



DevTreks –social budgeting that improves lives and livelihoods

Social Performance Analysis 2

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Introduction

This Appendix uses online datasets to explain how to carry out Social Performance, or Quality of Life, Assessments. The examples also demonstrate how to use communication aids, such as graphs and tables, to explain the results of analyses. The examples and their datasets are used to *illustrate* social performance analysis and should not be interpreted differently. [Because, to date, complete empirical datasets that can support the RCA Framework, or the 4 underlying frameworks, have not been found.]

Although many of these examples focus on the agricultural sector (i.e. because that's the author's area of expertise), these algorithms can be used in any industry. The Hyati (2017) reference found in Example 1 provides historical context for measuring agricultural sustainability.

Example	Page
• 1. Coffee Company Social Performance Trends Score (RCA2)	2
• 1A. Coffee Company Trends SAFA Score (RCA2)	55
• 2. Coffee Company PRA Social Performance Score (RCA1)	68
• 3. Product Life Cycle Impact Assessments (P-LCIA) for Representative Small Scale Coffee Farms (RCA3)	82
• 3A. Organization Life Cycle Impact Assessments (O-LCIA) for Representative Small Scale Coffee Farms	125
• 3B. Social Life Cycle Assessment (S-LCA) for Representative Coffee Production Stakeholders	151
• 4. Life Cycle Costs, or Benefits, (LCC or LCB) for Representative Small Scale Coffee Farms (RCA4)	172
• 4A. Coffee Farm Compliance Cost Effectiveness Analysis (CEA) (RCA5)	195



DevTreks –social budgeting that improves lives and livelihoods

• 4B. Generalized Cost Effectiveness Analysis (GCEA) with Quality Adjusted Stock Years (QASYs) (RCA5)	224
• 4C. GCEA and LCIA (RCA5)	275

All of the algorithms in this reference were tested using the upgraded Version 2.1.6 calculator patterns.

A video tutorial explaining this reference can be found at:

The Performance Analysis tutorial on the DevTreks home page.



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Example 1. Coffee Company Social Performance Trends Score (RCA2)

URLs:

[https://www.devtreks.org/greentreks/preview/carbon/resourcepack/RCA Images/1549/none](https://www.devtreks.org/greentreks/preview/carbon/resourcepack/RCA%20Images/1549/none)

[https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 1/1550/none](https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee%20Firm%20RCA%20Example%201/1550/none)

[http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 1/538/none](http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee%20Firm%20RCA%20Example%201/538/none)

Resource Stock Assessment

[https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA2 Stock/2141223476/none](https://www.devtreks.org/greentreks/preview/carbon/output/Coffee%20Firm%20RCA2%20Stock/2141223476/none)

[http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA2 Stock/2141223482/none](http://localhost:5000/greentreks/preview/carbon/output/Coffee%20Firm%20RCA2%20Stock/2141223482/none)

Monitoring and Evaluation Assessment

[https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA2 MandE/2141223477/none](https://www.devtreks.org/greentreks/preview/carbon/output/Coffee%20Firm%20RCA2%20MandE/2141223477/none)

[http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA2 MandE/2141223485/none](http://localhost:5000/greentreks/preview/carbon/output/Coffee%20Firm%20RCA2%20MandE/2141223485/none)

A. Introduction

Several U.S. states allow corporations to register for public benefit purposes. Although these corporations are still judged on their profitability, customers and investors are also interested in proof of the social benefits they generate. This example illustrates how public benefit corporations, such as socially sound farms, can supply this proof. This proof is usually a requirement for companies to obtain certification of compliance with third party standards, such as organic farming standards. The example also illustrates how private companies can assess the business continuity risks associated with probable future scenarios, such as a 1.5 degree



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temperature increase. The example uses the RCA2 algorithm, Resource Conservation Value Accounting Trends, together with data that has been abstracted from the Natural Capital Protocol coffee farm example (NCC, 2016). No actual on-farm, raw, data was found (**10***).

Although focused on coffee production, where more than 25% of production is certified, these types of “proofs of social soundness” are becoming increasingly used throughout the agricultural sector. Lernoud et al. (2017) describe this trend as follows:

“... sustainable commodities, as defined by products that are demonstrably (e.g. third-party verified) compliant with internationally recognized standards, are growing rapidly, and at a pace that far outstrips markets for conventional commodities. Highlights of the current market context are continued exceptional growth, expanding coverage of agricultural land, and dominance in some sectors of single-sector standards”

The following image (Antonopoulos et al, 2016) introduces an “instruction manual” that can serve as a training manual for this example. The authors demonstrate using best environmental management practices (BEMPs) and indicators, benchmark levels of excellence, strategic farm management plans, accreditation schemes, algorithms (i.e. that calculate N, P, and K cycles), scoring systems, and ecosystem services metrics, to assess “measurable resource and environmental efficiency”, or to conduct Social Performance Analysis, for farms and ranches.

In the context of this algorithm, each BEMP (i.e. Strategic farm management plan) shown in the image’s table, corresponds to either a Categorical or Locational Index. The “Key environmental performance indicators” correspond to the Indicators used to assess the BEMP. Example 4’s crop and household budgets and Example 5’s Stakeholder Impact Assessments can be used to supply the demographic, geographical, and economic, variables needed to more fully understand social performance. FAO SAFA’s (2013) instructions for distinguishing performance, practice, and target indicators are particularly relevant with these indicators.



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Table 13.1: Overview of the key environmental performance indicators and benchmarks of excellence

BEMPs	Benchmarks of excellence	Key environmental performance indicators ²⁸
3.1. Strategic farm management plan	The farm is managed according to a strategic management plan that: i. considers a time period of at least five years; ii. improves the sustainability performance of the farm in three dimensions: a. economic, b. social and c. environment iii. considers ecosystem services delivery in a local, regional and global context using appropriate, simple indicators described throughout this report	Accreditation schemes such as LEAF Marque, Global G.A.P., Swedish Climate Label for Food, etc. Ecosystem services indicators e.g. biomass production, water quality, soil infiltration capacity etc.
3.2. Embed benchmarking in environmental management	Relevant indicators are applied to benchmark the performance of individual processes, and the entire farm system, against all relevant best practice benchmarks described in this report Permanent staff participates in mandatory training environmental management programs at a regular intervals; in temporary staff information on environmental management objectives is provided as well as training on relevant actions	Key indicators in areas: Water e.g. irrigation m ³ /ha/year Energy e.g. field energy (L diesel/ha/year) GHG emissions e.g. farm and/or product carbon footprint kg CO ₂ e/kg product or per year Animal feed e.g. feed conversion ratio % Manure management e.g. anaerobic digestion % slurry Waste e.g. kg/ha/year waste generated Biodiversity e.g. native species – number
3.3. Landscape water quality management	Catchment sensitive farming is implemented via all applicable BEMP techniques described in this report (Table 3.6) Buffer zones comprising of at least 10 m in width are established adjacent to all water courses, where tillage and grazing are excluded Farmers work collaboratively with neighbouring farmers and river basin managers from relevant authorities to minimise risk of water pollution, for example through the establishment of strategically located integrated constructed wetlands	Soil nutrient concentrations (mg/kg) Visible signs of erosion or runoff Width of buffer strips (m)
3.4. Landscape scale biodiversity management	A biodiversity action plan is implemented on the farm, to maintain and enhance the number and abundance of locally important species	N application rate (kg/ha/year) Key species abundance metrics (no./m ²)
3.5. Energy and water efficiency	An energy management plan must be implemented and revised every five years, to include: (i) Mapping of direct energy consumption across major energy-consuming processes; (ii) Mapping of indirect energy consumption via fertiliser and animal feed consumption; (iii)	Total primary energy use (e.g. kWh or L diesel per tonne product) water footprint m ³ (blue, green, grey – depending on the water footprint)/tonne product

The following image of a small-scale agricultural WBS (Sustainable Food Lab, 2016) demonstrates that, for developing countries, the COSA (2014) and Sustainable Food Lab references, and those organizations' related publications, can serve as primary instruction manuals. The reason that some capitals, notably natural capital, receive short shrift in this WBS is that the primary goal of many agricultural development schemes in developing countries is to lift producers out of poverty and to achieve national goals for food security. In addition, data scarcity forces the use of proxy, or SAFA's practice, indicators. Asten et al (2015) provide a good example of a BEMP for coffee production in developing countries that addresses both climate change and improved farm income.



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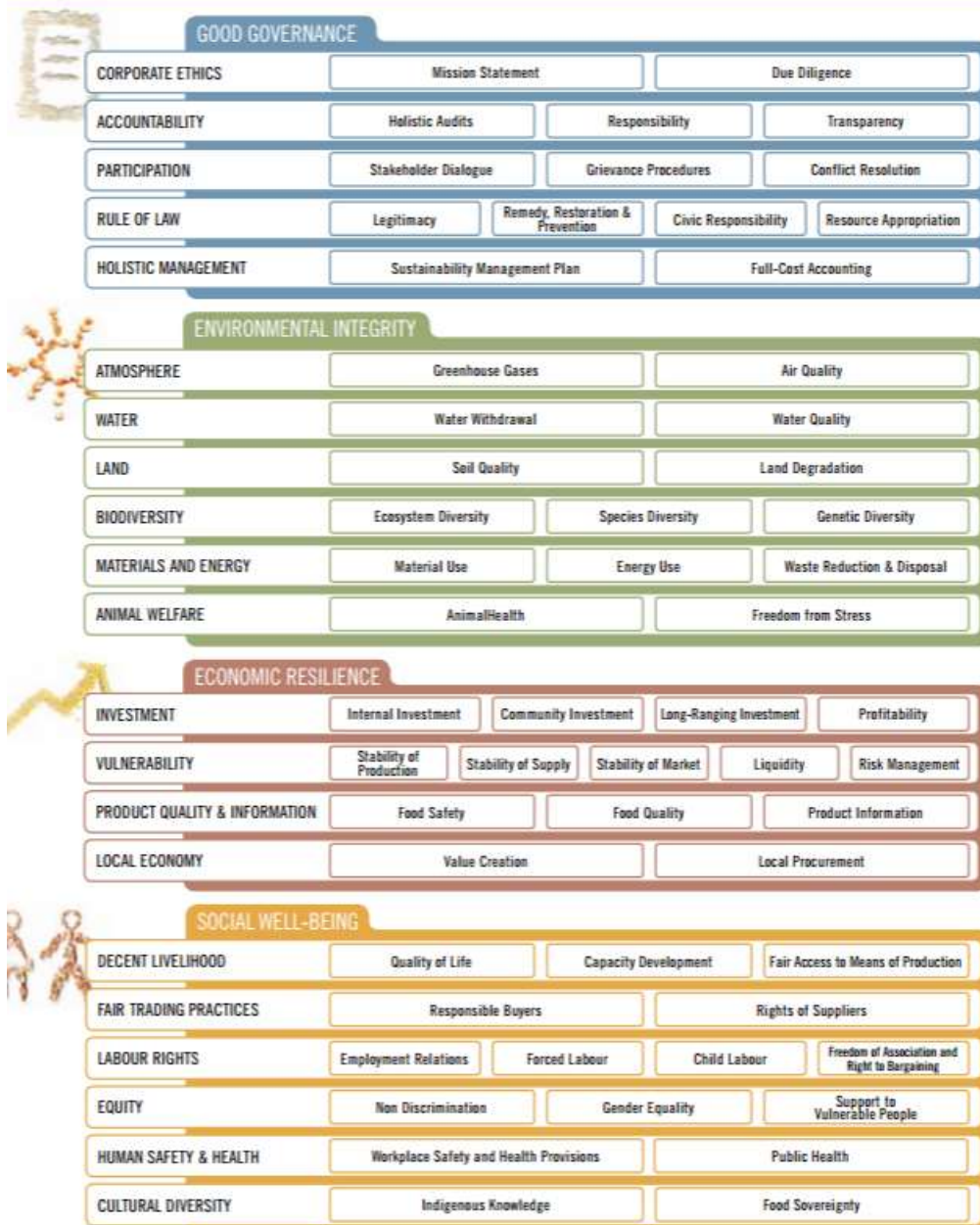
Table 1. Common Indicator Framework

Impact Areas	Guiding Question	Indicator Area	Rationale
Livelihood and Well Being	Are farmers meeting basic needs and seeing improvement?	Food Security: Access to sufficient food	Food security is a key component of sustainable livelihoods, understood by many as a basic right, and is a CSA and sustainability risk. It is important to measure separately where possible because at times when gains in income didn't lead to gains in food security.
		Income	Household income can show whether the household is above a poverty line and whether overall revenue is improving with crop income.
		Assets	Measurement of a few key assets like land-holding, source of water, access to electricity, allows us to learn more about the farmer's living conditions and is complementary to efforts to measure wealth. To understand poverty status the <u>Progress out of Poverty Index (POPI)</u> is a 10 question, country specific survey developed by the Grameen Foundation. It measures the likely percent of producers above a poverty line.
		Perceived Well-Being	Farmer perception of well-being can be equally as important as other livelihood indicators as it gives a sense of whether farmers believe their basic needs are being met and whether they will continue with this crop.
Gender	What are gender roles and benefits in this crop?	Participation	It is important to understand the role of women in the supply chain in order to better target training and other interventions.
		Benefits	If women are doing the work of the crop, but not going to training, trading, or involved in decision-making, there may be opportunities for improving inclusivity of women. It is also important that data is collected in a way that enables users to disaggregate finding by the gender of the head of household as outcomes can be examined by gender.
Environmental Stewardship	Are natural resources well stewarded?	Adoption of conservation practices	Identify 3-5 key conservation practices appropriate to the system being examined, such as cover cropping, no till, drip irrigation, etc. Where practical also look for outcome based indicators that fit within the scope of performance measurement.
Farm Productivity	Are farmers realizing the potential of their farm?	Adoption of best practices	Training only has benefits if the new practices are adopted. Typical approaches look at 3-5 key practices that drive productivity or quality. Specific practices must be identified for each crop. Adoption signifies an investment on the part of the farmer and that they are following practices most likely to result in good productivity.
		Estimated Productivity	It is important to measure productivity to track improvements in farming outcomes independent of price volatility. Look at farmer recollection of productivity through survey questions about 1) yield and 2) land area planted.
		Crop Revenue	Crop revenue (production times price) tracks the revenue contribution of the crop. Net crop income is much better whenever possible because profits are dependent on production costs. Typical key costs to measure are hired labor and inputs costs.
Access to Services	Do farmers have access to services?	Access to credit, training and inputs	Access to services like training, credit and inputs is critical for farmer success.
	Are farmers using these services?	Use of credit, training, and inputs	Use of services measures the functional attractiveness of the services. Only if farmer use the services can they improve farm outcomes.
Trading Relationships	Are farmers experiencing good trading relationships?	Organization	While participation in a farmer org is not necessary for good trading relationships, it is one indicator that farmers are organized and therefore have potential for better negotiating power. The capacity of the farmer organizations matters and should be included for in-depth studies. See COSEA PO Index .
		Equity	When farmers have options of who to sell to, locally—the choice of farmers to sell to a specific buyer—is the best “testing with your feet” indicator that the trading relationship is equid.
		Transparency	When farmers have access to information—prices, price structures, quality grades, etc.—they are better able to make informed choices about market participation and meeting in their production. Contracts are one vehicle for transparency.
		Producer Perception	Relationship and to some degree, better likelihood to continue farming the crop/selling to the primary buyer.
Next Generation Farmers	Is the supply chain cultivating a next generation of farmers?	Attractiveness of Growing Crop Profitability	What are the future of a sector/global food supply and as such, those investing in agricultural development initiatives would do well to monitor progress in this area in a common way in order to compare and share learning, adapt strategies and speed up progress and innovation.

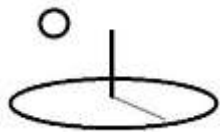
The following image of a general purpose sustainable agricultural WBS (FAO SAFA, 2013)) demonstrates the use of 4, rather than 7, capitals to conduct social performance assessment. This publication, and similar agricultural sustainability WBSs (see Hayati, 2017), can also serve as primary instruction manuals for applying this tutorial. The FAO and Hyati references use the terms “dimensions”, “themes” and “subthemes” for its hierarchical Indicators in a similar manner to this algorithm’s Total Risk, Locational, and Categorical, Indexes. In the context of the RCA Framework, Institutional Capital = Good Governance, Natural Resources and Physical Capital = Environmental Integrity, Economic Capital = Economic Integrity, and Human, Social, and Cultural Capital = Social Well Being.



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Keep in mind that most of the existing financial reporting systems introduced in SPA1 are grounded in “impact pathways”, “causal chains”, or “results chains”, based on the principles of social performance assessment. Even if the 7 capital stocks are not overtly elements of a Social Performance Assessment’s Indicator system, they must still be implicitly addressed in the alternative Indicator systems, such as SAFA’s, COSA’s, or EU’s. Mbowa et al (2014) present an



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example for coffee production that uses the Sustainable Livelihoods Framework (SLF), which “emphasizes access to or ownership of livelihood assets – (i.e. human capital; social capital; [natural capital]; and physical capital) that are key in influencing livelihood strategies.” It’s worth mentioning that the SLF can be modeled using this algorithm: Indicator 1. Vulnerability Factors, Indicator 2. Livelihood Assets, Indicator 3. Livelihood Strategies, and Indicator 4. Livelihood Outcomes (i.e. the SPA3 reference further demonstrates the use of SLF).

UNFSS (2016 in SPA1) points out that more than 400 sustainability standards systems currently exist. Although it’s likely that they use similar Indicators in each standard, their independent systems lead to problems collecting, aggregating, understanding, advancing the science, communicating, and achieving results with social performance data. UNFSS (2016) states that this lack of mainstreamed standards can undermine the fundamental credibility of standards systems. Appendix A’s concluding advice that firms and public entities work in tandem and use mainstream, generic, open source, IT platforms and standards, applies. Several examples in this tutorial will revisit this issue.

B. Indicator Thresholds

An objective, science-based, social network (i.e. Coffee Resource Conservation Value Accounting Network) has developed an Indicator Threshold system that their clubs can follow when developing resource conservation accounting and financial reports. The network started by prioritizing risks faced by their industry and communities. They then built Indicator Threshold Systems by using Indicators from established systems, such as the SDG, Sendai DRR, FAO, IPBES, COSA, EMAS, ISO, and IPCC, systems. Their goal is to be able to use the same Indicator WBS to support the full industrial sector of their countries, with supplements appropriate for specific industries, such as agriculture. The industrial sector is defined as all product supply chain participants, from producer to consumer, in multiple economic sectors. Several of the standards systems introduced in SPA1, such as SDG, EMAS, SASB, and GSSB, are examples.



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The following image (FAO SAFA Guidelines, 2013) demonstrates the use of an agricultural Indicator Threshold system applicable to agricultural supply chains. FAO defines the upper and lower thresholds (FAO SAFA Indicators, 2013) while leaving the 3 remaining thresholds to be defined by the social network. The latter publication provides guidance for each separate Indicator, including descriptions, relevance, units of measurement, collection methods, limitations, and further sources of information.

Determinating thresholds

SAFA seeks to offer a fair playing field to assessing all types of enterprises across regions and sectors. While flexibility is required to account for the diversity of settings, subjectivity needs to be minimized in order to secure fairness of the SAFA outcomes. The SAFA scoring system is crucial to this end.

Indicator rating

SAFA offers a 5 scale rating for performance. Generally the best rating and unacceptable practices are defined for each sub-theme (see Part 3), with the three middle ratings to be defined by the user based on context. This is detailed per indicator in the complement “SAFA Indicators”.

PERFORMANCE	PERCENTAGE SCORES
● BEST	80-100 percent
● GOOD	60-80 percent
● MODERATE	40-60 percent
● LIMITED	20-40 percent
● UNACCEPTABLE	0-20 percent

Indicator weighting

In order that all sub-themes are weighted equally, it is necessary to weight indicators in instances where there are multiple indicators at the sub-theme level. When sub-themes only have one indicator, no weighting is necessary. The main dimension where weighting is a critical step is the environmental dimension, for which all of the sub-themes have three or more indicators.



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The network’s clubs are engaged in coffee growing, processing, and advising. Resource conservationists, working with this case study firm’s managers, have used the tables displayed throughout this Example to customize the network’s Thresholds for the needs of the company and its associated stakeholders (i.e. SAFA contextualization). The first four factors are based on the NCC (2016) coffee firm example. Three of these target natural capital stocks and the fourth targets physical capital stocks. They included the physical capital stock risk, Flood Control, for their business continuity plan.

The fifth factor, Employee Management, has been added to reemphasize the importance of accounting for all 7 capitals. The following image (Global Coffee Platform, 2016) demonstrates how a similar socioeconomic indicator, with thresholds, is currently being used in the coffee industry. The Global Coffee Platform includes a WBS with Indicator Thresholds for 8 economic principles and performance indicators, 9 social principles and performance indicators, and 10 environmental principles and performance indicators. Their stated objective “is that, over time, all coffee producers around the world, and therefore all coffee production, will achieve a baseline level of social, environmental and economic sustainability.” Although focused on the coffee industry, most of their principles are broadly applicable to the agricultural sector. [The NCC 2016 coffee example was believed to have more complete decision support data and therefore used in this case study.]



BASELINE COMMON CODE

GCP_Doc_01_Baseline Common Code_v2.1_en|April 2016



2. SOCIAL DIMENSION

PRINCIPLES APPLICABLE TO ALL FARMERS AND PRODUCERS (2.1-2.2)

Principle	Category:	Applies to:
2.1	Discrimination (ILO Conventions 110, 111, 100)	Producing Entity and Producers and their permanently or temporarily hired workers
Equal rights are secured with respect to gender, maternity, religion, ethnicity, physical conditions and political views.		

Positive action programmes to secure equal rights are implemented.	Awareness to secure equal rights is raised and concrete steps to develop positive action programmes are evident.	No positive action to either raise awareness or secure equal rights is evident.
INDICATORS		
Policy and procedures include grievance mechanisms to secure equal rights exist and are communicated within the Producing Entity. AND The policy and procedures are being implemented, i.e. potentially vulnerable groups are identified and efforts have been made in order to explain in further detail the procedures to them, in particular the grievance mechanisms.	Policy and procedures to secure equal rights exist and are communicated within the Producing Entity. AND In case incidents of discrimination, harassment or abusive treatment have occurred, these are being addressed.	No policy or procedures for equal rights exist. AND Incidents of discrimination, harassment or abusive treatment have occurred.

The following image (Fairtrade International, 2011) demonstrates a similar socioeconomic standard developed by the Fairtrade Labelling Organization. These types of certification organizations require producers, producer organizations, and supply chain participants, to comply with these types of standards in order to label their products as “socially sound”. The image also demonstrates the use of performance targets that can be modeled using this algorithm’s Trends.



4.3 Non Discrimination		
		<p>Intent and scope</p> <p>Fairtrade International follows the Universal Declaration of Human Rights on ending discrimination. The Declaration rejects “distinction of any kind such as, race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status” (Article 2). Discrimination is making an unfair distinction in the treatment of one person over another on grounds that are not related to ability or merit. This section intends that these principles are followed.</p> <p>This is a voluntary social standard aiming to support the development of its beneficiaries. The “positive discrimination” of small producer members is therefore intended (see small producer definition and requirements of Standard section 1.2.). The same applies also for members from disadvantaged or minority groups as specified in 4.3.3.</p>
Year 0	Core	<p>4.3.1 You must not discriminate against members or restrict new membership on the basis of race, colour, gender, sexual orientation, disability, marital status, age, HIV/AIDS status, religion, political opinion, language, property, nationality, ethnicity or social origin. You must not discriminate regarding participation, voting rights, the right to be elected, access to markets, or access to training, technical support or any other benefit of membership.</p> <p>Guidance: Where particular forms of discrimination exist within an economic sector or geographical region, you are encouraged to show progress towards removing them, addressing them in your Fairtrade Development Plan.</p>
Year 0	Core	<p>4.3.2 Your rules that determine who can become a member must not be discriminatory.</p>
Year 3	Dev	<p>4.3.3 You must identify disadvantaged/minority groups within your organization according to, for example, gender, age, income or land area.</p>
Year 6	Dev	<p>4.3.4 You must have programmes in place related to the disadvantaged/minority groups</p>

The following image (IITA and COSA, 2016) illustrates how other international Voluntary Sustainability Standards (VSS) groups use both Indicators and Indexes to measure social impacts in the small-scale agricultural sector. The authors based this Indicator system on the “Theory of Change” system developed by the Fair Trade Labelling Organization (2015). The M&E tutorials, and Gertler et al (2016), explain their Theory of Change, or “results chain”, of Inputs->Activities->Outputs->Outcomes->Impacts. In the context of the RCA Framework’s 4 or 5 level hierarchy of indicators, these indexes coincide, loosely, with either Locational or Categorical Indexes.



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Table 6.1 Baseline outcome and output indices

	Target		CMS control		Non-CMS control	
	PO A	PO B	PO C	PO D	PO E	PO F
Impact level farmer indicator index	0.93	0.94	0.61	0.79	0.83	0.67
Resilient viable small producer businesses ⁴¹						
Marketing relationships index	0.50	0.50	0.83	0.33	0.92	1.00
Profitability index	0.03	0.00	0.00	0.03	0.00	1.00
Strong and inclusive POs						
Leadership index	0.67	0.86	0.72	0.98	0.90	0.45
Women's participation index	0.85	0.71	0.57	0.96	1.00	0.69
Membership volatility index	0.00	0.20	0.00	0.70	0.93	1.00
PO service and support index	0.67	0.75	0.70	0.97	0.93	0.72
Infrastructure index	0.89	1.00	0.73	0.72	0.57	0.67
Fair price index	0.87	1.00	0.75	0.87	0.62	0.99
Increased investment in small producer organizations						
Investment and financing index	0.48	0.76	0.38	0.50	0.43	0.67
Management systems index	0.50	0.33	0.67	0.17	1.00	0.79
Democratic processes, transparency index	0.83	0.73	0.95	0.81	0.86	0.90
Combined output and outcome indicators index	0.57	0.62	0.57	0.64	0.745	0.81

⁴¹ Taken from the resilient and reliable small producer businesses outcome, this outcome refers to small businesses, but not exclusively POs. We have applied these to the sample POs as they are highly appropriate for measuring the business outcomes of the POs, an important component of PO strength.

52

The following images shows that Indicator Thresholds have been defined separately for Actions, Conditions, Services, and Impacts. These Indicators, which are added to separate Indicator.URL datasets, define the social impact pathway used in this example. Other social networks may prefer using other systems of Indicators such as “results chains”, “exposure pathways”, “causal chains”, or “disaster impact pathways”. Care, combined with a thorough understanding of the background science, must be used when developing these Thresholds. The Global Coffee Exchange image demonstrates using 3 Indicator Threshold categories. SAFA demonstrates using 5 Threshold categories. Future releases will continue exploring how to automatically link these separate Indicators (i.e. using AI techniques).



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label	loca risks_and_indicators	threshold6	threshold5	threshold4	threshold3	threshold2	threshold1	threshold0
		strongly positive	moderately positive	slightly positive	neutral	slightly negative	moderately negative	strongly negative
	qualitative threshold	6	5	4	3	2	1	0
	quantitative threshold							
NCA	1 Fresh Water Supply							
AF1A	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	<.1%	.1 to .25%	0.25 to .5%	0.5 to 1%	1 to 1.5	1.5 to 2	>2%
AF1B	6.5.1 Degree of integrated water resources management implementation	>90%	75 to 90%	60 to 74%	45 to 59%	30 to 44%	15 to 29%	<15%
CF1A	Surface water capacity to support output supply (food production services)	very high	high	slightly high	neutral	slightly low	low	very low
CF1B	Surface and groundwater water capacity to support clean water supplies (life support services)	very high	high	slightly high	neutral	slightly low	low	very low
SF1A	Percent crop yield reduction from water supply capacity	0	1 to 2	3 to 4	5 to 9	10 to 14	15 to 20%	>20%
SF1B	Percent population with insufficient clean water supply	0	1 to 2	3 to 4	5 to 9	10 to 14	15 to 20%	>20%
IF1A	1 Change in net income from water supply constraints	<.1%	.1 to .25%	0.25 to .5%	0.5 to 1%	1 to 1.5	1.5 to 2	>2%
IF1B	DALYs per 1,000 people attributed to clean water supply constraints	>90%	75 to 90%	60 to 74%	45 to 59%	30 to 44%	15 to 29%	<15%
NCB	1 Pollination							
AF2A	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	>90%	75 to 90%	60 to 74%	45 to 59%	30 to 44%	15 to 29%	<15%
AF2B	Percent hectares supporting large and well-connected plant-pollinator networks (IPBES)	>10%	8 to 9%	6 to 7%	4 to 5%	2 to 3%	1 to 2%	<1%
CF2A	Degree to which pollinator health, diversity and abundance support food production services	very high capacity	high capacity	slightly high capacity	neutral	slightly low capacity	low capacity	very low capacity
CF2B	Degree to which sustainable agricultural practices support biodiversity, including bee pollinators	very high capacity	high capacity	slightly high capacity	neutral	slightly low capacity	low capacity	very low capacity
SF2A	Percent crop yield reduction, or percent operating cost increase for substitute pollinating services, caused by pollinator reductions	0	1 to 2	3 to 4	5 to 9	10 to 14	15 to 20%	>20%
SF2B	Degree to which sustainable agricultural practices support consumer satisfaction with company biodiversity actions, including bee pollinators	very high	high	slightly high	neutral	slightly low	low	very low
IF2A	1 Change in net income from pollinator conditions	0	1 to 2	3 to 4	5 to 9	10 to 14	15 to 20%	>20%
IF2B	Change in operating costs per unit increase in consumer satisfaction with company biodiversity actions	>90%	75 to 90%	60 to 74%	45 to 59%	30 to 44%	15 to 29%	<15%
NCC	1 Air quality							
AF3A	Percent manufacturing facilities achieving air pollution levels within safety standards	100%	91 to 99	81 to 90	71 to 80	61 to 70	50 to 60	<50%
AF3B	1 9.4.1 GHG emission per unit of value added	<5	5 to 6	6 to 7%	7 to 8	8 to 9	9 to 10	>10
CF3A	Percent air quality level (mm per m3) against safety standard	>90%	75 to 90%	60 to 74%	45 to 59%	30 to 44%	15 to 29%	<15%
CF3B	Degree to which GHG emission levels support carbon sequestration and climate regulating services	very high capacity	high capacity	slightly high capacity	neutral	slightly low capacity	low capacity	very low capacity
SF3A	3.9.1 Percent employees reporting manufacturing facility air quality-related health issues, such as respiratory problems and offensive odors	<1	1 to 3	4 to 6	7 to 9	10 to 12	13 to 15	>15
SF3B	Compliance costs as percent total costs from national carbon sequestration and climate regulating requirements	<1	1 to 3	4 to 6	7 to 9	10 to 12	13 to 15	>15
IF3A	DALYs per employee related to air quality in manufacturing facilities	0	0.05 to	0 to .1	0.11 to .2	.21 to .3	.3 to 1	>1
IF3B	Change in operating cost per unit increase in consumer satisfaction with company GHG emission actions	<1	1 to 3	4 to 6	7 to 9	10 to 12	13 to 15	>15
NC	1 Natural Capital Score							



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PCA	1 Flood Control							
AF4A	Percent company assets upgraded to withstand severe flood events	100%	91 to 99	81 to 90	71 to 80	61 to 70	50 to 60	<50%
AF4B	11.b.1 Degree to which business continuity plan supports community disaster risk reduction strategies	very low support	moderately low support	very low support	neutral	slightly high support	moderately high support	very high support
CF4A	Percent employees vulnerable to extreme flood safety risk per total company employees	0	<1%	1 to 2 %	3 to 5%	6 to 10%	11 to 15%	>15%
CF4B	Degree to which company BCP supports community policies for restoring hydrological balances that protect property and lives	very low support	moderately low support	very low support	neutral	slightly high support	moderately high support	very high support
SF4A	Percent company assets that effectively reduce safety risks to employees from extreme flood events	100%	95 to 99%	94 to 95%	91 to 93%	81 to 90%	71 to 80%	<70%
SF4B	Percent community assets protected from damages to life and property from extreme flood events	100%	95 to 99%	94 to 95%	91 to 93%	81 to 90%	71 to 80%	<70%
IF4A	Percent employees projected to be physically harmed per extreme flood event	0	<1%	1 to 2 %	3 to 5%	6 to 10%	11 to 15%	>15%
IF4B	Number of DALYs per 1,000 population per extreme flood event	<10	11 to 19	20 to 30	40 to 59	60 to 79	80 to 100	>100
PC	1 Physical Capital Score							
ECA	1 Employee Management							
AF5A	5.1.1 Degree to which legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex	very high	medium high	slightly high	stable	slightly low	medium low	very low
AF5B	Percent company supply sourced with SSIFs, small-scale food producers who are female and indigenous	>15	14 to 15	12 to 13	9 to 11	6 to 8	2 to 5	<2%
AF5C	Percent company supply sourced with SSNMs, small-scale food producers who are male and nonindigenous	>50	41 to 50	36 to 40	31 to 35	26 to 30	21 to 25	<20%
CF5A	Percent employees filing sexual discrimination complaints per total number of employees	0	.01 to .10	.11 to .25	.24 to .5	.49 to 1	1.1 to 2	>2%
CF5B	2.3.2 Percent SSIF coffee producers supplying company versus total SSIF coffee producers.	> 150% median income	124 to 150% median income	109 to 125% median income	90 to 110% median income	75 to 89% median income	50 to 74% median income	< 50% median income
CF5C	2.3.2 Percent SSNM coffee producers supplying company versus total SSNM coffee producers.	> 150% median income	124 to 150% median income	109 to 125% median income	90 to 110% median income	75 to 89% median income	50 to 74% median income	< 50% median income
SF5A	Percent employees satisfied with company discrimination policies	100%	95 to 99%	94 to 95%	91 to 93%	81 to 90%	71 to 80%	<70%
SF5B	2.3.2 Average income of small-scale food producers who are female and indigenous	> 150% median income	124 to 150% median income	109 to 125% median income	90 to 110% median income	75 to 89% median income	50 to 74% median income	< 50% median income
SF5C	2.3.2 Average income of small-scale food producers who are male and nonindigenous	> 150% median income	124 to 150% median income	109 to 125% median income	90 to 110% median income	75 to 89% median income	50 to 74% median income	< 50% median income
IF5A	Percent employees leaving company per year due to discrimination enforcement	0%	0.1 to 1%	1.1 to 2	2.1 to 3	3.1 to 4	4.1 to 5	> 5%
IF5B	1 Stability and quality of supply from SSIF sources	very high	medium high	slightly high	stable	slightly low	medium low	very low
IF5C	1 Stability and quality of supply from SSNM sources	very high	medium high	slightly high	stable	slightly low	medium low	very low
EC	1 Economic Capital Score							
TR	1 Social Performance Score							



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The following statement (Loconto et al, 2014) hints at why Indicators from all 7 capitals must, at the very least, be considered when conducting social performance assessments associated with standards systems. Several capitals, especially institutional, social, and cultural, may not have received their due in past Social Performance assessments. As an example for coffee production, Mbowa et al (2014) discuss the importance of Uganda’s National Coffee Policy (NCP) and land tenure (i.e. both are institutional capital indicators) in smallholder poverty alleviation.

“The institutional contexts within which smallholders operate are important. Recent research has begun to pay attention to institutional contexts in order to understand how standards interact with pre-existing norms of production and trade. A necessary but insufficient condition for increasing smallholder participation in markets is national institutions to support compliance by farmers with standards that reflect a market demand.”

C. Quality of Life Scenarios

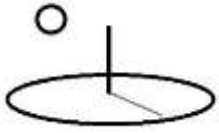
The company chose to use the following two scenarios for the purpose of building a business continuity plan (BCP). The plan helps them understand the primary risks that may impact the company’s performance and employees in the near future. They use the BCP and their Social Performance Score to identify needed investments in mitigation and adaptation Actions. They use Part D’s Social Performance Score to monitor and evaluate how well the Actions are actually reducing risks.

Scenario 1. Current Quality of Life or Current Social Performance

Scenario 2. Threatened Quality of Life or Threatened Social Performance

Stressors: High GHG result in 1.5 degree temperature increase with higher incidence of droughts, severe heat waves, crop and livestock production risks, air pollution, floods, and social discord.

Targeted Stakeholder Groups: Small Scale Coffee farmers; Coffee company employees; Consumers concerned about coffee produced using socially sound principles; Managers



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concerned about consumers who want companies to independently comply with socially sound business practices

Mitigation and Adaptation Actions: Improvement 1 consists of a) ..., b)...., and c).... (see Antonopoulos et al, 2016)

D. Social Performance Score (1*)

The following image (SAFA, 2013) demonstrates the use of a sustainable company scoring, or rating, system that is used with this algorithm. Landert et al (2017) describe this scoring system as follows:

“Using Multi-Criteria Analysis, the degree of goal achievement for each subtheme, using the following equation, was calculated. The degree of goal achievement [DGA] accordingly expresses, on a scale from 0 to 100%, the extent to which a subtheme’s sustainability goal was reached. This type of metric was selected to yield meaningful and comprehensible assessment results and to reduce the complexity when comparing between different assessments.

$$DGA_i = \sum_{n=1}^N (IM_{ni} \times IS_n) / \sum_{n=1}^N (IM_{ni})$$

where N is the number of indicators per subtheme, i is the index of the subtheme, IM_{ni} is the subtheme-specific weight of an indicator [1–3], and IS_n is the rating of an indicator (0–100%).”

RAND (2016, in SPA1) describes this same scoring system in the following statement.

Subalgorithms that employ normalization, including 13 and 14, carry this out (i.e. carry out Multi-Criteria Analysis) by using the sum of a Locational Index’s Indicators, along with a normalization type = weights.

“The third column in this section is the product of the weight and score. The values of this product may then be normalized in the fourth column. This normalization involves dividing the



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product of the weight and score by the total sum of the weights. These normalized values may then be summed to produce an unmitigated normalized value for the risk component.”

The following image and tables show that Indicator TEXT datasets store this firm’s initial Scoring system. The Thresholds are used to assign quantitative ratings for each time trend in these tables. Resource conservationists have been trained to understand how to use this social impact pathway (or, if applicable, causal chain or results chain). A key part of that training is to understand the linkages, interactions, and cause-effect relationships, among all of these Indicators and Indexes. The author is certain that he does not fully understand these relationships, but he’s also certain that machines are getting smarter and it’s likely they’ll help out (i.e. via more advanced algorithms). Additionally, UNFSS (2016, in SPA1) points to current international efforts to gather better evidence proving the actual impacts of “sustainability reporting”, or Voluntary Sustainability Standards, towards public and private sector performance objectives. A concrete example for coffee production can be found in IITA and COSA (2016). The latter publication demonstrates using public surveys to provide scientific evidence of social performance.

This example demonstrates a 1:1 relationship among all of the Indicators and Indexes within each of the 4 base Indicators. With this technique, the same Indicator is described and scored differently depending on whether it’s being used as an Action, Condition, Service, or Impact (i.e. labels AF1A, CF1A, SF1A, and IF1A). This technique supports a sophisticated understanding of how to use social impact pathways, causal chains, and results chains, to reduce risks, but it fails to capture the reality that multiple factors interact in multiple ways. Alternatively, 1:1 relationships can be described only for the Indexes, with the Indicators themselves only being used to “explain” each Index (i.e. labels NCA, NCB, and ECA). The same Indicator can appear in more than one Index. Decision making and reporting mostly focus on the Index results (refer to the IITA and COSA, 2016, image above for an example).



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Example 7 in the Social Performance Analysis 3 (SPA3) reference begins to demonstrate using machine learning algorithms to account for multiple factors that interact in multiple ways, or SPA3’s “complex intersecting patterns”.

This example also illustrates using separate benchmark, target, and actual, Indicators to monitor and evaluate performance. In this algorithm, the targets append a 2 character suffix such as “_A” and the actuals append a 3 character suffix such as “_AA”. That’s believed to be the most transparent way to score, but there’s no requirement to use separate benchmarks, targets, and actuals. The benchmarks in this example can be replaced with actuals, and the existing targets and actuals eliminated. That scoring system is how most existing reporting systems work. In that type of reporting, the Action Indicators include company activities that serve as mitigation and adaptation improvements and the Trend scores can serve as future targets.

The trend periods in this scoring system correspond to the firm’s 20 year planning horizon, similar to the replacement life of a coffee orchard. Although useful for financial accounting purposes, that horizon may not be as appropriate for resource conservation accounting –many capital stocks take longer to improve. In general, private sector planning horizons should be aligned, or at least in accord, with public sector horizons. For example, a company’s current GHG emission levels may not have serious impacts on the firm in the next 20 years, but they will have serious consequences on society for the foreseeable future (i.e. 100+ years). Version 2.1.2 upgraded this algorithm by requiring trend periods for each separate Categorical Impact –trend dates for long term climate change data have different scales than trends for current particulate matter air pollution.

The trend periods can be defined flexibly. The Eurostat 2014 reference demonstrates that, when in doubt, linear trends may serve as appropriate “guesstimates”. When used for short term project accounting, their simplest use may be to ignore benchmarks, and just record targets and actuals over 7 periods, with periods such as quarterly, semiannual, annual, or biannual. If more periods are needed, add sibling base elements or add additional calculators to existing base elements.



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The normalized, weighted, time trends are summed and averaged in the final Indicator.QTM, Indicator.QTL, and Indicator.QU, properties. For that reason, the “Actuals” should use 0’s for time trend periods that haven’t occurred. Further documentations about these calculations can be found in Appendix B.

