construction jobs: insert the number of workers (persons). 47. Ancillary jobs: insert the number of workers (persons). 48. Number of weeks: insert the number of weeks the temporary workers will be employed per year. If construction takes place over 1.5 years, it will be 52 weeks in Year 1, 26 weeks in Year 2, and 0 for the remainder of 20 years.
(B) Displaced employment	49. Displaced employment refers to jobs lost due to closure/restructuring to be done in the project.
(C) Split of employment costs	50. The split of employment costs is mainly used for estimating the salary costs for the local community, where only the total amount of salary costs had been provided. 51. Management jobs salary level: insert the percentage of salary as a multiple of minimum wage. 52. Percentage of technical positions filled: insert the number of positions filled (100% if all positions filled). This can be useful if employment increases with a ramp-up in capacity or rate of occupancy. 53. Technical jobs salary level: insert the percentage of salary as a multiple of minimum wage. 54. Percentage of general positions filled (100% if all positions filled): this can be useful if employment increases with a ramp-up in capacity or rate of occupancy. 55. General jobs salary level: insert the percentage of salary as a multiple of minimum wage. 56. Estimating the salary costs backwards can require trying various combinations of inputs/assumptions and should ideally be confirmed with investors. The main output from this exercise is to estimate the percentage of salary costs that would be retained in the local community. 57. The number of months the salary is paid. Choose 12 or 13 months. 58. Bonus as percentage of total salary can be an additional assumption. If there is no bonus, the number is 0.

Component of cost–benefit analysis tool	Instructions and comments
	59. The comparison of salary costs from the cost table with actual or projected salaries should show a common pattern; the expectation is that the figures in the salary cost section accurately reflect the compensation for the local community. 60. This method uses a defined percentage to calculate salary amounts, establishing a clear link between the cost table data and the community's salary expectations. This defined percentage refers to a specific number or ratio that has been set beforehand. For example, if the defined percentage for management salaries is 150% of the minimum wage, it means that management salaries are expected to be 1.5 times the minimum wage. By applying this defined percentage, the tool calculates the expected salary amounts for different job roles. For instance, if the minimum wage is $1,000, a management salary calculated at 150% would be $1,500. By using these defined percentages, the calculation creates a clear connection between the data in the cost table (which lists estimated salary costs) and what the community expects workers in those roles to earn. The cost data table refers to a section where all the salary estimates are laid out. When the tool uses the defined percentages to calculate salaries, it ensures that these estimates are reasonable and in line with local expectations. 61. Employment tax calculation automatically calculates the Pay as you earn (PAYE) tax, based on the PAYE tax table. The tax table must be updated every year in March to keep it accurate.
(D) Employment costs, local jobs	62. Local employment costs are the total employment costs that accrue to local community members.
(E) Training costs	63. Training costs are another key benefit to the local community. The cost estimates are to be provided by the investor.
Other benefits	64. Other benefits must be considered, but it may or may not be possible to monetize them (e.g., a new road or environmental damage). The benefits in this guide include partnerships facilitated, investments that have been mobilized, proportion of land put in use, and jobs created or saved.

Component of cost–benefit analysis tool	Instructions and comments
Report and analysis	65. Report and analysis exhibits follow the same order as in the commentary report. Most of the exhibits are not calculations, but just reporting in a particular format, except for NPV calculations.
NPV calculation	66. NPV calculation in Exhibit 6: Benefits to Community/CPA: the NPV calculation uses the discount rate and the values over 20 years. 67. NPV calculation of capital invested is different, as it considers that investment capital (or portion thereof) is invested in Year 0. This is why the present value of that amount is the same as the amount invested in that year.
Types of benefits	68. Types of benefits must be reviewed and, if necessary, updated for each project, depending on the specifics of that project. The main change may be the stakeholder to whom the value of enterprise accrues – the investor or the community.

The GIZ cost–benefit analysis template

The GIZ CBA template[4] helps to evaluate adaptation options in the agriculture sector, for example, improving water management through rainwater harvesting systems or enhancing irrigation practices that can optimize water use, or cultivating climate-resilient crops that are more resistant to drought, pests or flooding can help ensure food security.

The GIZ CBA template is useful for evaluating various projects and initiatives aimed at adaptation. For example, when assessing a proposed infrastructure project like a new irrigation system, the tool can be used to weigh the benefits, such as increased agricultural productivity and income, against the associated costs, including construction and maintenance.