SAFA’s Accuracy Score can be replicated, reasonably, with the certainty1 and certainty2 columns in the TEXT datasets.

Version 2.1.0 upgraded algorithms 13 and 14 by using average, rather than total, scores, in the Total Risk (TR) Indexes for QTMost, QTLow, QUp, certainty1, and certainty2 (i.e. see the Landert 2017 images used to communicate these types of scores). Version 2.1.2 supported separate trend dates for each Categorical Index, rather than uniform trend dates for all data. Some images may still reflect earlier versions.

The first image displays the Output Stock Calculator and the second image displays the equivalent Monitoring and Evaluation Output Calculator. The Input Stock Calculator, and the Input, Operation, Component, Outcome, Operating and Capital Budget, M&E calculators can also be used to run the algorithms. Their respective tutorials, Resource Stock Calculation and M&E Calculation, discuss the appropriate uses of the various calculators.



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GreenTr...	Search	Preview	Select
Edit	Pack	Views	Club

Select

PackIt

Edit Linked Views

Make base

Output Stock Calculator--

Get

Media

Mobile

Desktop

Intro	1	2	3	Help
Stock Calculation View				
Stock Budgeting 1 Output Calculator				
<p>Introduction This tool tracks resource stock indicators for output uris. Up to 15 new indicators can be added for each output.</p> <p>Calculation View Description This Social Performance Assessment can be found as Example 1 in the Social Performance Analysis reference. 208d</p> <p>Version: 2.0.2</p> <p>Feedback About carbon/output/Coffee Firm RCA2/2141223482/none</p>				

Output Group: RCA Output Examples

Output : Coffee Firm RCA2

Indicators

Math Expression: I4.QTM

Score Amount: 18.1276 Score Unit: most likely score

Select

PackIt

Edit Linked Views

Make base

M and E Output 2 Calculat

Get

Media

Mobile

Desktop

Indicators Details

Indic 0 Name: Social Performance Score **Label:** RCA0

Date: 04/27/2016 **Rel Label:** none

Math Type: none **Dist Type:** none

Indicator 1. Actions Meta (all scores are filled in automatically)

When the Indicator.DistType property has been set to none, each Indicator in a dataset calculates an Indicator.QTMost, Indicator.QTLow and Indicator.QTUp, based on the average, lowest, and highest respective ratings in the trend periods. When this property is set to normal or triangular, those values are generated from a Probability Distribution derived from combining the 7 trend period ratings. Additional PRA distributions are not yet supported.



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Indicator 1	
<div>Actions</div>	
<div>Indicator 1 Description</div> <div>These indicators score the principal risks and stressors that result in stock conditions and services</div>	
<div>Indicator 1 URL</div> <div>https://devtreks1.blob.core.windows.net/resources/network_carbon/resourcepack_1550/resource_9116/Ind1-Actions.csv</div>	
<div>Label 1</div> <div>RCA1</div>	<div>Rel Label 1</div> <div>RCA2</div>
<div>Date 1</div> <div>04/21/2017</div>	<div>Dist Type 1</div> <div>none</div>
<div>Q1 1</div> <div>3.6136</div>	<div>Q1 Unit 1</div> <div>target most score</div>
<div>Q2 1</div> <div>2.4286</div>	<div>Q2 Unit 1</div> <div>target low score</div>
<div>Q3 1</div> <div>4.8732</div>	<div>Q3 Unit 1</div> <div>target high score</div>
<div>Q4 1</div> <div>2.0660</div>	<div>Q4 Unit 1</div> <div>benchmark most score</div>
<div>Q5 1</div> <div>1.5713</div>	<div>Q5 Unit 1</div> <div>benchmark low score</div>
<div>Math Operator 1</div> <div>equalto</div>	<div>Base Unit 1</div> <div>none</div>
<div>QT 1</div> <div>3.0004</div>	<div>QT Unit 1</div> <div>benchmark high score</div>
<div>Math Type 1</div> <div>algorithm1</div>	<div>Math Sub Type 1</div> <div>subalgorithm14</div>
<div>QT D1 1</div> <div>4.5000</div>	<div>QT D1 Unit 1</div> <div>actual certainty1</div>
<div>QT D2 1</div> <div>2.5000</div>	<div>QT D2 Unit 1</div> <div>actual certainty2</div>
<div>QT Most 1</div> <div>2.8424</div>	<div>QT Most Unit 1</div> <div>actual most score</div>
<div>QT Low 1</div> <div>1.5240</div>	<div>QT Low Unit 1</div> <div>actual low score</div>
<div>QT High 1</div> <div>3.9288</div>	<div>QT High Unit 1</div> <div>actual high score</div>
<div>Math Expression 1</div> <div>I1.Q1.factor1 + I1.Q2.factor2 + I1.Q3.factor3 +</div>	
<div>Math Result 1</div> <div>https://devtreks1.blob.core.windows.net/resources/network_carbon/resourcepack_1550/resource_9117/Ind1-MathResult2.csv</div>	

Indicator1.URL TEXT dataset

Benchmarks

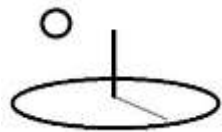


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The following image confirms that Version 2.1.2 upgraded this algorithm by moving the trend dates from the title row to each Categorical Index row. Although, for convenience, all dates are the same in this example, each Category might require substantial differences. For example, Climate Change trend dates may require 100 year projections while Air Quality trend dates may be needed annually.

label	local	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	ertainty	ertainty	norm	weight
NCA	1	Fresh Water Supply	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
AF1A	1	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	0	0	0	1	2	3	3	5	3	weights	3
AF1B	1	6.5.1 Degree of integrated water resources management implementation	2	2	2	2	2	3	3	4	2	weights	4
NCB	1	Pollination	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF2A	1	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	1	1	1	1	2	3	3	5	3	weights	3
AF2B	1	Percent hectares supporting large and well-connected plant-pollinator networks (IPBES)	2	2	2	2	2	3	3	4	2	weights	4
NCC	1	Air quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF3A	1	Percent manufacturing facilities achieving air pollution levels within safety standards	1	1	1	1	2	3	3	5	3	weights	3
AF3B	1	9.4.1 GHG emission per unit of value added	2	2	2	2	2	3	3	4	2	weights	4
NC	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA	1	Flood Control	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF4A	1	Percent company assets upgraded to withstand severe flood events	1	1	1	1	2	3	3	5	3	weights	3
AF4B	1	11.b.1 Degree to which business continuity plan supports community disaster risk reduction strategies	2	2	2	2	2	3	3	4	2	weights	4
PC	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA	1	Employee Management	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF5A	1	5.1.1 Degree to which legal frameworks promote; enforce and monitor equality and non-discrimination on the basis of sex	1	1	1	1	2	3	3	5	3	weights	3
AF5B	1	Percent company supply sourced with SSIFs; small-scale food producers who are female and indigenous	2	2	2	2	2	3	3	4	2	weights	4
EC	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Targets



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NCA_A	1	Fresh Water Supply	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF1A_A	1	6.4.2 Level of water stress: freshwater	5	5	5	4	3	3	3	5	3	weights	3
AF1B_A	1	6.5.1 Degree of integrated water	5	4	4	4	3	2	2	4	2	weights	4
NCB_A	1	Pollination	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF2A_A	1	2.4.1 Proportion of agricultural area under	4	5	5	4	3	3	3	5	3	weights	3
AF2B_A	1	Percent hectares supporting large and well-	4	4	4	4	3	2	2	4	2	weights	4
NCC_A	1	Air quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF3A_A	1	Percent manufacturing facilities achieving	5	5	5	4	3	3	3	5	3	weights	3
AF3B_A	1	9.4.1 GHG emission per unit of value added	3.5	4	4	4	3	2	2	4	2	weights	4
NC_A	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_A	1	Flood Control	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF4A_A	1	Percent company assets upgraded to	4.5	5	5	4	3	3	3	5	3	weights	3
AF4B_A	1	11.b.1 Degree to which business	5	4	4	4	3	2	2	4	2	weights	4
PC_A	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_A	1	Employee Management	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF5A_A	1	5.1.1 Degree to which legal frameworks	4	5	5	4	3	3	3	5	3	weights	3
AF5B_A	1	Percent company supply sourced with	5	4	4	4	3	2	2	4	2	weights	4
EC_A	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_A	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1
NCA_AA	1	Fresh Water Supply	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1

Actuals

NCA_AA	1	Fresh Water Supply	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
AF1A_AA	1	6.4.2 Level of water stress: freshwater	2	4.5	4	3.5	3	3	3	5	3	weights	3
AF1B_AA	1	6.5.1 Degree of integrated water	2	3.5	3	3	2	1	2.5	4	2	weights	4
NCB_AA	1	Pollination	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF2A_AA	1	2.4.1 Proportion of agricultural area under	3.5	4.5	4	3.5	3	3	3	5	3	weights	3
AF2B_AA	1	Percent hectares supporting large and well-	3.5	3.5	3	3	2	1	2.5	4	2	weights	4
NCC_AA	1	Air quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF3A_AA	1	Percent manufacturing facilities achieving	4	4.5	4	3.5	3	3	3	5	3	weights	3
AF3B_AA	1	9.4.1 GHG emission per unit of value added	3	3.5	3	3	2	1	2.5	4	2	weights	4
NC_AA	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_AA	1	Flood Control	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF4A_AA	1	Percent company assets upgraded to	3	4.5	4	3.5	3	3	3	5	3	weights	3
AF4B_AA	1	11.b.1 Degree to which business	2.5	3.5	3	3	2	1	2.5	4	2	weights	4
PC_AA	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_AA	1	Employee Management	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	weights	1
AF5A_AA	1	5.1.1 Degree to which legal frameworks	1	4.5	4	3.5	3	3	3	5	3	weights	3
AF5B_AA	1	Percent company supply sourced with	1.5	3.5	3	3	2	1	2.5	4	2	weights	4
EC_AA	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_AA	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Indicator1.MathExpression

I1.Q1.factor1 (used as a placeholder)

Indicator1.MathResult (stored using a Resource URL in the MathResult)

Benchmarks

The following image confirms that that Categorical Index rows now append their numeric results to the starting performance measurement dates. In this example, the Indicator.QTMost measures the average, normalized and weighted, rating for the 7 trend periods. Indicator.QTLow and Indicator.QTUp measure low and high estimates derived as either the lowest trend period rating, or the result of PRA calculations. Indicators that are rated 0, as shown in the 3rd row, are no longer included in the calculations for average Indicator.QTM, QTL, and QTU.



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The source code should be examined to verify that normalization and weighting are carried out by vectors of Locational Index Indicators, not Categorical Indexes (i.e. because many of the categories will only have 1 or 2 children Indicators).

label	local risks_and_factor1	factor2	factor3	factor4	factor5	factor6	factor7	certainty1	certainty2	QTMost	QTMostUr
NCA	1 Fresh Wat01_01_2037_0.3808	01_01_2027_0.3808	01_01_2022_0.3808	01_01_2020_0.5236	01_01_20:01_01_20:01_01_20:			4.5	2.5	0.7565	most
AF1A	1 6.4.2 Leve0	0	0	0.1428	0.2856	0.4287	0.4287	5	3	0.3213	mean scor
AF1B	1 6.5.1 Degr0.3808	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.4352	mean scor
NCB	1 Pollination01_01_2037_0.5236	01_01_2027_0.5236	01_01_2022_0.5236	01_01_2020_0.5236	01_01_20:01_01_20:01_01_20:			4.5	2.5	0.68	most
AF2A	1 2.4.1 Prop0.1428	0.1428	0.1428	0.1428	0.2856	0.4287	0.4287	5	3	0.2448	mean scor
AF2B	1 Percent he0.3808	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.4352	mean scor
NCC	1 Air quality01_01_2037_0.5236	01_01_2027_0.5236	01_01_2022_0.5236	01_01_2020_0.5236	01_01_20:01_01_20:01_01_20:			4.5	2.5	0.68	most
AF3A	1 Percent mi0.1428	0.1428	0.1428	0.1428	0.2856	0.4287	0.4287	5	3	0.2448	mean scor
AF3B	1 9.4.1 GHG0.3808	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.4352	mean scor
NC	1 Natural Ca1.428	1.428	1.428	1.5708	1.9992	3.0009	3.0009	4.5	2.5	2.1165	performan
PCA	1 Flood Con01_01_2037_1.5715	01_01_2027_1.5715	01_01_2022_1.5715	01_01_2020_1.5715	01_01_20:01_01_20:01_01_20:			4.5	2.5	2.0407	most
AF4A	1 Percent co0.4287	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	5	3	0.7347	mean scor
AF4B	1 11.b.1 De1.1428	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	4	2	1.306	mean scor
PC	1 Physical C1.5715	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	4.5	2.5	2.0407	performan
ECA	1 Employee01_01_2037_1.5715	01_01_2027_1.5715	01_01_2022_1.5715	01_01_2020_1.5715	01_01_20:01_01_20:01_01_20:			4.5	2.5	2.0407	most
AF5A	1 5.1.1 Degr0.4287	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	5	3	0.7347	mean scor
AF5B	1 Percent co1.1428	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	4	2	1.306	mean scor
EC	1 Economic1.5715	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	4.5	2.5	2.0407	performan
TR	1 Social Perf4.571	4.571	4.571	4.7138	5.999	9.0013	9.0013	4.5	2.5	2.066	performan
NCA_A	1 Fresh Wat01_01_2037_1.6667	01_01_2027_1.4763	01_01_2022_1.4763	01_01_2020_1.3335	01_01_20:01_01_20:01_01_20:			4.5	2.5	1.2247	most

Targets

AF1A_A	1 6.4.2 Leve	0.7143	0.7143	0.7143	0.5715	0.4287	0.4287	0.4287	5	3	0.5715	mean scor	0.4287	lowest sco	0.7143	highest scc
AF1B_A	1 6.5.1 Degr	0.9524	0.762	0.762	0.762	0.5716	0.3808	0.3808	4	2	0.6532	mean scor	0.3808	lowest sco	0.9524	highest scc
NCB_A	1 Pollination01_01_2037_1.333	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	1.1771	most	0.8095	low ci	1.4763	high ci
AF2A_A	1 2.4.1 Prop	0.5715	0.7143	0.7143	0.5715	0.4287	0.4287	0.4287	5	3	0.5511	mean scor	0.4287	lowest sco	0.7143	highest scc
AF2B_A	1 Percent he	0.762	0.762	0.762	0.762	0.5716	0.3808	0.3808	4	2	0.626	mean scor	0.3808	lowest sco	0.762	highest scc
NCC_A	1 Air quality01_01_2037_1.381	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	1.1839	most	0.8095	low ci	1.4763	high ci
AF3A_A	1 Percent mi	0.7143	0.7143	0.7143	0.5715	0.4287	0.4287	0.4287	5	3	0.5715	mean scor	0.4287	lowest sco	0.7143	highest scc
AF3B_A	1 9.4.1 GHG	0.6668	0.762	0.762	0.762	0.5716	0.3808	0.3808	4	2	0.6124	mean scor	0.3808	lowest sco	0.762	highest scc
NC_A	1 Natural Ca	4.3813	4.4289	4.4289	4.0005	3.0009	2.4285	2.4285	4.5	2.5	3.5857	performan	2.4285	low ci	4.6193	high ci
PCA_A	1 Flood Con01_01_2037_4.785	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	3.6428	most	2.4286	low ci	5.0001	high ci
AF4A_A	1 Percent co	1.9287	2.1429	2.1429	1.7142	1.2858	1.2858	1.2858	5	3	1.6836	mean scor	1.2858	lowest sco	2.1429	highest scc
AF4B_A	1 11.b.1 De	2.8572	2.2856	2.2856	2.2856	1.7144	1.1428	1.1428	4	2	1.9592	mean scor	1.1428	lowest sco	2.8572	highest scc
PC_A	1 Physical C	4.7859	4.4285	4.4285	3.9998	3.0002	2.4286	2.4286	4.5	2.5	3.6428	performan	2.4286	low ci	5.0001	high ci
ECA_A	1 Employee01_01_2037_4.571	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	3.6122	most	2.4286	low ci	5.0001	high ci
AF5A_A	1 5.1.1 Degr	1.7142	2.1429	2.1429	1.7142	1.2858	1.2858	1.2858	5	3	1.653	mean scor	1.2858	lowest sco	2.1429	highest scc
AF5B_A	1 Percent co	2.8572	2.2856	2.2856	2.2856	1.7144	1.1428	1.1428	4	2	1.9592	mean scor	1.1428	lowest sco	2.8572	highest scc
EC_A	1 Economic	4.5714	4.4285	4.4285	3.9998	3.0002	2.4286	2.4286	4.5	2.5	3.6122	performan	2.4286	low ci	5.0001	high ci
TR_A	1 Social Perf	13.7386	13.2859	13.2859	12.0001	9.0013	7.2857	7.2857	4.5	2.5	3.6136	performan	2.4286	low ci	4.8732	high ci

Actuals

NCA_AA	1 Fresh Wat01_01_2037_0.666	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	0.9319	most	0.476	low ci	1.3097	high ci
AF1A_A	1 6.4.2 Leve	0.2856	0.6429	0.5715	0.5001	0.4287	0.4287	0.4287	5	3	0.4695	mean scor	0.2856	lowest sco	0.6429	highest scc
AF1B_A	1 6.5.1 Degr	0.3808	0.6668	0.5716	0.5716	0.3808	0.1904	0.476	4	2	0.4624	mean scor	0.1904	lowest sco	0.6668	highest scc
NCB_AA	1 Pollination01_01_2037_1.166	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	1.0037	most	0.6191	low ci	1.3097	high ci
AF2A_A	1 2.4.1 Prop	0.5001	0.6429	0.5715	0.5001	0.4287	0.4287	0.4287	5	3	0.5001	mean scor	0.4287	lowest sco	0.6429	highest scc
AF2B_A	1 Percent he	0.6668	0.6668	0.5716	0.5716	0.3808	0.1904	0.476	4	2	0.5036	mean scor	0.1904	lowest sco	0.6668	highest scc
NCC_AA	1 Air quality01_01_2037_1.143	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	0.9999	most	0.6191	low ci	1.3097	high ci
AF3A_A	1 Percent mi	0.5715	0.6429	0.5715	0.5001	0.4287	0.4287	0.4287	5	3	0.5103	mean scor	0.4287	lowest sco	0.6429	highest scc
AF3B_A	1 9.4.1 GHG	0.5716	0.6668	0.5716	0.5716	0.3808	0.1904	0.476	4	2	0.4896	mean scor	0.1904	lowest sco	0.6668	highest scc
NC_AA	1 Natural Ca	2.9764	3.9291	3.4293	3.2151	2.4285	1.8573	2.7141	4.5	2.5	2.9355	performan	1.7142	low ci	3.9291	high ci
PCA_AA	1 Flood Con01_01_2037_2.714	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	2.8978	most	1.8574	low ci	3.9287	high ci
AF4A_A	1 Percent co	1.2858	1.9287	1.7142	1.5	1.2858	1.2858	1.2858	5	3	1.4694	mean scor	1.2858	lowest sco	1.9287	highest scc
AF4B_A	1 11.b.1 De	1.4284	2	1.7144	1.7144	1.1428	0.5716	1.4284	4	2	1.4284	mean scor	0.5716	lowest sco	2	highest scc
PC_AA	1 Physical C	2.7142	3.9287	3.4286	3.2144	2.4286	1.8574	2.7142	4.5	2.5	2.8978	performan	1.8574	low ci	3.9287	high ci
ECA_AA	1 Employee01_01_2037_1.285	01_01_202701_01_20:01_01_20:01_01_20:01_01_20:							4.5	2.5	2.6938	most	1.0003	low ci	3.9287	high ci
AF5A_A	1 5.1.1 Degr	0.4287	1.9287	1.7142	1.5	1.2858	1.2858	1.2858	5	3	1.347	mean scor	0.4287	lowest sco	1.9287	highest scc
AF5B_A	1 Percent co	0.8572	2	1.7144	1.7144	1.1428	0.5716	1.4284	4	2	1.3468	mean scor	0.5716	lowest sco	2	highest scc
EC_AA	1 Economic	1.2859	3.9287	3.4286	3.2144	2.4286	1.8574	2.7142	4.5	2.5	2.6938	performan	1.0003	low ci	3.9287	high ci
TR_AA	1 Social Perf	6.9765	11.7865	10.2865	9.6439	7.2857	5.5721	8.1425	4.5	2.5	2.8424	performan	1.524	low ci	3.9288	high ci



DevTreks –social budgeting that improves lives and livelihoods

Indicator 2. Conditions Meta

Indicator 2

Conditions

Indicator 2 Description

These indicators score the principal condition of the structure and function of capital stocks..

Indicator 2 URL

http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1889/Ind2-Conditions.csv

Label 2

RCA2

Rel Label 2

none

Date 2

04/21/2017

Dist Type 2

none

Q1 2

9.5378

Q1 Unit 2

target most score

Q2 2

6.4762

Q2 Unit 2

target low score

Q3 2

12.0000

Q3 Unit 2

target high score

Q4 2

6.0062

Q4 Unit 2

benchmark most sco

Q5 2

3.1900

Q5 Unit 2

benchmark low score

Math Operator 2

equalto

BaseIO 2

none

QT 2

9.3821

QT Unit 2

benchmark high scor

Math Type 2

algorithm1

Math Sub Type 2

subalgorithm14

QT D1 2

4.5000

QT D1 Unit 2

actual certainty1

QT D2 2

2.5000

QT D2 Unit 2

actual certainty2

QT Most 2

8.7150

QT Most Unit 2

actual most score

QT Low 2

5.3817

QT Low Unit 2

actual low score

QT High 2

11.7865

QT High Unit 2

actual high score

Math Expression 2

I2.Q1.01_01_2037 + I2.Q2.01_01_2027 + I2.Q3.01_01_2027 + I2.Q4.01_01_2027 + I2.Q5.01_01_2027

Math Result 2

http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1897/Ind2-MathResult.csv

Indicator2.URL TEXT dataset (note what happens with the row that has a weight = 0)

Benchmarks



DevTreks –social budgeting that improves lives and livelihoods

label	locati	risks_and_indicators	1_01_2031	1_01_2021	1_01_2021	1_01_2021	1_01_2011	1_01_2011	1_01_2011	1_01_2011	certainty1	certainty2	norm	weight
NCA	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	0	weights	1
CF1A	1	Surface water capacity to support output supply (food production services)	2	1	1	1	2	3	3	5	3	3	weights	3
CF1B	1	Surface and groundwater water capacity to support clean water supplies (life support services)	1	2	2	2	2	3	3	4	2	2	weights	4
NCB	1	Pollination	0	0	0	0	0	0	0	0	0	0	weights	1
CF2A	1	Degree to which pollinator health; diversity and abundance support food production services	1	1	1	1	2	3	3	5	3	3	weights	3
CF2B	1	Degree to which sustainable agricultural practices support biodiversity; including bee pollinators	1	2	2	2	2	3	3	4	2	2	weights	4
NCC	1	Air quality	0	0	0	0	0	0	0	0	0	0	weights	1
CF3A	1	Percent air quality level (mm per m3) against safety standard	1	1	1	1	2	3	3	5	3	3	weights	3
CF3B	1	Degree to which GHG emission levels support carbon sequestration and climate regulating services	5	2	2	2	2	3	3	4	2	2	weights	4
NC	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	0	weights	1
PCA	1	Flood Control	0	0	0	0	0	0	0	0	0	0	weights	1
CF4A	1	Percent employees vulnerable to extreme flood safety risk per total company employees	0	1	1	1	2	3	3	5	3	3	weights	3
CF4B	1	Degree to which company BCP supports community policies for restoring hydrological balances that protect property and lives	1.5	2	2	2	2	3	3	4	2	2	weights	4
PC	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	0	weights	1
ECA	1	Employee Management	0	0	0	0	0	0	0	0	0	0	weights	1
CF5A	1	Percent employees filing sexual discrimination complaints per total number of employees	0	1	1	1	2	3	3	5	3	3	weights	3
CF5B	1	2.3.2 Percent SSIF coffee producers supplying company versus total SSIF coffee producers.	2	2	2	2	2	3	3	4	2	2	weights	4
EC	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	0	weights	1
TR	1	Social Performance Score	0	0	0	0	0	0	0	0	0	0	weights	1

Targets



DevTreks –social budgeting that improves lives and livelihoods

NCA_A	1	Fresh Water Supply											1
CF1A_A	1	Surface water capacity to support output supply (food production services)	5	5	5	4	3	3	3	5	3	weights	3
CF1B_A	1	Surface and groundwater water capacity to support clean water supplies (life support services)	3	4	4	4	3	2	2	4	2	weights	4
NCB_A	1	Pollination	0	0	0	0	0	0	0	0	0	weights	1
CF2A_A	1	Degree to which pollinator health; diversity and abundance support food production services	5	5	5	4	3	3	3	5	3	weights	3
CF2B_A	1	Degree to which sustainable agricultural practices support biodiversity; including bee pollinators	5	4	4	4	3	2	2	4	2	weights	4
NCC_A	1	Air quality	0	0	0	0	0	0	0	0	0	weights	0
CF3A_A	1	Percent air quality level (mm per m3) against safety standard	5	5	5	4	3	3	3	5	3	weights	3
CF3B_A	1	Degree to which GHG emission levels support carbon sequestration and climate regulating services	4	4	4	4	3	2	2	4	2	weights	4
NC_A	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_A	1	Flood Control	0	0	0	0	0	0	0	0	0	weights	1
CF4A_A	1	Percent employees vulnerable to extreme flood safety risk per total company employees	5	5	5	4	3	3	3	5	3	weights	3
CF4B_A	1	Degree to which company BCP supports community policies for restoring hydrological balances that protect property and lives	3.5	4	4	4	3	2	2	4	2	weights	4
PC_A	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_A	1	Employee Management	0	0	0	0	0	0	0	0	0	weights	1
CF5A_A	1	Percent employees filing sexual discrimination complaints per total number of employees	5	5	5	4	3	3	3	5	3	weights	3
CF5B_A	1	2.3.2 Percent SSIF coffee producers supplying company versus total SSIF coffee producers.	4	4	4	4	3	2	2	4	2	weights	4
EC_A	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_A	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Actuals



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NCA_AA	1	Fresh Water Supply											1
CF1A_AA	1	Surface water capacity to support output supply (food production services)	3	4.5	4	3.5	3	3	3	5	3	weights	3
CF1B_AA	1	Surface and groundwater water capacity to support clean water supplies (life support services)	2	3.5	3	3	2	1	2.5	4	2	weights	4
NCB_AA	1	Pollination	0	0	0	0	0	0	0	0	0	weights	1
CF2A_AA	1	Degree to which pollinator health; diversity and abundance support food production services	3.5	4.5	4	3.5	3	3	3	5	3	weights	3
CF2B_AA	1	Degree to which sustainable agricultural practices support biodiversity; including bee pollinators	1.5	3.5	3	3	2	1	2.5	4	2	weights	4
NCC_AA	1	Air quality	0	0	0	0	0	0	0	0	0	weights	1
CF3A_AA	1	Percent air quality level (mm per m3) against safety standard	3.5	4.5	4	3.5	3	3	3	5	3	weights	3
CF3B_AA	1	Degree to which GHG emission levels support carbon sequestration and climate regulating services	0	3.5	3	3	2	1	2.5	4	2	weights	4
NC_AA	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_AA	1	Flood Control	0	0	0	0	0	0	0	0	0	weights	1
CF4A_AA	1	Percent employees vulnerable to extreme flood safety risk per total company employees	4.3	4.5	4	3.5	3	3	3	5	3	weights	3
CF4B_AA	1	Degree to which company BCP supports community policies for restoring hydrological balances that protect property and lives	2.5	3.5	3	3	2	1	2.5	4	2	weights	4
PC_AA	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_AA	1	Employee Management	0	0	0	0	0	0	0	0	0	weights	1
CF5A_AA	1	Percent employees filing sexual discrimination complaints per total number of employees	3.5	4.5	4	3.5	3	3	3	5	3	weights	3
CF5B_AA	1	2.3.2 Percent SSIF coffee producers supplying company versus total SSIF coffee producers.	2.5	3.5	3	3	2	1	2.5	4	2	weights	4
EC_AA	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_AA	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Indicator2.MathExpression

I2.Q1.factor1 (used as a placeholder)

Indicator2.MathResult

Same format for results as Indicator 1

Indicator 3. Services Meta

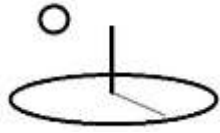


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Indicator 3	
<div>Services</div>	
<div>Description 3</div> <div>These indicators score the principal services generated by the resource stock.</div>	
<div>Indicator 3 URL</div> <div>http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1890/Ind3-Services.csv</div>	
<div>Label 3</div> <div>RCA3</div>	<div>Rel Label 3</div> <div></div>
<div>Date 3</div> <div>04/21/2017</div>	<div>Dist Type 3</div> <div>none</div>
<div>Q1 3</div> <div>8.8789</div>	<div>Q1 Unit 3</div> <div>target most score</div>
<div>Q2 3</div> <div>0.0000</div>	<div>Q2 Unit 3</div> <div>target low score</div>
<div>Q3 3</div> <div>13.2859</div>	<div>Q3 Unit 3</div> <div>target high score</div>
<div>Q4 3</div> <div>4.9712</div>	<div>Q4 Unit 3</div> <div>benchmark most score</div>
<div>Q5 3</div> <div>0.0000</div>	<div>Q5 Unit 3</div> <div>benchmark low score</div>
<div>Math Operator 3</div> <div>equalto</div>	
<div>BaseIO 3</div> <div>none</div>	
<div>QT 3</div> <div>8.2110</div>	<div>QT Unit 3</div> <div>benchmark high score</div>
<div>Math Type 3</div> <div>algorithm1</div>	<div>Math Sub Type 3</div> <div>subalgorithm14</div>
<div>QT D1 3</div> <div>4.5000</div>	<div>QT D1 Unit 3</div> <div>actual certainty1</div>
<div>QT D2 3</div> <div>2.5000</div>	<div>QT D2 Unit 3</div> <div>actual certainty2</div>
<div>QT Most 3</div> <div>7.5305</div>	<div>QT Most Unit 3</div> <div>actual most score</div>
<div>QT Low 3</div> <div>0.0000</div>	<div>QT Low Unit 3</div> <div>actual low score</div>
<div>QT High 3</div> <div>11.7865</div>	<div>QT High Unit 3</div> <div>actual high score</div>
<div>Math Expression 3</div> <div>I3.Q1.01_01_2037 + I3.Q2.01_01_2027 + I3.Q3.01_01_2027</div>	
<div>Math Result 3</div> <div>http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1898/Ind3-MathResult.csv</div>	

Indicator3.URL TEXT dataset

Benchmarks (spot the major mistake in this dataset)



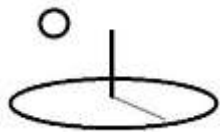
DevTreks –social budgeting that improves lives and livelihoods

label	location	risks_and_indicators	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	certainty1	certainty2	norm	weight
NCA	1	Fresh Water Supply											
SF1A	1	Percent crop yield reduction from water supply capacity	0	0	0	0	0	0	0	0	0	weights	1
SF1B	1	Percent population with insufficient clean water supply	0	2	2	2	2	3	3	4	2	weights	4
NCB	1	Pollination	0	0	0	0	0	0	0	0	0	weights	1
SF2A	1	Percent crop yield reduction; or percent operating cost increase for substitute pollinating services; caused by pollinator	0	1	1	1	2	3	3	5	3	weights	3
SF2B	1	Degree to which sustainable agricultural practices support consumer satisfaction with company biodiversity actions;	0	2	2	2	2	3	3	4	2	weights	4
NCC	1	Air quality	0	0	0	0	0	0	0	0	0	weights	1
SF3A	1	3.9.1 Percent employees reporting manufacturing facility air quality-related health issues; such as respiratory	0	1	1	1	2	3	3	5	3	weights	3
SF3B	1	Compliance costs as percent total costs from national carbon sequestration and climate regulating requirements	0	2	2	2	2	3	3	4	2	weights	4
NC	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA	1	Flood Control	0	0	0	0	0	0	0	0	0	weights	1
SF4A	1	Percent company assets that effectively reduce safety risks to employees from extreme flood events	0	1	1	1	2	3	3	5	3	weights	3
SF4B	1	Percent community assets protected from damages to life and property from extreme flood events	0	2	2	2	2	3	3	4	2	weights	4
PC	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
SF5A	1	Percent employees satisfied with company discrimination policies	0	1	1	1	2	3	3	5	3	weights	3
SF5B	1	2.3.2 Average income of small-scale food producers who are female and indigenous	0	2	2	2	2	3	3	4	2	weights	4
EC	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Targets

NCA_A	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	weights	1
SF1A_A	1	Percent crop yield reduction from water	0	5	5	4	3	3	3	5	3	weights	3
SF1B_A	1	Percent population with insufficient clean	0	4	4	4	3	2	2	4	2	weights	4
NCB_A	1	Pollination	0	0	0	0	0	0	0	0	0	weights	1
SF2A_A	1	Percent crop yield reduction; or percent	0	5	5	4	3	3	3	5	3	weights	3
SF2B_A	1	Degree to which sustainable agricultural	0	4	4	4	3	2	2	4	2	weights	4
NCC_A	1	Air quality	0	0	0	0	0	0	0	0	0	weights	1
SF3A_A	1	3.9.1 Percent employees reporting	0	5	5	4	3	3	3	5	3	weights	3
SF3B_A	1	Compliance costs as percent total costs	0	4	4	4	3	2	2	4	2	weights	4
NC_A	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_A	1	Flood Control	0	0	0	0	0	0	0	0	0	weights	1
SF4A_A	1	Percent company assets that effectively	0	5	5	4	3	3	3	5	3	weights	3
SF4B_A	1	Percent community assets protected	0	4	4	4	3	2	2	4	2	weights	4
PC_A	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_A	1	Employee Management	0	0	0	0	0	0	0	0	0	weights	1
SF5A_A		Percent employees satisfied with	0	5	5	4	3	3	3	5	3	weights	3
SF5B_A	1	2.3.2 Average income of small-scale food	0	4	4	4	3	2	2	4	2	weights	4
EC_A	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_A	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Actuals



DevTreks –social budgeting that improves lives and livelihoods

NCA_AA	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	weights	1
SF1A_AA	1	Percent crop yield reduction from water	0	4.5	4	3.5	3	3	3	5	3	weights	3
SF1B_AA	1	Percent population with insufficient clean	0	3.5	3	3	2	1	2.5	4	2	weights	4
NCB_AA	1	Pollination	0	0	0	0	0	0	0	0	0	weights	1
SF2A_AA	1	Percent crop yield reduction; or percent	0	4.5	4	3.5	3	3	3	5	3	weights	3
SF2B_AA	1	Degree to which sustainable agricultural	0	3.5	3	3	2	1	2.5	4	2	weights	4
NCC_AA	1	Air quality	0	0	0	0	0	0	0	0	0	weights	1
SF3A_AA	1	3.9.1 Percent employees reporting	0	4.5	4	3.5	3	3	3	5	3	weights	3
SF3B_AA	1	Compliance costs as percent total costs	0	3.5	3	3	2	1	2.5	4	2	weights	4
NC_AA	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	weights	1
PCA_AA	1	Flood Control	0	0	0	0	0	0	0	0	0	weights	1
SF4A_AA	1	Percent company assets that effectively	0	4.5	4	3.5	3	3	3	5	3	weights	3
SF4B_AA	1	Percent community assets protected	0	3.5	3	3	2	1	2.5	4	2	weights	4
PC_AA	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	weights	1
ECA_AA	1	Employee Management	0	0	0	0	0	0	0	0	0	weights	1
SF5A_AA	1	Percent employees satisfied with	0	4.5	4	3.5	3	3	3	5	3	weights	3
SF5B_AA	1	2.3.2 Average income of small-scale food	0	3.5	3	3	2	1	2.5	4	2	weights	4
EC_AA	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	weights	1
TR_AA	1	Social Performance Score	0	0	0	0	0	0	0	0	0	weights	1

Indicator3.MathExpression

I3.Q1.factor1 (used as a placeholder)

Indicator3.MathResult

Same format for results as Indicator 1

Indicator4. Impacts Meta



DevTreks –social budgeting that improves lives and livelihoods

Indicator 4	
Impacts	
Description 4	
These indicators score the principal changes to stakeholders' quality of life resulting from changes to service flows..	
Indicator 4 URL	
http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1891/lnd4-Impacts.csv	
Label 4	Rel Label 4
RCA4	
Date 4	Dist Type 4
04/21/2017	none
Q1 4	Q1 Unit 4
19.6536	target most score
Q2 4	Q2 Unit 4
2.0587	target low score
Q3 4	Q3 Unit 4
30.4168	target high score
Q4 4	Q4 Unit 4
19.3386	benchmark most score
Q5 4	Q5 Unit 4
3.8324	benchmark low score
Math Operator 4	BaseIO 4
equalto	none
QT 4	QT Unit 4
35.0000	benchmark high score
Math Type 4	Math Sub Type 4
algorithm1	subalgorithm14
QT D1 4	QT D1 Unit 4
4.5000	actual certainty1
QT D2 4	QT D2 Unit 4
2.5000	actual certainty2
QT Most 4	QT Most Unit 4
18.1276	actual most score
QT Low 4	QT Low Unit 4
1.4280	actual low score
QT High 4	QT High Unit 4
29.8220	actual high score
Math Expression 4	
I4.Q1.01_01_2037 + I4.Q2.01_01_2027 + I4.Q3.01_01_2027 + I4.Q4.01_01_2027 + I4.Q5.01_01_2027	
Math Result 4	
http://localhost:50032/resources/network_carbon/resourcepack_538/resource_1899/lnd4-MathResult.csv	

Indicator4.URL TEXT dataset (note that this normalization type was not used in the final data)

Benchmarks



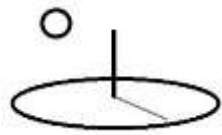
DevTreks –social budgeting that improves lives and livelihoods

label	locatic	risks_and_indicators	y1_01_203	y1_01_202	y1_01_201	y1_01_200	y1_01_2019	y1_01_2018	y1_01_2017	certainty1	certainty2	norm	weight
NCA	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	tanh	1
IF1A	1	Change in net income from water supply constraints	0.5	1	1	1	2	3	3	5	3	tanh	3
IF1B	1	DALYs per 1,000 people attributed to clean water supply constraints	0.5	2	2	2	2	3	3	4	2	tanh	4
NCB	1	Pollination	0	0	0	0	0	0	0	0	0	tanh	1
IF2A	1	Change in net income from pollinator conditions	0.6	1	1	1	2	3	3	5	3	tanh	3
IF2B	1	Change in operating costs per unit increase in consumer satisfaction with company biodiversity actions	0.6	2	2	2	2	3	3	4	2	tanh	4
NCC	1	Air quality	0	0	0	0	0	0	0	0	0	tanh	1
IF3A	1	DALYs per employee related to air quality in manufacturing facilities	1	1	1	1	2	3	3	5	3	tanh	3
IF3B	1	Change in operating cost per unit increase in consumer satisfaction with company GHG emission actions	1	2	2	2	2	3	3	4	2	tanh	4
NC	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
PCA	1	Flood Control	0	0	0	0	0	0	0	0	0	tanh	1
IF4A	1	Percent employees projected to be physically harmed per extreme flood event	0.75	1	1	1	2	3	3	5	3	tanh	3
IF4B	1	Number of DALYs per 1,000 population per extreme flood event	1.5	2	2	2	2	3	3	4	2	tanh	4
PC	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
ECA	1	Employee Management	0	0	0	0	0	0	0	0	0	tanh	1
IF5A	1	Percent employees leaving company per year due to discrimination enforcement	0.9	1	1	1	2	3	3	5	3	tanh	3
IF5B	1	Stability and quality of supply from SSIF sources	1.33	2	2	2	2	3	3	4	2	tanh	4
EC	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
TR	1	Social Performance Score	0	0	0	0	0	0	0	0	0	tanh	1

Targets

NCA_A	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	tanh	1
IF1A_A	1	Change in net income from water supply constraints	1.5	3	3	3	6	9	9	15	9	tanh	3
IF1B_A	1	DALYs per 1,000 people attributed to clean water supply constraints	1.5	6	6	6	6	9	9	12	6	tanh	4
NCB_A	1	Pollination	0	0	0	0	0	0	0	0	0	tanh	1
IF2A_A	1	Change in net income from pollinator conditions	1.8	3	3	3	6	9	9	15	9	tanh	3
IF2B_A	1	Change in operating costs per unit increase in consumer satisfaction with company biodiversity actions	1.8	6	6	6	6	9	9	12	6	tanh	4
NCC_A	1	Air quality	0	0	0	0	0	0	0	0	0	tanh	1
IF3A_A	1	DALYs per employee related to air quality in manufacturing facilities	3	3	3	3	6	9	9	15	9	tanh	3
IF3B_A	1	Change in operating cost per unit increase in consumer satisfaction with company GHG emission actions	3	6	6	6	6	9	9	12	6	tanh	4
NC_A	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
PCA_A	1	Flood Control	0	0	0	0	0	0	0	0	0	tanh	1
IF4A_A	1	Percent employees projected to be physically harmed per extreme flood event	2.25	3	3	3	6	9	9	15	9	tanh	3
IF4B_A	1	Number of DALYs per 1,000 population per extreme flood event	4.5	6	6	6	6	9	9	12	6	tanh	4
PC_A	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
ECA_A	1	Employee Management	0	0	0	0	0	0	0	0	0	tanh	1
IF5A_A	1	Percent employees leaving company per year due to discrimination enforcement	2.7	3	3	3	6	9	9	15	9	tanh	3
IF5B_A	1	Stability and quality of supply from SSIF sources	3.99	6	6	6	6	9	9	12	6	tanh	4
EC_A	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
TR_A	1	Social Performance Score	0	0	0	0	0	0	0	0	0	tanh	1