The template is an Excel spreadsheet designed to compare up to three adaptation options according to their NPV and their IRR. If costs and benefits cannot be quantified with certainty, the template allows up to five different cost and benefit schemes to be entered for each option. Additionally, the template includes a sensitivity analysis component, which assesses how variations in cost and benefit estimates affect the CBA's key metrics. By exploring different scenarios, users can gain insights into how sensitive the NPV and IRR are to changes in assumptions, enhancing understanding of the risks and potential returns associated with each adaptation option.

The GIZ CBA template is structured to help compare up to three adaptation options based on their NPV and IRR. It accommodates uncertainty in quantifying costs and benefits by allowing users to input up to five different cost and benefit scenarios for each option, enabling a sensitivity analysis to evaluate how varying estimates influence the CBA outcomes. Each adaptation option is organized into dedicated sheets for costs and benefits, along with a summary sheet for individual results and a results overview for comparative analysis. Comprehensive instructions for completing each sheet are provided, alongside the necessary data inputs, which include annual costs and benefits in monetary terms and a discount rate for temporal comparisons. The template features a user-friendly design, with clearly defined cells for input, automatic calculations, and locked cells for data integrity.

WinDASI: a software for cost–benefit analysis of investment projects

The Food and Agricultural Organization's (FAO) Wind Data Analysis and Simulation Interface (WinDASI) tool,[5] is an analytical tool for cost–benefit calculations to assess the benefits of wind energy on farming operations. It evaluates both the capital and operational costs associated with wind installations, including expenses for turbine purchase, installation, maintenance and the integration of renewable energy into agricultural practices. Additionally, WinDASI calculates potential revenue from energy generation,

[4] This template is available at: https://www.adaptationcommunity.net/publications/giz-cost-benefit-analysis-template-imacc-2012-2/

[5] This tool is available at: https://openknowledge.fao.org/items/1ad6288a-9182-4d66-9685-bd3473a8871c

highlighting its role in reducing energy costs for farmers. It also assesses the broader benefits of reliable energy access, such as increased resilience to energy price fluctuations and enhanced agricultural productivity.

The WinDASI tool provides a step-by-step procedure for calculating flows of physical quantities of outputs, inputs and investment items, as well as flows of current, discounted, and cumulative costs; benefits; and net benefits. It also covers incremental (with-project and without-project) current, discounted and cumulative net benefits, with project indicators such as NPV, IRR, BCR, switching values and sensitivity analysis.

The WinDASI CBA software calculates economic indicators through a structured five-step process.

1. To begin using the toolkit, users access the "calculation options" window by either selecting the calculation button on the main toolbar or within a specific plan, zone or project window.
2. In the second step, users choose the type of calculation by focusing on inputs or outputs and specifying whether to calculate "by quantity" or "by value". If opting for "by value", users must also decide the type of costs to include in the CBA and provide a discount rate for calculating the NPV and related indicators. Additionally, users must enter the duration of the analysis and the desired format of the results (e.g., thousands or millions).
3. In step three, users name and describe their calculation results before executing the request in WinDASI. Once the execution is complete, a results window automatically opens, displaying the outputs based on the selected calculation options. These outputs are organized into flows analyzed over specific periods for the chosen components, whether they are related to a plan, zone or project. Key calculation options include inputs categorized by quantity, which represent physical input flows, and by value, which reflect cost flows. Outputs are similarly divided into flows by quantity for physical outputs and by value for benefits.
4. Step four calculates indicators. When you select the "net present value" calculation option, you can further analyze the flows by clicking on the buttons for switching values, aggregation, sensitivity and comparisons. Clicking the "switching values" button opens the "switching values" window, where WinDASI presents key indicators such as NPV, switching values, and IRR.
5. In the last step, which is the sensitivity analysis, users can assess the robustness of their cost and benefit indicators by selecting various inputs or outputs and applying percentage changes to them. This process involves accessing the "sensitivity" window, where users specify the desired percentage change, either positive or negative, for selected items.

Additionally, the software includes a comparison feature that allows users to evaluate the incremental NPV of project benefits. By using the with-project–without-project facility, it calculates the difference between cumulated discounted net benefits in with-project and

without-project scenarios. The results, displayed in a comparison window, provide a clear summary of how the incremental NPV is derived, illustrating the differences in net present values and the corresponding benefits and costs.