Actuals



DevTreks –social budgeting that improves lives and livelihoods

NCA_AA	1	Fresh Water Supply	0	0	0	0	0	0	0	0	0	tanh	1
IF1A_AA	1	Change in net income from water supply constraints	0.75	1.5	1.5	1.5	3	4.5	4.5	7.5	4.5	tanh	3
IF1B_AA	1	DALYs per 1,000 people attributed to clean water supply constraints	0.75	3	3	3	3	4.5	4.5	6	3	tanh	4
NCB_AA	1	Pollination	0	0	0	0	0	0	0	0	0	tanh	1
IF2A_AA	1	Change in net income from pollinator conditions	0.9	1.5	1.5	1.5	3	4.5	4.5	7.5	4.5	tanh	3
IF2B_AA	1	Change in operating costs per unit increase in consumer satisfaction with company biodiversity actions	0.9	3	3	3	3	4.5	4.5	6	3	tanh	4
NCC_AA	1	Air quality	0	0	0	0	0	0	0	0	0	tanh	1
IF3A_AA	1	DALYs per employee related to air quality in manufacturing facilities	1.5	1.5	1.5	1.5	3	4.5	4.5	7.5	4.5	tanh	3
IF3B_AA	1	Change in operating cost per unit increase in consumer satisfaction with company GHG emission actions	1.5	3	3	3	3	4.5	4.5	6	3	tanh	4
NC_AA	1	Natural Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
PCA_AA	1	Flood Control	0	0	0	0	0	0	0	0	0	tanh	1
IF4A_AA	1	Percent employees projected to be physically harmed per extreme flood event	1.125	1.5	1.5	1.5	3	4.5	4.5	7.5	4.5	tanh	3
IF4B_AA	1	Number of DALYs per 1,000 population per extreme flood event	2.25	3	3	3	3	4.5	4.5	6	3	tanh	4
PC_AA	1	Physical Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
ECA	1	Employee Management	0	0	0	0	0	0	0	0	0	tanh	1
IF5A_AA	1	Percent employees leaving company per year due to discrimination enforcement	1.35	1.5	1.5	1.5	3	4.5	4.5	7.5	4.5	tanh	3
IF5B_AA	1	Stability and quality of supply from SSIF sources	1.995	3	3	3	3	4.5	4.5	6	3	tanh	4
EC_AA	1	Economic Capital Score	0	0	0	0	0	0	0	0	0	tanh	1
TR_AA	1	Social Performance Score	0	0	0	0	0	0	0	0	0	tanh	1

Indicator4.MathExpression

I4.Q1.factor1 (used as a placeholder)

Indicator4.MathResult

Benchmarks

label	location	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	certainty	certainty	QTMost	QTMostU	QTLow	QTLowUr	QTUp	QTUpUnit
NCA	1	Fresh Wa	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	4.5	2.5	0.629	most	0.1666	low ci	1.0003	high ci
IF1A	1	Change in	0.0714	0.1428	0.1428	0.1428	0.2856	0.4287	0.4287	5	3	0.2346	mean sco	0.0714	lowest sc	0.4287	highest sc
IF1B	1	DALYs per	0.0952	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.3944	mean sco	0.0952	lowest sc	0.5716	highest sc
NCB	1	Pollinatio	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	4.5	2.5	0.6339	most	0.2002	low ci	1.0003	high ci
IF2A	1	Change in	0.0858	0.1428	0.1428	0.1428	0.2856	0.4287	0.4287	5	3	0.2367	mean sco	0.0858	lowest sc	0.4287	highest sc
IF2B	1	Change in	0.1144	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.3972	mean sco	0.1144	lowest sc	0.5716	highest sc
NCC	1	Air quality	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	4.5	2.5	0.6528	most	0.3332	low ci	1.0003	high ci
IF3A	1	DALYs per	0.1428	0.1428	0.1428	0.1428	0.2856	0.4287	0.4287	5	3	0.2448	mean sco	0.1428	lowest sc	0.4287	highest sc
IF3B	1	Change in	0.1904	0.3808	0.3808	0.3808	0.3808	0.5716	0.5716	4	2	0.408	mean sco	0.1904	lowest sc	0.5716	highest sc
NC	1	Natural C	0.7	1.5708	1.5708	1.5708	1.9992	3.0009	3.0009	4.5	2.5	1.9157	performa	0.7	low ci	3.0009	high ci
PCA	1	Flood Cor	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	4.5	2.5	1.9846	most	1.1785	low ci	3.0002	high ci
IF4A	1	Percent e	0.3213	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	5	3	0.7194	mean sco	0.3213	lowest sc	1.2858	highest sc
IF4B	1	Number c	0.8572	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	4	2	1.2652	mean sco	0.8572	lowest sc	1.7144	highest sc
PC	1	Physical C	1.1785	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	4.5	2.5	1.9846	performa	1.1785	low ci	3.0002	high ci
ECA	1	Employee	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	4.5	2.5	1.9803	most	1.1458	low ci	3.0002	high ci
IF5A	1	Percent e	0.3858	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	5	3	0.7287	mean sco	0.3858	lowest sc	1.2858	highest sc
IF5B	1	Stability a	0.76	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	4	2	1.2516	mean sco	0.76	lowest sc	1.7144	highest sc
EC	1	Economic	1.1458	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	4.5	2.5	1.9803	performa	1.1458	low ci	3.0002	high ci
TR	1	Social Per	3.0243	4.7138	4.7138	4.7138	5.999	9.0013	9.0013	4.5	2.5	1.9602	performa	1.0081	low ci	3.0004	high ci
NCA_A	1	Fresh Wa	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	01_01_2C	13.5	7.5	1.8877	most	0.4998	low ci	3.0002	high ci
IF1A_A	1	Change in	0.2142	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	15	9	0.7041	mean sco	0.2142	lowest sc	1.2858	highest sc
IF1B_A	1	DALYs per	0.2856	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	12	6	1.1836	mean sco	0.2856	lowest sc	1.7144	highest sc

Targets



DevTreks –social budgeting that improves lives and livelihoods

NCA_A	1 Fresh Wat	0.4998	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	13.5	7.5	1.8877	mean	0.4998	low ci	3.0002	high ci
IF1A_A	1 Change in	0.2142	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	15	9	0.7041	mean scor	0.2142	lowest sco	1.2858	highest scc
IF1B_A	1 DALYs per	0.2856	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	12	6	1.1836	mean scor	0.2856	lowest sco	1.7144	highest scc
NCB_A	1 Pollination	0.5999	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	13.5	7.5	1.9021	mean	0.5999	low ci	3.0002	high ci
IF2A_A	1 Change in	0.2571	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	15	9	0.7101	mean scor	0.2571	lowest sco	1.2858	highest scc
IF2B_A	1 Change in	0.3428	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	12	6	1.1192	mean scor	0.3428	lowest sco	1.7144	highest scc
NCC_A	1 Air quality	1.0003	1.5715	1.5715	1.5715	1.9999	3.0002	3.0002	13.5	7.5	1.9591	mean	1.0003	low ci	3.0002	high ci
IF3A_A	1 DALYs per	0.4287	0.4287	0.4287	0.4287	0.8571	1.2858	1.2858	15	9	0.7347	mean scor	0.4287	lowest sco	1.2858	highest scc
IF3B_A	1 Change in	0.5716	1.1428	1.1428	1.1428	1.1428	1.7144	1.7144	12	6	1.2244	mean scor	0.5716	lowest sco	1.7144	highest scc
NC_A	1 Natural Ca	2.1	4.7145	4.7145	4.7145	5.9997	9.0006	9.0006	13.5	7.5	5.7489	performan	2.1	low ci	9.0006	high ci
PCA_A	1 Flood Con	3.5358	4.7142	4.7142	4.7142	5.9997	8.9999	8.9999	13.5	7.5	5.9542	mean	3.5358	low ci	8.9999	high ci
IF4A_A	1 Percent en	0.9642	1.2858	1.2858	1.2858	2.5713	3.8571	3.8571	15	9	2.1582	mean scor	0.9642	lowest sco	3.8571	highest scc
IF4B_A	1 Number of	2.5716	3.4284	3.4284	3.4284	3.4284	5.1428	5.1428	12	6	3.796	mean scor	2.5716	lowest sco	5.1428	highest scc
PC_A	1 Physical C	3.5358	4.7142	4.7142	4.7142	5.9997	8.9999	8.9999	13.5	7.5	5.9542	performan	3.5358	low ci	8.9999	high ci
ECA_A	1 Employee	3.4371	4.7142	4.7142	4.7142	5.9997	8.9999	8.9999	13.5	7.5	5.9402	mean	3.4371	low ci	8.9999	high ci
IF5A_A	1 Percent en	1.1571	1.2858	1.2858	1.2858	2.5713	3.8571	3.8571	15	9	2.1858	mean scor	1.1571	lowest sco	3.8571	highest scc
IF5B_A	1 Stability ar	2.28	3.4284	3.4284	3.4284	3.4284	5.1428	5.1428	12	6	3.7544	mean scor	2.28	lowest sco	5.1428	highest scc
EC_A	1 Economic	3.4371	4.7142	4.7142	4.7142	5.9997	8.9999	8.9999	13.5	7.5	5.9402	performan	3.4371	low ci	8.9999	high ci
TR_A	1 Social Perf	9.0729	14.1429	14.1429	14.1429	17.9991	27.0004	27.0004	13.5	7.5	17.6433	performan	9.0729	low ci	27.0004	high ci

Actuals

NCA_AA	1 Fresh Wat	0.2499	0.7858	0.7858	0.7858	1.0003	1.5001	1.5001	6.75	3.75	0.9439	mean	0.2499	low ci	1.5001	high ci
IF1A_AA	1 Change in	0.1071	0.2142	0.2142	0.2142	0.4287	0.6429	0.6429	7.5	4.5	0.3519	mean scor	0.1071	lowest sco	0.6429	highest scc
IF1B_AA	1 DALYs per	0.1428	0.5716	0.5716	0.5716	0.5716	0.8572	0.8572	6	3	0.592	mean scor	0.1428	lowest sco	0.8572	highest scc
NCB_AA	1 Pollination	0.3003	0.7858	0.7858	0.7858	1.0003	1.5001	1.5001	6.75	3.75	0.9512	mean	0.3003	low ci	1.5001	high ci
IF2A_AA	1 Change in	0.1287	0.2142	0.2142	0.2142	0.4287	0.6429	0.6429	7.5	4.5	0.3552	mean scor	0.1287	lowest sco	0.6429	highest scc
IF2B_AA	1 Change in	0.1716	0.5716	0.5716	0.5716	0.5716	0.8572	0.8572	6	3	0.596	mean scor	0.1716	lowest sco	0.8572	highest scc
NCC_AA	1 Air quality	0.4998	0.7858	0.7858	0.7858	1.0003	1.5001	1.5001	6.75	3.75	0.9796	mean	0.4998	low ci	1.5001	high ci
IF3A_AA	1 DALYs per	0.2142	0.2142	0.2142	0.2142	0.4287	0.6429	0.6429	7.5	4.5	0.3672	mean scor	0.2142	lowest sco	0.6429	highest scc
IF3B_AA	1 Change in	0.2856	0.5716	0.5716	0.5716	0.5716	0.8572	0.8572	6	3	0.6124	mean scor	0.2856	lowest sco	0.8572	highest scc
NC_AA	1 Natural Ca	1.05	2.3574	2.3574	2.3574	3.0009	4.5003	4.5003	6.75	3.75	2.8747	performan	1.05	low ci	4.5003	high ci
PCA_AA	1 Flood Con	1.7677	2.3573	2.3573	2.3573	3.0002	4.5003	4.5003	6.75	3.75	2.9771	mean	1.7677	low ci	4.5003	high ci
IF4A_AA	1 Percent en	0.4821	0.6429	0.6429	0.6429	1.2858	1.9287	1.9287	7.5	4.5	1.0791	mean scor	0.4821	lowest sco	1.9287	highest scc
IF4B_AA	1 Number of	1.2856	1.7144	1.7144	1.7144	1.7144	2.5716	2.5716	6	3	1.898	mean scor	1.2856	lowest sco	2.5716	highest scc
PC_AA	1 Physical C	1.7677	2.3573	2.3573	2.3573	3.0002	4.5003	4.5003	6.75	3.75	2.9771	performan	1.7677	low ci	4.5003	high ci
ECA	1 Employee	1.7187	2.3573	2.3573	2.3573	3.0002	4.5003	4.5003	6.75	3.75	2.9701	mean	1.7187	low ci	4.5003	high ci
IF5A_AA	1 Percent en	0.5787	0.6429	0.6429	0.6429	1.2858	1.9287	1.9287	7.5	4.5	1.0929	mean scor	0.5787	lowest sco	1.9287	highest scc
IF5B_AA	1 Stability ar	1.14	1.7144	1.7144	1.7144	1.7144	2.5716	2.5716	6	3	1.8772	mean scor	1.14	lowest sco	2.5716	highest scc
EC_AA	1 Economic	1.7187	2.3573	2.3573	2.3573	3.0002	4.5003	4.5003	6.75	3.75	2.9701	performan	1.7187	low ci	4.5003	high ci
TR_AA	1 Social Perf	4.5364	7.072	7.072	7.072	9.0013	13.5009	13.5009	6.75	3.75	8.8219	performan	4.5364	low ci	13.5009	high ci

Optional Indicator5. Impacts Meta

As of Version 2.1.8, all of the Social Performance Analysis algorithms can be run from all of the 15 Indicators and the Score.



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the resource stock.

Indic 4 Name: Impacts	Label: RCA4
Date: 04/21/2017	Rel Label: RCA1
Math Type: algorithm1	Dist Type: none
Math Sub Type: subalgorithm14	Base IO: none
Q1 Amount: 17.6433	Q1 Unit: target most score
Q2 Amount: 9.0729	Q2 Unit: target low score
Q3 Amount: 27.0004	Q3 Unit: target high score
Q4 Amount: 5.8806	Q4 Unit: benchmark most score
Q5 Amount: 3.0243	Q5 Unit: benchmark low score
Math Express: I4.Q1.01_01_2037 + I4.Q2.01_01_2027 + I4.Q3.01_01_2022 + I4.Q4.01_01_2020 + I4.Q5.01_01_2019 + I4.Q6.01_01_2018 + I4.Q7.01_01_2017 + I4.Q8.certainty1 + I4.Q9.certainty2 + I4.Q10.norm + I4.Q11.weight	Math Operator: equalto
QT Amount: 9.0013	QT Unit: benchmark high score
QT D1 Amount: 6.7500	QT D1 Unit: actual certainty1
QT D2 Amount: 3.7500	QT D2 Unit: actual certainty2
QT Most Amount: 8.8219	QT Most Unit: actual most score
QT Low Amount: 4.5364	QT Low Unit: actual low score
QT High Amount: 13.5009	QT High Unit: actual high score

Indic 4 Description: These indicators score the principal changes to stakeholders' quality of life resulting from changes to service flows..

Indic 5 Name: Results Chain Impacts	Label: RCA5
Date: 07/12/2017	Rel Label: none
Math Type: algorithm1	Dist Type: none
Math Sub Type: subalgorithm14	Base IO: none
Q1 Amount: 17.6433	Q1 Unit: target most score
Q2 Amount: 9.0729	Q2 Unit: target low score
Q3 Amount: 27.0004	Q3 Unit: target high score
Q4 Amount: 5.8806	Q4 Unit: benchmark most score
Q5 Amount: 3.0243	Q5 Unit: benchmark low score
Math Express: I5.Q1.01_01_2037 + I5.Q2.01_01_2027 + I5.Q3.01_01_2022 + I5.Q4.01_01_2020 + I5.Q5.01_01_2019 + I5.Q6.01_01_2018 + I5.Q7.01_01_2017 + I5.Q8.certainty1 + I5.Q9.certainty2 + I5.Q10.norm + I5.Q11.weight	Math Operator: equalto
QT Amount: 9.0013	QT Unit: benchmark high score
QT D1 Amount: 6.7500	QT D1 Unit: actual certainty1
QT D2 Amount: 3.7500	QT D2 Unit: actual certainty2
QT Most Amount: 8.8219	QT Most Unit: actual most score
QT Low Amount: 4.5364	QT Low Unit: actual low score
QT High Amount: 13.5009	QT High Unit: actual high score

Indic 5 Description: These indicators score the impacts documented in M and E

Social Performance Score



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Version 2.1.2 investigated the use of separate algorithms to shore up Scores. For example, by assuming that enough Social Performance Assessments have been completed to train a neural network and then using a time series regression algo to predict cause and effect – will the conservation practices cause sustainability to change, by how much, and by when? Version 2.1.4 introduces new algorithms, including machine learning, that demonstrate using the Scores to conduct Impact Evaluations.

Scores can be defined several ways: 1) actual score / target score, 2) actual score / benchmark score, 3) Indicator 4's direct Impact scores, or 4) by custom mathematical algorithms that use Indicators 1 to 4, or even separate datasets. The reporting standard developed by this social network provides guidance to their clubs.

Example 4B demonstrates how to also define a Social Performance Score as a Quality of Life Score that can be used to assess the cost effectiveness of sustainable technologies.

This firm uses their final Performance Score to monitor and evaluate how well they are accomplishing targeted goals. The following image confirms that they chose to use Indicator 4's Impacts directly in the Scores as well.



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GreenTreks	Search	Preview	Select
Edit	Pack	Views	Club

Select

PackIt

Edit Linked Views

Make base

Output Stock Calculator--

Get

Media

Mobile

Desktop

Intro	1	2	3	Help
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Step 3 of 3. Save

Method 1. Do you wish to save step 2's calculations? These calculations are viewed by opening this particular calculator addin.

Save Calcs

Output Group: RCA Output Examples

Output : Coffee Firm RCA2

Indicators

Math Expression: I4.QTM

Score Amount: 8.8219

Score D1 Amount: 0.0000

Score D2 Amount: 0.0000

Distribution Type: none

Score Most Amount: 8.8219

Score Low Amount: 4.5364

Score High Amount: 13.5009

Iterations: 0

Score Unit: most likely score

Score D1 Unit: none

Score D2 Unit: none

Math Type: none

Score Most Unit: most likely score

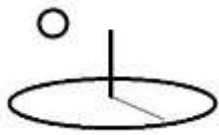
Score Low Unit: lowest score

Score High Unit: highest score

Math Sub Type: none

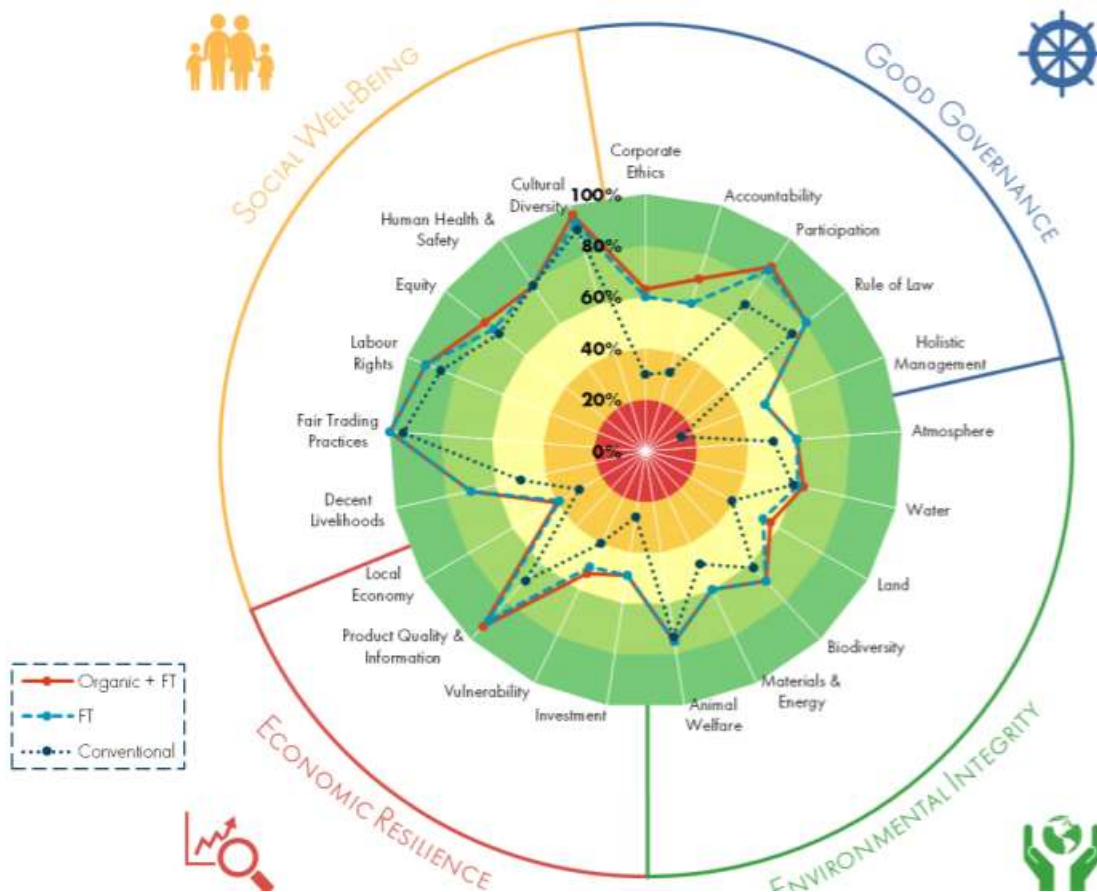
E. Communication

The following image (Landert, 2017) demonstrates applying the SAFA guidelines to communicate the results of social performance assessments. This assessment compares the



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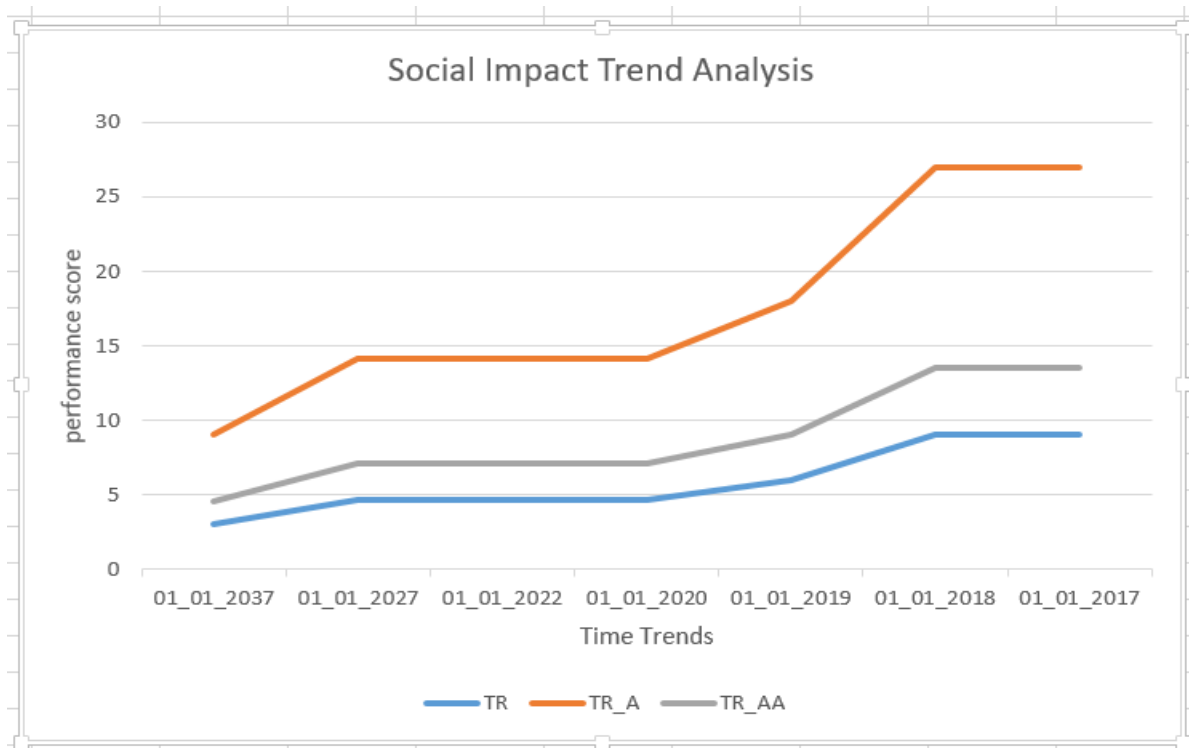
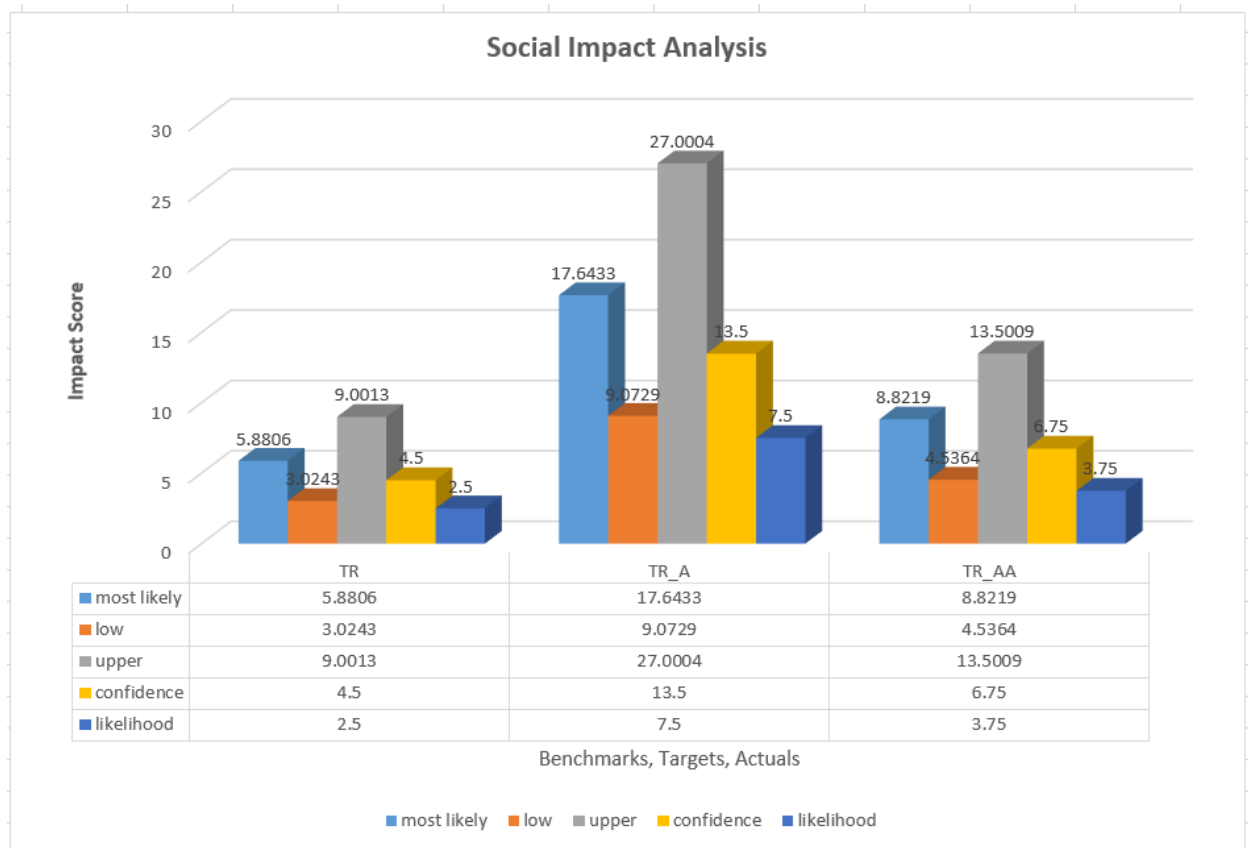
performance of 3 separate coffee production alternatives, Fairtrade Organic, Fairtrade, and Conventional, using assessments completed for 180 Ugandan coffee farms.



For this example, the company uses the following types of multimedia to communicate the results of their Performance Scores to stakeholders (TR = benchmark Impact Scores, TR_A = target Impact Scores, TR_AA = actual Impact Scores).



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Why are Trends in the previous image lower in the future than now? Because empirical datasets (i.e. URIs) are not yet available for these types of assessments.

F. Decisions

The goal of this company’s conservation efforts, and their overall Social Performance Assessment, is to increase the quality of life for their stakeholders. In order to do so, they must understand the interactions, linkages, and cause-effect relationships, between this ecosystem and their 5 impact and dependency pathways. Their resultant knowledge of the tradeoffs that must be made between services, mitigation actions and impacts, and stakeholder values, assists them to achieve their business performance goals.

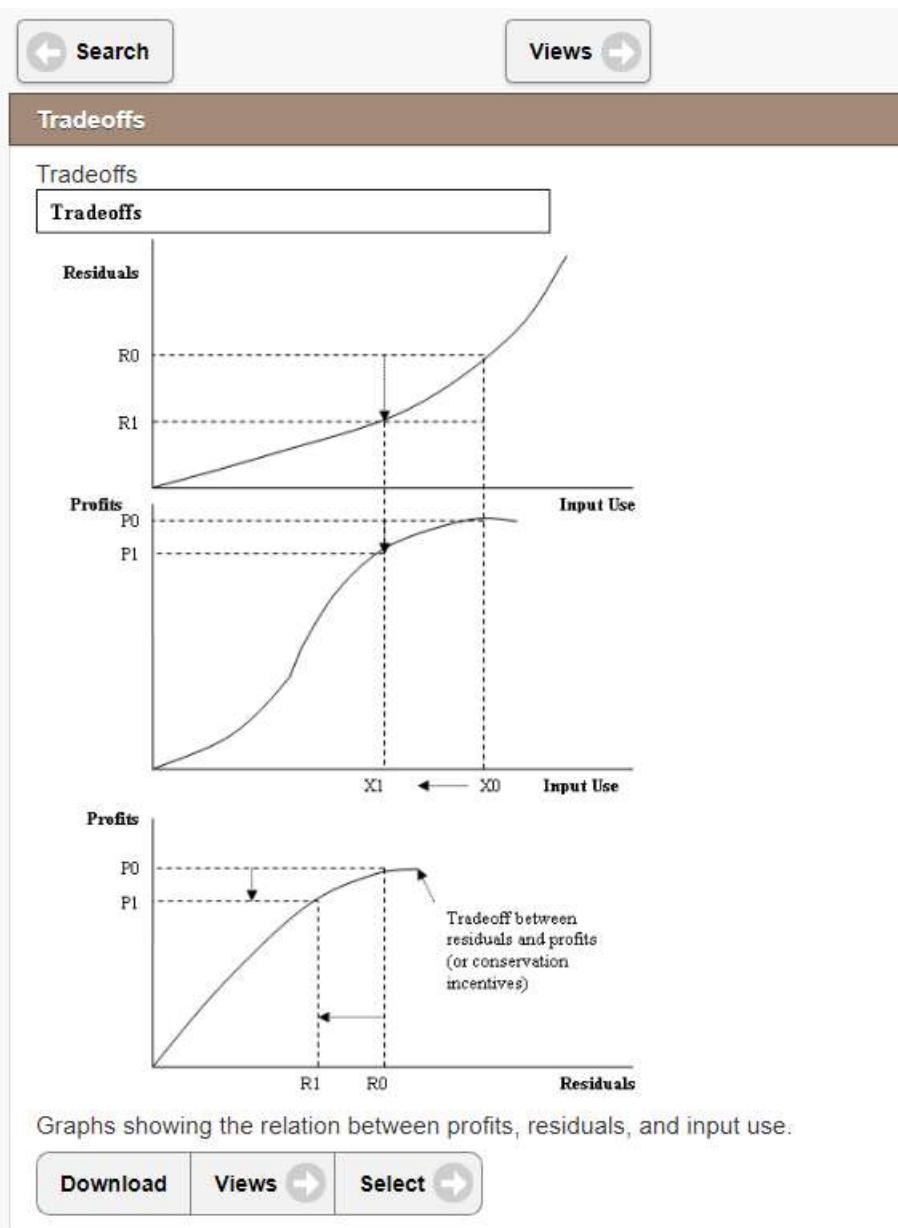
That understanding is enhanced by the monitoring and evaluation that takes place using Part D’s scoring system. Each mitigation and adaptation improvement is scored in terms of benchmarks, targets, and actuals. They use their resultant knowledge of the efficiency and performance of their investments in Alternatives (i.e. _A to _Z), along with Adaptive Management, to reduce the risks to their stakeholders’ quality of life.

The following URL provides a graphical explanation of economic Tradeoffs.

<https://www.devtreks.org/agtreks/preview/crops/resourcepack/Tradeoffs/67/none>



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The most straightforward example of evaluating stakeholder tradeoffs is covered in the UNEP/SETAC S-LCA (Social Life Cycle Assessment) references (2009 and 2011) found in Example 3B.

G. Impact Evaluation



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To understand the relation between Social Performance Assessments and formal Agricultural Project Impact Evaluations, Winters et al (2010) use the following statement to describe using “list of indicators [that are correlated within] a vertical logic” to evaluate the impact of agricultural development projects. That vertical logic corresponds to the “social impact pathways”, “causal chains”, or “results chains” used by the RCA Framework.

“To successfully identify the important set of final and intermediate indicators requires considering the logic of the intervention model; that is, how is the project going to improve the well-being of farmers? This should be reflected in lists of indicators used such as those found in a project’s Results Matrix often used by development organization such as the Inter-American Development Bank. The indicators should have a vertical logic that show how project investments alter farmer behavior and, in due course, lead to an impact on farmer well-being. Ultimately, these sets of indicators create a series of hypothesis regarding how the project will be successful and if an evaluation is carefully designed, these hypotheses can be tested. Box 1 provides an example of the indicators used to assess the logic of a project in Ecuador, the Plataformas de concertación, that links poor potato farmers to high-value potato markets.”

Gertler et al (2016) provide the following definition for Impact Evaluation and explain the importance of understanding the causal relation, or attribution, between action and result.

“[A]n impact evaluation assesses the changes in the well-being of individuals that can be attributed to a particular project, program, or policy. This focus on attribution is the hallmark of impact evaluations. Correspondingly, the central challenge in carrying out effective impact evaluations is to identify the causal relationship between the program or policy and the outcomes of interest.”

Several references (COSA, Sustainable Food Lab, ISEAL, Gertler et al) demonstrate that Impact Evaluation takes a more comprehensive, long term approach, often using public surveys, than the “social impact pathway” performance analysis demonstrated in this example. The Sustainable



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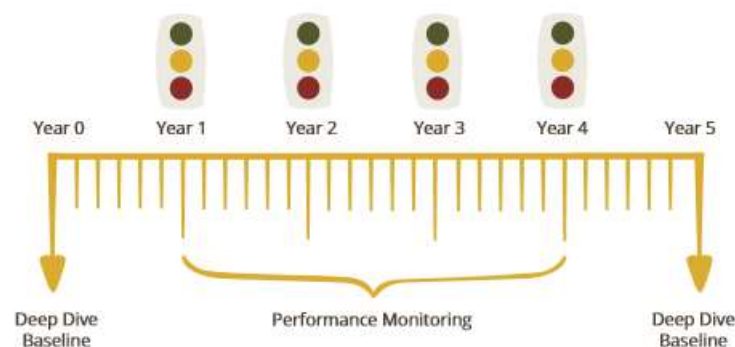
Food Lab (2013, 2016) discusses the relation between performance analysis and impact evaluation as follows:

“Performance Measurement is an approach that assesses current status and tracks change over time. The goal is cost effective ways to measure performance that can complement more intensive and expensive in-depth assessment. Performance measurement approaches are not designed to measure attribution between specific interventions and specific outcomes the way an impact assessment might.”

COSA (2014) further distinguishes Performance Monitoring’s short term goal of tactical decision making, with Impact Evaluation’s long term goal of strategic decision making. The Sustainable Food Lab (2016) uses the following images to describe how results chains employ both short term Performance Monitoring and long term Impact Evaluations. ISEAL (2014) defines guidelines that explain how these assessments relate to Monitoring and Evaluation systems. ISEAL also provides a glossary for the principle terms used in these types of assessments.

Report, “Impacts can take many years to evolve and manifest... in the meantime, investments continue and require ongoing direction and decision-making.”² This is where performance measurement can play a very useful role.

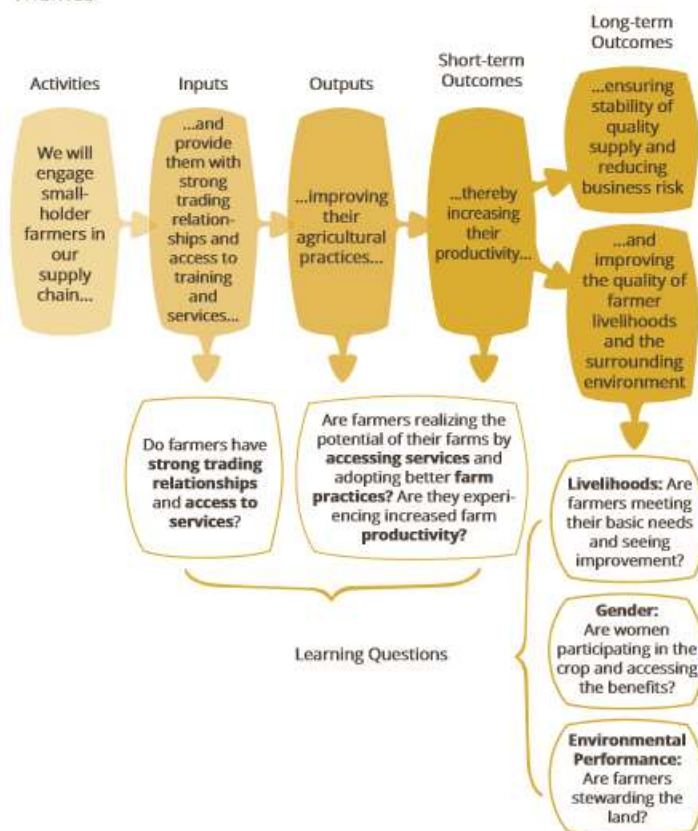
Figure 1. Example of Performance Measurement as an Ongoing Approach to Data Collection





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Figure 6. How the Results Chain Leads to Learning Questions and Themes



The following image (Bamberger, 2010) is used to provide historical context explaining the relation between quantitative Impact Evaluation, such as Randomized Control Trials (RCTs), and qualitative mixed methods Impact Evaluations, such as this image's M&E-based system. Example 4B demonstrates how the health care sector is addressing these authors' recommendations about "[the need to] provide guidelines on minimum levels of acceptable methodological rigor when drawing on diverse data sources that are often collected under tight budget and time constraints or where much of the data is collected under difficult circumstances".



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Figure 3. Contextual and process analysis

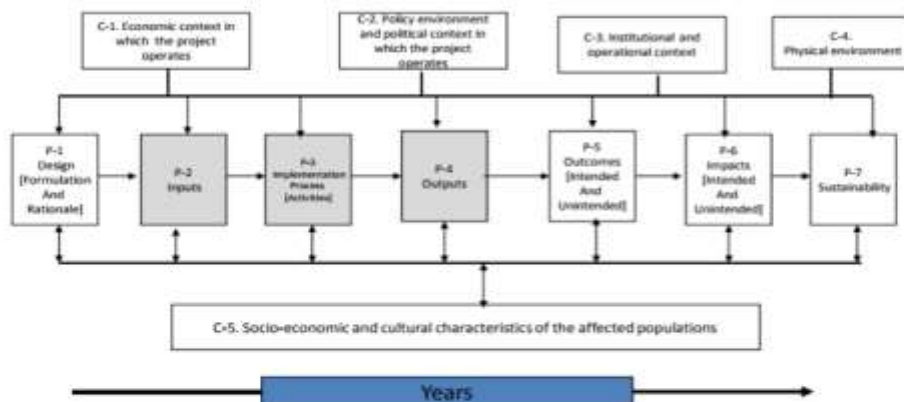


Figure 3 presents a stylized model that provides a framework for assessing both the quality of project implementation and the level of conformity to the original implementation plan and contextual factors that affect both overall implementation and factors explaining variations of performance in different project settings. Steps P-1 through P-7 describe the typical stages of the project implementation process, while Boxes C-1 through C-5 identify five sets of contextual factors such as the local, regional and national economy; the policy and political environment; the institutional and operational environment; the physical environment (droughts, floods, soil erosion etc); and the socio-economic and cultural characteristics of the affected populations that can affect implementation and impacts in different locations.

A major goal for any social network is to aggregate the individual Social Performance Assessments completed by their clubs. The Sustainable Food Lab (2016) discusses the complementary relation between Performance Monitoring and Impact Evaluation -the aggregated Performance data serves as input to Impact Evaluation, which in turn feeds back to improve the [QOL] Assessments. Formal Monitoring and Evaluation (M&E) systems, with adaptive learning mechanisms, provide the formal linkage. They use the term, Performance Monitoring Assessment, for that type of performance reporting. The following image (ISEAL, 2014) shows the M&E, Performance Monitoring, and Impact Evaluation, requirements that ISEAL employs for “scheme owners”, or organizations who administer certification standards.



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Clause 8.2 Indicators

Desired Outcome	Requirement	Guidance
The scheme owner has defined indicators for performance monitoring and for outcome and impact evaluations that will provide the data necessary to measure progress and monitor unintended effects in a standardized way over time and across studies.	1. The scheme owner shall: <ol style="list-style-type: none"> define and document the indicators to be employed in the M&E system; and show to which sustainability outcomes, impacts and unintended effects each indicator contributes. 	The scheme owner may use common or standardized indicators recommended by the ISEAL Alliance and/or other sector-specific reporting initiatives (see 5.9 and 8.8).
	2. The scheme owner shall identify which indicators are to be included in performance monitoring activities, which in outcome and impact evaluations, and which in both.	