3.2. Cost–effectiveness analysis

To effectively use the following CEA tools, users should begin by clearly identifying the main area of the intervention they want to evaluate (e.g., climate change adaptation, nutrition, technology adoption, women's agency). Once the focus area is established, users should choose the most suitable tools for the CEA. It is important to consider the required level of detail, as some tools offer comprehensive frameworks while others prioritize automated data entry.

Innovations for Poverty Action cost-effectiveness analysis library

To easily calculate CEAs in real-time, Innovations for Poverty Action (IPA) has developed an automated cost collection tool[6] to input costs for the duration of a project on a monthly basis. The tool adopts the "ingredients method of costing" and allows users to identify cost drivers and how these costs may change when the program is replicated or scaled up. Each month, the user can input line-item costs, the corresponding date and description for these costs, and choose the cost ingredient category and assigned interventions from drop-down menus. Additionally, IPA has developed a library of CEAs[7] that they have conducted (Innovations for Poverty Action n.d.).

When using this template, it is essential to first discuss the CEA with project partners or principal investigators to ensure alignment with the project's objectives. Users should fill in the yellow-highlighted fields in the "project info" tab, replacing "treatment A" and "treatment B" with the actual interventions being tested, adding more if applicable. Monthly costs are then entered into the respective tabs, ensuring they are recorded in local currency and limited to program's implementation costs. Research design costs should be excluded. For projects extending beyond three years, additional monthly tabs should be created.

Each cost entry requires selection of a relevant CEA category from a drop-down menu in column D and the appropriate treatment arm in column E; costs shared between treatment arms need careful allocation. The "monthly costs" data will automatically populate the CEA tab to calculate overall cost-effectiveness. Additionally, any user costs, such as opportunity costs incurred by beneficiaries, should be included.

J-Pal costing template

[6] This tool can be accessed at: https://docs.google.com/spreadsheets/d/1DN31iuld1eYuWBs0wp6fyq4XiIe9-U2C/edit?usp=drive_web&ouid=111960407732623017980&rtpof=true

[7] This library can be accessed at: https://drive.google.com/drive/folders/1eSQOFcKKyf5tZlHhAiaVfpDbDMSHSjCE

This J-PAL costing template aims to help users generate an estimate of total program costs. It provides users with a comprehensive list of the many different cost categories or ingredients that may be included in a program. Then, within each category, the template prompts users to input the various details about cost data, such as unit cost, number of units, currency and year.

There are two versions of J-PAL's cost excel templates: a standard template for estimating program costs across a range of common cost items, and a "basic" template for situations where detailed program costs are difficult to obtain. The standard template (J-PAL Costing Template) offers a straightforward format for documenting costs across various sectors, encouraging users to consider broad cost categories relevant to different types of costs, such as staff training, implementation, user costs, and averted costs. The Basic J-PAL Costing Template helps users generate a rough estimate of total program cost by breaking costs out into the main, general categories or ingredients.

Additionally, J-PAL's CEA resource suite offers several sample templates with examples that show what detailed cost information looks like. It also includes a "costing guidelines" document that highlights important factors to consider. These resources are designed to help researchers understand and develop a clear and accurate estimate of costs associated with their projects. These guidelines provide critical information to researchers who may have limited time, including a primer on ingredient methods and important considerations like startup versus ongoing costs, fixed versus variable costs, and cost streams over time (J-PAL 2020).

When using this template, the first step involves clearly defining the program/intervention and its "ingredients", which includes assessing whether the program is entirely new or an extension of an existing one, and accounting for all relevant costs, including those that may be incurred by users or replaced by the program. J-PAL employs an "ingredients approach" that categorizes costs into staff, targeting (costs incurred to raise awareness among potential subjects), training, implementation, and monitoring, among others.

Users are guided through preliminary questions to identify applicable cost categories and adjust for exchange rates, leading to an initial estimate of cost per unit of impact. The template features eight ingredient tabs for detailed line-item breakdowns, with conditional formatting to simplify the process. The final tab consolidates total program costs and, if impact estimates are available, calculates the cost per unit of impact. Additional tips within the template highlight features like hover-over suggestions for filling cells and pre-populating data to streamline the cost estimation process. The tool does not have a section for inputting the estimated impacts. It only estimates costs then impact estimates from evaluation exercises conducted are used together with the costs for the cost effectiveness analysis.

3.3. Cost–efficiency analysis

Cost-efficiency analysis refers to the analysis of cost per output of a program or activity, allowing you to compare cost-per-output for programs that all produce the same output (International Rescue Committee 2019).

Dioptra online tool

The Dioptra online tool[8] is a valuable resource for conducting cost-efficiency analyses in humanitarian and development contexts. It offers deeper insights into performance management and sector learning. It is also essential to consider organizational technical capabilities because Dioptra's cloud-based solution allows for customization and data privacy. Organizations should also assess their existing data systems to ensure compatibility with the tool.

The Dioptra online tool enables staff at humanitarian and development organizations to rapidly estimate the cost-efficiency of their programs, using existing accounting and monitoring data. It provides the greatest value for:

- Sectoral learning: the typical cost-per-output of common activities can be explored and how cost-per-output is driven by differences in activity design or program context.
- Performance management: the cost-efficiency of a program can be periodically analyzed and benchmarks for that activity compared to assess whether greater reach might be possible if the program design were adapted.

The Dioptra online tool is a web-based software developed on Django/Python, specifically designed to streamline cost-per-output analysis for organizations, particularly non-governmental organizations (NGOs). It uses an ingredients-based costing methodology, automatically pulling from existing financial transaction data to automate the analysis process, significantly reducing the time required from several days to just a few hours. The tool uses standardized metrics for cost-efficiency across more than 20 activities, which allows for meaningful comparison of results. It incorporates shared and indirect costs for a comprehensive view of total implementation costs, avoiding misleading differences in cost-efficiency outcomes. Additionally, the Dioptra online tool estimates shared costs based on established allocation methods.

The cost-efficiency analysis process begins with defining the analysis by specifying details such as activity type and funding codes, followed by loading relevant financial transactions or budget data. The software automatically categorizes the financial data, allowing users to adjust as necessary. Users then confirm these categories, indicate which contributed to the specific activity, and allocate costs based on their relevance. After identifying the total output value, the Dioptra online tool allows users to view insights from the analysis,

[8] This tool is available at: https://www.dioptratool.org/

presenting results alongside similar programs and offering strategies for improving cost-efficiency.[9]

Education in Emergency cost capture template

The Education in Emergency (EiE) cost capture template,[10] from the United Nations Girls' Education Initiative, aims to guide gender-responsive cost tracking for education in emergency interventions. This Excel-based tool provides flexible support to track costs before, during and after implementing a program. The template is developed based on an ingredient-costing approach and allows for inflation and currency adjustments. Users can undertake cost–economy and cost–efficiency analyses. The template includes several tabs: the cover page outlines the program's general information, including activities and locations; the personnel tab captures costs associated with staff; the other ingredients tab details additional cost components; the timeline tab presents monthly costs (which should not be edited); the results tab displays the outcomes of the cost tracking model; and the questions tab allows for documenting inquiries and responses throughout the cost tracking process. The last sheet of the tool provides a space to document questions that arise during costing and the response provided and by whom.

3.4. Other cost-analysis tools

Other tools that can complement the cost analyses already described, particularly for helping teams collect cost data either for delivery or implementation of interventions and programs. These include direct costs, such as personnel salaries, materials, and operational expenses, as well as indirect costs like overhead and administrative expenses. By providing structured templates and data entry interfaces, these tools simplify the cost data collection process.

OneHealth tool

The OneHealth tool,[11] launched in May 2012 with support from organizations such as the World Health Organization and UNICEF, is a software application designed for strategic health planning at the national level. This tool estimates the costs of water, sanitation and hygiene (WASH) activities, assesses potential life-saving impacts, and identifies workforce needs. Its outputs include health impact assessments, necessary investments in health systems, budget breakdowns, financial forecasts and scenario analyses for various program strategies.

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[9] More information on navigating the Dioptra online tool is available at: https://www.dioptratool.org/videos

[10] This template is available at: https://www.ungei.org/publication/eie-cost-capture-template

[11] The tool is available at: https://avenirhealth.org/software-onehealth.html. The guidelines for this tool are available at: https://avenirhealth.org/Download/Spectrum/Manuals/OneHealth Start up manual 2016 2 18.pdf

The OneHealth tool estimates the costs and health impacts associated with investments in the health system, informing medium- to long-term strategic planning. The tool estimates the costs of service delivery under individual health programs and the costs of cross-cutting health system components, including infrastructure, human resources for health, logistics, health information systems, health financing and governance. The tool uses a bottom-up, ingredients-based costing approach, and standards and guidelines for quality clinical care are translated into quantities of inputs required per year. Quantities are multiplied by input-specific prices that can be set up to change over time. The tool is pre-populated with data from global literature and country-specific health and population surveys; however, the user can change input assumptions when more appropriate local data is available.