Clause 8.3 Performance Monitoring

Desired Outcome	Requirement	Guidance
The scheme owner has sufficient information to determine the extent to which	1. The scheme owner shall ensure that data is collected on an ongoing basis to track and report progress on their current performance monitoring indicators.	Data is collected on an on-going basis when data collection is recurrent and on a regular schedule (e.g. once a year, during each audit, each time a new certificate is issued, etc.).
	2. The scheme owner shall compile	For 'internal purposes' means that there



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Clause 8.4 Quality Assurance for Performance Monitoring

Desired Outcome	Requirement	Guidance
Monitoring data is collected accurately and consistently.	1. The scheme owner shall implement data quality assurance measures to help ensure the quality, reliability and accuracy of data used for performance monitoring. At a minimum, these measures shall include creating and following specific indicator protocols for each monitoring indicator currently in use.	Data quality assurance measures can also include building cross-checks into data entry systems; defining procedures for identifying and handling outliers and missing values; and following recognized data quality assurance guidelines.

Clause 8.5 Outcome and Impact Evaluations

Desired Outcome	Requirement	Guidance
Periodic in-depth evaluations provide the scheme owner with the information necessary to understand the extent to which its desired changes are occurring as well as why the system is or is not producing intended results.	1. If the scheme owner has had an operational standards system for at least two years, it shall conduct, commission or otherwise undergo at least one in-depth outcome or impact evaluation per year.	A standards system becomes operational when it certifies or verifies the first entity to its standard. Outcome or impact evaluations that are consistent with the spirit of the definitions in the glossary and meet the requirements of 8.5, 8.6, 8.7, and 10.2 are eligible to count towards compliance with this requirement.
	2. The scheme owner shall ensure that at least some of these in-depth evaluations	The number, regularity and extent of impact evaluations should be

Farm record keeping associations commonly aggregate their members' data to support advanced decision support, such as the identification of "best farm management practices" and the establishment of targets for financial, or in this case, social, performance. IITA and COSA (2016) demonstrate using aggregated farm production data to identify the most and least efficient production practices used by groups of farmers. Several examples in this tutorial, such as Example 4B and Examples 5 through 8, demonstrate how to integrate Impact Evaluation, M&E, and Social Performance Assessment.

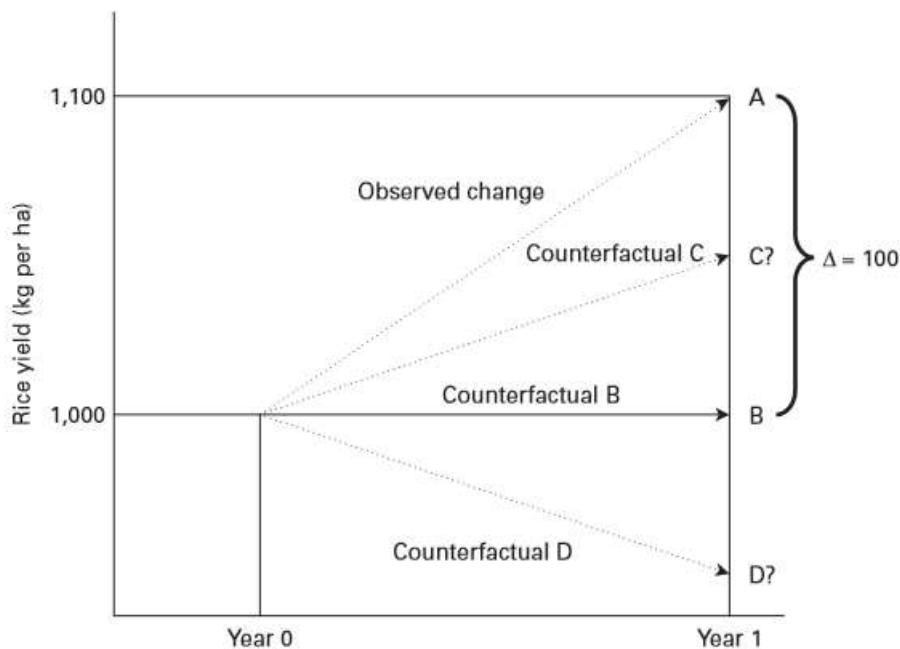
Gertler et al (2016) use the following image to indirectly address the integration of Impact Evaluation, M&E, and Social Performance Assessment. The simple "benchmark -> target -> actual->" M&E Indicator approach introduced in this example can completely fail to capture real cause and effect attribution. That approach can easily lead to this image's conclusion that rice



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yields increased 100 kg (B to A) due to the project, compared to “counterfactual benchmark” real yield differences (C to A and D to A). Full Impact Evaluations are addressed in the Social Performance 3 reference.

Figure 3.3 Before-and-After Estimates of a Microfinance Program



Note: Δ = Change in rice yield (kg); ha = hectares; kg = kilograms.

However, imagine that rainfall was normal in the year before the program was launched, but a drought occurred in the year the program operated. Because of the drought, the farmers’ average yield without the microloan scheme is likely to be lower than *B*: say, at level *D*. In that case, the true impact of the program would be $A-D$, which is larger than the 100 kg estimated using the before-and-after comparison. By contrast, if rainfall actually improved between the two years, the counterfactual rice yield might have been at level *C*. In that case, the true program impact would have been smaller than 100 kg. In other words, unless our impact analysis can account for rainfall and *every other factor* that can affect rice yields over time, we simply cannot calculate the true impact of the program by making a before-and-after comparison.

Grenz and Sereke (2017) demonstrate software that also uses a survey approach for assessing agricultural sustainability. This RCA algorithm assumes that a separate survey or interview,



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containing questions for assessing each Indicator, as demonstrated in the FAO (2013), EPA (2016, in Example 4B), and COSA references, has been completed prior to completing the TEXT data files. [DevTreks is reluctant to supply automated surveys (i.e. by adding a new schema to the Story-Telling application) because numerous automated surveys are already available and because DevPacks remain on the horizon.]

Footnotes

1. [Although Version 2.1.8 began relaxing this requirement, it's still considered sound advice. The source code can be changed, easily, to support as many trend periods as needed.] DevTreks limits TEXT.csv input datasets to 14 columns (3 descriptive, 1 y, 10 x) for 2 reasons. First, Occam may be right –it's the lowest, acceptable, common denominator for professional data. Second, almost every single reference used in this reference, along with the CTAP tutorial, uses different data formats making it impossible to compare, aggregate, analyze, or use data in any serious way (i.e. modern IT way). That's part of the reason, along with conventional academics, that almost no useful data could be found for the examples in this reference. Standardized, raw, TEXT datasets, mean that terms like “futile” will no longer be needed by authors completing these assessments (**10***). Make sure to check TEXT.csv files for incompatible characters, such as commas, prior to saving them.

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DevTreks –social budgeting that improves lives and livelihoods

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Example 1A. Coffee Company Trends SAFA Score (RCA2)

URLs:

Data

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 1A/1554/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 1A/542/none>

Resource Stock Assessment

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA1A Stock/2141223491/none>

Monitoring and Evaluation Assessment

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA1A M and E/2141223481/none>

Stories

<https://www.devtreks.org/greentreks/preview/carbon/linkedviewpack/Social Performance Stories/183/none>

<http://localhost:5000/greentreks/preview/watershed/linkedviewpack/Social Performance Stories/183/none>

A. Introduction

This example has been added to address the de Olde et al (2016) conclusion that, in practice, some farmers are reluctant to fully apply recommendations derived from these types of Social Assessment, and sustainability assessment, tools. This example addresses that concern with the following, increasing likely, agricultural production scenario:



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1. **Farmer versus Resource Conservationist Reporting:** Example 1’s pathways are completed by professional Resource Conservationists who have been trained how to use the 4 or 5 Indicator-based impact pathways. Farmers focus mostly on the Impact Indicators that directly impact their financial and social performance. They have been trained to complete and use the 1 Impact Indicator TEXT dataset needed to carry out the final part of the pathway. Alternatively, Example 4 demonstrates how to use the hierarchical TEXT files to define impact pathways directly. Although not demonstrated in this example, full results chains can be documented using 1 Indicator’s TEXT dataset.
2. **Certification-Required Indicators:** The only SAFA Indicators used in this assessment correspond to the Global Coffee Platform’s (GCP) 8 economic indicators, 9 social indicators, and 10 environmental indicators. The coffee company can’t receive certification unless those 27 Indicators meet the GCP certification requirements. Lernoud et al (2017) document the increasing trend by commodity producers to comply with these types of standards (i.e. because more supply chain buyers and end product consumers are demanding evidence of the social soundness of the products and services they buy).
3. **M&E Decision Making:** The certification organization bases their production and marketing assistance, and certification verification, on accurate M&E reporting. This coffee company will comply if their net returns have increased more than the increased costs associated with the reporting and certification requirements. Farms that have received organic certification are typical examples (refer to Loconto et al, 2014).

B. Indicator Thresholds

The following image displays the 27 elements of the Global Coffee Platform as “harmonized” with the SAFA Indicator Thresholds and WBS. The complete SAFA list can be found in the URLs. The FAO Indicators reference (2013) defines the upper and lower thresholds for each Indicator, but the coffee certification organization defines the middle 3 thresholds. An example can be found in Example 1.



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SAFA-Coffee (Sustainability Assessment of Food and Agriculture Systems) Indicator Thresholds							
	SAFA	Global Coffee Platform					
	performance and percent		best	good	moderate	limited	unacceptab
label	indicator		80 to 100	60 to 80	40 to 60	20 to 40	0 to 20
G23	transparency						
G231	transparency	business integrity					
G2	accountability						
G32	grievance procedures						
G321	grievance procedures	working condition and labor contracts					
G52	full-cost accounting						
G521	full-cost accounting	record keeping					
G5	holistic management						
G	good governance						
E21	water withdrawal						
E212	water conservation practices	water - water sources					
E22	water quality						
E224	wastewater quality	water - waste water					
E2	water						
E31	soil quality						
E313	soil chemical quality	soil fertility and nutrient management - fertilizers					
E315	soil organic matter	soil fertility and nutrient management - organic matter					
E3	land						
E41	ecosystem diversity						
E412	ecosystem enhancing practices	conservation of biodiversity					
E4	biodiversity						
E52	energy use						
E522	energy saving practices	energy					
E53	waste reduction and disposal						
E533	waste disposal	hazardous waste					
E5	materials and energy						
E	environmental integrity						
C13	long ranging investment						
C131	long term profitability	profitability and long term productivity					
C14	profitability						
C143	price determination	market information and commerce					
C1	investment						
C31	food safety						
C312	hazardous pesticides	use of pesticides					
C32	food quality						
C321	food quality	quality					
C33	product information						
C332	traceability system	traceability					
C3	product quality and information						
C	economic resilience						
S11	quality of life						
S111	right to quality of life	working conditions and working hours					
S112	wage level	working conditions and wages					
S12	capacity development						
S121	capacity development	capacity and skill development					
S13	fair access to means of production						
S131	fair access to means of production	access to services					
S1	decent livelihood						
S31	employment relations						
S311	employment relations	right to collective bargaining					
S32	forced labour						
S321	forced labour	working conditions and seasonal and piece rate workers					
S33	child labour						
S331	child labour	right to childhood and education					
S34	freedom of association and right to bargaining						
S341	freedom of association and right to bargaining	freedom of association					
S3	labour rights						
S41	non discrimination						
S411	non discrimination	discrimination					
S4	equity						
S51	workplace safety and health provisions						
S511	safety and health trainings	handling of pesticides and and other hazardous chemicals					
S512	safety of workplace, operations and health	working conditions and occupational health and safety					
S5	human safety and health						
S	social well being						



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Version 2.1.0 upgraded several subalgorithms, including 13 and 14, to accommodate the single letter labels used by the SAFA WBS. The new convention is that any “Total Risk” index must be prefaced with the characters “TR”. The former “TR” labels meet this criteria. In the SAFA WBS, those labels are now TRG, TRE, TRS, and TRC.

The image confirms that although most Coffee Indicators have straightforward relations to SAFA Indicators, some relationships are strained. In addition, whole categories of SAFA Indicators had to be eliminated. One take home message from this exercise is that a WBS that can support both on-farm decision making and international reporting norms is probably somewhere in the middle of these 2 systems. In addition, these WBSs and Thresholds systems need active support and evolution. SAFA hasn’t changed in 4 years (i.e. recent FAO publications suggest they are moving towards Example 1’s COSA Indicator system), while the Coffee Platform was updated last year. Feedback in the form of the de Olde et al (2016) on-farm testing, provides valuable insight into how to improve these systems.

C. Quality of Life Scenarios

Same as Example 1.

D. Social Performance Score

The SAFA scoring system, that normalizes Indicator quantities by dividing them by the sum of the Indicator weights for each Locational Index, and then multiplying the Indicator’s normalized value by its individual weight, is used with this example.

Version 2.1.0 upgraded algorithms 13 and 14 by using average, rather than total, scores, in the Total Risk (TR) Indexes for QTMost, QTLow, QTUp, certainty1, and certainty2 (i.e. see the Landert 2017 images in Example 1 used to communicate these types of scores). Version 2.1.2 supported separate trend dates for each Categorical Index, rather than uniform trend dates for all data.

Indicator 1. Impacts Meta (all scores are filled in automatically)



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Indicator 1

Impacts

Indicator 1 Description

These impact indicators measure changes to the coffee firm's stakeholders quality of life.

Indicator 1 URL

https://devtreks1.blob.core.windows.net/resources/network_carbon/resourcepack_1554/resource_9138/lnd1-Impacts.csv

Label 1

RCA1A

Rel Label 1

none

Date 1

11/29/2017

Dist Type 1

none

Q1 1

0.0000

Q1 Unit 1

none

Q2 1

0.0000

Q2 Unit 1

none

Q3 1

0.0000

Q3 Unit 1

none

Q4 1

60.0000

Q4 Unit 1

benchmark most scc

Q5 1

30.0000

Q5 Unit 1

benchmark low scor

Math Operator 1

equalto

BaseIO 1

none

equalto

none

QT 1

90.0000

QT Unit 1

benchmark high sco

Math Type 1

algorithm1

Math Sub Type 1

subalgorithm14

QT D1 1

1.0000

QT D1 Unit 1

actual certainty1

QT D2 1

1.5000

QT D2 Unit 1

actual certainty2

QT Most 1

15.9375

QT Most Unit 1

actual most score

QT Low 1

7.9688

QT Low Unit 1

actual low score

QT High 1

23.9063

QT High Unit 1

actual high score

Math Expression 1

l1.Q1.factor1 + l1.Q2.factor2 + l1.Q3.factor3

Math Result 1

https://devtreks1.blob.core.windows.net/resources/network_carbon/resourcepack_1554/resource_9162/lnd1-Results.csv

Indicator 2

The following table displays the calculations for the Indicator1 QT Most 1 property, 15.94, from the “actuals” dataset explained next. As mentioned throughout DevTreks, these types of “data standards” are the responsibility of full social networks.



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S4_AA	1	equity	45	40	35	30	25	20	15	1	1.5	7.5	performan	3.75	low ci	11.25	high ci
S51_AA	1	workplace	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	1	1.5	30	most	15	low ci	45	high ci
S511_A	1	safety and	45	40	35	30	25	20	15	1	1.5	30	mean scor	15	lowest sco	45	highest scc
S512_A	1	safety of v	45	40	35	30	25	20	15	1	1.5	30	mean scor	15	lowest sco	45	highest scc
S5_AA	1	human saf	90	80	70	60	50	40	30	1	1.5	15	performan	7.5	low ci	22.5	high ci
TRS_AA	1	social well	495	440	385	330	275	220	165	1	1.5	20.625	performan	10.3125	low ci	30.9375	high ci
												Sum of TRs	Avg of TRs				
Score												63.75	15.9375				

Indicator1.URL TEXT dataset Benchmarks (same rating for each Indicator because real datasets are not available)



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label	loc risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	certainty1	certainty2	norm	weight
G23	1 transparency	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
G231	1 transparency	90	80	70	60	50	40	30	2	3	weights	2
G2	1 accountability	0	0	0	0	0	0	0	0	0	none	1
G32	1 grievance procedures	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
G321	1 grievance procedures	90	80	70	60	50	40	30	2	3	weights	2
G52	1 full-cost accounting	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
G521	1 full-cost accounting	90	80	70	60	50	40	30	2	3	weights	2
G5	1 holistic management	0	0	0	0	0	0	0	0	0	none	1
TRG	1 good governance	0	0	0	0	0	0	0	0	0	none	1
E21	1 water withdrawal	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E212	1 water conservation practices	90	80	70	60	50	40	30	2	3	weights	2
E22	1 water quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E224	1 wastewater quality	90	80	70	60	50	40	30	2	3	weights	2
E2	1 water	0	0	0	0	0	0	0	0	0	none	1
E31	1 soil quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E313	1 soil chemical quality	90	80	70	60	50	40	30	2	3	weights	2
E315	1 soil organic matter	90	80	70	60	50	40	30	2	3	weights	2
E3	1 land	0	0	0	0	0	0	0	0	0	none	1
E41	1 ecosystem diversity	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E412	1 ecosystem enhancing practice	90	80	70	60	50	40	30	2	3	weights	2
E4	1 biodiversity	0	0	0	0	0	0	0	0	0	none	1
E52	1 energy use	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E522	1 energy saving practices	90	80	70	60	50	40	30	2	3	weights	2
E53	1 waste reduction and disposal	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
E533	1 waste disposal	90	80	70	60	50	40	30	2	3	weights	2
E5	1 materials and energy	0	0	0	0	0	0	0	0	0	none	1
TRE	1 environmental integrity	0	0	0	0	0	0	0	0	0	none	1
C13	1 long ranging investment	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
C131	1 long term profitability	90	80	70	60	50	40	30	2	3	weights	2
C14	1 profitability	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
C143	1 price determination	90	80	70	60	50	40	30	2	3	weights	2
C1	1 investment	0	0	0	0	0	0	0	0	0	none	1
C31	1 food safety	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
C312	1 hazardous pesticides	90	80	70	60	50	40	30	2	3	weights	2
C32	1 food quality	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
C321	1 food quality	90	80	70	60	50	40	30	2	3	weights	2
C33	1 product information	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
C332	1 traceability system	90	80	70	60	50	40	30	2	3	weights	2
C3	1 product quality and information	0	0	0	0	0	0	0	0	0	none	1
TRC	1 economic resilience	0	0	0	0	0	0	0	0	0	none	1
S11	1 quality of life	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S111	1 right to quality of life	90	80	70	60	50	40	30	2	3	weights	2
S112	1 wage level	90	80	70	60	50	40	30	2	3	weights	2
S12	1 capacity development	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S121	1 capacity development	90	80	70	60	50	40	30	2	3	weights	2
S13	1 fair access to means of production	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S131	1 fair access to means of production	90	80	70	60	50	40	30	2	3	weights	2
S1	1 decent livelihood	0	0	0	0	0	0	0	0	0	none	1
S31	1 employment relations	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S311	1 employment relations	90	80	70	60	50	40	30	2	3	weights	2
S32	1 forced labour	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S321	1 forced labour	90	80	70	60	50	40	30	2	3	weights	2
S33	1 child labour	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S331	1 child labour	90	80	70	60	50	40	30	2	3	weights	2
S34	1 freedom of association and right to organise	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S341	1 freedom of association and right to organise	90	80	70	60	50	40	30	2	3	weights	2
S3	1 labour rights	0	0	0	0	0	0	0	0	0	none	1
S41	1 non discrimination	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S411	1 non discrimination	90	80	70	60	50	40	30	2	3	weights	2
S4	1 equity	0	0	0	0	0	0	0	0	0	none	1
S51	1 workplace safety and health protection	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	none	1
S511	1 safety and health trainings	90	80	70	60	50	40	30	2	3	weights	2
S512	1 safety of workplace; operation	90	80	70	60	50	40	30	2	3	weights	2
S5	1 human safety and health	0	0	0	0	0	0	0	0	0	none	1
TRS	1 social well being	0	0	0	0	0	0	0	0	0	none	1



DevTreks –social budgeting that improves lives and livelihoods

Actuals (no separate Targets were used; Actuals set arbitrarily at 50% of Benchmarks, partial data displayed)

S1_AA	1 decent livelihood	0	0	0	0	0	0	0	0	0	0	0.5
S31_AA	1 employment relations	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S311_AA	1 employment relations	45	40	35	30	25	20	15	1	1.5	0	1
S32_AA	1 forced labour	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S321_AA	1 forced labour	45	40	35	30	25	20	15	1	1.5	0	1
S33_AA	1 child labour	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S331_AA	1 child labour	45	40	35	30	25	20	15	1	1.5	0	1
S34_AA	1 freedom of association and rig	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S341_AA	1 freedom of association and rig	45	40	35	30	25	20	15	1	1.5	0	1
S3_AA	1 labour rights	0	0	0	0	0	0	0	0	0	0	0.5
S41_AA	1 non discrimination	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S411_AA	1 non discrimination	45	40	35	30	25	20	15	1	1.5	0	1
S4_AA	1 equity	0	0	0	0	0	0	0	0	0	0	0.5
S51_AA	1 workplace safety and health p	01_01_2037	01_01_2027	01_01_2022	01_01_2020	01_01_2019	01_01_2018	01_01_2017	0	0	0	0.5
S511_AA	1 safety and health trainings	45	40	35	30	25	20	15	1	1.5	0	1
S512_AA	1 safety of workplace; operation	45	40	35	30	25	20	15	1	1.5	0	1
S5_AA	1 human safety and health	0	0	0	0	0	0	0	0	0	0	0.5
TRS_AA	1 social well being	0	0	0	0	0	0	0	0	0	0	0.5

Indicator1.MathExpression

$I1.Q1.factor1 + I1.Q2.factor2 + I1.Q3.factor3 + I1.Q4.factor4 + I1.Q5.factor5 + I1.Q6.factor6 + I1.Q7.factor7 + I1.Q8.certainty1 + I1.Q9.certainty2 + I1.Q10.norm + I1.Q11.weight$

Indicator1.MathResult (partial results displayed)

The certainty values, or SAFA Accuracy Scores, are all equal because the original dataset set them equal for each separate Indicator. It's easier to confirm the results –dividing the aggregated totals by the number of Indicators in the aggregation must return the original Indicator values.



DevTreks –social budgeting that improves lives and livelihoods

label	locati	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	certain	certain	QTMost	QTMostUr	QTLow	QTLowUni	QTUp	QTUpUnit
G23	1	transparer	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	60	most	30	low ci	90	high ci
G231	1	transparer	90	80	70	60	50	40	30	2	3	60	mean scor	30	lowest sco	90	highest scc
G2	1	accountab	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
G32	1	grievance	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
G321	1	grievance	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
G52	1	full-cost a	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
G521	1	full-cost a	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
G5	1	holistic ma	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
TRG	1	good gove	180	160	140	120	100	80	60	2	3	60	performan	30	low ci	90	high ci
E21	1	water with	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
E212	1	water con:	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E22	1	water qual	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
E224	1	wastewate	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E2	1	water	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
E31	1	soil quality	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	60	most	30	low ci	90	high ci
E313	1	soil chemi	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E315	1	soil organi	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E3	1	land	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
E41	1	ecosystem	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	60	most	30	low ci	90	high ci
E412	1	ecosystem	90	80	70	60	50	40	30	2	3	60	mean scor	30	lowest sco	90	highest scc
E4	1	biodiversit	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
E52	1	energy use	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
E522	1	energy sav	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E53	1	waste redi	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
E533	1	waste disp	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
E5	1	materials	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
TRE	1	environme	360	320	280	240	200	160	120	2	3	60	performan	30	low ci	90	high ci
C13	1	long rangir	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
C131	1	long term	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
C14	1	profitabilit	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
C143	1	price deter	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
C1	1	investmen	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
C31	1	food safet	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	20	most	10	low ci	30	high ci
C312	1	hazardous	30	26.6666	23.3334	20	16.6666	13.3334	10	2	3	20	mean scor	10	lowest sco	30	highest scc
C32	1	food quali	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	20	most	10	low ci	30	high ci
C321	1	food quali	30	26.6666	23.3334	20	16.6666	13.3334	10	2	3	20	mean scor	10	lowest sco	30	highest scc
C33	1	product in	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	20	most	10	low ci	30	high ci
C332	1	traceabilit	30	26.6666	23.3334	20	16.6666	13.3334	10	2	3	20	mean scor	10	lowest sco	30	highest scc
C3	1	product qu	90	79.9998	70.0002	60	49.9998	40.0002	30	2	3	60	performan	30	low ci	90	high ci
TRC	1	economic	180	159.9998	140.0002	120	99.9998	80.0002	60	2	3	60	performan	30	low ci	90	high ci
S11	1	quality of l	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	30	most	15	low ci	45	high ci
S111	1	right to qu	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S112	1	wage level	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S12	1	capacity d	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S121	1	capacity d	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S13	1	fair access	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S131	1	fair access	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S1	1	decent live	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
S31	1	employe	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S311	1	employe	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S32	1	forced lab	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S321	1	forced lab	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S33	1	child labou	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S331	1	child labou	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S34	1	freedom o	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	15	most	7.5	low ci	22.5	high ci
S341	1	freedom o	22.5	20	17.5	15	12.5	10	7.5	2	3	15	mean scor	7.5	lowest sco	22.5	highest scc
S3	1	labour righ	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
S41	1	non discrir	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	60	most	30	low ci	90	high ci
S411	1	non discrir	90	80	70	60	50	40	30	2	3	60	mean scor	30	lowest sco	90	highest scc
S4	1	equity	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
S51	1	workplace	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	01_01_20:	2	3	60	most	30	low ci	90	high ci
S511	1	safety and	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
S512	1	safety of v	45	40	35	30	25	20	15	2	3	30	mean scor	15	lowest sco	45	highest scc
S5	1	human saf	90	80	70	60	50	40	30	2	3	60	performan	30	low ci	90	high ci
TRS	1	social well	360	320	280	240	200	160	120	2	3	60	performan	30	low ci	90	high ci

E. Communication



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The certification standards organization requires complete documentation for every Indicator used in an assessment. Besides the quantitative scores, an explanation for each rating for each Indicator must also be completed. The standard tool in DevTreks for explanatory content is the paragraph editor explained in the Story Telling tutorial. The following image displays the story completed as part of the Social Assessment. Each paragraph in the story corresponds directly to an Indicator scored in the Social Assessment. The first image demonstrates a metadata cover page, while the second image demonstrates the first page of an explanatory story.

The Calculator tutorial points out that the Calculator.MediaURL property can also be used to store a link to a pdf file holding this data.



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Gree...	Search	Previ...	Select
Edit	Pack	Views	Club

← Select

A- Summary----- ▼ Get

no linked addins available _____ ▼

← Open in Edits Panel.

Title

2017 Coffee Firm Social Performance Assessment

Creator

www.devtreks.org

Subject

Social Performance Assessment

Description

Documentation for this assessment can be found in the Social Performance Analysis tutorial,

Publisher

Description

Documentation for this assessment can be found in the Social Performance Analysis tutorial,

Publisher

www.devtreks.org

Contributor

Kevin Boyle

Date

July 08, 2017

Language

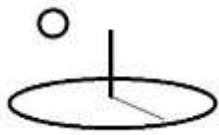
English

[Feedback about watershed/linkedviewpack/Social Performance Stories/183/none](#)

Dataset: [A- Summary IRI](#) This story is documented in the Social Performance Analysis tutorial. v208a

Search IRIs:

[http://localhost:5000/greentreks/linkedviews/Performance Stories/183/none](http://localhost:5000/greentreks/linkedviews/Performance%20Stories/183/none)



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DevTreks -soc

localhost:5000/greentreks

GreenT...	Search	Preview	Select
Edit	Pack	Views	Club

Select

A Coffee Firm Social Asse

Get

no linked addins available

Open in Edits Panel.

2017 Social Performance Assessment: Coffee Firm

This story explains the scores contained in the associated Social Performance Assessment completed for fiscal year 2017.

G231

Business Integrity

The 2017 rating of 50% reflects ethical questions arising from company negotiations to acquire small, neighboring farms.

Social Impact Analysis

This image summarizes the final Social Assessment Scores for 2017.

G231

Working Conditions and Labor Contracts-

The 2017 rating of 80% reflects major investments made to improve the working conditions of farm workers living on the farm.

- Living Quarters:** new living quarters were constructed during 2017
- Salary Increased:** Workers received a 5% salary increase in 2017.

G521

Record Keeping

The 95% score for 2017 reflects the addition of explanatory stories as further documentation for accounting records.

E212

Water - Water Resources

The 60% score for 2017 reflects slight progress in recycling water for irrigation.

E224

Water - Waste Water

The 2017 rating of 80% reflects recycling of wastewater.

[Feedback about](#)

F. Decisions



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This example left out the Targets demonstrated in Example 1 that many full M&E systems employ. Instead, in keeping with this example’s simplification theme, only Benchmarks and Actuals have been completed. The Actuals are associated with the coffee firm’s adoption of new conservation practices needed to comply with the certification requirements. The certification organization bases their decision on progress demonstrated by the Actuals.

Case Study Footnotes

1. Although it took less than 10 minutes to upgrade subalgorithms 13 and 14 to accommodate SAFA, it still took several hours to run this algorithm successfully because, even with 1 TEXT dataset, several mistakes still took place. Labels mistakenly had trailing spaces that had to be found and fixed with new code, some rows of data were put in the wrong place, and the normalization and weighting used by the algorithm had been forgotten (even with Example 1’s clear documentation). Footnote 11 was added to SPA1 for good reason.

Case Study References

Same as Example 1.



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Example 2. Coffee Company Probabilistic Risk (PRA) Social Performance Score (RCA1)

URLs:

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 2/1551/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 2/539/none>

Resource Stock Assessment

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA1 Stock/2141223475/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA1 Stock/2141223483/none>

Monitoring and Evaluation Assessment

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA1 MandE/2141223474/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA1 MandE/2141223484/none>

G. Introduction

This is the same coffee company as in Example 1, except this example uses the RCA1 algorithm. RCA1 substitutes RCA2's Time Trends with probability distributions to calculate scores. Instead of RCA2's emphasis on calculating relative, qualitative, Social Performance Trends, this algorithm provides an absolute, quantitative, snapshot in time of the uncertainty of the firm's social performance. The firm can, of course, account for trends by completing this Measure multiple times, or by deriving the probability distributions from time trend data.

Example 4B demonstrates how to use this algorithm for the meta-analysis of social performance data. For example, networks that aggregate their individual club Performance Monitoring Assessments can use this algorithm to conduct an Impact Evaluation of the aggregated data.



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Because this algorithm follows the same 4 to 6 Indicator pattern as already demonstrated with Example 1, only a few Indicator images are displayed.

H. Indicator Thresholds

Same as Example 1.

I. Quality of Life Scenarios

Same as Example 1.

J. Social Performance Score

Version 2.1.0 upgraded algorithms 13 and 14 by using average, rather than total, scores, in the Total Risk (TR) Indexes for QTMost, QTLow, QTUp, certainty1, and certainty2 (i.e. see the Landert 2017 images in Example 1 used to communicate these types of scores). Some images may still reflect earlier versions.

Indicator 1. Actions Meta (the scores are filled in automatically)



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Output Stock Calculator--

Get

Media

Mobile

☒ Desktop

Intro

1

2

3

Help

Step 1 of 3. Make Selections

Get Selects

Cancel

Close

Calculator Name

Stock Budgeting 1 Output Calculator

Stock Indicators

Indicator 1

Actions

Indicator 1 Description

These actions are the principle risks, or stressors, affecting resource stock conditions and services

Indicator 1 URL

https://devtreks1.blob.core.windows.net/resources/network_carbon/resourcepack_1551/resource_9124/lnd1-

Label 1

Rel Label 1

RCA1

RCA2

Date 1

Dist Type 1

04/25/2017

none

Q1 1

Q1 Unit 1

16.1094

target most score

Q2 1

Q2 Unit 1

Q5 1

Q5 Unit 1

7.4559

benchmark low scor

Math Operator 1

BaselO 1

equalto

none

QT 1

QT Unit 1

8.3102

benchmark high sco

Math Type 1

Math Sub Type 1

algorithm1

subalgorithm13

QT D1 1

QT D1 Unit 1

6.5000

actual certainty1

QT D2 1

QT D2 Unit 1

7.5000

actual certainty2

QT Most 1

QT Most Unit 1

9.9209

actual most score

QT Low 1

QT Low Unit 1

9.3822

actual low score

QT High 1

QT High Unit 1

10.4595

actual high score

Math Expression 1

$$I1.Q1.distribtype + I1.Q2.QT + I1.Q3.QTUnit$$

Math Result 1

rca results
label,location,risks_and_indicators,distribtype
,QTMost,QTMostUnit,QLow,QLowUnit,QTU
p,QTUpUnit,certainty1,certainty2,norm,weight
NCA,1,Fresh Water

Indicator1.URL TEXT dataset

Benchmarks



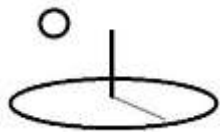
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label	local	risks_and_indicators	distribtype	QT	QTunit	QTD1	QTD1Unit	QTD2	QTD2Unit	ertainty	ertainty	norm	weight
NCA	1	Fresh Water Supply	none	0	none	0	none	0	none	0	0	weights	1
AF1A	1	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	normal	2.4	mean	2.4	mean	0.72	sd	2.5	4	weights	1
AF1B	1	6.5.1 Degree of integrated water resources management implementation	normal	60	mean	60	mean	18	sd	4	3.5	weights	1
NCB	1	Pollination	none	0	none	0	none	0	none	0	0	weights	1
AF2A	1	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	normal	60	mean	60	mean	18	sd	2.5	4	weights	1
AF2B	1	Percent of crop production supported by connected plant-pollinator networks (IPBES)	normal	3	mean	3	mean	0.9	sd	4	3.5	weights	1
NCC	1	Air quality	none	0	none	0	none	0	none	0	0	weights	1
AF3A	1	Percent manufacturing facilities achieving air pollution levels within safety standards	normal	60	mean	60	mean	18	sd	2.5	4	weights	1
AF3B	1	9.4.1 GHG emission per unit of value added	normal	8.4	mean	8.4	mean	2.52	sd	4	3.5	weights	1
NC	1	Natural Capital Score	none	0	0	0	0	0	0	0	0	weights	1
PCA	1	Flood Control	none	0	0	0	0	0	0	0	0	weights	1
AF4A	1	Percent company assets upgraded to withstand severe flood events	normal	60	mean	60	mean	18	sd	2.5	4	weights	1
AF4B	1	11.b.1 Degree to which business continuity plan supports community disaster risk reduction strategies	normal	3.6	mean	3.6	mean	1.08	sd	4	3.5	weights	1
PC	1	Physical Capital Score	none	0	none	0	none	0	none	0	0	weights	1
ECA	1	Employee Management	none	0	none	0	none	0	none	0	0	weights	1
AF5A	1	7.4.1 Degree to which legal frameworks are in place to promote; enforce and monitor equality and non-discrimination on the basis of sex	normal	3.6	mean	3.6	mean	1.08	sd	2.5	4	weights	1
AF5B	1	Percent company supply sourced with SSIFs; small-scale food producers who are female and indigenous	normal	8.4	mean	8.4	mean	2.52	sd	4	3.5	weights	1
EC	1	Economic Capital Score	none	0	none	0	none	0	none	0	0	weights	1
TR	1	Social Performance Score	none	0	none	0	none	0	none	0	0	weights	1

Targets

NCA_A	1	Fresh Water Supply	none	0	none	0	none	0	none	0	0	weights	1
AF1A_A	1	withdrawal as a proportion of available	normal	4.8	mean	4.8	mean	1.44	sd	2.5	4	weights	1
AF1B_A	1	resources management implementation	normal	120	mean	120	mean	36	sd	4	3.5	weights	1
NCB_A	1	Pollination	none	0	none	0	none	0	none	0	0	weights	1
AF2A_A	1	productive and sustainable agriculture	normal	120	mean	120	mean	36	sd	2.5	4	weights	1
AF2B_A	1	connected plant-pollinator networks	normal	6	mean	6	mean	1.8	sd	4	3.5	weights	1
NCC_A	1	Air quality	none	0	none	0	none	0	none	0	0	weights	1
AF3A_A	1	air pollution levels within safety standards	normal	120	mean	120	mean	36	sd	2.5	4	weights	1
AF3B_A	1	9.4.1 GHG emission per unit of value added	normal	16.8	mean	16.8	mean	5.04	sd	4	3.5	weights	1
NC_A	1	Natural Capital Score	none	0	0	0	0	0	0	0	0	weights	1
PCA_A	1	Flood Control	none	0	0	0	0	0	0	0	0	weights	1
AF4A_A	1	withstand severe flood events	normal	120	mean	120	mean	36	sd	2.5	4	weights	1
AF4B_A	1	continuity plan supports community	normal	7.2	mean	7.2	mean	2.16	sd	4	3.5	weights	1
PC_A	1	Physical Capital Score	none	0	none	0	none	0	none	0	0	weights	1
ECA_A	1	Employee Management	none	0	none	0	none	0	none	0	0	weights	1
AF5A_A	1	are in place to promote; enforce and	normal	7.2	mean	7.2	mean	2.16	sd	2.5	4	weights	1
AF5B_A	1	SSIFs; small-scale food producers who are	normal	16.8	mean	16.8	mean	5.04	sd	4	3.5	weights	1
EC_A	1	Economic Capital Score	none	0	none	0	none	0	none	0	0	weights	1
TR_A	1	Social Performance Score	none	0	none	0	none	0	none	0	0	weights	1

Actuals



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NCA_AA	1	Fresh Water Supply	none	0	none	0	none	0	none	0	0	weights	1
AF1A_AA	1	withdrawal as a proportion of available	normal	3	mean	3	mean	0.9	sd	2.5	4	weights	1
AF1B_AA	1	resources management implementation	normal	75	mean	75	mean	22.5	sd	4	3.5	weights	1
NCB_AA	1	Pollination	none	0	none	0	none	0	none	0	0	weights	1
AF2A_AA	1	productive and sustainable agriculture	normal	75	mean	75	mean	22.5	sd	2.5	4	weights	1
AF2B_AA	1	connected plant-pollinator networks	normal	3.75	mean	3.75	mean	1.125	sd	4	3.5	weights	1
NCC_AA	1	Air quality	none	0	none	0	none	0	none	0	0	weights	1
AF3A_AA	1	air pollution levels within safety standards	normal	75	mean	75	mean	22.5	sd	2.5	4	weights	1
AF3B_AA	1	9.4.1 GHG emission per unit of value added	normal	10.5	mean	10.5	mean	3.15	sd	4	3.5	weights	1
NC_AA	1	Natural Capital Score	none	0	0	0	0	0	0	0	0	weights	1
PCA_AA	1	Flood Control	none	0	0	0	0	0	0	0	0	weights	1
AF4A_AA	1	withstand severe flood events	normal	75	mean	75	mean	22.5	sd	2.5	4	weights	1
AF4B_AA	1	continuity plan supports community	normal	4.5	mean	4.5	mean	1.35	sd	4	3.5	weights	1
PC_AA	1	Physical Capital Score	none	0	none	0	none	0	none	0	0	weights	1
ECA_AA	1	Employee Management	none	0	none	0	none	0	none	0	0	weights	1
AF5A_AA	1	are in place to promote; enforce and	normal	4.5	mean	4.5	mean	1.35	sd	2.5	4	weights	1
AF5B_AA	1	SSIFs; small-scale food producers who are	normal	10.5	mean	10.5	mean	3.15	sd	4	3.5	weights	1
EC_AA	1	Economic Capital Score	none	0	none	0	none	0	none	0	0	weights	1
TR_AA	1	Social Performance Score	none	0	none	0	none	0	none	0	0	weights	1

Indicator1.MathExpression

I1.Q1.factor1 (a placeholder)

Indicator1.MathResult

Benchmarks

label	location	risks_and	distribtype	QTMost	QTMostUr	QTLow	QTLowUni	QTUp	QTUpUnit	certainty1	certainty2	norm	weight
NCA	1	Fresh Wat	none	10.5215	most	10.4082	low ci	10.6346	high ci	3.25	3.75	weights	1
AF1A	1	6.4.2 Leve	normal	0.4047	actual mos	0.4003	actual low	0.409	actual high	2.5	4	weights	1
AF1B	1	6.5.1 Degr	normal	10.1168	actual mos	10.0079	actual low	10.2256	actual high	4	3.5	weights	1
NCB	1	Pollination	none	10.6226	most	10.5083	low ci	10.7369	high ci	3.25	3.75	weights	1
AF2A	1	2.4.1 Prop	normal	10.1168	actual mos	10.0079	actual low	10.2256	actual high	2.5	4	weights	1
AF2B	1	Percent he	normal	0.5058	actual mos	0.5004	actual low	0.5113	actual high	4	3.5	weights	1
NCC	1	Air quality	none	11.5332	most	11.409	low ci	11.6572	high ci	3.25	3.75	weights	1
AF3A	1	Percent m	normal	10.1168	actual mos	10.0079	actual low	10.2256	actual high	2.5	4	weights	1
AF3B	1	9.4.1 GHG	normal	1.4164	actual mos	1.4011	actual low	1.4316	actual high	4	3.5	weights	1
NC	1	Natural Ca	none	32.6773	performan	32.3255	low ci	33.0287	high ci	3.25	3.75	weights	1
PCA	1	Flood Con	none	32.1713	most	31.8252	low ci	32.5174	high ci	3.25	3.75	weights	1
AF4A	1	Percent co	normal	30.3503	actual mos	30.0238	actual low	30.6768	actual high	2.5	4	weights	1
AF4B	1	11.b.1 De	normal	1.821	actual mos	1.8014	actual low	1.8406	actual high	4	3.5	weights	1
PC	1	Physical C	none	32.1713	performan	31.8252	low ci	32.5174	high ci	3.25	3.75	weights	1
ECA	1	Employee	none	6.0701	most	6.0048	low ci	6.1353	high ci	3.25	3.75	weights	1
AF5A	1	5.1.1 Degr	normal	1.821	actual mos	1.8014	actual low	1.8406	actual high	2.5	4	weights	1
AF5B	1	Percent co	normal	4.2491	actual mos	4.2034	actual low	4.2947	actual high	4	3.5	weights	1
EC	1	Economic	none	6.0701	performan	6.0048	low ci	6.1353	high ci	3.25	3.75	weights	1
TR	1	Social Perf	none	23.6396	performan	23.3852	low ci	23.8938	high ci	3.25	3.75	weights	1