The OneHealth tool operates through projections, allowing users to create up to ten different scenarios in a single session. Users typically start by establishing a "base" scenario, which can then be replicated to explore various future health scale-up plans. Key features of the tool include several modules. These modules include areas where service delivery distribution, populations in need and intervention resource requirements (including labor, inpatient time, and drugs/commodities) can be defined. Separately, via a program-costing editor, program-related functions may be costed. The program costing or delivery channel modules include a bottleneck analysis where the user can investigate alternative strategies for removing the impediments to health services scale-ups. The program costing module allows for detailed planning and costing of intervention-related expenses, including commodities and training costs, while the intervention-coverages editor defines the scale of intervention implementation. The bottleneck analysis feature helps identify barriers to health service expansion and offers strategies for overcoming them.

Additionally, the human resources module allows users to plan and cost staffing needs, including salaries and training, while the infrastructure module covers the costs of facilities and equipment. The logistics module helps planning the transport of commodities, offering both costing templates and optimization options to ensure cost-effective logistics systems. Other modules, such as health financing, fiscal space, health information systems and governance provide templates for assessing the costs of implementing various health financing schemes, evaluating financial resource scenarios and planning effective governance structures, all while accounting for associated administrative costs.

The Water, Sanitation and Hygiene Sustainable Development Goal Costing Tool

The Water, Sanitation and Hygiene (WASH) Sustainable Development Goal (SDG) costing tool[12] is a spreadsheet-based resource created by UNICEF to help countries estimate the costs associated with achieving SDG targets related to WASH. Launched in 2017 and updated in 2020, the tool allows users to assess the financial requirements for fulfilling SDG

[12] This tool is available at: https://www.sanitationandwaterforall.org/tools-portal/tool/sdg-costing-tool and the guidelines are available at: https://www.sanitationandwaterforall.org/sites/default/files/2020-02/Easy-to-use%20guidelines%20on%20the%20SDG%20WASH%20Costing%20tool.pdf

targets 6.1 and 6.2, as well as identify financing gaps. It includes easy-to-follow guidelines and can be used to cost various services, such as basic and safely managed water supplies, sanitation facilities and hygiene practices like handwashing.

The tool comprises four sheets: an introduction, a data verification sheet, and two SDG costing summary reports (in USD and local currency). Users can unlock and edit these sheets to input data specific to their country, including service coverage estimates and costs categorized into capital costs, capital maintenance costs and operating costs. The model promotes sustainability through a cost-sharing mechanism between beneficiaries and government and allows for adjustments based on local financing policies. With a default discount rate of 5 percent, the tool helps calculate the costs of investments needed to achieve universal WASH coverage by 2030, assuming a gradual increase in service access for the unserved population.

Strengthening Economic Evaluation for Multisectoral Strategies for Nutrition

The Strengthening Economic Evaluation for Multisectoral Strategies for Nutrition (SEEMS-Nutrition)[13] project developed a common approach to measure the costs of multisectoral nutrition strategies, building on standard economic evaluation methods. The SEEMS-Nutrition Common Approach and Tools has been developed by the University of Washington, International Food Policy Research Institute, Helen Keller International, Results for Development and the International Livestock Research Institute.

The SEEMS-Nutrition costing suite has a comprehensive package of resources designed to support cost estimation of nutrition interventions. Key components include:

- Options for allocation methods: guidelines for selecting appropriate methods to allocate costs effectively
- Cost codebook: a reference document that defines various cost categories and coding systems for consistency in data collection
- Data collection planning form: a tool to assist researchers organize and plan their data collection

The suite also provides various data collection instruments tailored for different uses among researchers, including:

- Time allocation form: to track how time is spent on various activities
- Focus group discussion guides: for interviewing beneficiaries and frontline workers to facilitate structured discussions on costs
- Key informant interview guides: for interviewing district-level NGO staff, market-based enterprise staff and national-level NGO staff

[13] To access the material and resources from this project, please refer to Annex 1 in Levin et al. (2023).