Targets



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NCA_A	1	Fresh Wat	none	21.0428	most	20.8165	low ci	21.2692	high ci	3.25	3.75	weights	1
AF1A_A	1	6.4.2 Leve	normal	0.8093	actual mos	0.8006	actual low	0.818	actual high	2.5	4	weights	1
AF1B_A	1	6.5.1 Degr	normal	20.2335	actual mos	20.0159	actual low	20.4512	actual high	4	3.5	weights	1
NCB_A	1	Pollination	none	21.2452	most	21.0167	low ci	21.4738	high ci	3.25	3.75	weights	1
AF2A_A	1	2.4.1 Prop	normal	20.2335	actual mos	20.0159	actual low	20.4512	actual high	2.5	4	weights	1
AF2B_A	1	Percent he	normal	1.0117	actual mos	1.0008	actual low	1.0226	actual high	4	3.5	weights	1
NCC_A	1	Air quality	none	23.0662	most	22.8181	low ci	23.3144	high ci	3.25	3.75	weights	1
AF3A_A	1	Percent m	normal	20.2335	actual mos	20.0159	actual low	20.4512	actual high	2.5	4	weights	1
AF3B_A	1	9.4.1 GHG	normal	2.8327	actual mos	2.8022	actual low	2.8632	actual high	4	3.5	weights	1
NC_A	1	Natural Ca	none	65.3542	performan	64.6513	low ci	66.0574	high ci	3.25	3.75	weights	1
PCA_A	1	Flood Con	none	64.3426	most	63.6506	low ci	65.0347	high ci	3.25	3.75	weights	1
AF4A_A	1	Percent co	normal	60.7006	actual mos	60.0477	actual low	61.3535	actual high	2.5	4	weights	1
AF4B_A	1	11.b.1 De	normal	3.642	actual mos	3.6029	actual low	3.6812	actual high	4	3.5	weights	1
PC_A	1	Physical C	none	64.3426	performan	63.6506	low ci	65.0347	high ci	3.25	3.75	weights	1
ECA_A	1	Employee	none	12.1401	most	12.0096	low ci	12.2707	high ci	3.25	3.75	weights	1
AF5A_A	1	5.1.1 Degr	normal	3.642	actual mos	3.6029	actual low	3.6812	actual high	2.5	4	weights	1
AF5B_A	1	Percent co	normal	8.4981	actual mos	8.4067	actual low	8.5895	actual high	4	3.5	weights	1
EC_A	1	Economic	none	12.1401	performan	12.0096	low ci	12.2707	high ci	3.25	3.75	weights	1
TR_A	1	Social Perf	none	47.279	performan	46.7705	low ci	47.7876	high ci	3.25	3.75	weights	1
NCA_AA	1	Fresh Wat	none	13.1518	most	13.0104	low ci	13.2933	high ci	3.25	3.75	weights	1

Actuals

NCA_AA	1	Fresh Wat	none	13.1518	most	13.0104	low ci	13.2933	high ci	3.25	3.75	weights	1
AF1A_A	1	6.4.2 Leve	normal	0.5058	actual mos	0.5004	actual low	0.5113	actual high	2.5	4	weights	1
AF1B_A	1	6.5.1 Degr	normal	12.646	actual mos	12.51	actual low	12.782	actual high	4	3.5	weights	1
NCB_AA	1	Pollination	none	13.2783	most	13.1355	low ci	13.4211	high ci	3.25	3.75	weights	1
AF2A_A	1	2.4.1 Prop	normal	12.646	actual mos	12.51	actual low	12.782	actual high	2.5	4	weights	1
AF2B_A	1	Percent he	normal	0.6323	actual mos	0.6255	actual low	0.6391	actual high	4	3.5	weights	1
NCC_AA	1	Air quality	none	14.4164	most	14.2614	low ci	14.5715	high ci	3.25	3.75	weights	1
AF3A_A	1	Percent m	normal	12.646	actual mos	12.51	actual low	12.782	actual high	2.5	4	weights	1
AF3B_A	1	9.4.1 GHG	normal	1.7704	actual mos	1.7514	actual low	1.7895	actual high	4	3.5	weights	1
NC_AA	1	Natural Ca	none	40.8465	performan	40.4073	low ci	41.2859	high ci	3.25	3.75	weights	1
PCA_AA	1	Flood Con	none	40.2141	most	39.7817	low ci	40.6468	high ci	3.25	3.75	weights	1
AF4A_A	1	Percent co	normal	37.9379	actual mos	37.5299	actual low	38.346	actual high	2.5	4	weights	1
AF4B_A	1	11.b.1 De	normal	2.2762	actual mos	2.2518	actual low	2.3008	actual high	4	3.5	weights	1
PC_AA	1	Physical C	none	40.2141	performan	39.7817	low ci	40.6468	high ci	3.25	3.75	weights	1
ECA_AA	1	Employee	none	7.5875	most	7.506	low ci	7.6692	high ci	3.25	3.75	weights	1
AF5A_A	1	5.1.1 Degr	normal	2.2762	actual mos	2.2518	actual low	2.3008	actual high	2.5	4	weights	1
AF5B_A	1	Percent co	normal	5.3113	actual mos	5.2542	actual low	5.3684	actual high	4	3.5	weights	1
EC_AA	1	Economic	none	7.5875	performan	7.506	low ci	7.6692	high ci	3.25	3.75	weights	1
TR_AA	1	Social Perf	none	29.5494	performan	29.2317	low ci	29.8673	high ci	3.25	3.75	weights	1

Indicator 2. Conditions Meta

Not displayed

Indicator 3. Services Meta

Not displayed

Indicator 4. Impacts Meta



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Indicator 4	
Impacts	
Description 4	
These impacts are the benefits affecting stakeholder quality of life associated with the stock services.	
Indicator 4 URL	
http://localhost:50032/resources/network_carbon/resourcepack_539/resource_1895/Ind4-Impacts.csv	
Label 4	Rel Label 4
RCA4	
Date 4	Dist Type 4
04/25/2017	none
Q1 4	Q1 Unit 4
200.4295	target most score
Q2 4	Q2 Unit 4
198.2053	target low score
Q3 4	Q3 Unit 4
202.6533	target high score
Q4 4	Q4 Unit 4
100.2146	benchmark most sco
Q5 4	Q5 Unit 4
99.1026	benchmark low score
Math Operator 4	BaseIO 4
equalto	none
QT 4	QT Unit 4
101.3266	benchmark high scor
Math Type 4	Math Sub Type 4
algorithm1	subalgorithm13
QT D1 4	QT D1 Unit 4
3.2500	actual certainty1
QT D2 4	QT D2 Unit 4
3.7500	actual certainty2
QT Most 4	QT Most Unit 4
125.2685	actual most score
QT Low 4	QT Low Unit 4
123.8785	actual low score
QT High 4	QT High Unit 4
126.6583	actual high score
Math Expression 4	
I4.Q1.distribtype + I4.Q2.QT + I4.Q3.QTUnit +	
Math Result 4	
rca results label,location,risks_and_indicators,distribtype, QTM,QTMUnit,QTL,QTLUnit,QTU,QTUUnit,cert tainty1,certainty2,norm,weight NCA,1,Fresh Water Supply,none,14.8678,mean,14.7028,low ci,15.0328,high ci,3.2500,3.7500,weights,1.0000 IF1A,1,Change in net income from water	

Indicator4.URL TEXT dataset

Benchmarks



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label	locatic	risks_and_indicators	distribtype	QT	QTUnit	QTD1	QTD1Unit	QTD2	QTD2Unit	certainty1	certainty2	norm	weight
NCA	1	Fresh Water Supply	none	0	none	0	none	0	none	0	0	weights	1
IF1A	1	Change in net income from water supply constraints	normal	3.432	mean	3.432	mean	1.0296	sd	2.5	4	weights	1
IF1B	1	DALYs per 1,000 people attributed to clean water supply constraints	normal	85.8	mean	85.8	mean	25.74	sd	4	3.5	weights	1
NCB	1	Pollination	none	0	none	0	none	0	none	0	0	weights	1
IF2A	1	Change in net income from pollinator conditions	normal	85.8	mean	85.8	mean	25.74	sd	2.5	4	weights	1
IF2B	1	Change in operating costs per unit increase in consumer satisfaction with company biodiversity actions	normal	4.29	mean	4.29	mean	1.287	sd	4	3.5	weights	1
NCC	1	Air quality	none	0	none	0	none	0	none	0	0	weights	1
IF3A	1	DALYs per employee related to air quality in manufacturing facilities	normal	85.8	mean	85.8	mean	25.74	sd	2.5	4	weights	1
IF3B	1	Change in operating cost per unit increase in consumer satisfaction with company GHG emission actions	normal	12.012	mean	12.012	mean	3.6036	sd	4	3.5	weights	1
NC	1	Natural Capital Score	none	0	0	0	0	0	0	0	0	weights	1
PCA	1	Flood Control	none	0	0	0	0	0	0	0	0	weights	1
IF4A	1	Percent employees projected to be physically harmed per extreme flood event	normal	85.8	mean	85.8	mean	25.74	sd	2.5	4	weights	1
IF4B	1	Number of DALYs per 1,000 population per extreme flood event	normal	5.148	mean	5.148	mean	1.5444	sd	4	3.5	weights	1
PC	1	Physical Capital Score	none	0	none	0	none	0	none	0	0	weights	1
ECA	1	Employee Management	none	0	none	0	none	0	none	0	0	weights	1
IF5A	1	Percent employees leaving company per year due to discrimination enforcement	normal	5.148	mean	5.148	mean	1.5444	sd	2.5	4	weights	1
IF5B	1	Stability and quality of supply from SSIF sources	normal	12.012	mean	12.012	mean	3.6036	sd	4	3.5	weights	1
EC	1	Economic Capital Score	none	0	none	0	none	0	none	0	0	weights	1
TR	1	Social Performance Score	none	0	none	0	none	0	none	0	0	weights	1

Targets

Not displayed

Actuals

Not displayed

Indicator4.MathExpression

I4.Q1.factor1

Indicator4.MathResult

Benchmarks

Not displayed

Targets

Not displayed

Actuals



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NCA_AA	1	Fresh Water Supply	none	18.5848	mean	18.3786	low ci	18.7909	high ci	3.25	3.75	weights	1
IF1A_AA	1	Change in net income from water supply	normal	0.7148	actual most	0.7069	actual low	0.7227	actual high	2.5	4	weights	1
IF1B_AA	1	water supply constraints	normal	17.87	actual most	17.6717	actual low	18.0682	actual high	4	3.5	weights	1
NCB_AA	1	Pollination	none	18.7635	mean	18.5553	low ci	18.9716	high ci	3.25	3.75	weights	1
IF2A_AA		conditions	normal	17.87	actual most	17.6717	actual low	18.0682	actual high	2.5	4	weights	1
IF2B_AA		in consumer satisfaction with company	normal	0.8935	actual most	0.8836	actual low	0.9034	actual high	4	3.5	weights	1
NCC_AA	1	Air quality	none	20.3718	mean	20.1457	low ci	20.5978	high ci	3.25	3.75	weights	1
IF3A_AA		in manufacturing facilities	normal	17.87	actual most	17.6717	actual low	18.0682	actual high	2.5	4	weights	1
IF3B_AA		in consumer satisfaction with company	normal	2.5018	actual most	2.474	actual low	2.5296	actual high	4	3.5	weights	1
NC_AA	1	Natural Capital Score	none	57.7201	performance	57.0796	low ci	58.3603	high ci	3.25	3.75	weights	1
PCA_AA	1	Flood Control	none	56.8264	mean	56.1959	low ci	57.457	high ci	3.25	3.75	weights	1
IF4A_AA		Percent employees projected to be	normal	53.6098	actual most	53.015	actual low	54.2047	actual high	2.5	4	weights	1
IF4B_AA		extreme flood event	normal	3.2166	actual most	3.1809	actual low	3.2523	actual high	4	3.5	weights	1
PC_AA	1	Physical Capital Score	none	56.8264	performance	56.1959	low ci	57.457	high ci	3.25	3.75	weights	1
ECA	1	Employee Management	none	10.722	mean	10.603	low ci	10.841	high ci	3.25	3.75	weights	1
IF5A_AA		Percent employees leaving company per	normal	3.2166	actual most	3.1809	actual low	3.2523	actual high	2.5	4	weights	1
IF5B_AA		sources	normal	7.5054	actual most	7.4221	actual low	7.5887	actual high	4	3.5	weights	1
EC_AA	1	Economic Capital Score	none	10.722	performance	10.603	low ci	10.841	high ci	3.25	3.75	weights	1
TR_AA	1	Social Performance Score	none	125.2685	performance	123.8785	low ci	126.6583	high ci	3.25	3.75	weights	1

Optional Indicator5. Impacts Meta

Version 2.1.0 upgraded this algorithm so that it can be run for Indicators 1 to 5. That accommodates the full “results chain”, of Inputs->Activities->Outputs->Outcomes->Impacts, explained in the M&E tutorials. For testing purposes, the same data used in Indicator 4 produced the following result for Indicator 5.

Version 2.14 upgraded algorithms 13 and 14 by allowing up to 6 separate calculator Indicators to be used to define impact pathways (i.e. SPA3, Example 6’s disaster impact pathway of Drivers -> Hazards -> Exposure -> Vulnerability -> Capacity -> Impacts). Version 2.1.8+ started supporting this tutorials’ algorithms for all 15 Indicators.



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by the current condition of resource groups.

Indic 4 Name: Impacts **Label:** RCA4
Date: 04/25/2017 **Rel Label:**
Math Type: algorithm1 **Type:** none
Q1 Amount: 200.4295 **Q1 Unit:** target most score
Q2 Amount: 198.2053 **Q2 Unit:** target low score
Q3 Amount: 202.6533 **Q3 Unit:** target high score
Q4 Amount: 100.2146 **Q4 Unit:** benchmark most score
Q5 Amount: 99.1026 **Q5 Unit:** benchmark low score
Math Express: I4.Q1.distribtype + **Math Operator:** equalto
 I4.Q2.QT + I4.Q3.QTUnit + I4.Q4.QTD1
 + I4.Q5.QTD1Unit + I4.Q6.QT1D2 +
 I4.Q7.QTD2Unit + I4.Q8.certainty2 +
 I4.Q9.norm + I4.Q10.weight
QT Amount: 101.3266 **QT Unit:** benchmark high score
QT D1 Amount: 3.2500 **QT D1 Unit:** actual certainty1
QT D2 Amount: 3.7500 **QT D2 Unit:** actual certainty2
QT Most Amount: 125.2685 **QT Most Unit:** actual most score
QT Low Amount: 123.8785 **QT Low Unit:** actual low score
QT High Amount: 126.6583 **QT High Unit:** actual high score
Math Sub Type: subalgorithm13 **Base IO:** none
Indic 4 Description: These impacts are the benefits affecting stakeholder quality of life associated with the stock services.

Indic 5 Name: Results Chain Impacts **Label:** RCA5
Date: 07/12/2017 **Rel Label:** none
Math Type: algorithm1 **Type:** none
Q1 Amount: 200.4295 **Q1 Unit:** target most score
Q2 Amount: 198.2053 **Q2 Unit:** target low score
Q3 Amount: 202.6533 **Q3 Unit:** target high score
Q4 Amount: 100.2146 **Q4 Unit:** benchmark most score
Q5 Amount: 99.1026 **Q5 Unit:** benchmark low score
Math Express: I5.Q1.01_01_2037 + **Math Operator:** equalto
 I5.Q2.01_01_2027 + I5.Q3.01_01_2022
 + I5.Q4.01_01_2020 +
 I5.Q5.01_01_2019 + I5.Q6.01_01_2018
 + I5.Q7.01_01_2017 + I5.Q8.certainty1
 + I5.Q9.certainty2 + I5.Q10.norm +
 I5.Q11.weight
QT Amount: 101.3266 **QT Unit:** benchmark high score
QT D1 Amount: 3.2500 **QT D1 Unit:** actual certainty1
QT D2 Amount: 3.7500 **QT D2 Unit:** actual certainty2
QT Most Amount: 125.2685 **QT Most Unit:** actual most score
QT Low Amount: 123.8785 **QT Low Unit:** actual low score
QT High Amount: 126.6583 **QT High Unit:** actual high score
Math Sub Type: subalgorithm13 **Base IO:** none
Indic 5 Description: These indicators score the impacts documented in M and E analysis.

Output Series : Coffee Firm RCA1

Social Performance Score



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Version 2.1.2 investigated the use of separate algorithms to shore up Scores. For example, by assuming that enough Social Performance Assessments have been completed to train a neural network and then using a time series regression algo to predict cause and effect – will the conservation practices cause sustainability to change, by how much, and by when? Version 2.1.4 introduced algorithms that demonstrate using the Score to conduct both formal and informal Impact Evaluations.

This firm uses their final Performance Score to monitor and evaluate how well they are accomplishing targeted goals. They use the formula, $(\text{Impact actual score} / \text{Impact target score}) * 100$) to display their overall progress in the image below, but use tables and charts to communicate the full results to company leaders. The reason that the most likely, low, and high, scores are equal is that all of the data used in Indicator 2, 3, 4, was built by multiplying Indicator 1's data by 1.1, 1.2, and 1.3, respectively.

The Score's Iterations, Confidence Interval, and Random Seed, are used with each Indicator's Monte Carlo calculations.



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Score Math Expression	
<input type="text" value="(I4.QTM/I4.Q1)*100"/>	
Score	Score Unit
<input type="text" value="62.5000"/>	<input type="text" value="most likely % target"/>
Score D1	Score D1 Unit
<input type="text" value="0.0000"/>	<input type="text"/>
Score D2	Score D2 Unit
<input type="text" value="0.0000"/>	<input type="text"/>
Score Dist Type	Iterations
<input type="text" value="none"/>	<input type="text" value="1000"/>
Confidence Interval	Random Seed
<input type="text" value="75"/>	<input type="text" value="5"/>
Score BaseIO	
<input type="text" value="none"/>	
Score Most Likely	Score Most Unit
<input type="text" value="62.5000"/>	<input type="text" value="most likely % target"/>
Score Low Estimate	Score Low Unit
<input type="text" value="62.5000"/>	<input type="text" value="low % target"/>
Score High Estimate	Score High Unit
<input type="text" value="62.5000"/>	<input type="text" value="high % target"/>
Score Math Type	Score Math Sub Type
<input type="text" value="none"/>	<input type="text" value="none"/>
Score Math Result	

K. Communication

The company uses the following types of media to communicate the final scores to company stakeholders.

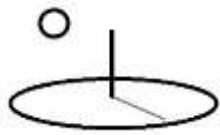


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L. Decisions

Same as Example 1.



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Case Study References

Same as Example 1.



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Example 3. Product Life Cycle Impact Assessments (P-LCIA) for Representative Small Scale Coffee Farms (RCA3)

Version 2.2.0. This release includes an SDG Plan reference which provides a fuller context and additional examples for LCIA. Example 12 in that reference explains that this subalgorithm has been upgraded to be compatible with subalgorithm20. The example demonstrates running Example 4’s subalgorithm16 jointly with this algorithm by putting subalgo16’s data URL in the second position.

URLs

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 3/1552/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 3/540/none>

The cloud datasets used Inputs rather than Outputs in order to mix things up a bit.

Resource Stock Assessment

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA3 Stock/2147397559/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA3 Stock/2141223486/none>

Monitoring and Evaluation Assessment

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA3 M and E/2147397561/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA3 M and E/2141223488/none> (has both Stock and MandE calculators)

The reason that the Stock Indicators are in index position 1, 7, and 8, while the M&E Indicators are in position 1, 2, and 3, is that the M&E calculators don’t allow Indicators to be skipped. And the only reason for skipping Indicators was to test that up to 8 life cycle stages are supported.

Version 2.1.8+ started supporting this tutorials’ algorithms for all 15 Indicators.



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A. Introduction or Goal and Scope

This example continues with Example 1 and 2's coffee farm to demonstrate how to use life cycle assessments to complete social assessments for products. UNSETACc defines the purpose of life cycle assessments as follows:

“LCIA is about the quantification of potential environmental impacts caused by the supply chain of products and services [Product LCA], as well as by the activities of organizations including the upstream and downstream suppliers [Organization LCA].”

Large commercial firms commonly complete standard LCAs as further proof of their “emissions management”, but small scale growers do not (refer to the UNSETACd and UNSETACf references). This example demonstrates that Product LCAs may still be appropriate for small scale farms, but not necessarily for each individual farm. Instead, representative LCAs are completed by the network's resource conservationists for typical, small scale farm-made products within some geographic region (i.e. watershed), ecosystem (i.e. humid, upland, tropical savannah), or industrial sector (i.e. the European Commission's, 2016, Product Environmental Footprint Category Rules). The latter use can help avoid confidentiality issues dealing with divulging company technology secrets.

This example, along with Examples 3A, 3B, 4C and 5, demonstrate combining several of the approaches recommended by UNSETAC: Social Life Cycle Assessments (S-LCA: UNSETACa and UNSETACb), Organization Life Cycle Assessments (O-LCA: UNSETACd and UNSETACf), Life Cycle Impact Assessments (LCIA: UNSETACc) and Life Cycle Costs.

To set the context for this algorithm, UNSETACc describes the reasons for developing strong standards to conduct LCIA as follows:



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“With the globalization of economies there has also been a steadily growing need to create a worldwide consensus set of environmental impact category indicators embedded in a consistent, methodological framework. Such a set of indicators is expected to be used in environmental product information schemes, benchmarking in industry sectors, corporate reporting by companies, intergovernmental and national environmental policies, and common LCA work commissioned by governments and companies.”

This algorithm can be used several different ways:

Standalone Life Cycle Assessments. This algorithm can be used with standalone Indicators that are not related to the RCA Framework. Instead, the approaches recommending in the ILCD Handbook (LCA), UN-SECTAC S-LCA, UN-SECTAC LCIA, and UN-SECTAC O-LCA, references are followed. This example demonstrates combining several of those approaches. The current release supports LCAs for Indicators 1 to 8 for supply chain analysis.

RCA Framework. The RCA Framework’s “social impact pathway” of Actions->Conditions->Services->Impacts (or “results chain” of Activities->Outputs->Outcomes->Impacts), might be used in a similar manner to how those pathways are used in LCA. UN-SETAC (2016) uses the term “impact pathway” to define the cause and effect relationship contained in their recommended 4 level LCIA hierarchy. They encourage further experimentation and expansion of their LCIA techniques to include such factors as cultural heritage, ecosystem services, and “identification and further modeling of a general environmental mechanism, applicable to all resources”. Suggesting that the RCA Framework’s 4 or 5 Indicator impact pathways may also be an appropriate approach.

Substitutes for Indicators that use subalgorithms 13 or 14. The algorithm can be used to replace specific Indicators in subalgorithms 13 and 14. For example, some assessments may find the ILCD LCA techniques to be a suitable replacement for Actions (i.e. quantified damages serve as stressors or risks). Others may find the UN-SETAC LCIA techniques, or Example 4’s Life Cycle Cost or Benefits techniques, to be a suitable replacement for Impacts. They can, of course,



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also be used as a supplemental set of calculations for each of the 4 or 5 Indicators (i.e. by linking 2 calculators to each base element).

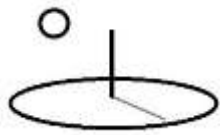
Whole Operating or Capital Budget. The Ag Production tutorial demonstrates that DevTreks supports complete farm budgeting, where all of the inputs and outputs used by a company are quantified and categorized. Each of those inputs and outputs can use this algorithm to quantify their associated social impacts, including emissions. Alternatively, Components, Operations, Outcomes, Time Periods, and/or Budget, base elements can be used. In addition, rather than the Ag Production tutorial's focus on commodity cost and return estimating, these budgets are also appropriate for supply chain budgeting. The full use of the hierarchical base elements can be used to address the UN-SETACc recommendations for spatial, regional, and temporal scales. For an example, navigate around the national crop rotation database URI found in the Ag Production tutorial and in Section C (regional = state Budget Groups, spatial = specific crop rotation Budgets, temporal = enterprise Time Periods).

Organization LCA (O-LCA): Example 3A explains the differences between Organization LCIA and Product LCIA.

The following uses support the fuller sustainability assessments identified by several references (EC, 2012, UNSETACe) as being logical extensions of Product and Organization LCIA.

Social Life Cycle Analysis (S-LCA): Example 3B demonstrates conducting S-LCA to assess the socioeconomic impacts of company production on stakeholders.

LCIA and Cost Effectiveness Analysis: Example 4C demonstrates how to use this algorithm to conduct Cost Effectiveness Analysis (CEA). It demonstrates how to ensure that money spent mitigating and adapting to environmental damages generates cost effective value. It also demonstrates the use of complementary algorithms that use harmonized data (i.e. the 22 properties of this algorithm also use the 22 properties of other algorithms, such as Example 4's economic and temporal properties).



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LCA and Stakeholder Impact Analysis (SIA): Example 5 in the Social Performance Analysis 3 reference demonstrates integrating population algorithms with this algorithm to conduct SIAs.

Social Sustainability Accounting Platforms: Example 12 in the Social Performance Analysis 4 reference demonstrates using social sustainability media platforms to conduct more thorough LCIs and LCIAs.

B. Indicator Thresholds, or System Boundary and Resource Inventory

The RCA Coffee social network has developed the following typical LCA resource inventory using a “system boundary” defined for their members’ typical coffee farms (the image comes from Coltro et al, 2006). Resource conservationists in these networks work with individual firm managers to customize the final system boundary, elements, and Indicators, to fit individual company, or representative farm, requirements. The Frischknecht et al reference (2016) demonstrate inventories for a product’s multiple life cycle stages. The fact that finding a complete, rather than this image’s summary, LCA raw dataset for even a single coffee farm “proved futile” (2* and 10*) suggests that social networks and clubs need to get busy.



Table 1: Summary of the Brazilian life cycle inventory for 1,000 kg of green coffee production for the reference crops 2001/02 and 2002/03

Parameters	Unit	Weighted Average	Arithmetic Average	Maximum	Minimum	'Surplus Index'
Input						
Energy						
Total	MJ	10,670	12,195	66,566	3,824	5
Electric (public grid)	MJ	646	533	1,934	36	4
LPG	kg	6	26	49	5	2
Wood	kg	368	782	6,350	29	8
Diesel	kg	94	77	331	5	4
Other Resources						
Water for coffee processing	kg	11,437	10,160	60,000	72	6
Fertilizers						
Total ^a	kg	911	1,160	3,583	11	3
N, P, K	kg	274	318	927	1.26	3
B, Cu, Fe, Mn, S, Zn	kg	6	8	33	0.19	4
Pesticides						
Total ^a	kg	10	10	30	0.73	3
Fungicide	kg	1.72	1.06	6	0.01	6
Herbicide	kg	1.15	1.49	12	0.13	8
Insecticide	kg	0.98	1.51	11	0.02	7
Bactericide	kg	0.14	0.72	0.98	0.40	1
Acaricide	kg	0.35	0.48	1.11	0.02	2
Acaricide/ Insecticide	kg	0.002	0.09	0.13	0.06	1
Correctives						
Total ^a	kg	622	749	4,480	200	6
Ca, Mg	kg	273	320	1954	0.01	6
Land Use						
Land use ^b	ha.a	0.05	0.05	0.1	0.03	2
Output						
Organic residue used as fertilizer	kg	757	758	758	752	1
Waste water (coffee washing)	kg	2,901	5,803	60,000	72	10
Waste water (wet route)	kg	8,535	6,808	15,277	2,618	2

Surplus index = Maximum value divided by the arithmetic average

^a Total = Active and filler elements

^b 12 years was considered as the life time of the profitable harvest for calculating the hectare of annual land use

The following image and tables show that Indicator TEXT datasets store this firm's initial Scoring system. This stylized system uses the same Indicators and Categories as used with Indicator 4 in Examples 1 and 2, because this social network uses the same WBS for all of its resource accounting. It then adapts, or "harmonizes", those categories to the UN-SETAC techniques to carry out LCIA in a stylized fashion as demonstrated in the following table. The UNSETAC references focus on frameworks, standards, and detailed calculations, not harmonized data that fits nicely into tabular datasets, so no actual data was available for this example (2*).



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label	locat	Coffee RCA network	UN-SETAC	Unit
NCA	1	Fresh Water Supply	Water Use Impacts	AMD (available water remaining)
IF1A	1	Indicator 1		
IF1B	1	Indicator 2		
NCB	1	Pollination	Land Use Impacts on Biodiversity	BDP (biodiversity damage potential)
IF2A	1	Indicator 1		
IF2B	1	Indicator 2		
NCC	1	Air Quality	PM Health Impacts	DALY/kg PM25 (disability adjusted life year per PM25)
IF3A	1	Indicator 1		
IF3B	1	Indicator 2		
NCD	1	Air Quality, Climate	Climate Change Impacts Short Term	
IF4A	1	GHG emissions	Global Warming Potential 100 year	GWP 100
IF4B	1	GHG emissions	Global Temperature Change Potential 100 year	GTP 100
NCE	1	Air Quality, Climate	Climate Change Impacts Long Term	
IF5A	1	GHG emissions	Global Warming Potential 100 year	GWP 100
IF5B	1	GHG emissions	Global Temperature Change Potential 100 year	GTP 100
NC	1	Natural Capital Score	Ecosystem Quality	normalized and weighted
PCA	1	Flood Control	Physical Capital Impacts	DALY
IF4A	1	Indicator 1		
IF4B	1	Indicator 2		
PC	1	Physical Capital Score	Human Health	normalized and weighted
ECA	1	Employee Management	Socio-Economic Capital Impacts	HCI (human capital index)
IF5A	1	Indicator 1		
IF5B	1	Indicator 2		
EC	1	Economic Capital Score	Socio-Economic Assets	normalized and weighted
TR	1	Social Performance Score	Social Performance Score	average

Example 4C will demonstrate how to harmonize this type of data with actual on-farm budget data. To summarize that approach, each farm operation, such as Nutrient Management, can have multiple Damage Categories, or Categorical Indexes (CIs), such as Human Health and Ecosystem Quality. This algorithm sums, normalizes, and weights the Damage Categories to produce one Locational Index. The Locational Indexes (LIs) can then be independently normalized, weighted, and summed in the Total Risk Index. The LIs, if carefully defined, can support the “Areas of Protection” identified in the UNSECTACc reference.



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To conduct cost effectiveness analysis, the LIs from this algorithm must then be allocated to each farm operation. In effect, this algorithm’s LIs must correspond to Example 4’s CIs (or careful use must be made of Example 4’s CategoricalIndex.factor6, allocation factor). The result will be cost per unit normalized damage index, or cost per unit damage per citizen.

UN-SETACc makes the following recommendation, along with caveats, for using their LCIA techniques (1*). Their “Hotspots Analysis” will be demonstrated with this example’s Score.

“The environmental impact category indicators recommended in this guidance are primarily suited for hot spot analyses in product and organizational LCA. Some of them are also suited for identifying Hotspots in consumption-based assessments of the environmental impacts of nations (Frischknecht et al. 2015; Tukker et al. 2014) and intergovernmental organizations such as the European Union (JRC 2012). The indicators try to model complex cause-effect chains in general and disregard specific local aspects. Therefore, they are not (yet) fully suited for the identification of environmentally optimal agricultural management practices for a particular farm, a particular [agriculture, or forest land] with respect to terrestrial biodiversity protection. They are also not fully ready for the measurement of actual human health impacts of particulate matter emissions in a particular city district, nor in the prediction of human health effects of a severe drought period in a given year in Central Africa.”

C. Quality of Life Scenarios

The company’s overall Quality of Life Scenarios are the same as explained in Example 1, but they want to use LCAs as further, quantitative proof, of the claims they report using Example 1 and 2’s techniques. Small scale farms use the representative LCAs to further define mitigation and adaptation actions that help them achieve their resource conservation accounting goals.

The ILCD Handbook defines scenarios very technically:



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“Scenario for the analysed process or system that varies data and method assumptions with the purpose of evaluating the robustness of the study results and conclusions. If more than one alternative system or option are compared, each of them would have its own assumption scenarios.”

In effect, they are saying that quantifying the inputs and outputs associated with any product, production process, technology, or supply chain, requires making a lot of assumptions. More so, when the LCA is being done for representative farms or farm products –what are typical soil conditions, slopes, rainfall amounts, plant varieties, fertilizer applications, pesticide practices, yields, and bean grades? Making those assumptions for representative farm budgets alone is difficult. This issue can be addressed by developing several scenarios that define sideboards for the uncertain production characteristics.

Example 3A will use examples of comparative LCIA, such as between organic and conventional production, to address this issue. Example 4C also demonstrates using Scenario Analysis with LCIA and CEA.

D. Social Performance Indicators and Life Cycle Impact Assessment

For LCIA calculations, the following image (UNSETACc) demonstrates a representative LCIA impact pathway used to assess air pollution’s impact on human health.

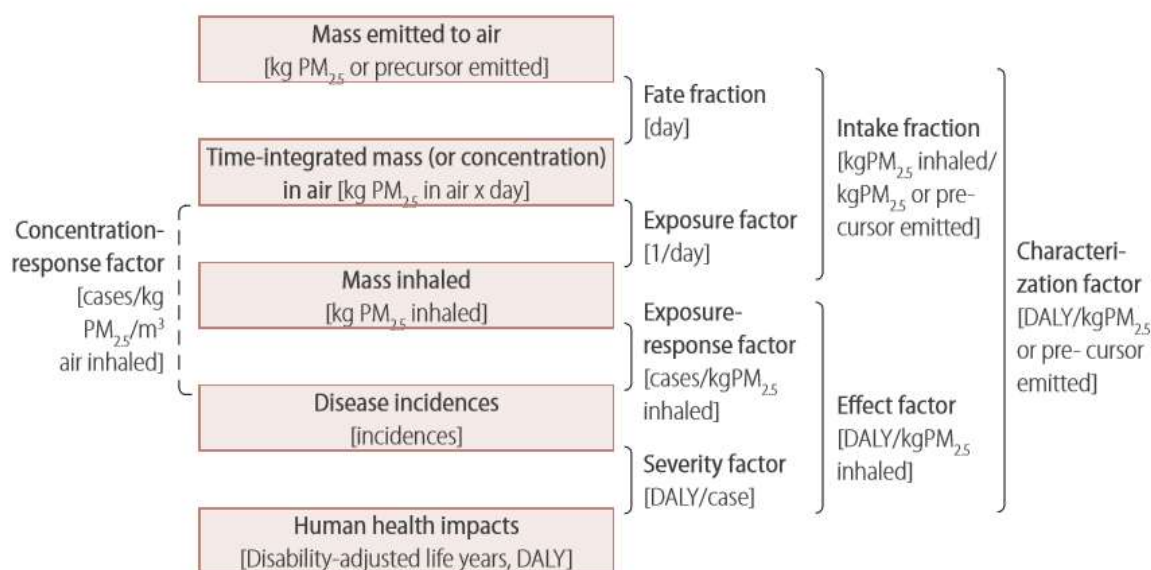


Figure 4.1: Impact pathway followed and framework for assessing human health effects from fine particulate matter (PM_{2.5}) exposure in life cycle impact assessment

Adapted from (Fantke et al. 2015).

These calculations support the general LCIA impact pathway approach of (see the Resource Calculation reference for an introductory example)

- 1) **Pathway Part 1:** starting with a field measurement, such as mass emitted to air from an input or output
- 2) **Pathway Part 2:** using multipliers, or factors, to allocate the first measurement to account for the parent Indicator contribution to emissions (i.e. when Co-Inputs or Co-Outputs also contribute to the first measurement) –in the previous image, this factor is part of the Intake fraction calculation
- 3) **Pathway Part 3:** using a multiplier, or factor, to convert the second calculation to an emission unit –in the previous image, this factor is similar to the Intake fraction
- 4) **Pathway Part 4:** using a multiplier, or characterization factor, to convert the third calculation to an Environmental Impact Category –in the previous image, this factor is similar to the Effect factor



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- 5) **Pathway Part 5:** optionally using a multiplier, or characterization factor, to convert the Environmental Impact Category to a Damage Category –in the image above, this factor is the final DALY per kgPM25

The UNSETAC references demonstrate that the simplified multipliers, or factors, in these pathways can derive from complex calculations (i.e. land use conversions, YLL and YLD factors used to calculate DALYs, waste recycling, and energy consumption). The UNSETAC recommendations to document these related calculations can be handled using the paragraph editor introduced in Example 1A, or the Calculator.MediaURL property to link a pdf file that shows the calculations. Example 12 explained how to use either Version 2.2.0’s new Math Expressions, or automated Guidance Documents, to conduct the calculations.

The following 24 properties (12 factors for Indicators and 12 factors for Categorical Indexes) define the full LCIA impact pathway from initial Input or Output quantity to final LCIA damages. Unlike the “vertical impact pathways” introduced in Example 1, which are defined using multiple Indicators, these horizontal impact pathways are defined by the 24 properties. Although a case can be made that additional properties may be needed to conduct more comprehensive LCAs, examples will be added that demonstrate using complementary subalgorithms for that purpose (i.e. using Example 4’s economic and temporal properties; using Example 5’s socioeconomic properties). Some of the references use the term “full sustainability assessment” for LCAs that address the latter purposes.

Although the algorithm doesn’t care about property names, DevTreks recommends using the generic property names. Although these multipliers demonstrate typical uses, they can be used for whatever purpose fits best with the impact pathway (i.e. product footprints).

- **factor1:** Most likely quantity of Indicator (i.e. input or output quantity). This will be used to calculate Indicator.QTM. Version 2.1.2 upgraded this algorithm to also support Example 2’s PRA techniques. If using this to conduct PRA, this factor is equivalent to QT.



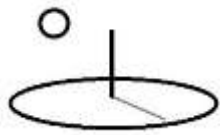
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- **factor2:** Low quantity of Indicator. This will be used to calculate Indicator.QTL. Version 2.1.2 upgraded this algorithm to also support Example 2’s PRA techniques. If using this to conduct PRA, this factor is equivalent to QTD1 (i.e. shape).
- **factor3:** High quantity of Indicator. This will be used to calculate Indicator.QTU. Version 2.1.2 upgraded this algorithm to also support Example 2’s PRA techniques. If using this to conduct PRA, this factor is equivalent to QTD2 (i.e. scale).
- **factor4:** Unit of measurement for factor1.
- **factor5:** probability distribution type (see Example 2: none, normal, lognormal, triangle ...) when factor1, factor2, and factor3 are used to conduct PRA.
- **factor6:** General multiplier applied to the quantities. The references show that the simplest use of this factor is as percent Q to be allocated to this Indicator (because of co-inputs or co-outputs).
- **factor7:** Unit of measurement for the factor6 conversion (i.e. when factor6 is not a simple allocation factor).
- **factor8:** Multiplier used to convert the unit of measurement of Q from the input or output quantity (kg N / ha) to the emission unit (kg NO₂ / ha).
- **factor9:** Unit of measurement for the factor8 conversion.
- **factor10:** Characterization factor used to convert the calculated emission quantity to the Categorical Index, or Impact Category, Unit (CO₂ equivalents).
- **factor11:** Unit of measurement for the factor10 conversion (i.e. CO₂ Equivalents).

Version 2.2.0 broke Occam’s rule for these datasets to make them consistent with Example 12, sibalgorithm20, in the SDG Plan reference.

- **factor12:** math expression used to calculate the 4 LCIA midpoint measurements; the expression takes the form of $Q1*Q2*Q3*Q4$ or, as explained in the Resource Stock Calculator reference, $Q1*(Q2/3)*Q3*Q4*2$; the term “none” signifies that no calculations should be run

The following formula is used with these columns.



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Indicator.QTM = Version 2.2.0 uses the math expression, $Q1*Q2*Q3*Q4$, in factor12

Indicator.QTL = uses factor2 in the math expression

Indicator.QTU = used factor3 in the math expression

The Categorical Indexes used in this example were upgraded in Version 2.1.2 to allow the results of Environmental Impact categories to be converted to Damage categories as displayed in the following image (UNSETACTc). That reference also explains that the damage category can be substituted for the Impact category, with no additional conversion (i.e. not all impact pathways use Midpoint Impact Categories).

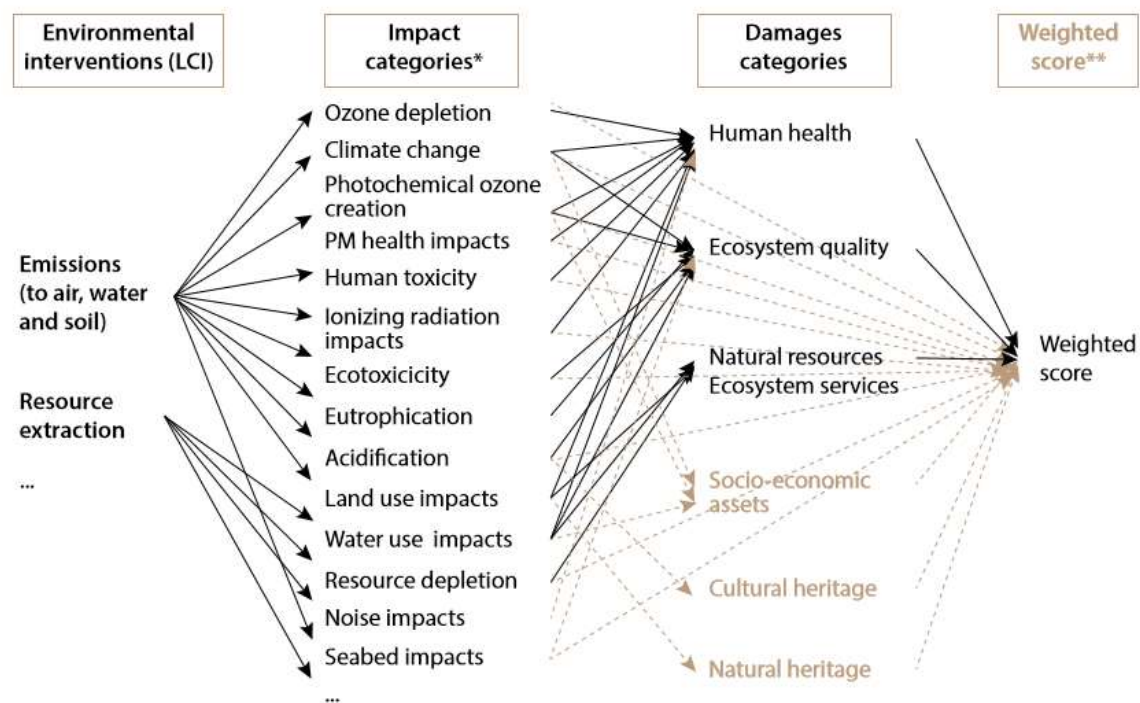


Figure 2.1: Updated structure of the LCIA framework.

*The list of impact categories is indicative rather than exhaustive and subject to change due to future developments. Be aware that all of the categories represent impacts. "Land use impacts" includes both land occupation and land transformation impacts.

**Weighting is an optional step in impact assessment which can be used to facilitate interpretation. Weighting may also utilize normalization.

The UNSETAC references explain that each stage in an LCA pathway has uncertainty. The properties in the following list accounts for the uncertainty of the Damage Category



characterization factor. For example, the following image (UNSETACc) shows that factor1, factor2, and factor3, can be documented using characterization factors that derive from the marginal, or average, slope of an exposure-response curve at most likely (shown), low (not shown), and high (not shown), emission concentrations (also refer to Figure 4.2 and Figure 5.5).

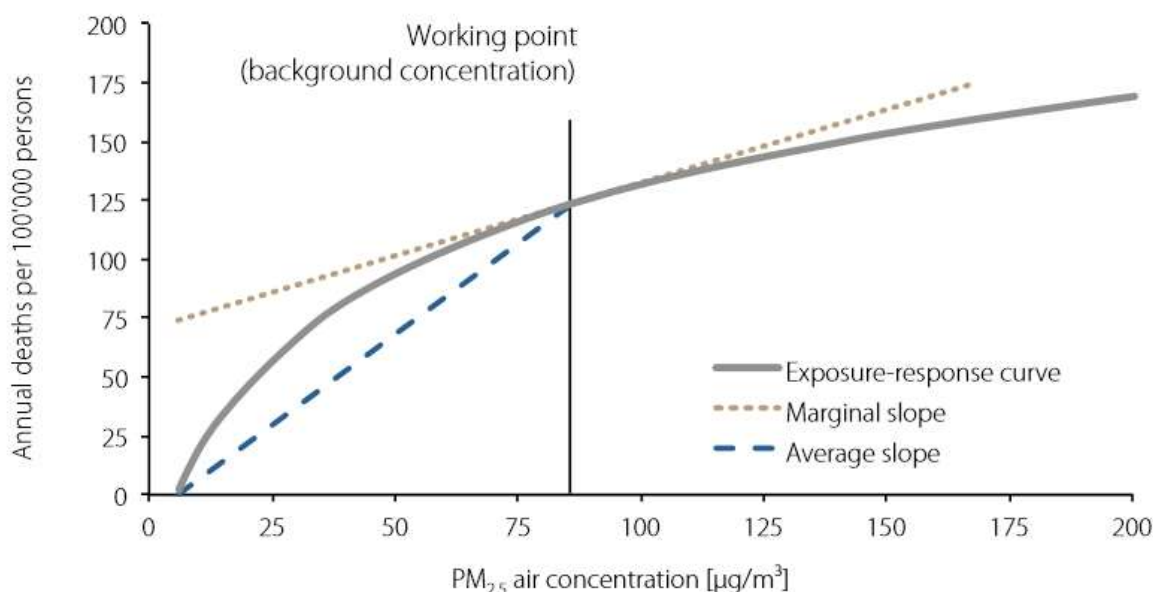


Figure 2.2: Illustration of applying the exposure-response curve for calculating health impacts from exposure to PM_{2.5}

Red dotted line shows an approach for the calculation of marginal characterization factors related to the background concentration at the working point, while blue dashed line shows an approach for calculating average characterization factors as average between the background concentration at the working point and the theoretical minimum-risk concentration. The working point used as example is the actual background concentration in (Apte et al. 2015).

To support these calculations, the following list defines the final 11 columns of data for Categorical Indexes. Although the normalization and weights used in this example demonstrate typical uses, they can be adjusted for whatever purpose fits best with the production technology.

- **factor1:** Most likely quantity of Damage Category characterization factor. If using this to conduct PRA, this factor is equivalent to QT. The results of this calculation will be multiplied by the Indicator.QTM (most likely Impact Category quantity).
- **factor2:** Low quantity of Damage Category characterization factor. If using this to conduct PRA, this factor is equivalent to QTD1 (i.e. shape). The results of this calculation will be multiplied by the Indicator.QLT (low Impact Category quantity).



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- **factor3.** High quantity of Damage Category characterization factor. If using this to conduct PRA, this factor is equivalent to QTD2 (i.e. scale). The results of this calculation will be multiplied by the Indicator.QTU (high Impact Category quantity).
- **factor4.** Unit of measurement for Damage Category characterization factor. Also used to aggregate multiple CIs into Elementary Flows for the Score's Hotspots Analysis.
- **factor5:** probability distribution type (see Example 2: none, normal, lognormal, triangle ...) when factor1, factor2, and factor3 are used to conduct PRA.
- **factor6:** Label used to aggregate multiple CIs into Life Cycle Stages for the Score's Hotspots Analysis (i.e. when each Indicator has multiple life cycle stages).
- **factor7:** Label used to aggregate multiple CIs into the Production Processes for the Score's Hotspots Analysis. When possible, use the Labels from Example 4's budgets.
- **factor8:** certainty1 of Categorical Index
- **factor9:** certainty2 of Categorical Index
- **factor10:** normalization (use "none" if the calculated Categorical Indexes, such as Human Health and Ecosystem Quality, are not being normalized)
- **factor11:** weight (use 1 if the calculated Categorical Indexes are not being weighted)

Version 2.2.0 broke Occam's rule for these datasets to make them consistent with Example 12, subalgorithm20, in the SDG Plan reference.

- **factor12:** math expression used to calculate the final LCIA damage measurements; the expression takes the form of $Q1*Q2$ or $(Q1*2)*(Q2/4.5)$, with Q1 derived from the Indicator calculations and Q2 derived from these Categorical Index properties; the term "none" signifies that no calculations should be run; using a prefix of "mcda:" in the expression (i.e. mcda:Q1*Q2) signifies that the Indicators should also be normalized (i.e. Example 4B's MCDA calculations)

The following list defines how the final 11 columns of data for Locational Indexes are used.

- **factor1:** not applicable, use 0
- **factor2:** not applicable, use 0



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- **factor3:** not applicable, use 0
- **factor4:** Unit of measurement for LocationalIndex.QTM calculation
- **factor5:** not applicable, use “none”
- **factor6:** not applicable, use “none”
- **factor7:** not applicable, use “none”
- **factor8:** not applicable, use “none”
- **factor9:** not applicable, use “none”
- **factor10:** normalization (use “none” if the calculated Locational Indexes are not being normalized). This factor normalizes the Locational Indexes, which start with normalized Categorical Indexes. Some of the references use the term “Area of Protection” in a similar way to the Locational Indexes.
- **factor11:** weight (use 1 if the calculated Locational Indexes are not being weighted)
- **factor12:** none

The MathResult section, below, explains the calculations used with these properties to produce the final LCIA report. The results add 4 additional columns to hold the final normalized, weighted, calculations. The final column, percent, displays the percent contribution of the row to the parent aggregator. The final column supports the Hotspots Analysis explained for the Score.

Analysts should follow the recommendations for normalization and weighting found in the references. Those recommendations involve deriving the values from national or international standards, such as those displayed in the following image (European Commission, 2016). This algorithm upgraded the techniques demonstrated for Examples 1 and 2. Besides containing the standard options (weights, minmax, zscore, tanh, logit, logistic), the “norm” column can now contain doubles which will be used as a multiplier with each Indicator total (i.e. the population multipliers shown in the following image that normalizes damages to damage per EU person). Depending on the source of the normalization multiplier, the normalization factors may need to be entered based on the calculation, $\text{factor10} = (1 / \text{normalization factor})$. Example 9 demonstrates how to use a new option, modzscore, to conduct modified z-scores.



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This example uses multipliers for the Categorical Index normalization factors, and minmax for the Locational Index normalization factors.

Table A-2 Recommended Normalisation factors for EU 27 (2010) based on domestic inventory

Impact category	Unit	DOMESTIC	Normalisation Factor per Person (domestic)
Climate change	kg CO ₂ eq	4.60E+12	9.22E+03
Ozone depletion	kg CFC-11 eq	1.08E+07	2.16E-02
Human toxicity - cancer effects	CTUh	1.84E+04	3.69E-05
Human toxicity - non cancer effects	CTUh	2.66E+05	5.33E-04
Acidification	mol H ⁺ eq	2.36E+10	4.73E+01
Particulate matter	kg PM _{2.5} eq	1.90E+09	3.80E+00
Ecotoxicity - freshwater	CTUe	4.36E+12	8.74E+03
Ionizing radiation HH	kbq U235 eq	5.64E+11	1.13E+03
Photochemical ozone formation	kg NMVOC eq	1.58E+10	3.17E+01
Eutrophication - terrestrial	mol N eq	8.76E+10	1.76E+02
Eutrophication - freshwater	kg P eq	7.41E+08	1.48E+00
Eutrophication - marine	kg N eq	8.44E+09	1.69E+01
Land use	kg C deficit	3.74E+13	7.480E+04
Resource depletion - water	m ³ water eq	4.06E+10	8.14E+01
Resource depletion - mineral, fossil	kg Sb eq	5.03E+07	1.01E-01

The certainty factors (factors 8 and 9 of Categorical Indexes) can be used to address the “qualitative communication of uncertainty” discussed in Appendix A, including the following UNSETACc recommendations for handling uncertainty:

“It is strongly recommended to make all uncertainties explicit by reporting them at least in a qualitative way”



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“We recommend to include a vulnerability term for impacts on species richness and possibly ecosystems, to reflect that there are species and ecosystems that are more at risk due to specific interventions than others.”

Indicator 1. Life cycle stage 1. Production LCIA Meta. The benchmark, target, and actual metrics shown in the following image reflect the final normalized, weighted, environmental, or damage, impact for this life cycle stage, or Indicator. It’s important to understand that the algorithms demonstrated in this reference produce these types of final aggregated results, because these are the metrics that can be further analyzed using the Resource Stock and M&E Analyzers (i.e. Totals, Statistics, Change By, and Progress).

UNSETACd provides the following guidance for using these “single aggregated impacts”. The actual Indicator.MathResults are used to fully address the mentioned caveats. The Score will further explain these metrics. This statement verifies that the most useful analyses must be derived from the Score’s Categorical Index Hotspots data.

“Single-score impact category indicators (i.e., expressing the results of the environmental multi-impact assessment with only one aggregated indicator) have potential for O-LCA (see Report 9 on p.80). Based on value choices, they ease the interpretation of the results for non LCA experts, like managers. However, single-score indicators hide information trade-offs and have higher uncertainties as long as normalization and weighting factors are used. If the organization is aware of the limitations of inventory-level indicators and single-score impact category indicators, they may be used in the study.”



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Stock Indicators	
Indicator 1	
Indicator 1 - LCIA	
Indicator 1 Description This indicator conducts an LCIA of a coffee firm.	
Indicator 1 URL http://localhost:5000/resources/network_carbon/resourcepack_540/resource_1902/Ind1-LCA.csv	
Label 1 RCA3	Rel Label 1 none
Date 1 05/04/2017	Dist Type 1 none
Q1 1 11,010.0000	Q1 Unit 1 target most score
Q2 1 1,664.5500	Q2 Unit 1 target low score
Q3 1 94,809.0000	Q3 Unit 1 target high score
Q4 1 10,792.9200	Q4 Unit 1 benchmark most score
Q5 1 1,610.9700	Q5 Unit 1 benchmark low score
Math Operator 1 equalto	BaselO 1 none
QT 1 93,709.8000	QT Unit 1 benchmark high score
Math Type 1 algorithm1	Math Sub Type 1 subalgorithm15
QT D1 1 0.0000	QT D1 Unit 1 none
QT D2 1 0.0000	QT D2 Unit 1 none
QT Most 1 10,770.4800	QT Most Unit 1 actual most score
QT Low 1 1,604.4300	QT Low Unit 1 actual low score
QT High 1 93,616.2000	QT High Unit 1 actual high score
Math Expression 1 I1.Q1.factor1 + I1.Q2.factor2 + I1.Q3.factor3 + I1	
Math Result 1 rca results label,location,risks_and_indicators,factor1,factor2,factor3,factor4,QTMostUnit,factor6,factor7,factor8,factor9,factor10,factor11,QTMost,QTLow,QTUp,percent NCA,1,Fresh Water Supply,2.00E+00,5.00E-01,1.00E+01,daly/m3,none,production,EDF,2.0E+00,3.0E+00,2.50E-01,4.0E+00,6.03E+02,9.069E+01,5.217E+03,2.498E+01 IF1A,1,Indicator 1,1.00E+01,5.00E+00,2.00E+01,m3,none,1.0E+00,m3/ha,2.0E+00,m3m2,1.0E+01,amd,2.0E+02,1.	

Indicator1.URL TEXT dataset

Although the Frischknecht et al (2016) reference documents the rice crop Resource Inventory used with the UNSETACc LCIA techniques, no complete LCA reference dataset, containing a complete TEXT dataset of the full LCIA impact pathways, including final Damage Category



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calculations and Indexes, is offered by any of the references (i.e. 2*). Social networks must work with their information technologists to proof these LCA calculations before using them for professional work. For example, alternative normalization and weighting techniques can certainly be devised that might fit better with some LCIA impact pathways (i.e. and therefore require a separate subalgorithm). Just remember Appendix A's concluding advice –use generic over custom whenever possible.

Benchmarks. UNSETACc refers to this as a Reference case; the functional unit is based on crop production or per kg product (2*). The CategoricalIndex.factor10s, or normalization factors, are straight multipliers. The LocationalIndex.factor10s use minmax for normalization. The primary purpose of this stylized data was to proof this algorithm, not as representative data. The Indicators, Categorical Indexeds, and Locational Indexes, all have equal properties, and, with allowances for the PRA randomization techniques, will return similar final calculations.

The following image confirms that Version 2.1.2 upgraded this algorithm to use the standard scientific notation format used in LCAs. Although the TEXT input data sets can still use digital formats, the MathResults will always return scientific notation. Version 2.2.0 standardized the labeling system to Example 9's SDG labeling system and added Example 12's MathExpression.



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label	category	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
TNCA	1	Fresh Water Supply	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF1A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+01	amd	Q1*Q2*Q3
IF1B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+02	amd	Q1*Q2*Q3
TNCB	1	Pollination	2.00E+00	5.00E-01	1.00E+01	bdp	triangular	production	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF2A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	ha	none	1.00E+00	effective ha	2.00E+00	m2/year/kg yield	1.00E+01	bdp	Q1*Q2*Q3
IF2B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	ha	normal	1.00E+00	effective ha	2.00E+00	m2/year/kg yield	1.00E+02	bdp	Q1*Q2*Q3
TNCC	1	Air quality	2.00E+00	5.00E-01	1.00E+01	daly/kg pm25	none	production	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	pm10	none	1.00E+00	pm10	2.00E+00	kg PM25 inhaled / kg PM25 inhaled /	1.00E+01	deaths/kg emitted	Q1*Q2*Q3
IF3B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	pm10	normal	1.00E+00	pm10	2.00E+00	kg PM25 inhaled / kg PM25 inhaled /	1.00E+02	deaths/kg emitted	Q1*Q2*Q3
TNCD	1	Air quality -climate	2.00E+00	5.00E-01	1.00E+01	GTP	none	production	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	kg N	none	1.00E+00	kg N	2.00E+00	NH4	1.00E+01	CO2 Equivs	Q1*Q2*Q3
IF3B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	kg N	normal	1.00E+00	kg N	2.00E+00	NH4	1.00E+02	CO2 Equivs	Q1*Q2*Q3
GNC	1	Natural Capital Score	0.00E+00	0.00E+00	0.00E+00	NC score	none	0.00E+00	NC score	0.00E+00	none	minmax	3.00E+00	
TPCA	1	Flood Control	2.00E+00	5.00E-01	1.00E+01	daly/1000 people	none	production	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF4A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3	2.00E+00	m3m2	1.00E+01	daly/1000 people	Q1*Q2*Q3
IF4B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3	2.00E+00	m3m2	1.00E+02	daly/1000 people	Q1*Q2*Q3
GPC	1	Physical Capital Score	0.00E+00	0.00E+00	0.00E+00	PC score	none	0.00E+00	PC score	0.00E+00	none	minmax	3.00E+00	
TECA	1	Employee Management	2.00E+00	5.00E-01	1.00E+01	hci per employee or percent employees percent suppliers	none	production	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF5A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	hci per employee or percent employees percent suppliers	none	1.00E+00	percent employees percent suppliers	2.00E+00	qol/employee e qol/employee e	1.00E+01	hci/employee	Q1*Q2*Q3
IF5B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	hci per employee or percent employees percent suppliers	normal	1.00E+00	percent employees percent suppliers	2.00E+00	qol/employee e qol/employee e	1.00E+02	hci/employee	
EC	1	Economic Capital Score	0.00E+00	0.00E+00	0.00E+00	EC score	none	0.00E+00	EC score	0.00E+00	none	minmax	3.00E+00	
TR01	1	Social Performance Score	0.00E+00	0.00E+00	0.00E+00	TR score	none	0.00E+00	TR score	0.00E+00	none	1.00E+00	1.00E+00	
TNCA_A	1	Fresh Water Supply	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2

Targets

Not displayed -for testing same data as Benchmarks, but with _A suffix

Actuals

Not displayed -for testing same data as Benchmarks, but with _AA suffix

Indicator1.MathExpression

11.Q1.factor1

Indicator1.MathResult

Benchmarks. Although this image displays numbers in digital format, the raw csv data is in scientific notation. The calculations that are displayed below the image explain why these results don't easily support simple “eyeball verification”.



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label	location	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
TNCA		1 Fresh Wat	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF1A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+01	amd	Q1*Q2*Q3
IF1B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+02	amd	Q1*Q2*Q3
TNCB		1 Pollination	2.00E+00	5.00E-01	1.00E+01	bdp	triangular	production	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF2A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	ha	none	1.00E+00	effective h	2.00E+00	m2/year/k	1.00E+01	bdp	Q1*Q2*Q3
IF2B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	ha	normal	1.00E+00	effective h	2.00E+00	m2/year/k	1.00E+02	bdp	Q1*Q2*Q3
TNCC		1 Air quality	2.00E+00	5.00E-01	1.00E+01	daly/kg pm	none	production	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	pm10	none	1.00E+00	pm10	2.00E+00	kg PM25 ir	1.00E+01	deaths/kg	Q1*Q2*Q3
IF3B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	pm10	normal	1.00E+00	pm10	2.00E+00	kg PM25 ir	1.00E+02	deaths/kg	Q1*Q2*Q3
TNCD		1 Air quality	2.00E+00	5.00E-01	1.00E+01	GTP	none	production	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	kg N	none	1.00E+00	kg N	2.00E+00	NH4	1.00E+01	CO2 Equiv	Q1*Q2*Q3
IF3B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	kg N	normal	1.00E+00	kg N	2.00E+00	NH4	1.00E+02	CO2 Equiv	Q1*Q2*Q3
GNC		1 Natural Ca	0.00E+00	0.00E+00	0.00E+00	NC score	none	0.00E+00	NC score	0.00E+00	none	minmax	3.00E+00	none
TPCA		1 Flood Con	2.00E+00	5.00E-01	1.00E+01	daly/1000	none	production	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF4A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3	2.00E+00	m3m2	1.00E+01	daly/1000	Q1*Q2*Q3
IF4B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3	2.00E+00	m3m2	1.00E+02	daly/1000	Q1*Q2*Q3
GPC		1 Physical C	0.00E+00	0.00E+00	0.00E+00	PC score	none	0.00E+00	PC score	0.00E+00	none	minmax	3.00E+00	none
TECA		1 Employee	2.00E+00	5.00E-01	1.00E+01	hci per em	none	production	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF5A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	percent er	none	1.00E+00	percent en	2.00E+00	qol/emplo	1.00E+01	hci/emplo	Q1*Q2*Q3
IF5B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	percent su	normal	1.00E+00	percent su	2.00E+00	qol/emplo	1.00E+02	hci/emplo	Q1*Q2*Q3
EC		1 Economic	0.00E+00	0.00E+00	0.00E+00	EC score	none	0.00E+00	EC score	0.00E+00	none	minmax	3.00E+00	none
TR01		1 Social Perf	0.00E+00	0.00E+00	0.00E+00	TR score	none	0.00E+00	TR score	0.00E+00	none	1.00E+00	1.00E+00	none
TNCA_A		1 Fresh Wat	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2

QTMost	QTLow	QTHigh	QTMost2	QTLow2	QTHigh2	PercentTo	certainty1	certainty2
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	50.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
6336.000	875.200	57850.000	1056.000	583.500	1928.000	64.920	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
1712.000	241.700	15280.000	285.300	161.200	509.500	17.540	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
1712.000	241.700	15280.000	285.300	161.200	509.500	17.540	2.000	3.000
9760.000	1359.000	88420.000	1627.000	905.800	2947.000	0.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000



For Indicators, the columns, QTMost and QTMost2, are derived by:

- 1) Running the PRA (i.e. normal distribution) on the first LCIA measurement (i.e. Q1 in the Indicator.MathExpression).
- 2) Running the Indicator.MathExpression for the 4 LCIA measurements and adding the result to Indicator.QTM.
- 3) If the parent CategoricalIndex.MathExpression uses a “mcda:” prefix, the calculated children Indicators will be normalized and the column, QTMost will hold the normalized results (i.e. Example 4B’s MCDA technique). If the Indicators have not been normalized, the same column holds the nonnormalized calculated results.
- 4) Adding the nonnormalized calculated results to the QTMost2 column.

For Indicators, the columns, Benchmark and Target Percents, are derived by:

- 1) For subalgorithm20, dividing the benchmark and target amounts by their respective Indicator.benchmark and target amounts (prior to normalizing and weighting the CIs). Subalgorithm15 doesn’t have benchmark or target amounts and doesn’t have these columns.

For Indicators, the column, Total Percent, is derived by:

- 1) Dividing column Indicator.QTMost by the parent CI.QTMost prior to normalization of the CIs.

For Categorical Indexes, or CIs, the columns, QTMost and QTMost2 are derived by:

- 1) Running the PRA (i.e. normal distribution) on the fifth LCIA measurement (i.e. Q1).
- 2) Summing the children Indicator.QTMs (i.e. Q2), running the CI.MathExpression (i.e. Q1 * Q2), storing the calculated results for display in QTMost2, and adding the calculated results to a vector of CI.QTMs.
- 3) Normalizing and weighting the vector of CI.QTMs and adding each normalized value to CI.QTM for display in the QTMost column.

For CIs, the columns, Benchmark and Target Percents, are derived by:

1. For subalgorithm20, dividing the benchmark and target amounts by their respective CI.benchmark and target amounts (prior to normalizing and weighting the CIs)..



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Subalgorithm15 doesn't have benchmark or target amounts (i.e. although DevTreks convention of conducting scenario analysis using “_A” and “_AA” suffixes can be used for that purpose).

For CIs, the column, Total Percent, is derived by:

- 1) Dividing each separate normalized CI by the sum of the normalized CIs.

For Locational Indexes, the columns, QTMost and QTMost2 are derived by:

- 1) Summing the children normalized and weighted Categorical Index.QTMs.
- 2) Normalizing and weighting a vector of LocationalIndex.QTMs, from step 1's results, and adding each normalized member to the LocationalIndex.QTMost property.
- 3) Summing the children Categorical Index QTMost2 calculations (nonnormalized amounts) and adding the result to QTMost2.

The column, Percents, are derived by:

- 1) For subalgorithm20, summing the children benchmark and target percents and adding the average of the sum to the percent columns.
- 2) For TotalPercent, Dividing each separate normalized LI by the sum of the normalized LIs.

For Total Risk Indexes (TR), the calculated results derive from simple summations or averages of their children Locational Indexes.

Targets

Not displayed –for testing, same at Actuals

Actuals

Not displayed–for testing, same at Actuals

Optional Indicators 2 to 15. Additional Life Cycle Stages (or Results Chains)

The following image (UN-SETACe) demonstrates typical life cycle stages in full LCA product evaluations. Version 2.1.8 upgraded this algorithm so that it can be run for Indicators 1 to 15.



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The CategoricalIndex.factor6 property, Life Cycle Stage Label, allows each Indicator to contain multiple life cycle stages. These 15 Indicators can be used for alternative uses, such as thoroughly analyzing primary product production processes or to support the RCA reporting demonstrated in the SPA3 reference. Example 1 demonstrates using separate Indicators to document the results chains and impact pathways needed for thorough RCA reports.

Table 2: The split of life cycle stages in 3 different approaches

WRAP	EU Organisation Environmental Footprint (OEF) and Product Environmental Footprint (PEF)	ISO14025 Environmental Product Declarations
5 Stages	8 Stages	Product Specific Requirements, typically covering 4 Stages :
Raw Materials	Raw material acquisition and pre-processing	Production
Manufacturing	Capital goods (optional)	Transport
Packaging	Production of the main product	Customer use
Distribution	Production of ancillary materials	End of life
Use Stage including end of life	Product distribution and storage	
	Use stage (if in scope)	
	Transports/Logistics	
	End-of-life	

For testing purposes, the same data used in Indicator 1 produced the following result for Indicator 8.



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Output Group: RCA Output Examples

Output : Coffee Firm RCA3 Stock

Indicators	
Math Expression: I1.QTM	
Score Amount: 10,770.4800	Score Unit: most likely score
Score D1 Amount: 0.0000	Score D1 Unit:
Score D2 Amount: 0.0000	Score D2 Unit:
Distribution Type: none	Math Type: none
Score Most Amount: 37,988.0000	Score Most Unit: most likely score
Score Low Amount: 22,785.8250	Score Low Unit: low score
Score High Amount: 65,132.2500	Score High Unit: high score
Iterations: 0	Math Sub Type: none
Confid Int: 0	Random Seed: 0
Base IO: none	
Score Math Result:	
Indic 1 Name: Indicator 1 - LCIA	Label: RCA3
Date: 05/04/2017	Rel Label: none
Math Type: algorithm1	Dist Type: none
Q1 Amount: 11,010.0000	Q1 Unit: target most score
Q2 Amount: 1,664.5500	Q2 Unit: target low score
Q3 Amount: 94,809.0000	Q3 Unit: target high score
Q4 Amount: 10,792.9200	Q4 Unit: benchmark most score
Q5 Amount: 1,610.9700	Q5 Unit: benchmark low score
Math Express: I1.Q1.factor1 + I1.Q2.factor2 + I1.Q3.factor3 + I1.Q4.factor4 + I1.Q5.factor5 + I1.Q6.factor6 + I1.Q7.factor7 + I1.Q8.factor8 + I1.Q9.factor9 + I1.Q10.factor10 + I1.Q11.factor11	Math Operator: equalto
QT Amount: 93,709.8000	QT Unit: benchmark high score
QT D1 Amount: 0.0000	QT D1 Unit: none
QT D2 Amount: 0.0000	QT D2 Unit: none
QT Most Amount: 10,770.4800	QT Most Unit: actual most score
QT Low Amount: 1,604.4300	QT Low Unit: actual low score
QT High Amount: 93,616.2000	QT High Unit: actual high score
Math Sub Type: subalgorithm15	Base IO: none
Indic 1 Description: This indicator conducts an LCIA of a coffee firm.	
Indic 8 Name: Indicator 8 - LCIA	Label: RCA8
Date: 07/12/2017	Rel Label: none
Math Type: algorithm1	Type: none
Q1 Amount: 10,933.8000	Q1 Unit: target most score
Q2 Amount: 1,644.4800	Q2 Unit: target low score
Q3 Amount: 94,448.4000	Q3 Unit: target high score
Q4 Amount: 10,934.4000	Q4 Unit: benchmark most score
Q5 Amount: 1,647.5700	Q5 Unit: benchmark low score

Continuing with national and international data standards, the following image (USDA, 2015) demonstrates the data standards required when submitting LCAs to alternative databases. It's the role of social networks and clubs to follow these types of standards (i.e. Example 1A



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demonstrates how to link a story page holding the Dublin Core Meta data standards to base elements). Appendix C in SPA4 discusses potential limitations with existing LCI databases.

LCA Commons Submission Guidelines, December 10, 2015

openCA – USDA LCI Element Name	ILCD Element/Attribute Name	ISO 14048:2002 Field Name	EcoSpold v1 Element/Attribute Name
KML			
Description (Geography)	Geographical representativeness description	Area description	text (Geography)
Description (Technology)	Technology description including background system	Technical content and functionality, Operating conditions	text (Technology)
Intended Application	Intended applications	Intended application	generalComment (Reference Function)
Data generator (Actor data set)	Data set generator / modeler (Contact data set)	Data generator	person (Data generator and publication)
Data set owner (Actor data set)	Owner of data set (Contact data set)		person (Data generator and publication)
Data documentor (Actor data set)	Data set documentor (Contact data set)	Data documentor	person (Data generator and publication - Data entry by)
Project	Project		
Publication (Source data set)	Unchanged republication of (Source data set)	Publication	source
Access and Use Restrictions	Access and use restrictions	Access restrictions	text (Source)
Creation Date	Timestamp (last saved)	Date completed	accessRestrictedTo
			timestamp
			copyright
Copyright (Y/N)	Copyright?	Copyright	
LCI Method	LCI method and allocation		allocationMethod (Flow dataset)
Process type	Type of data set	parts of: Modelling principles, Modelling choices, including criteria for excluding elementary flows	type (Dataset information)

E. Communication and Interpretation

Indicators

The following images (UNSETACc) demonstrate using the results of each Indicator to communicate the final Damage Impacts to network stakeholders. These images demonstrate conducting the water consumption and climate change categories of an LCIA conducted for representative rice farms in the 3 regions.



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Table 5.7: Results of the rice case studies for 1 kg of white rice cooked

Case	Inventory Water consumption (m³) in rice production (share of total in %)	Watershed	CF _{agri} (DALY/m³)			Impact (DALY)		
			CF (National)	CF (Trade-Induced)	CF (Total)	National damage	Trade-induced damage	Total damage
			[DALY/m³]	[DALY/m³]	[DALY/m³]	[DALY]	[DALY]	[DALY]
Rural India	0.78 (99.9%)	Average	1.8E-06	1.8E-06	3.6E-06	1.4E-06	1.4E-06	2.8E-06
		Ganges	2.1E-07	2.1E-07	4.1E-07	1.6E-07	1.6E-07	3.2E-07
		Godavari	9.7E-07	9.6E-07	1.9E-06	7.6E-07	7.5E-07	1.5E-06
Urban China	0.46 (99.5%)	Average	3.5E-06	3.2E-06	6.7E-06	1.6E-06	1.5E-06	3.1E-06
		Yellow River	9.2E-06	8.3E-06	1.8E-05	4.3E-06	3.8E-06	8.1E-06
		Pearl River	1.7E-07	1.6E-07	3.3E-07	8.0E-08	7.2E-08	1.5E-07
USA-Switzerland	0.08 (99.4%)	Average	0.0E+00	7.0E-06	7.0E-06	0.0E+00	5.6E-07	5.6E-07
		Red River	0.0E+00	4.6E-07	4.6E-07	0.0E+00	3.7E-08	3.7E-08
		Arkansas River	0.0E+00	4.6E-07	4.6E-07	0.0E+00	3.7E-08	3.7E-08

India case results in lower impacts than urban China. While for China and India the human health impacts and the CF of the Godavari River is still 50% lower than average. In China, the selected case of the Yellow



Figure 3.6: Sensitivity analysis for NTCFs using GWP20

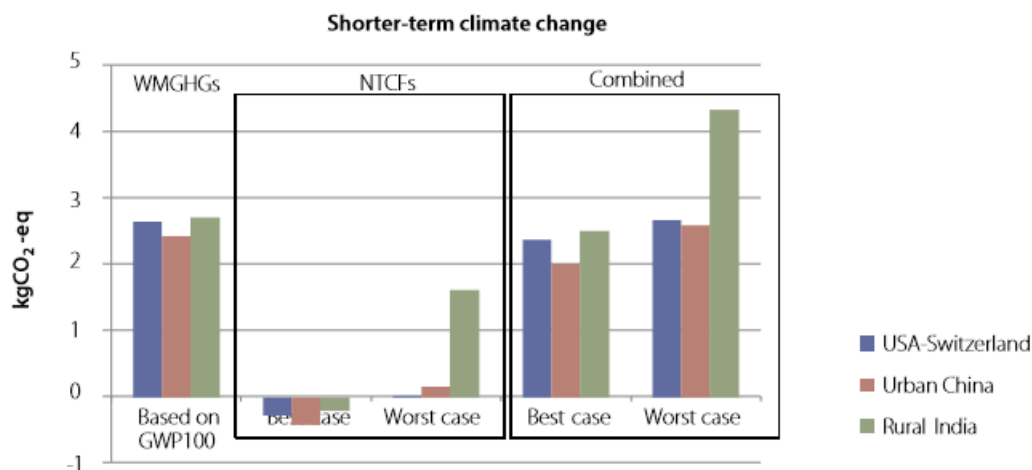


Figure 3.7: Sensitivity analysis for NTCFs using GWP100

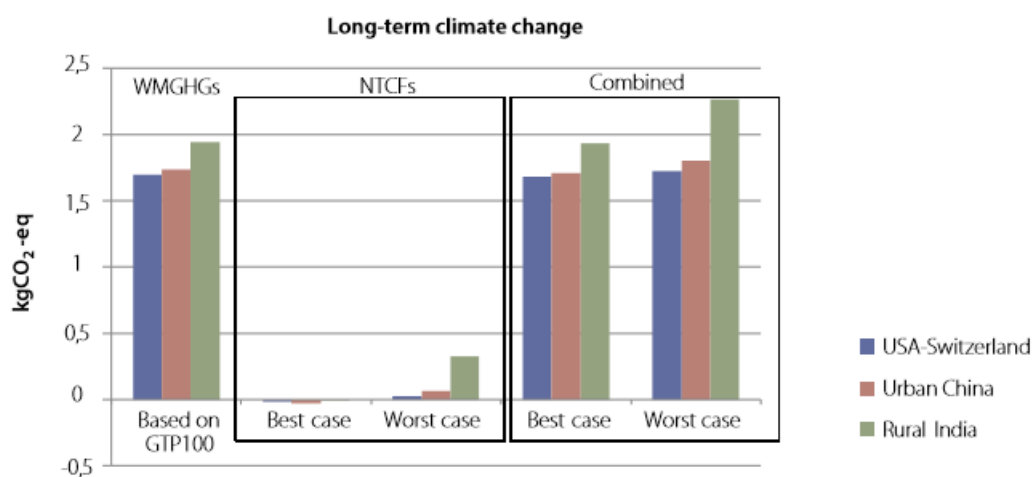


Figure 3.8: Sensitivity analysis for NTCFs using GTP100

Scores and Hotspots Analysis

Scores can be defined using standard mathematical expressions that use combinations of Indicators 1 to 15. They can also be calculated by using this algorithm, or subalgorithm20, to produce a Hotspots Analysis. UNSETACe defines Hotspots Analysis as follows:



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“The rapid assimilation and analysis of a range of information sources, including life cycle based studies, market, and scientific research, expert opinion and stakeholder concerns. The outputs from this analysis can then be used to identify and prioritise potential actions around the most significant economic, environmental and social sustainability impacts or benefits associated with a specific country, city, industry sector, organization, product portfolio, product category or individual product or service. Hotspots analysis is often used as a pre-cursor to developing more detailed or granular sustainability information.”

They use the following image to define 2 options for identifying Hotspots:

Hotspot A life cycle stage whose contribution to the impact category is greater than even distribution of that impact across the life cycle stages.	Warmspot A life cycle stage whose contribution is approximately equivalent to an even distribution of the impact across the life cycle stages.	Cold Spot A life cycle stage whose contribution to any impact category is less than even distribution of that impact across the life cycle stages
Hotspot All life cycle stages collectively contributing more than 50% to any impact category.		Cold Spot All life cycle stages collectively contributing less than 50% to any impact category.

Figure 6: Options for identifying hotspots

The European Commission (2016) defines Hotspots Analysis as follows:

“In the context of PEF/OEF pilot phase we can define a hotspot as either:

OPTION A: (1) life cycle stages, (2) processes and (3) elementary flows cumulatively contributing at least 50% to any impact category before normalisation and weighting (from the most contributing in descending order).

OPTION B: At least the two most relevant life cycle stages, processes and at least two elementary flows (minimum 6). Additional hotspots may be identified by the TS.”

The following image (European Commission, 2016) highlights the general process of using Indicator 1 to 15’s data to conduct Hotspots Analysis (UNSETACe), or Product Environmental



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Footprints (PEF) (European Commission, 2016) (3*). The Lippiatt reference (2007) provides a good overview of how software can be designed to conduct these analyses.

1. **Elementary Flows:** Identify the most important environmental impacts or elementary flows. The flows are measured using the CategoricalIndex.factor4 property to aggregate similar impacts and then calculating a % damage to determine importance.
2. **Life Cycle Stages:** Identify the most relevant life cycle stages. The flows are measured using the CategoricalIndex.factor6 property to aggregate similar impacts and then calculating a % damage to determine importance.
3. **Production Processes:** Identify the most impactful production processes or farm operations. The flows are measured using the CategoricalIndex.factor7 property to aggregate similar impacts and then calculating a % damage to determine importance.



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D.5.5 Hotspots

In Tables D-8 and D-9 the identified hotspots based on the two different approaches available.

Table D-8: Hotspots based on 50% cumulative contribution (OPTION A).

	Hotspots
Life cycle stages	<ul style="list-style-type: none"> Raw material acquisition and pre-processing Production of the main product
Processes	<ul style="list-style-type: none"> Process B
Elementary flows	Option 1: Substance 1 and 2 Option 2: <ul style="list-style-type: none"> Substance 1 and 2 in processes B Substance 1 and 5 in process C Substance 1 in process E

Table D-9: Hotspots based on top two representatives (OPTION B).

	Hotspots
Life cycle stages	<ul style="list-style-type: none"> Raw material acquisition and pre-processing Production of the main product
Processes	<ul style="list-style-type: none"> Process B Process C

Guidance for the implementation of the EU PEF during the EF pilot phase - Version 5.2Page 74 of 95

Elementary flows	Option 1: Substance 1 and 2 in process B Option 2: Substance 1 in process E ⁴⁶ and substance 5 in process C
------------------	---

UN-SETACe describes the following advantages to using Hotspots Analysis.

“When applied to Life Cycle Assessment, the benefits of Hotspots Analysis include ensuring:

- Focus on priority issues (e.g., waste, water, materials of concern)
- Focus on the right life cycle stage (e.g., material acquisition, manufacturing, use, end of life)



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- Focus on the right actors (e.g., producers, manufacturers, suppliers, retailers, customers, government officials) to evaluate, influence and implement solutions
- Implications of trade-offs are understood
- Resources (e.g., time, money) can be effectively allocated to actions.”

The following image (European Commission, 2016) displays the recommended data to include in a Hotspots Analysis, or Product Environmental Footprint (PEF) screening analysis, reports.

Guidance for the implementation of the EU PEF during the EF pilot phase - Version 5.2Page **33** of **95**

The screening report shall contain following information:

- Definition of the functional unit and reference flow;
- Flow diagram for each life cycle stage with a clear link between all processes involved and one global system boundary diagram;
- Identification of the foreground and background data;
- For each life cycle stage, a table with all processes involved with a clear identification of the source of the Life Cycle Inventory and calculation of the reference flow for each process¹⁷;
- Assumption about the use, re-use (if appropriate) and end-of-life scenario including the way the EoL formula is applied;
- Treatment of any multi-functionality issues encountered in the PEF modelling activity;
- Results of the sensitivity analysis with a clear identification of the minimum-maximum values used to perform it;
- Results for each EF impact category with a split per life cycle stage.