In terms of cost estimation, the suite includes:

- Financial expenditure-analysis template: for analyzing expenditures, accompanied by guidance on its use
- Economic cost-analysis template: for assessing the economic costs of interventions, also with instructional guidance
- A combination of financial and economic costs template: this template[14] provides options on how to combine financial and economic costs. Financial and economic costs can be used as inputs into modelling of costs and impact (for example application of the Lives Saved tool (LIST)[15] or optima nutrition models[16] used in economic evaluations to analyze the cost–effectiveness or cost–benefit of nutrition-sensitive interventions delivered through multisectoral projects, or general financial budget projections as part of scaling-up nutrition-sensitive interventions (Levin et al. 2023) It offers a comprehensive cost summary that breaks down expenses by SEEMS-Nutrition categories, allowing users to input data from cost-analysis spreadsheets categorized by year, stage, input and activity. Additionally, users can present costs by location, linking summaries from financial data for specific areas such as districts or provinces. The template also includes a section where users can detail estimated costs for various locations. Finally, the unit cost-analysis feature provides summary tables that automatically calculate and illustrate the total and unit costs of the project, with examples included for clarity on annual and overall implementation costs.

CGIAR decision-support tool

CGIAR has developed a decision-support tool designed to facilitate cost estimation for Genebank operations.[17] It is available for download as an Excel spreadsheet and was created following extensive consultations and has been reviewed by Genebank managers. The tool assists in categorizing and compiling all potential Genebank costs, helping users identify unit costs for various activities (such as storage and regeneration) and uncover cost drivers that influence these expenses. The tool features a user-friendly interface with eight data entry boxes that cover general information, crops, activity tables and various cost

[14] This template is available at: https://docs.google.com/spreadsheets/d/1SOy73IEh3jJ4zW0wV1a9y5eht859UZLy/edit?usp=share_link&ouid=101964150521327324227&rtpof=true&sd=true

[15] This tool is available at: https://www.livessavedtool.org/

[16] This tool is available at: https://optimamodel.com/nutrition/

[17] This tool is available at: https://genebanks.cgiar.org/resources/general-genebank-management/decision-management-tool/ and the guidelines are available at: https://cropGenebank.sgrp.cgiar.org/index.php?option=com_content&view=article&id=579&Itemid=784

categories, including capital and variable costs. Users begin by entering essential details about the Genebank, such as the year of evaluation, the number of accessions managed and local currency information, which impacts cost estimations. Once the relevant data has been input across five sheets, the tool automatically generates various cost reports that provide insights into Genebank's financial operations.

The decision-support tool for Genebank management features several modules that help track and analyze costs related to equipment, staff and operations. The equipment module requires users to input historical data on equipment, including names, acquisition details and allocation rates for specific operations. The quasi-fixed cost module focuses on senior scientists and technicians, capturing staff titles, numbers, average salaries and their operational roles. The variable labor costs module addresses expenses for temporary workers and non-senior staff, while the variable non-labor costs module accounts for daily consumables like energy and supplies. The tool also offers robust reporting capabilities, generating various reports that detail costs per input category, per-accession costs for conservation, and total annual costs for managing accessions.

It can complement the three types of cost analysis. Researchers who have either monetized the benefits of their Genebank operations, estimated the impacts of these operations, or assessed the outputs of their Genebank activities elsewhere can use this cost data to calculate CBA, CEA and cost-efficiency analysis.

4. Guidelines for integrating cost and gender in monitoring and evaluation systems

Integrating cost data into monitoring and evaluation (M&E) systems is essential for assessing project progress and sustainability. Often, researchers focus on collecting cost data only after a project or intervention has concluded, which can pose significant challenges. M&E is also conducted in silos, leading to missed opportunities for synergies and learning. Without systematically collecting cost data during implementation, accurately estimating costs and making informed resource allocation decisions becomes challenging. Integrating cost data collection into M&E systems from the outset is essential to ensure precise tracking of design, implementation and delivery costs of an intervention.

Equally important is the integration of gender data into M&E systems. Integrating gender considerations into M&E systems fosters inclusivity and equality within programs. By recognizing and rectifying gender-specific disparities, researchers can create environments where everyone, regardless of their gender identity, has equal access to opportunities and resources. Incorporating gender considerations into M&E systems also enhances accountability and transparency. Stakeholders, including donors, governments and the public, gauge if organizations are committed to addressing gender disparities and are actively working towards gender equality. These foster trust and support for programs, which is crucial for their sustainability (Monitoring and Action for Gender and Equity n.d.)

The following sections provide guidance on strategies for integrating gender and cost data within M&E systems.

4.1. Steps in integrating gender data into monitoring and evaluation systems

Define objectives

Collaborate with stakeholders to develop objectives that strengthen the synergy between gender equity and the program or intervention goals. These objectives should address gender-based constraints, stigma, discrimination, and opportunities. The objectives should be clear and specific, and concisely answer:

- **What** do we want to happen?
- **How** will this change affect the individual, community, and society?
- **When** do we want these changes?

Develop a theory of change or a logical framework

Develop a Theory of Change that clearly outlines expected changes in outputs and outcomes for the entire target population, as well as for specific subgroups (e.g., women and men separately), resulting from the inputs and activities implemented by the program or intervention (Pereznieto & Taylor 2014). Other types of frameworks for M&E include

results frameworks and logical frameworks, all of them aim to map out the expected inputs, activities, outputs, outcomes and impacts of a program.

Developing adaptive frameworks that evolve based on real-time feedback and changing circumstances is essential for understanding how gender intersects with other social categories such as race, class, and age (Engender-SIDA n.d.). Researchers should try to incorporate qualitative methods, such as interviews and focus groups, to inform the expected pathways of change. Qualitative research is essential for gaining deeper insights into complex issues. It helps researchers understand the underlying reasons behind observed outcomes, capturing perspectives, experiences and narratives that reveal how programs are perceived and experienced by different stakeholders.

Engender the Theory of Change

An engendered Theory of Change goes beyond traditional Theory of Change by explicitly addressing how gender dynamics influence the expected pathway of change of an intervention. It recognizes that women and men may experience and respond to project activities differently based on their gender roles, responsibilities, and access to resources. An engendered Theory of Change identifies activities and describes processes and mechanisms through which interventions are expected to achieve their intended outputs and outcomes, recognizing the role gender plays (Bamberger 2013). For instance, if the goal is to improve women's economic empowerment, the Theory of Change should detail how specific training programs will help women acquire skills and access to markets, leading to increased income and autonomy. The preparation of an engendered Theory of Change involves the participation of gender specialists, project planners, stakeholders, and beneficiaries in analyzing gender relations and addressing questions at each level of the Theory of Change.

Indicator selection

Depending on the desired change and outcomes the project or intervention aims to achieve, a combination of gender-specific and gender-sensitive indicators could be included:

- Gender-specific: indicators that pertain particularly to only one gender. For example, number of women that participated to the training sessions with small children, number of men who came with their wives to participate in disseminations activities, etc.
- Gender-disaggregated: indicators that capture sex-disaggregated differences in relation to a particular metric. For example, number of participants to disseminations activities disaggregated by sex or age group, number of participants who attended at least one training session disaggregated by sex, etc.
- Gender power relations and systems: indicators that track the dynamics and structures influencing gender equality and roles within a society. For example, number of training sessions facilitated by men, ratio of male to female extension agents, etc.

During indicator selection, the researchers should review the existing indicators in the M&E framework to assess if they are gender sensitive. This assessment not only identifies gaps in tracking gender inequality but also highlights opportunities to enhance existing indicators. It is also crucial to identify important aspects of gender that are not addressed by the current indicator set. If the existing indicators fail to adequately measure these relevant gender aspects, revising or expanding the indicator set may be necessary to ensure comprehensive coverage of gender issues.

Key considerations when selecting indicators

- Indicators must be developed in a participatory way, involving all relevant stakeholders.
- Indicators must be relevant to users' needs and at a level they can understand and analyze.
- Where gaps/differences between women and men are of interest, the relevant indicators should be gender disaggregated.
- The number of indicators chosen should be small: the rule of thumb is that up to six indicators can be chosen for each type of indicator (output and outcome indicators) (Canadian International Development Agency 1997).
- Indicators should be able to measure trends over time.

Types of indicators

- Output indicators refer to the products or services produced by program activities and inputs. The program supplies essential inputs, such as resources, training and support, which are expected to lead to specific outputs. These indicators measure the implementation of an intervention and assess whether the implementing team is on track to achieve its planned activities. For example, they might include tracking the number of training sessions on women's rights conducted within a community (Innovations Poverty Action 2016).
- Outcome indicators refer to the intended results of a program or the change it seeks to create. Outcomes are typically outside control of the organization. This is where the "theory" comes in; the organization has reason to believe that the provision of outputs should lead to the intended outcomes, but key assumptions will need to hold, and outside factors will also influence these outcomes. Often programs will have several linked outcomes they are seeking to achieve (Innovations Poverty Action 2016).