The following images of the Score show that the Score produces the basic data required by the PEF screening and UNSETACe recommendations. Use the Score.MediaURL property to link pdf files that address the full reporting recommendations. These aggregation techniques were first documented in the Resource Analysis reference for Version 1.8.2 and further developed for this algorithm.

Score Math Result



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No separate TEXT datasets are added to the score to generate the following MathResult. Instead, the CategoricalIndex data from Indicators 1 to 15 are simply added to the MathResult with no additional calculations. In this analysis, only Indicator 1, 7, and 8 were completed. That data must then be manipulated in a spreadsheet to produce the analysis. To repeat, the purpose of this stylized data is to proof this algorithm, not to demonstrate representative LCA data. The wide gap between Most Likely, Low, and High, estimates, if based on real LCA data, would be extremely difficult to use for making decisions (i.e. should the Locational Indexes' normalization use min-max or another option?).

This method was chosen because the Indexing used with these datasets support a wide range of aggregated reporting. For example, the EC (2016) reference recommends using Indicator summations that are not normalized or weighted when calculating the percent contribution to total Categorical Impacts. UNSETACe recommends using normalized and weighted data in the calculations. Neither publication fully discusses the Categorical Damage Impacts, PRAs, or the Locational Indexes, used in this algorithm. Rather than make tenuous assumptions about the best way to conduct Hotspots Analysis with this data, this release chose to just return raw Categorical Index data for further spreadsheet manipulation. Factors 4, 10, and 11, can be used to sort the data for Hotspots Analysis.

label	locatio	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
RCA3	na	Indicator 1	RCA3	na	Indicator 1	0	0	0	0	0	0	0	0	0.000
TNCA	1	Fresh Wat	0	cf04	5.00E-01	daly/m3	daly/m3	low units	productio	high units	2	productio	EDF	4.000
TNCB	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	productio	high units	triangular	productio	EDG	4.000
TNCC	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	productio	high units	2	productio	EDE	4.000
TNCD	1	Air quality	0	cf04	5.00E-01	GTP	GTP	low units	productio	high units	2	productio	ECB	4.000
TPCA	1	Flood Con	0	cf04	5.00E-01	daly/1000	daly/1000	low units	productio	high units	2	productio	PCB	4.000
TECA	1	Employee	0	cf04	5.00E-01	hci per em	hci per em	low units	productio	high units	2	productio	HCA	4.000
TNCA_A	1	Fresh Wat	0	cf04	5.00E-01	daly/m3	daly/m3	low units	productio	high units	2	productio	EDF	4.000
TNCB_A	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	productio	high units	triangular	productio	EDG	4.000
TNCC_A	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	productio	high units	2	productio	EDE	4.000
TNCD_A	1	Air quality	0	cf04	5.00E-01	GTP	GTP	low units	productio	high units	2	productio	ECB	4.000
TPCA_A	1	Flood Con	0	cf04	5.00E-01	daly/1000	daly/1000	low units	productio	high units	2	productio	PCB	4.000
TECA_A	1	Employee	0	cf04	5.00E-01	hci per em	hci per em	low units	productio	high units	2	productio	HCA	4.000
TNCA_AA	1	Fresh Wat	0	cf04	5.00E-01	daly/m3	daly/m3	low units	productio	high units	2	productio	EDF	4.000
TNCB_AA	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	productio	high units	triangular	productio	EDG	4.000
TNCC_AA	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	productio	high units	2	productio	EDE	4.000
TNCD_AA	1	Air quality	0	cf04	5.00E-01	GTP	GTP	low units	productio	high units	2	productio	ECB	4.000
TPCA_AA	1	Flood Con	0	cf04	5.00E-01	daly/1000	daly/1000	low units	productio	high units	2	productio	PCB	4.000
TECA_AA	1	Employee	0	cf04	5.00E-01	hci per em	hci per em	low units	productio	high units	2	productio	HCA	4.000
RCA5	na	Indicator 2	RCA5	na	Indicator 2	0	0	0	0	0	0	0	0	0.000
TNCA	1	Fresh Wat	0	cf04	5.00E-01	daly/m3	daly/m3	low units	productio	high units	2	productio	EDF	4.000



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QTMost	QTLow	QTHigh	QTMost2	QTLow2	QTHigh2	PercentTo	certainty1	certainty2
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	25.000	2.000	3.000

An alternative to using the Categorical Index data in this Score.MathResult is to copy the Indicator.MathResults into 1 dataset and manipulate the full dataset to conduct other types of LCA or Hotspots Analysis.

Score Properties

Prior to Version 2.2.0, this reference failed to mention that, with the exception of the Score.MathResult, this subalgorithm requires the manual completion of the remaining Score properties. The Score's Hotspots Analysis data can be manipulated to produce multiple Scores for multiple purposes –select the one needed in subsequent Stock and M&E Analyses and fill in the properties.

The following Score properties were manually set by adding together each Indicator.QTM, QTL, and QTU. In effect, the sum of the normalized and weighted Indicator.LocationIndexes.



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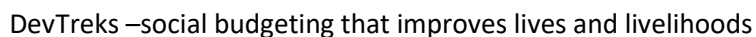
Example 3A will demonstrate how similar “ecopoints” are used with Organization LCIA. The Score’s Iterations, Confidence Interval, and Random Seed, properties are used with each Indicator’s probability distribution, or PRA, calculations. Score.MathExpressions are not run with this subalgorithm.

UNSETACe recommends not using “single score impact assessment indicators” when making Organization LCIA comparisons among companies. Care must be exercised if using these results to carry out the comparative analyses supported by the Resource Stock and M&E Analyzers. Example 3A discusses this further.



Media <input type="checkbox"/> Mobile <input checked="" type="checkbox"/> Desktop <input type="checkbox"/>		Confidence Interval <input type="text" value="80"/> Random Seed <input type="text" value="3"/>	
Intro 1 2 3 Help		Score BaseLO <input type="text" value="none"/>	
Step 2 of 3. Enter Stock Indicators		Score Most Likely <input type="text" value="24,500.0000"/> Score Most Unit <input type="text" value="most likely score"/>	
Run Cancel Close		Score Low Estimate <input type="text" value="3,200.0000"/> Score Low Unit <input type="text" value="low score"/>	
+ Relations		Score High Estimate <input type="text" value="187,000.0000"/> Score High Unit <input type="text" value="high score"/>	
More Stock Indicators		Score Math Type <input type="text" value="algorithm1"/> Score Math Sub Type <input type="text" value="subalgorithm15"/>	
+ Indicator 11		Score Math Result <input type="text" value="rca results label,location,risks_and_indicators,factor1,factor2,factor3"/>	
+ Indicator 12		Joint Data <input type="text" value="none"/>	
+ Indicator 13		Calculations Description <input type="text" value="This LCA can be found as Example 3 in the Social Performance Assessment reference. v212b"/>	
+ Indicator 14		Media URL <input type="text" value="http://localhost:5000/resources/network_carbon/resourcepack_537/resource_1903/BEES1.PNG"/>	
+ Indicator 15		Data URL <input type="text" value="none"/>	
Altern Type <input type="text" value="none"/>	Target Type <input type="text" value="none"/>	Output Group: RCA Output Examples	
Score Math Expression <input type="text" value="I1.QTM + I8.QTM"/>			
Score <input type="text" value="10,770.4800"/>	Score Unit <input type="text" value="most likely score"/>		
Score D1 <input type="text" value="0.0000"/>	Score D1 Unit <input type="text" value="none"/>		
Score D2 <input type="text" value="0.0000"/>	Score D2 Unit <input type="text" value="none"/>		

The following image shows why Score.MathResults should be stored in URLs, not in the Score itself. Score.MathResults are also displayed with base element results. That technique is acceptable for small amounts of data, but it is not good practice with tabular datasets.



Output : Coffee Firm RCA3 Stock

Math Expression: I1.QTM + I8.QTM	
Score Amount:	Score Unit: most likely score
10,770.4800	
Score D1 Amount: 0.0000	Score D1 Unit: none
Score D2 Amount: 0.0000	Score D2 Unit: none
Distribution Type: none	Math Type: algorithm1
Score Most Amount:	Score Most Unit: most likely score
24,500.0000	
Score Low Amount:	Score Low Unit: low score
3,200.0000	
Score High Amount:	Score High Unit: high score
187,000.0000	
Iterations: 500	Math Sub Type: subalgorithm15
	Random Seed: 3
Confid Int: 80	
Base IO: none	
Score Math Result: rca results	
label,location,risks_and_indicators,factor1,factor2,factor3,factor4	
RCA3,na,Indicator 1,RCA3,na,Indicator	
1,0,0,0,0,0,0,0,0,0,0,0,0,0 NCA,1,Fresh Water	
Supply,2.853E+02,1.612E+02,5.095E+02,daly/m3,none,prod	
01,4.0E+00,5.706E+02,8.058E+01,5.095E+03,2.5E+01	
NCB,1,Pollination,2.853E+02,1.612E+02,5.095E+02,bdp,tri	
01,4.0E+00,5.706E+02,8.058E+01,5.095E+03,2.5E+01	
NCC,1,Air	
quality,2.853E+02,1.612E+02,5.095E+02,daly/kg	
pm25,none,production,EDE,2.0E+00,3.0E+00,2.50E-	
01,4.0E+00,5.706E+02,8.058E+01,5.095E+03,2.5E+01	
NCD,1,Air quality	
-climate,2.853E+02,1.612E+02,5.095E+02,GTP,none,prod	
01,4.0E+00,5.706E+02,8.058E+01,5.095E+03,2.5E+01	
PCA,1,Flood	

The network uses the LCIA to advise their clubs about how alternative mitigation and adaptation actions impact public capital stock services, particularly ecosystem services. UNSETACe presents case studies demonstrating the central role played by stakeholders who must use LCA to make decisions. Their study of the tradeoffs that must be made community-wide between



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stakeholder values, ecosystem services, and mitigation and adaptation practices, ensure that “the severe conflict, inequity, and dissatisfied customers, which can arise from making decisions and taking actions that don’t account for the tradeoffs and synergies needed to balance the interests of diverse stakeholders“ is avoided. Example 3B and Example 5 through 8 in SPA3 addresses this further.

The following image (UNSETACe) demonstrates how some industries apply LCA very seriously. In this example, the appliance industry in the USA used a combination of LCA, Hotspots Analysis, and stakeholder engagement, to develop sustainability standards for appliances. Stores display those numbers with each appliance so that consumers can make informed decisions.



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Figure 11: Key elements of the stakeholder engagement process undertaken by AHAM

Numbers in parentheses indicate the methodology step during which the stakeholder engagement should occur

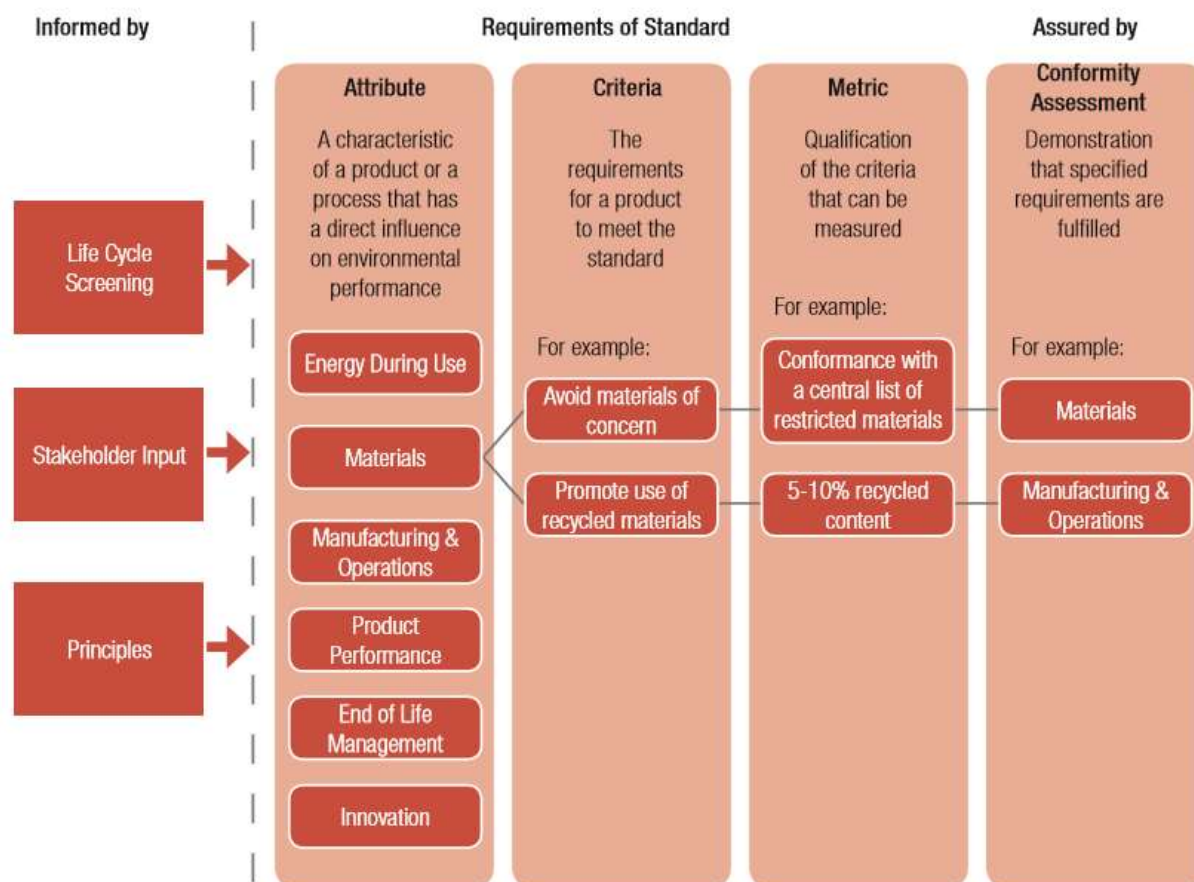


Figure 12: Translating results from life cycle screening, inputs from stakeholders and guiding principles into a standard

Notarnicola et al (2017) review the state of LCA art in food system analysis and highlight the numerous challenges remaining to be tackled in this industry. These challenges include

- the need for dietary shifts to sustainable food systems
- field level LCAs that don't adequately address landscape level sustainability impacts on soil quality and fertility, land erosion, reduced ecosystem services, and biodiversity loss
- integration of social, economic, and cultural factors into LCA studies



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- the reliance on average LCAs for predominant food production systems rather than the reality of extreme production variability
- technical deficiencies dealing with product quality, geographical contexts, temporal variability, machinery, functional units, ecosystem services and biodiversity
- consumer education that results in behavioral change
- missing supply chain phases such as food waste
- integration with “mixed methods explanatory approaches” used in food production studies
- accounting for accidents and disasters

Notarnicola et al (2017) point out that failure to address these challenges could surpass planetary food system sustainability, and therefore food security, needs. In the context of this reference, it’s the job of social networks and clubs to address those challenges, including the development of open access, rather than commercial, sustainable food system databases that make all of their TEXT data available through URIs (2*).

The Malnutrition Analysis tutorial explains that a complete database of the nutritional composition of most U.S. food products can be found in HomeTreks. (also refer to the ENVIFOOD 2013 reference) i.e.

[https://www.devtreks.org/hometreks/select/farmworkers/servicebase/Food Inputs, USDA SR24 codes/2635/none](https://www.devtreks.org/hometreks/select/farmworkers/servicebase/Food%20Inputs,%20USDA%20SR24%20codes/2635/none)

The Ag Production tutorial explains that a complete database of U.S. crop rotations can be found in AgTreks. i.e.

[https://www.devtreks.org/agtreks/select/crops/servicebase/Profits, Texas AM and NRCS national crop rotations/1076/none/](https://www.devtreks.org/agtreks/select/crops/servicebase/Profits,%20Texas%20AM%20and%20NRCS%20national%20crop%20rotations/1076/none/)

The Health Care tutorial explains that health care professionals can find complete ICD-10s for several base elements in HealthTreks. i.e.



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<https://www.devtreks.org/healthtreks/select/urbandelivery/serviceaccount/HealthTreksWest/459/none>

The Construction Analysis tutorial explains that construction analysts can find good examples of the UNIFORMAT II in BuildTreks (also refer to the Lippiatt 2007 reference). i.e.

[https://www.devtreks.org/buildtreks/select/commercial/servicebase/Inputs, WBSExamples/1220/none](https://www.devtreks.org/buildtreks/select/commercial/servicebase/Inputs,WBSExamples/1220/none)

Although challenging, the URLs demonstrate that it is still perfectly feasible for social networks to extend those types of datasets with “bulk uploaded” RCA calculators (2*).

Footnotes

1. Example 4B discusses WHO’s recommendation not to complete analyses that are too localized –because the results may be more useful at country and sector scale rather than local scale. In a similar fashion, the European Commission (2016) provides standards for “Product Environmental Footprint Category Rules” that can be used throughout industries. In other words, the UN-SETAC caveats may be strengths rather than weaknesses. The take home message is that people need to be getting their hands dirty and gaining experience building these algorithms and applying their tools so that they know when and how to use them properly.
2. Lack of applied IT knowledge and skills is a recurring theme throughout this reference. For example, the use of URIs as the standard way to access data should not be novel to anyone anymore, but no LCA data could be found using that universal storage access mechanism (i.e. try for yourself). For reasons that are not entirely clear, research peers and government agencies, in particular, are culpable. The intent of these tutorials is to help the next generation stop making the same mistakes over and over again because too much is at stake.
3. The European Commission (2016) and UNSETAC references target full-time professional LCA researchers and practitioners. For example, Annex B in the EC 2016 reference summarizes the recommended reporting that the EC requires for LCA and PEF



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submissions. In contrast, this reference targets professional resource conservationists, such as sustainability officers working for firms and community service organizations, who must apply LCA as one important set of tools in a more comprehensive RCA toolkit. Social networks are encouraged to develop similar standards for their clubs to follow, recognizing that applied work may require compromise.

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USDA-National Agricultural Library. LCA Commons Submission Guidelines. 2015

Zamponi L., Saouter E., Castellani V., Schau E., Cristobal J., Sala S.; Guide for interpreting life cycle assessment result; EUR 28266 EN; doi:10.2788/171315. 2016



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Example 3A. Organization Life Cycle Impact Assessments (O-LCIA) for Representative Small Scale Coffee Farms (1*)

URLs:

Conventional Inputs and Outputs (using stylized data)

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA3A Conv/2147397563/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA3 Stock, Conventional/2141223496/none>

Organic Inputs and Outputs (using stylized data)

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA3A Org/2147397564/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA3 Stock, Organic/2141223486/none>

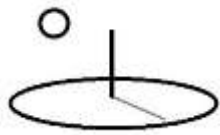
Operation and Outcome Group Comparison

<https://www.devtreks.org/greentreks/preview/carbon/operationgroup/RCA Crop Operations/765/none>

<http://localhost:5000/greentreks/preview/carbon/outcomegroup/RCA Conv vs Organic Coffee Crop Outcomes/50/none>

A. Introduction or Goal and Scope

Example 3 demonstrated conducting a Product LCA for coffee production. This example demonstrates conducting an Organization LCA for a coffee production firm. This example explains that, while the substance and purpose of the 2 analyses differ, the actual subalgorithm calculations are the same. UNEP/SETACd defines an Organization LCA as follows:



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“Compilation and evaluation of the inputs, outputs and potential environmental impacts of the activities associated with the organization as a whole or portion thereof adopting a life cycle perspective (ISO, 2014c).”

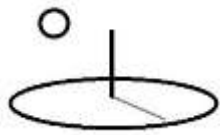
UNEP/SETACd use the following image to explain that one of the primary purposes of O-LCAs is to identify “opportunities for interventions”, such as mitigation and adaptation actions that companies can take to reduce environmental damages.



Figure 3. Layers of potential goals of an organization.

Pelletier et al (EC, 2012) use the term Organization Environmental Footprint (OEF) for a similar purpose and define the term as follows:

“Based on a life cycle approach, the OEF is a method for modelling and quantifying the physical environmental impacts of the flows of material/energy and resulting emissions and waste streams associated with Organisational activities from a supply-chain perspective (from extraction of raw materials, through use, to final waste management).”



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The following image (Appendix D in UNEP/SETACd) compares Product LCAs (the 2nd column) with Organization LCAs (the 3rd column). They further explain that O-LCAs do not necessarily have the same level of detail, and therefore cost, as P-LCAs.



Life cycle inventory analysis		
General	The involvement of stakeholders is encouraged (beyond the study commissioners) in the peer review of the study.	It is recommended, as far as possible, the involvement of the suppliers, especially for providing specific data of their operations and own suppliers.
	The outcomes may be of course updated but it is not common to do so periodically.	An ulterior improvement of data collection efforts and data quality is particularly recommended. Due to the performance tracking objective, O-LCA is expected to be applied to the organization in consecutive years.
Supporting activities	Those activities that are not directly linked to the production are usually not considered.	O-LCA does consider activities generally disregarded in product LCA (e.g., business travel, leased assets, heating, cleaning services, managerial offices).
Data collection	The use of specific data for the product assessed is expected.	The use of more generic or extrapolated data is expected, particularly in big organizations providing complex products.
Multi-functional situations	System expansion is one option to avoid allocation.	In general, system expansion is not used, due to the risk of inconsistent or poorly representative substitution scenarios.
Life cycle impact assessment		
General	Basically, the same methods are used for product and organizational LCA once the inventory has been compiled. In O-LCA, the use of inventory-level indicators, apart from impact categories, is common.	
Life cycle interpretation and uncertainty		
General	Comparison between products is possible and can be communicated, given the comparability of the assessment approach.	External communication of comparative assertions is discouraged, but performance monitoring and reporting is sought.
Reporting and communication		
General	Communication of results (e.g., through EPDs) is mainly targeted to consumers.	Organizational reporting (e.g., sustainability reporting) mainly aims to communicate the results to, consumers, institutions and society.

The following definition of Life Cycle Impact Analysis, or LCIA, was introduced in Example 3.



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“The environmental impact category indicators recommended in this guidance are primarily suited for hot spot analyses in product and organizational LCA. ...”

The definition explains why no changes had to be made in subalgorithm15, or subalgorithm20, to conduct either a Product LCIA or an Organization LCIA. Although the previous image shows the substance and purpose for these analyses differ, the LCIA calculations are the same. For that reason, and because Example 3’s data was originally based on coffee firm, not coffee product, analysis, Example 3’s Indicator calculations will not be repeated. Instead, this example focuses on prominent differences between the two LCIA approaches.

B. Indicator Thresholds, or System Boundary and Resource Inventory

Several distinct differences arise in defining the system boundary and resource flows used to develop Resource Inventories between O-LCA and P-LCA. Organizations can have multiple ownership structures with varying degree of product ownership between business entities and facilities. They must further identify upstream and downstream resource boundaries where they still have product responsibilities. The following image (UNSETACd) demonstrates representative recommendations available for identifying system boundaries and defining “cradle-to-grave” product responsibility.



C. Cradle-to-gate or cradle-to-grave assessment

A complete cradle-to-grave assessment of an organization should include the resource consumption and emissions of the use phase and the end-of-life phase (i.e., waste disposal and treatment) of products sold by the reporting organization in the reference period (see Figure 8) (ISO, 2014c).

Nevertheless, modeling the downstream activities is not always feasible. Calculating input and outputs for the use phase typically requires product design specifications and

assumptions about how consumers use products. Similarly, end-of-life assessment involves being informed about the final fate that users or waste managers give the product.

In accordance to ISO/TS 14072 (ISO, 2014c), downstream activities should be included if products directly consume energy or generate emissions during use phase (e.g., automobiles, aircraft, power plants and buildings) or indirectly consume energy or cause emissions during use (e.g., apparel that requires washing and drying, food that requires cooking and refrigeration or soaps and detergents that require heated water).

If the organization has no influence on the use and end-of life stage of its products (e.g., via product design or recycling campaigns), it may select the cradle-to-gate perspective, (i.e., up to the gate of the reporting organization), thus downstream stages are excluded. The latter situation is quite common for raw materials and intermediate products. In Figure 8, both a cradle-to-gate and cradle-to-grave²⁴ boundary are defined for the three simplified subjects of study (Sub-section 3.2.1.A).

D. Offsetting

The following image (UNSETACd) summarizes the methodology organizations employ when developing Resource Inventories for O-LCA. UNSETACf provides several case studies showing how companies have carried this method out. Example 4 explains how budgets can be used as a sound initial step in identifying all supply chain Inputs and Outputs. Although the NPV tutorials point out that Operating Budgets must generally include all of an organization's Operations and Inputs, and Outcomes and Outputs, UNSETACd explains that O-LCAs need not be as rigorous.



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For example, farm operations that don't have major environmental impacts need not be included. UNSETACd advises “[f]ocusing resources based on significance can enable organizations to collect higher quality data for the priority activities in the value chain.”

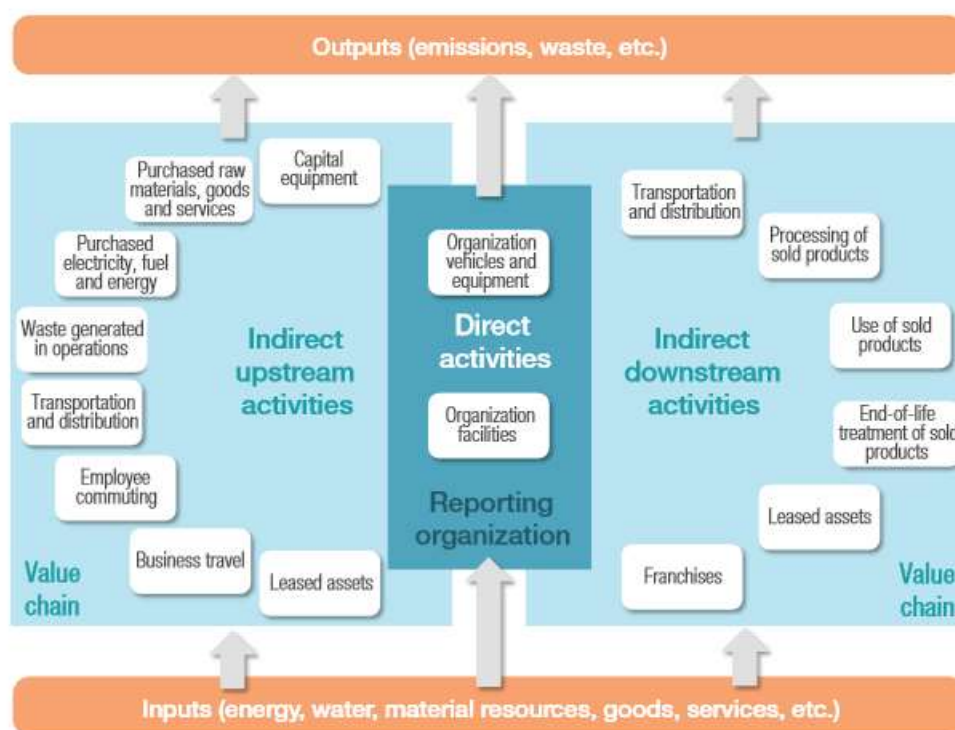


Figure 10. Direct and indirect activities and resource use and emissions.

Source: own elaboration based on WRI and WBCSD (2011a).

B. Indirect upstream activities

UNSETACd provides the following table to assist Small and Medium Enterprises (SMEs) apply O-LCIA according to their needs. Note that “activity data” is generally collected in DevTreks using the Operating Budgets and Capital Budgets explained throughout the tutorials. The TEXT datasets explained in this reference are introduced as more concise, flexible, integrated, complementary, alternatives that companies can use to “establish an enhanced environmental, [economic, and social,] collection system[s]”. Refer to the images in Section F.



Steps in O-LCA		Recommendations for small and medium organizations
Goal and scope	Goals	Very often, application of O-LCA by SMEs is motivated by requests from larger organizations purchasing their products, although it could benefit the organization in many other aspects. See Section 2.2.
	Reporting organization	The definition of the reporting organization is straightforward. In most cases, the subject of study is the entire organization. Without jointly owned operations, the selection of the consolidation method has no effect on the results. One-year reporting period is particularly recommended for SMEs, as it is the most common and can facilitate reporting to third parties.
	Reporting flow	The product portfolio is usually recorded by the SMEs in its site(s) and can easily be aggregated.
	System boundary	<p>The smaller size and fewer interconnections of SMEs should make it easier to describe the value chain and identify suppliers.</p> <p>Very often, SMEs are suppliers of larger companies, which in turn, sell the final products to consumers. This makes modeling of the use phase and EoL a difficult task. Therefore, SMEs would likely select cradle-to-gate assessments.</p>
Life cycle inventory analysis	Identify involved activities	SMEs should identify direct and indirect activities in its site(s) and bring them together in the inventory.
	Data collection	The same recommendations apply during the prioritization of data collection and the preference for specific data. In order to reduce costs, specific data may be estimated with activity data.
Impact assessment		When O-LCA outcomes are used to answer stakeholder's requests, it is recommended to directly apply assessment methods suggested by the stakeholder. Otherwise, use broadly used indicators (see Table 4, p.78).
Interpretation		No specific recommendation

Table 6. Complementary recommendations for a simplified implementation of O-LCA in small and medium organizations

Once an organization's Inputs, Activities, Outputs, and Outcomes, have been identified and prioritized, they must then be converted to the physical resource flows needed in Resource



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Inventories. UNSETACd explains how to use the “emission and consumption factors” introduced in Example 3’s LCIA Impact Pathways, for that purpose. For example, in the case of multi-functional products, such as when an organization only purchases a portion of a supplier’s full production, Indicator.factor6 can be used to allocate the responsible portion in the LCIA.

C. Quality of Life Scenarios

The concerns raised in Example 3 about farm production heterogeneity complicating P-LCIA is exactly the same with O-LCIA. A latter section of this example will discuss the use of comparative LCIA to address this important issue.

D. Social Performance Indicators and Life Cycle Impact Assessment

UNSETACd confirms that Life Cycle Impact Assessment is conducted in the same way for products and organizations. They use the following image to explain that firms often include additional Indicators, such as Inventory Indicators (i.e. energy or water consumed), in the full LCIA. The additional Indicators assist them to manage their resources. The image explains why these types of Indicators must be reported separately from the “ISO-required” potential Damage Impact-related Indicators. The next section will make this point clearer.

The statement related to “single score Impact Indicators” is addressed in the Score section of Example 3 and in this example.



Box 9. Particular indicators

It is important to note that environmental impact categories complying with the product LCA standards (ISO, 2006b, 2006c) are analyzing potential impacts, rather than predictions of actual environmental effects. Organizations may want to also quantify and show real impacts, particularly on-site. For example, they may add specific effects on the biodiversity of the region where the several facilities of the organization are located.

Additionally, it is currently typical for organizations to include inventory-level indicators, like waste produced, or water and energy consumed along the life cycle, as these are important metrics for organizations. However, this type of indicator does not integrate the impacts; for instance in the indicator 'waste produced', the total amounts of waste produced in different steps of the value chain are usually summed up without considering specific treatment processes for different types of materials, which could lead to a different intensity of impact. Water and energy consumption are two additional widespread inventory-level indicators, which may be substituted in the future by their equivalent impact category indicator, once regionalized impact assessment methods for water and improved abiotic depletion impact methods, respectively, are agreed in the scientific community.

The results for inventory-level indicators may be presented along with impact category indicators. However, it should be clearly acknowledged that the former do not reveal impacts and that the two types of indicators are not mutually exclusive, but provide different types of information. Moreover, the organization should check that no double counting occurs between the two types of indicators, as inventory data is also the source of data to calculate impact category indicators.

Single-score impact category indicators (i.e., expressing the results of the environmental multi-impact assessment with only one aggregated indicator) have potential for O-LCA (see Report 9 on p.80). Based on value choices, they ease the interpretation of the results for non LCA experts, like managers. However, single-score indicators hide information trade-offs and have higher uncertainties as long as normalization and weighting factors are used. If the organization is aware of the limitations of inventory-level indicators and single-score impact category indicators, they may be used in the study.

E. Communication and Interpretation

Indicators



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The following image (UNSETACf) demonstrates how to communicate final O-LCIA results. It also demonstrates reporting ISO-required LCIA Damage categories separately from Resource Use and Inventory Level categories.

ENVIRONMENTAL IMPACT CATEGORIES - CML-IA baseline (v4.2) method within SimaPro					
PARAMETER	UNIT	Indirect Upstream Activities	Direct Activities	Indirect Downstream Activities	Total
Global Warming Potential	tonnes CO ₂ eq.	266,000	22,800	59,100	348,000
Ozone Depletion Potential	kg CFC11 eq.	17	1	11	30
Formation Potential of Tropospheric Ozone Photochemical Oxidants	kg C ₂ H ₄ eq.	36,534	829	10,506	47,869
Acidification Potential	kg SO ₂ eq.	674,969	177,790	247,258	940,017
Eutrophication Potential	kg PO ₄ ³⁻ eq.	178,307	4,753	58,301	241,361
Abiotic Depletion Potential for Non-Fossil Resources	kg Sb eq.	655	0	149	805
RESOURCE USE - Cumulative Energy Demand (ver. 1.09) methodology within SimaPro					
Total use of renewable primary energy resources	GJ	110,000	4,880	13,400	128,000
Total use of non-renewable primary energy resources	GJ	1,919,000	3,810	948,000	2,870,000
INVENTORY LEVEL INDICATORS - Primary data provided by AKG Gazbeton					
Hazardous waste disposed	ton	92			
Non-hazardous waste disposed	ton	310			
Use of net fresh water (well)	m ³	542,000			

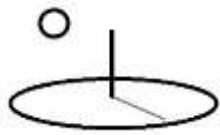
Table 3. AKG Gazbeton – Impact assessment results for 2015

The O-LCA study shows that upstream supply chain activities are the dominant life cycle stage (Table 3). Regarding energy, upstream activities have higher energy requirements (embodied) compared to direct and downstream activities. Within

Scores and Hotspots Analysis

UNEP/SETACe describes how business organizations are using O-LCIA and Hotspots Analysis:

“Businesses are using hotspots analysis to focus their resources, drawing up action plans and practical programmes of work to eliminate, reduce or mitigate hotspots in their global value chains; and tackling major societal and commercial issues like food waste, food and resource security (future supply risk and resilience issues); and water use in agriculture.”



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The following image (UNEP/SETACe) demonstrates that some O-LCAs employ normalized and weighted Indexes to generate final single score “ecopoints”. Ecopoints correspond to the normalized and weighted Locational Indexes that this algorithm aggregates into the final Total Risk, or TR, Indexes. Example 3 demonstrated adding together each life cycle stage’s TR Indexes to produce the final Scores. This image demonstrates that the single score impacts support the 100% reference point from which this image’s Overall Ecopoints can be measured and communicated to stakeholders.



Report 9. Inghams: Single-score ecopoints for the chicken line division

The goals of Inghams, a chicken and turkey products company, were to identify environmental hotspots with the view to reduce impacts and costs, and improve products, processes and supply chains in Australia, as well as underpin Inghams' marketing and communication initiatives. The study took approximately 6 months and covered cradle-to-retailer or quick service restaurant gate (i.e., the life cycle of chicken line from feed procurement and material acquisition to processing, production, distribution, and retail). Data was collected per Australian state when possible and the results were presented for the whole organization in Australia and per product¹.

A single-score overall environmental impact was measured in ecopoints with a weighted metric across 12 midpoint impact categories: abiotic resource depletion (minerals and nonrenewable fuels), acidification, eco-toxicity, eutrophication, global warming, human toxicity, ionizing radiation, land transformation and use, ozone depletion, photochemical smog, respiratory effects, and water consumption. The results for the overall impact, as well as for GHG emissions, water consumption, and consumption of non-renewable fuels are presented in Figure 18.

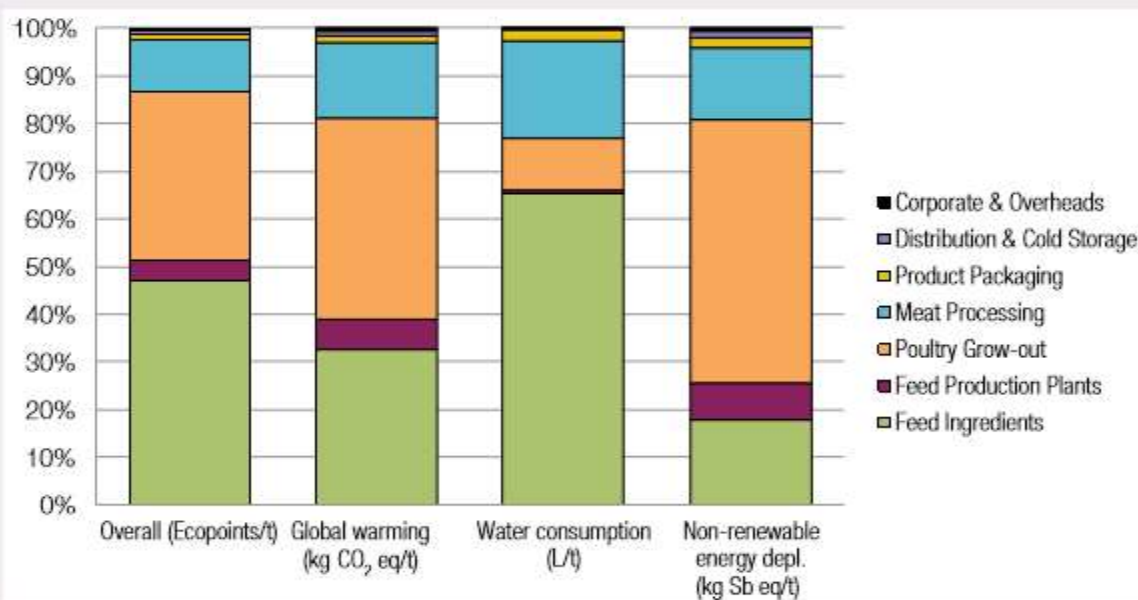
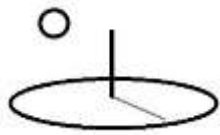


Figure 18. Inghams – Impact categories contribution by alternative life cycle input/stage. The results are presented per ton of generic chicken output.

F. Decisions



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This example addresses, in particular, the recommendations from the 12 road testers who proofed the O-LCA approach, related to “establishing an enhanced environmental [, economic, and social,] collection system[s]” and “setting reduction targets, tracking performance [and taking mitigation and adaptation actions]” as identified in the following image (UNEP/SETACf).



4.7 Communication and future steps

After completing the study, two of the twelve road testers plan to make their full final report public, while most road testers will publish a summary with all the results or a part thereof (see Section 5). The main audiences include societal stakeholders, other members of the supply chain and the local community. In all organizations, the O-LCA results will be deployed in internal communication procedures and in most cases the whole organizational staff will have access to the study.

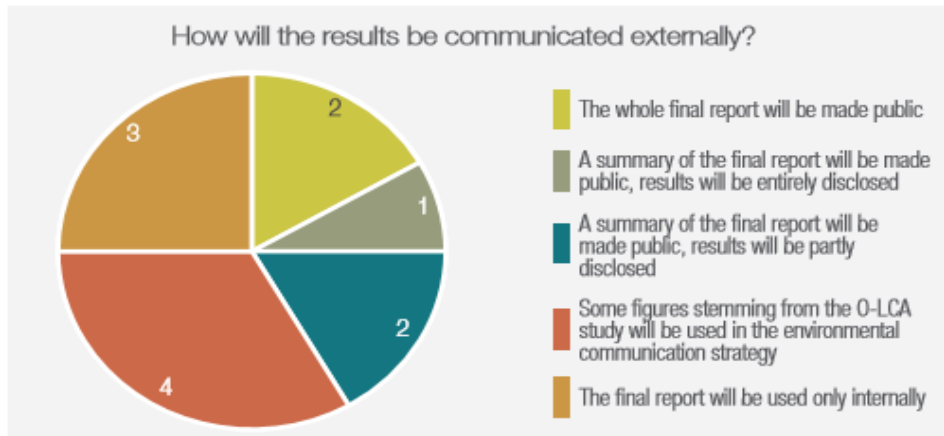


Figure 37: Planned external communication of the study results

The road testers plan to integrate the results obtained through the O-LCA study into the organization's strategy, (e.g., for establishing an enhanced environmental data collection system, setting reduction targets and tracking the organization's performance towards them, or putting in place mitigation measures (Figure 38). Some follow-up studies are also likely to be initiated, either at the product level or for suppliers that were identified as hotspots.

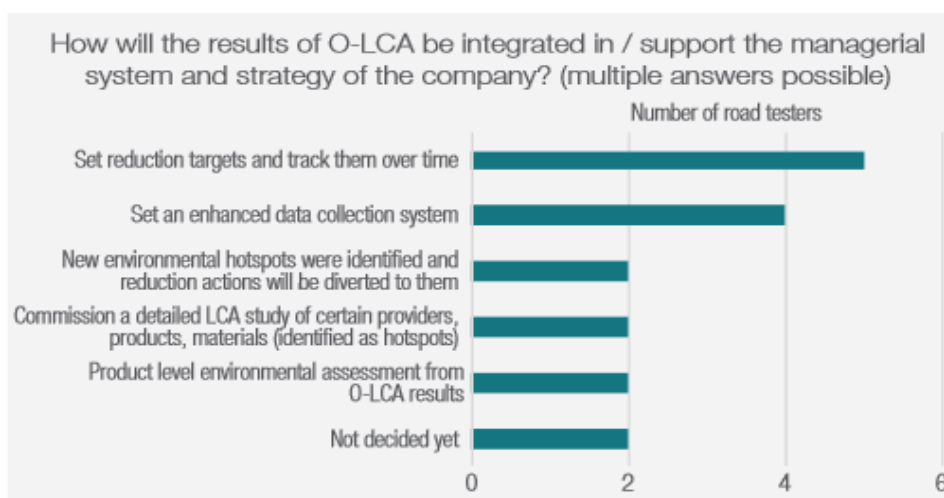


Figure 38: Use of the O-LCA results within the organizations' strategy

Road testers' feedback

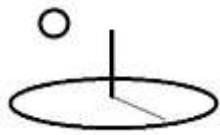
"Sharing experience and results with clients and stakeholders should be emphasized [as a relevant outcome of O-LCA implementation]."