Identify data sources, data collection frequency and responsible parties

Possible data sources include:

- **Routine information systems:** Regular data collected by the program staff that tracks the implementation of activities and provision of inputs.

- **Population-based surveys conducted during implementation:** Surveys targeted at program participants can provide valuable insights into output and outcome indicators. These surveys help validate and cross-check information from other data sources, ensuring greater accuracy and reliability.
- **Project reports:** These refer to the documentation generated throughout the project lifecycle that provides insights into progress, challenges and outcomes.
- **Administrative data:** These include data collected through organizational records, such as enrollment figures, attendance, and service utilization, which can provide context for understanding gender dynamics within the program.
- **Monitoring tools:** These include instruments used to systematically track progress and performance indicators throughout the implementation phase. These tools should include gender-specific indicators to measure outcomes related to gender.
- **Beneficiary feedback:** These include input from beneficiaries regarding their experiences and perceptions related to the program, specifically focusing on gender dynamics (Eval Community n.d.(a)).

Additionally, the frequency of data collection for the indicators should be outlined in the M&E framework. The data collection can be done regularly or intermittently, depending on the type of indicator and data source. The M&E plan should also clearly indicate how gender specialists and other stakeholders will be involved in monitoring results.

Outline reporting and feedback mechanisms

Establishing a feedback loop within M&E systems is crucial to ensure that gender data remains relevant and aligns with project objectives. M&E teams should prioritize these mechanisms to facilitate timely input from stakeholders, allowing them to flag challenges and suggest improvements in program implementation (Eval Community n.d.(a)). By encouraging open communication, programs can enable researchers and field workers to share their experiences and insights regarding implementation. This active engagement helps programs swiftly identify and rectify any shortcomings of interventions and ensure that they are responsive to the needs of all stakeholders involved (Eval Community n.d.(b)).

4.2. Steps in integrating costs into M&E systems

The steps for integrating cost into M&E systems are similar to those used in integrating gender into M&E systems. To begin with, it is essential to clearly define the program or intervention objectives and develop a Theory of Change. After laying this foundational groundwork, the subsequent steps are tailored to address the distinct aspects of integrating cost into M&E systems via five steps.

Itemize activities and sub-activities within the theory of change/logical framework

When the objectives and the Theory of Change are established, the next step is to break down the intervention into specific activities and sub-activities. Each activity should correspond with a component of the theory of change, detailing what needs to be done to

achieve the desired outcomes. This itemization allows for a granular understanding of where costs will be incurred and helps in tracking expenses effectively.

Determine the scale of implementation

Establishing the frequency and duration of data collection is also crucial; this should align with project timelines and the need for timely insights. (e.g., weekly, monthly) and what specific inputs are necessary, such as personnel, materials, and equipment. Additionally, determining geographic coverage is important, as this influences the costs incurred during the implementation process (Keel et al. 2017).

Identify the cost information needed to track implementation

This step involves delineating the specific cost categories that need to be tracked throughout the program's implementation in the M&E systems. Develop a clear framework to categorize costs associated with each activity and sub-activity within the M&E process. This includes direct costs (e.g., personnel salaries, materials) and indirect costs (e.g., overhead, facility usage). This framework should be established at the start of the evaluation period.

Common categories include:

- Program administration: costs associated with the overall management of the program, including salaries of administrative staff and overhead costs.
- Targeting costs: expenses related to identifying and reaching the target population, including marketing and outreach efforts.
- Staff training: costs for training personnel involved in delivering the intervention, including training materials and facilitators' fees.
- User training: expenses for training end-users or beneficiaries, ensuring they can effectively engage with the program.
- Implementation costs: direct costs incurred during the execution of activities, such as supplies, transportation, and utilities.
- Monitoring costs: resources allocated for evaluating the program's progress and effectiveness, including data collection tools and analysis.

Specify the data source, the frequency of data collection and the parties responsible for collecting data

Establish where the cost data will come from (e.g., financial records, procurement documents and determine how often the data will be collected (e.g., quarterly, annually). Assign responsibilities to specific individuals or teams for collecting and managing this data to ensure accountability and accuracy.

Outline reporting and feedback mechanisms

Ensure that there is a process for stakeholders to provide feedback on both the cost data and program implementation. Create a structured process for stakeholders to provide

feedback on the collected cost data and the overall execution of the program. This can involve regular meetings, a series of workshops, webinars and roundtable discussions that engage a diverse array of stakeholders to provide feedback on cost data implementation and program implementation.

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