- Rob Sianchuk,
Junk That Funk

Road testers' feedback

"O-LCA could be used to identify materiality in GRI Sustainability Reporting."

Jessica Hanafi & team, Industrial Engineering Dept, Universitas Pelita Harapan



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This reference discourages companies from keeping O-LCIA results private. That is, by using the localhost or Intranet version of DevTreks, rather the cloud version. As mentioned throughout this tutorial, companies with a real concern about sustainability must also be concerned about transparency. Informed investors, supply chain participants, end-product consumers, and local communities, want evidence, not more marketing pabulum.

G. Resource Stock and M&E Analyzer Scenarios and Comparisons

The following image (UNSETACd) demonstrates how firms use O-LCIA to conduct Scenario Analysis.



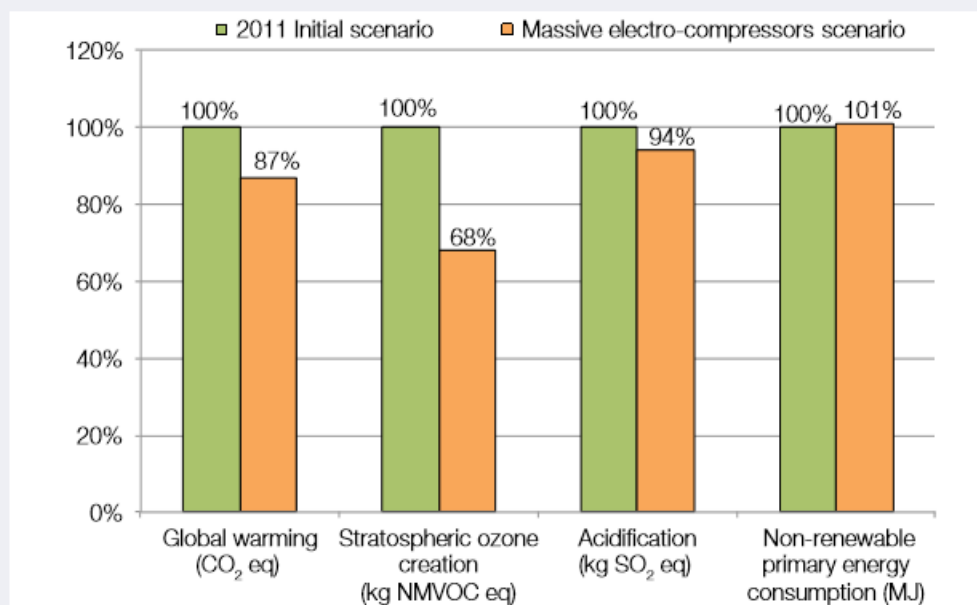
Report 14. Storengy: Improvement scenarios and savings quantification

The study results of Storengy¹ showed that industrial activities contributed more than 91% to all the indicators assessed, and that natural gas compressors comprised a high proportion of Storengy's overall impacts. Several scenarios for potential improvement were tested through the analysis of the results², three of which are summarized here.

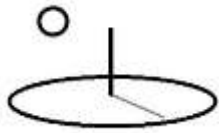
First, to reduce its CO₂ emissions, Storengy engaged in its industrial policy to replace old compressors (turbochargers) with more efficient new compressors (electro-compressors). The replacement reduces the natural gas combustion emissions, as well as certain direct discharges of CH₄ and NMVOC. This scenario indicates improvements on the order of up to 32%

for stratospheric ozone creation, 13% for global warming and 6% for acidification (see Figure 21). The second scenario prioritized high-speed train (TGV) to aircraft when travel time was similar, and the third proposed the recovery of direct discharges of CH₄ during chromatography operations. Savings for the latter two measures were almost negligible though they still represented environmental improvements at a low environmental cost.

In general, the methodology enabled Storengy to measure the potential improvements by the proposed actions. Additional potential gains identified in other scenarios were not quantifiable at that stage of the study due to a lack of required data, and require specific studies in the future.



The following image comes from the Resource Stock Analysis reference and demonstrates comparing the environmental performance of 3 different Scenarios, such as alternative mitigation and adaptation portfolios. Note carefully, that these comparisons, as with the previous image, are being made within an individual firm.



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Also note that numerous examples can be found throughout DevTreks (i.e. NPV 02, Construction Analysis, EVM, and CTA 01, references) of using Capital Budgets for the purpose of comparing Investment Scenarios (i.e. using the Change By Alternative Analyzers).

Time Period	All	Alt. 0	Alt. 1	Alt. 2
Name		2012 Conventional Orange Crop	2013 Conventional Orange Crop	2014 Conventional Orange Crop
Date		12/31/2012	12/31/2013	12/31/2014
Label		A1001C	A1001C	A1001C
Indicators	All	Alt. 0	Alt. 1	Alt. 2
Alternative				
Date		12/31/2012	12/31/2013	12/31/2014
Score Observations		2.0	2.0	2.0
Score Amount		1,302.4041	1,256.4118	12,383.6462
Score Unit		mean	mean	mean
Score Amount Change		0.0000	0.0000	11,127.2343
Score Percent Change		0.0000	0.0000	885.6359
Score Base Change		0.0000	-45.9923	11,081.2420
Score Base Percent Change		0.0000	-3.5313	850.8298
Score Low Amount		1,300.2832	1,254.2429	12,361.6606
Score Low Unit		lower 90% ci	lower 90% ci	lower 90% ci
Score Low Amount Change		0.0000	0.0000	11,107.4177
Score Low Percent Change		0.0000	0.0000	885.5874
Score Low Base Change		0.0000	-46.0403	11,061.3774
Score Low Base Percent Change		0.0000	-3.5408	850.6899
Score High Amount		1,304.5251	1,258.5808	12,405.6317
Score High Unit		upper 90% ci	upper 90% ci	upper 90% ci
Score High Amount Change		0.0000	0.0000	11,147.0510



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The following image also comes from the Resource Stock Analysis reference, but this time demonstrates making comparisons between representative organic and conventional farms (2*).

Budget Group : LCA Organic vs Conventional Orange Crops ; 07/16/2014			
Budget	All	Alt. 0	Alt. 1
Name	Conventional Orange Budget, Brazil		Organic Orange Budget, Brazil
Date	11/06/2015		11/06/2015
Label	A100C		A100C
Indicators	All	Alt. 0	Alt. 1
Alternative	A		B
Date	11/06/2015		11/06/2015
Score Observations	6.0		6.0
Score Amount	20,104.4206		13,462.9569
Score Unit	mean		mean
Score Amount Change	0.0000		0.0000
Score Percent Change	0.0000		0.0000
Score Base Change	0.0000		-6,641.4637
Score Base Percent Change	0.0000		-33.0348
Score Low Amount	20,069.4731		13,443.3282
Score Low Unit	lower 90% ci		lower 90% ci
Score Low Amount Change	0.0000		0.0000
Score Low Percent Change	0.0000		0.0000
Score Low Base Change	0.0000		-6,626.1449
Score Low Base Percent Change	0.0000		-33.0160
Score High Amount	20,139.3681		13,482.5856
Score High Unit	upper 90% ci		upper 90% ci
Score High Amount Change	0.0000		0.0000
Score High Percent Change	0.0000		0.0000
Score High Base Change	0.0000		-6,656.7825
Score High Base Percent	0.0000		-33.0536



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The following image (UNEP/SETACf) explains a prominent difference in using Product and Organization LCIA, and their related Hotspots Analyses: UNSETAC recommends that firms should not use O-LCIA and Hotspots Analysis to make comparisons between organizations.

Box 11. Requirements when O-LCA results are used for comparison by third parties

It bears repeating that O-LCA results are not appropriate for communicating comparisons with other organizations (Section 2.2). In general, it is quite likely that the O-LCA results have inconsistent goals and assess the organizations using different granularity levels, data specificity, supplier levels involved, indicator sets, etc. However, third parties might still use O-LCA results to perform comparisons. One example would be ranking organizations in the same sector or product section in terms of intensity (i.e., impacts per turnover or per equivalent product output).

The third party should gauge the comparability prior to the comparison. There are several elements that should be equivalent in order to make the comparison minimally meaningful:

- Goal and scope definition:
 - » Reporting organization and the reporting flow. It is particularly important to define the reference unit used for comparison. How are the differences of sector, size, and location, if any, being considered in the reference unit selected for comparison? Is the overall business model of each organization taken into account?
 - » System boundary. The criteria for the inclusion of inputs and outputs are identical (e.g., cut-off criteria);
 - » When the O-LCA results do not cover the full life cycle, the stages which are (or are not) considered; and
 - » Reporting period.
- Inventory analysis:
 - » Methods and calculations for data collection;
 - » Data quality requirements; and
 - » Allocation of resource use and emissions.
- Impact assessment:
 - » Impact category selection, calculation rules and the units used.

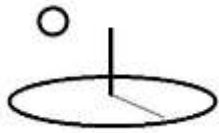
Furthermore, single-score impact assessment indicators (see Box 9, p.81) are not to be used in comparative assertions intended for public disclosure, but rather disaggregated results should be used.



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The image comparing organic and conventional production proves that this technology facilitates making organization comparisons –the question arises whether that approach is even sound. The tutorials throughout DevTreks argue, cautiously, that objective, science-based, 3rd party resource conservationists who use strong data standards applied using the RCA Framework can make consistent Organization LCA and Hotspots comparisons. Furthermore, the references used in this example suggest that companies might welcome having these high quality benchmark LCA standards and targets with which to compare their performance because their local communities, customers, supply chain buyers, and investors, demand this proof (2*).

For example, the following image uses data from Example 3 and Example 3B to illustrate using O-LCIA to make comparisons. This example ran Output Stock Calculators for 2 separate base element Output Series which were added to 2 separate base element Outcomes. An Outcome Resource Stock Analyzer, explained in the Resource Stock Analysis reference, was linked to an Outcome Group, RCA Conv vs Organic Coffee Production, to make the comparison.



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Outcome Group : RCA Conv vs Organic Coffee Crop Outcomes ; A100						
Outcome	All	Alt. 0	Alt. 1			
Name		Conventional Coffee Production	Organic Coffee Production			
Date		12/31/2017	12/31/2017			
Label		RCA4	RCA4			
Indicators	All	Alt. 0	Alt. 1			
Alternative						
Date		12/31/2017	12/31/2017			
Score Observations		1.0	1.0			
Score Amount		66,155.9400	29,402.6400			
Score Unit		most likely score	most likely score			
Score Amount Change		0.0000	0.0000			
Score Percent Change		0.0000	0.0000			
Score Base Change		0.0000	-36,753.3000			
Score Base Percent Change		0.0000	-55.5556			
Score Low Amount		9,330.9300	4,147.0800			
Score Low Unit		low score	low score			
Score Low Amount Change		0.0000	0.0000			
Score Low Percent Change		0.0000	0.0000			
Score Low Base Change		0.0000	-5,183.8500			
				Score High Base Percent Change	0.0000	-55.5556
				Indicator Observations	1.0	1.0
				Name	Indicator 1 - LCIA, Conv	Indicator 1 - LCIA
				Label	RCA3	RCA3
				Total	23,110.9200	10,271.5200
				Unit	actual most score	actual most score
				Amount Change	0.0000	0.0000
				Percent Change	0.0000	0.0000
				Base Change	0.0000	-12,839.4000
				Base Percent Change	0.0000	-55.5556
				Indicator Observations	1.0	1.0
				Name	Indicator 7 - SLCIA, Conv	Indicator 7 - SLCIA
				Label	RCA5	RCA5
				Total	19,934.1000	8,859.6000
				Unit	actual most score	actual most score
				Amount Change	0.0000	0.0000
				Percent Change	0.0000	0.0000
				Base Change	0.0000	-11,074.5000
				Base Percent Change	0.0000	-55.5556
				Indicator Observations	1.0	1.0
				Name	Indicator 8 - LCIA	Indicator 8 - LCIA

The following data come the Score.MathResults from 2 Output Series, Conventional and Organic Coffee Production. The raw data readily supports comparisons based on Elementary



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Flows (i.e. factor4, bdp), Production Processes (factor6, not shown), or Life Cycle Stages (factor7, not shown).

Conventional Coffee Production								Organic Coffee Production						
label	risks_and_indicators	factor4	certainty1	certainty2	QTMost	QTLow	QTUp	certainty1	certainty2	QTMost	QTLow	QTUp		
RCA3	Indicator 1	0	0	0	0	0	0	0	0	0	0	0		
NCA	Fresh Water Supply	daly/m3	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCB	Pollination	bdp	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCC	Air quality	daly/kg pm25	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCD	Air quality -climate	GTP	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
PCA	Flood Control	daly/1000 peo	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
ECA	Employee Manageme	hci per employ	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
RCA5	Indicator 2	0	0	0	0	0	0	0	0	0	0	0		
NCA	Fresh Water Supply	daly/m3	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCB	Pollination	bdp	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCC	Air quality	daly/kg pm25	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCD	Air quality -climate	GTP	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
PCA	Flood Control	daly/1000 peo	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
ECA	Working at 100 perce	PercentWorke	2	3	225	28.13	2025	2	3	100	12.5	900		
RCA8	Indicator 3	0	0	0	0	0	0	0	0	0	0	0		
NCA	Fresh Water Supply	daly/m3	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCB	Pollination	bdp	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCC	Air quality	daly/kg pm25	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
NCD	Air quality -climate	GTP	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
PCA	Flood Control	daly/1000 peo	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		
ECA	Employee Manageme	hci per employ	2	3	1284	181.3	11460	2	3	570.6	80.58	5095		

H. Performance and Product Tracking

UNSETACd uses the following image to explain how companies use O-LCIA to also track their performance over time.



Report 16. BASF: Environmental performance tracking and other sustainability schemes

One of the main outcomes of the Demarchi industrial complex project¹ was the comparison of its environmental performance over time, which enabled the evaluation of impact trends and identification of relevant effects on impact distribution due to changes in the production units. The same methodology was used for the assessment in 2010, 2011 and 2012, and the portfolio mix and proportions of production at Demarchi sites were fixed for consistency.

An assessment of economic performance was undertaken to take the costs required to fulfill customer needs (e.g., cost of production, investments, application, disposal, etc.) into account. The data from the environmental and economic assessments was then fed into an eco-efficiency analysis (EEA)², and compared over time. In fact, BASF was one of the first companies to establish an EEA methodology in the early 1990s and to use the eco-efficiency matrix³.

Figure 23a shows the implemented performance tracking scheme. A web chart was used with 2010 as the base year for comparing impact changes. Depletion of natural resources increased over time, while the impacts were reduced for the other categories. For each impact category, disaggregated results were provided per production unit, and divided into direct and indirect impacts (see Figure 23b for cumulative energy consumption).

The other pillar of the Demarchi project was education for sustainability, which promoted sustainable development by stimulating behavior change, achieved through the internalization of concepts and practices by managers and workers. Four steps were defined for the process – sensitization, awareness, training, and reality transformation – and included several tools (e.g., workshops, games, and training sessions).

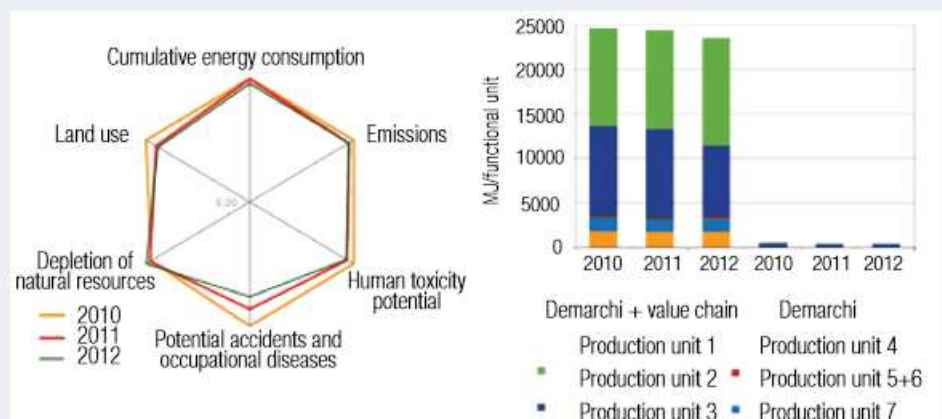


Figure 23. BASF – Performance tracking schemes: (a) overall impacts considered (left) and (b) specific results for cumulative energy consumption (right).

Source: Fundación Esnaco (2014).

This reference originally planned to address “cradle-to-grave” product tracking with a separate example. Closer study concluded that it would mostly duplicate this example’s O-LCIA and Example 1 and 2’s techniques (i.e. refer to the previous section’s image comparing Conventional



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Orange production over 3 years). Dynamic product tracking is a separate issue that isn't central, at this time, to this reference's focus on "social performance analysis" (3*).

Footnotes

1. Although the UNSETACa and UNSETACc references in Example 3 present case studies for multi-national corporations, this example demonstrates that the same results are fully applicable to small-scale representative farms and SMEs. Although not demonstrated in this reference yet, the multi-national corporation examples can be replicated by a) using large Indicator data sets, or b) using all of the hierarchical base elements in DevTreks' standard Operating and Capital Budgets (i.e. the Resource Stock Analysis reference demonstrates complementary techniques and examples that use the hierarchies).
2. Nemecek et al (2016) point out why multi-national company supply chain efficiency can't be dismissed on ideological grounds but should be investigated on empirical grounds: "Alternative food systems such as community supported agriculture, food processing, and distribution directly from farms have gained popularity in the last decades and have been shown to have better resource efficiency in some cases (Markussen et al. 2014; Schramski et al. 2013) and were also proposed as solutions to reduce food waste (Caputo et al. 2014). However, compared to industrial large-scale production, such systems often lack efficiency, so that in many cases they have higher impacts on the environment than standard systems (Kulak et al. 2015)." The SPA3 reference points out that environmental efficiency must be balanced with socioeconomic efficiency (i.e. some cultures place high value on small, local, farms).
3. Previous statements still hold true about the importance of supporting "\$28" contributions for open-source scientific software and criticizing public entities' propensity for spending \$multi-millions for proprietary software that serves the same purposes. The related issue of rent seeking carried out by special interest groups to get those \$\$ can begin to be addressed using the S-LCA techniques demonstrated in Example 3B and the consequential digital activism introduced in SPA3.

Case Study References



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Example 3's references, plus:

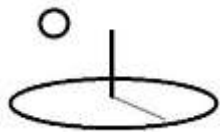
Nancy Auestad and Victor L Fulgoni. What Current Literature Tells Us about Sustainable Diets: Emerging Research Linking Dietary Patterns, Environmental Sustainability, and Economics. American Society for Nutrition. Adv. Nutr. 6: 19–36, 2015; doi:10.3945/an.114.005694.

Jan Landert, Christian Schader, Heidrun Moschitz and Matthias Stolze. A Holistic Sustainability Assessment Method for Urban Food System Governance. Sustainability 2017, 9, 490; doi:10.3390/su9040490

Christa Liedtke, Carolin Baedeker, Sandra Kolberg, Michael Lettenmeier. Resource intensity in global food chains: the Hot Spot Analysis. Wuppertal Institute, Germany. 2010

Thomas Nemecek & Niels Jungbluth & Llorenç Milà i Canals & Rita Schenck. Environmental impacts of food consumption and nutrition: where are we and what is next? Int J Life Cycle Assess (2016) 21:607–620

Nathan Pelletier, Karen Allacker, Simone Manfredi, Kirana Chomkhamsri, Danielle Maia de Souza. Organisation Environmental Footprint (OEF) Guide. European Commission Joint Research Center. 2012



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Example 3B. Social Life Cycle Assessment (S-LCA) for Representative Coffee Production Stakeholders

Version 2.1.8 and 2.2.0. These releases introduce an SDG Plan reference which provides a fuller context and additional examples for conducting S-LCA. Example 12 in that reference demonstrates how to use either subalgorithm15 or subalgorithm20 to conduct these analyses. The reference can be found in the Social Performance Analysis tutorial.

URLs:

Localhost:

Example 3A's Conventional and Organic Outputs

Cloud:

[https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA3 M and E/2147397561/none](https://www.devtreks.org/greentreks/preview/carbon/input/Coffee%20Firm%20RCA3%20M%20and%20E/2147397561/none)

A. Introduction or Goal and Scope

The following images (European Commission, 2012) summarize shortfalls in the Environmental Damage Impact emphasis of the LCIAs demonstrated in Examples 3 and 3A.



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Environmental LCA does not address **social and economic elements** of the product life cycle. For an integrated sustainability assessment, the ILCD Handbook needs to be complemented by other instruments that capture social and economic aspects of the analysed systems. **Social LCA** (that includes Life Cycle Working Environment and some elements of Life Cycle Accident Assessment) and LCC are instruments that are closely related conceptually and can be fully coherent with the (environmental) LCA provisions of the ILCD Handbook. They can be integrated with the ILCD guidance on environmental LCA to develop guidance on complete life cycle-based sustainability assessment.

The coherent integration of complementary information and methods, combining the ILCD Handbook with authoritative guides from other domains, could lead to a comprehensive, systematic approach for performing efficient and fully **integrated environmental, economic and social life cycle-based sustainability assessments**.

Environmental LCA is structurally open to a stepwise **extension to a full sustainability assessment** that includes Life Cycle Costing (LCC) and social LCA. Social LCA covers aspects such as job creation, equal pay for women, etc. This integration is possible because the basis of any environmental LCA is the technical life cycle model of the analysed product, i.e. its complete supply chain, use and end-of-life treatment. In environmental LCA, the environmental information on resource use and emissions is related to each of the process steps of this technical life cycle model. In the same way, cost and social information can be related to these very same process steps. A limited number of such integrated studies have been carried out in research and industry since about 2000. An integrated, authoritative approach for such an integrated life cycle sustainability assessment still needs to be developed.

UNSETACa uses the following definition of S-LCA to address these shortfalls.

“A social and socio-economic Life Cycle Assessment (S-LCA) is a social impact (and potential impact) assessment technique that aims to assess the social and socio-economic aspects of products and their potential positive and negative impacts along their life cycle encompassing extraction and processing of raw materials; manufacturing; distribution; use; re-use; maintenance; recycling; and final disposal. S-LCA complements [LCIA] with social and socio-economic aspects. It can either be applied on its own or in combination with [LCIA].”

The following image (UNSETACa) summarizes the major differences between S-LCA and Environmental LCA, or E-LCA (i.e. P-LCIA and O-LCIA). The functional unit in S-LCA relates primarily to stakeholders, not to product units or organization units. Impact categories are supplemented by stakeholder categories.



Phase of the study	Characteristics
Goal and scope	<p>The product utility is required to be described in functional terms, both in E-LCA and S-LCA. S-LCA goes further by also requiring that practitioners consider the social impacts of the product use phase and function.</p> <p>Whereas E-LCA encourages involvement of stakeholders (beyond the commissioners) in the peer review of the study, S-LCA encourages that such “external” stakeholders be involved in providing input on impacts, within the assessment itself.</p> <p>In S-LCA, justification needs to be presented when a subcategory is not included in the study. In E-LCA this is not a requirement.</p> <p>The subcategories are classified both by stakeholder categories and by impact categories in S-LCA. In E-LCA they are classified only by impacts categories.</p> <p>Whereas both E-LCA and S-LCA impact assessment methods may be sensitive to location, no E-LCA LCIA methods are site-specific, and E-LCA methods often define and use categories of location types that depend on physical factors such as geography type or population density. S-LCA may require site-specific LCIA in some cases, and may also need information about “political” attributes, such as the country and its laws.</p>
Life Cycle Inventory	<p>The activity variables²⁹ data is collected and used more often in S-LCA than in E-LCA (e.g. number of working hours for estimating the share of each unit process in the product system). In E-LCA, activity variables are used when data about impacts is not available.</p> <p>The subjective data is sometimes in S-LCA the most appropriate information to use. Bypassing subjective data in favor of more “objective” data would introduce greater uncertainty in the results, not less.</p> <p>The balance between quantitative, qualitative and semi-quantitative data will generally be different.</p> <p>The data sources will differ (coming from stakeholders).</p> <p>The data collection steps and methods vary (e.g. the irrelevance of mass balances).</p>
Life Cycle Impact	<p>The characterization models are different.</p> <p>The use of performance reference points is specific to S-LCA, e.g. thresholds.</p> <p>S-LCA encounters both positive and negative impacts of the product life cycle, beneficial impacts in E-LCA seldom occur.</p>
Interpretation	<p>The significant issues will differ.</p> <p>The addition of information on the level of engagement of stakeholders in S-LCA.</p>

Table 2 – Differences between S-LCA and E-LCA

The following image (UNSETACa) summarizes how the Goal and Scope phase of S-LCA incorporates Stakeholder categories, Impact categories, and Subcategories, discussed in the previous image.



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Stakeholder categories	Impact categories	Subcategories	Inv. indicators	Inventory data
Workers	Human rights			
Local community	Working conditions			
Society	Health and safety			
Consumers	Cultural heritage			
Value chain actors	Governance			
	Socio-economic repercussions			

Figure 5 – Assessment system from categories to unit of measurement. Adapted from Benoit et al., 2007

B. Indicator Thresholds, or System Boundary and Resource Inventory

The previous image and the following image (UNSETACa and UNSETACb) outline the process of defining a system boundary and Resource Inventory for S-LCAs. In relation to Example 3’s Damage Impact pathways, the “categorical pathway” displayed in these 2 images consist of “Stakeholder -> Impact categories -> Subcategories > Inventory Indicators”.



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Stakeholder categories	Subcategories
Stakeholder “worker”	Freedom of Association and Collective Bargaining Child Labour Fair Salary Working Hours Forced Labour Equal opportunities/Discrimination Health and Safety Social Benefits/Social Security
Stakeholder “consumer”	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility
Stakeholder “local community”	Access to material resources Access to immaterial resources Delocalization and Migration Cultural Heritage Safe & healthy living conditions Respect of indigenous rights Community engagement Local employment Secure living conditions
Stakeholder “society”	Public commitments to sustainability issues Contribution to economic development Prevention & mitigation of armed conflicts Technology development Corruption
Value chain actors* not including consumers	Fair competition Promoting social responsibility Supplier relationships

This pathway is more of a classification scheme rather than the impact pathways introduced in Examples 1 to 3. UNSETACa describes the purpose of these classifications:

“The purpose of the classification into impact categories is to support the identification of stakeholders, to classify subcategory indicators within groups that have the same impacts, and to support further impact assessment and interpretation.”



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Like O-LCIA, the Resource Inventory phase identifies and prioritizes an organization's Activities, Outcomes, Inputs, and Outputs. For example, Inputs and Activities are needed to assess hours worked per week per employee. Subjective data about employee satisfaction, as collected with Output and Outcome data, is needed to assess employee welfare. The key requirement for conducting S-LCA is to relate company production processes with stakeholder impacts, as defined by S-LCA subcategories.

C. Quality of Life Scenarios

The concerns raised in Example 3 about farm production heterogeneity complicating P-LCIA are compounded in S-LCA. Social science tends to be more subjective and qualitative than physical science. For the current release, use the comparative Scenario approach discussed in Section F, Decisions, of this example. As explained in other examples, the S-LCA emphasis on measuring stakeholder impacts is particularly suited for tradeoff analysis.

D. Social Performance Indicators and Life Cycle Impact Assessment

Examples 1 and 2 make use of a “nondiscrimination” Indicator in those datasets. Those socioeconomic indicators are analyzed in the context of “social impact pathways”, “results chains”, or “causal chains”, which use multiple Indicators in vertical pathways. In contrast, Example 3's LCIA Damage Impact pathways use “horizontal impact pathways”. The overall goal of all algorithms in this reference is to use these pathways to integrate Social Performance Assessment, M&E, and Impact Evaluation. The quest is for cause and effect attribution (or, as explained by UNSETACa in Annex 2, consequence).

The UNSETACa S-LCA calculations do not support the impact assessment techniques described in this reference for LCIA (i.e. impact pathways). UNSETACb explains the reason:

“Because in S-LCA there is very little information regarding cause-effect chain models that would enable practitioners to aggregate results (characterization) in an accurate manner”.



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Recognizing this reality, this example’s S-LCA treats each LCIA Indicator as a Multi-Criteria Decision Analysis (MCDA) rating. Similar to the following MCDA scoring system introduced in Example 1, but adjusted for the LCIA properties:

$$DGA_i = \sum_{n=1}^N (IM_{ni} \times IS_n) / \sum_{n=1}^N (IM_{ni})$$

where N is the number of Indicators per Categorical Index,

i is the index of the Indicators,

IM_{ni} is the Categorical Index-specific weight of an Indicator [1–3] = Indicator.factor10 and Indicator.factor11,

IS_n is the rating of an Indicator (0–100%) = Indicator.factor1 PRA calculation

Normalization type, or “weights” = Indicator.factor9

and factor5, factor6, factor7, and factor8 are not used (yet)

Version 2.2.0 will run this MCDA calculation when the CategoricalIndex.MathExpression for subalgorithms 15 or 20 begins with the prefix “mcda:”.

Advanced scientific networks may be capable of using Example 3’s horizontal impact pathways to conduct S-LCA. As explained throughout this reference, networks need to work with their information technologists to fine tune these approaches and to develop more advanced algorithms to address deficiencies with these algorithms.

This example demonstrates how to convert the vertical impact pathways into the S-LCA MCDA scoring system. The following social Indicators repeat the vertical pathway introduced in Examples 1 and 2 (1*).

Vertical Pathway Part 1. Actions (or, in terms of results chains, Activities)

Indicator 1. 5.1.1 Degree to which legal frameworks are in place to promote, enforce and monitor equality and non-discrimination on the basis of sex (i.e. this comes from the SDG)



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Indicator 2. Percent company supply sourced with SSIFs, small-scale food producers who are female and indigenous

Vertical Pathway Part 2. Conditions (or, in terms of results chains, Outputs)

Indicator 1. Percent employees filing sexual discrimination complaints per total number of employees

Indicator 2. 2.3.2 Percent SSIF coffee producers supplying company versus total SSIF coffee producers.

Vertical Pathway Part 3. Services (or, in terms of results chains, Outcomes)

Indicator 1. Percent employees satisfied with company discrimination policies

Indicator 2. Average income of small-scale food producers who are female and indigenous

Vertical Pathway Part 4. Impacts (the same for results chains)

Indicator 1. Percent employees leaving company per year due to discrimination enforcement

Indicator 2. Stability and quality of supply from SSIF sources

The following Indicators and properties illustrate a corresponding MCDA scoring system as introduced in Example 1. UNSETACs explains that qualitative and subjective Indicators derived from threshold systems, as introduced in Example 1, are appropriate metrics to use in these measurements. UNSETACb has a specific subcategory, Discrimination/Equal Opportunities, covering this topic. The SDG have several Indicators addressing both discrimination and sexual harassment. Although terms such as “percent workers” and “number of employees” can be used with these measurements, the metrics are usually based on MCDA-related qualitative rating scales and weights.



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Indicator 1. Legal Frameworks: Degree to which sexual harassment legal frameworks are in place

factor1. Most likely quantity (and factor2 = low estimate or PRA, factor3 = high estimate or PRA)

factor4. Unit of measurement for the factor1 rating, DegreeSHL

factor9. normalization type: weights

factor11. Weight: 0.25

Indicator 2. Enforced Frameworks: Degree to which sexual harassment legal frameworks are enforced.

factor1. Most likely quantity

factor4. Unit of measurement for the factor6 rating, DegreeSHLEnforced

factor9. normalization type: weights

factor11. Weight: 0.25

Indicator 3. Complaints: Percent employees reporting sexual harassment complaints per total number of employees

factor1. Most likely quantity

factor4. Unit of measurement for the factor8 rating, PercentEmployeeSH

factor9. normalization type: weights

factor11. Weight: 0.25

Indicator 4. Employee Satisfaction: Percent employees satisfied with company sexual harassment enforcement.

factor1. Most likely quantity



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factor4. Unit of measurement for the factor10 weight, PercentEmployeeSHS

factor9. normalization type: weights

factor11. Weight: 0.25

Once the Indicators have been normalized, weighted and summed into a Categorical Index, the following Categorical and Locational Indexes use the exact same techniques demonstrated in Example 3. Footnote 3 discusses this example’s approach of combining normalized socioeconomic CIs with normalized environmental damage CIs. The CategoricalIndex.factor1, factor2, and factor3, are still treated as uncertain characterization factors that act as multipliers. This example uses the assumption that these characterization factors do not exist yet, and sets them equal to 1, but stills normalizes and weights the CI in the same manner as the sibling CIs (i.e. using a normalization multiplier).

Categorical Index 1 (LCIA Damage Category or S-LCA Subcategory). Workers at 100% capacity: Workers able to work at 100% capacity due to sexual harassment enforcement (2*).

A more general S-LCA subcategory can be defined if the vertical impact pathway’s 2nd Indicator, related to small-scale, indigenous, female farmers, needs to be included in the same category (i.e. Effectiveness of Harassment/Discrimination Enforcement).

factor1. Most likely quantity

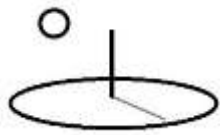
factor4. Unit of measurement for factor1, PercentWorkersatCapacity

Version 2.2.0 upgraded this algorithm by adding the prefix “mcda:” to Example 3’s CategoricalIndex.factor12, or MathExpression.

factor6: life cycle stage, **production**

[Version 2.2.0 deprecated this technique:

factor6: life cycle stage, **productionslcia**. S-LCA must add the characters “slcia” as a suffix to this property. That “tells” subalgorithm15 to use MCDA calculations, not LCIA calculations.]



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Locational Index: In S-LCA, this corresponds to Stakeholder categories, such as “Workers”.

UNSETACa defines this category as follows:

“A stakeholder category is a cluster of stakeholders that are expected to have shared interests due to their similar relationship to the investigated product systems.”

Very detailed S-LCA may want to use TR, or Total Risk Indexes, for this purpose as well.

UNSETACa emphasizes the importance of relating Impact Assessment measurements to specific groups of stakeholders. In effect, that’s what distinguishes S-LCA from other types of assessments.

Indicator 7. Life cycle stage 1. Production LCIA Meta. The benchmark, target, and actual metrics shown in the following image reflect the final normalized, weighted, environmental damages and socioeconomic impacts, for this life cycle stage, or Indicator. Indicator7 was chosen strictly for testing purposes.



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Indicator 7

Indicator 7 - SLCIA, Conv

Description 7

This indicator conducts an SLCIA of a coffee firm.

Indicator 7 URL

http://localhost:5000/resources/network_carbon/resourcepack_540/resource_1922/Ind7-SLCA2.csv

Label 7

RCA5

Rel Label 7

none

Date 7

11/17/2017

Dist Type 7

none

Q1 7

19,484.1000

Q1 Unit 7

target most score

Q2 7

2,832.0750

Q2 Unit 7

target low score

Q3 7

172,354.5000

Q3 Unit 7

target high score

Q4 7

19,484.1000

Q4 Unit 7

benchmark most score

Q5 7

2,832.0750

Q5 Unit 7

benchmark low score

Math Operator 7

equalto

BaselO 7

none

QT 7

172,354.5000

QT Unit 7

benchmark high score

Math Type 7

algorithm1

Math Sub Type 7

subalgorithm15

QT D1 7

0.0000

QT D1 Unit 7

QT D2 7

0.0000

QT D2 Unit 7

QT Most 7

19,484.1000

QT Most Unit 7

actual most score

QT Low 7

2,832.0750

QT Low Unit 7

actual low score

QT High 7

172,354.5000

QT High Unit 7

actual high score

Math Expression 7

I7.Q1.factor1 + I7.Q2.factor2 + I7.Q3.factor3 + I7

Math Result 7

rca results
label,location,risks_and_indicators,factor1,factor2,factor3,factor4,factor5,factor6,factor7,factor8,factor9,factor10,factor11,QTMost,QTLow,QTUp,percent
NCA,1,Fresh Water Supply,3.00E+00,7.50E-01,1.50E+01,daly/m3,none,production,EDF,2.0E+00,3.0E+00,2.50E-01,4.0E+00,1.284E+03,1.813E+02,1.146E+04,2.5E+01
IF1A,1,Indicator 1,1.50E+01,7.50E+00,3.00E+01,m3,none,1.0E+00,m3/ha,2.0E+00,m3m2,1.0E+01,amd,3.0E+02,1.5E+02,6.0E+02,7.01E+01
IF1B,1,Indicator 2,1.50E+00,7.50E-01,3.00E+00,m3,normal,1.0E+00,m3/ha,2.0E+00,m3m2,1.0E+01,amd,3.0E+02,1.5E+02,6.0E+02,7.01E+01

Indicator7.URL TEXT dataset



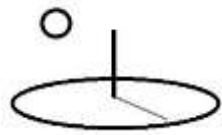
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The following images verify that the data from Example 3 has been modified for S-LCA. When using a Threshold system, such as SAFA, to rate each Indicator, the data is actually scaled according to the threshold ratings (i.e. 0 to 100, 1 to 5).

An alternative is to put all of the damage indicators into 1 Indicator dataset and all of the socioeconomic indicators into a separate Indicator dataset (i.e. Indicator 2).

Benchmarks. The following datasets confirms the S-LCA changes and the required property change: the row beginning with the label, ECA, is a Categorical Index, Workers at 100% capacity, with a factor6 property, or life cycle stage, of “production”.

When Locational Indexes are used as S-LCA Stakeholder categories, as demonstrated by this dataset, tradeoff analysis focuses on differences, such as equity, among those stakeholder groups. Section F. Decisions, of this example will also demonstrate using the CIs alone to study stakeholder tradeoffs.



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label	category	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
TNCA	1	Fresh Water Supply	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF1A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+01	amd	Q1*Q2*Q3
IF1B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+02	amd	Q1*Q2*Q3
TNCB	1	Pollination	2.00E+00	5.00E-01	1.00E+01	bdp	triangular	production	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF2A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	ha	none	1.00E+00	effective ha	2.00E+00	m2/year/kg yield	1.00E+01	bdp	Q1*Q2*Q3
IF2B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	ha	normal	1.00E+00	effective ha	2.00E+00	m2/year/kg yield	1.00E+02	bdp	Q1*Q2*Q3
TNCC	1	Air quality	2.00E+00	5.00E-01	1.00E+01	daly/kg pm25	none	production	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	pm10	none	1.00E+00	pm10	2.00E+00	kg PM25 inhaled /	1.00E+01	deaths/kg emitted	Q1*Q2*Q3
IF3B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	pm10	normal	1.00E+00	pm10	2.00E+00	kg PM25 inhaled /	1.00E+02	deaths/kg emitted	Q1*Q2*Q3
TNCD	1	Air quality -climate	2.00E+00	5.00E-01	1.00E+01	GTP	none	production	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	kg N	none	1.00E+00	kg N	2.00E+00	NH4	1.00E+01	CO2 Equivs	Q1*Q2*Q3
IF3B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	kg N	normal	1.00E+00	kg N	2.00E+00	NH4	1.00E+02	CO2 Equivs	Q1*Q2*Q3
GNC	1	Natural Capital Score	0.00E+00	0.00E+00	0.00E+00	NC score	none	0.00E+00	NC score	0.00E+00	none	minmax	3.00E+00	
TPCA	1	Flood Control	2.00E+00	5.00E-01	1.00E+01	daly/1000 people	none	production	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF4A	1	Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3	2.00E+00	m3m2	1.00E+01	daly/1000 people	Q1*Q2*Q3
IF4B	1	Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3	2.00E+00	m3m2	1.00E+02	daly/1000 people	Q1*Q2*Q3
GPC	1	Physical Capital Score	0.00E+00	0.00E+00	0.00E+00	PC score	none	0.00E+00	PC score	0.00E+00	none	minmax	3.00E+00	
TECA	1	Working at 100 percent capacity	1.00E+00	1.00E+00	1.00E+00	PercentWorker satCapacity	none	production	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	mdca:Q1*
IF5A	1	Legal Frameworks	5.00E+01	2.50E+01	9.00E+01	DegreeSDL	none	0.00E+00	none	0.00E+00	weights	none	2.00E+00	Q1*Q2*Q3
IF5B	1	Enforced Frameworks	5.00E+01	2.50E+01	9.00E+01	DegreeSDLEnforced	none	0.00E+00	none	0.00E+00	weights	none	2.00E+00	Q1*Q2*Q3
IF5C	1	Complaints	5.00E+01	2.50E+01	9.00E+01	PercentEmployeeSD	none	0.00E+00	none	0.00E+00	weights	none	2.00E+00	Q1*Q2*Q3
IF5D	1	Employee Satisfaction	5.00E+01	2.50E+01	9.00E+01	PercentEmployeeSDS	none	0.00E+00	none	0.00E+00	weights	none	2.00E+00	Q1*Q2*Q3
GEC	1	Workers	0.00E+00	0.00E+00	0.00E+00	SLCA score	none	0.00E+00	EC score	0.00E+00	none	minmax	3.00E+00	
TR01	1	Social Performance Score	0.00E+00	0.00E+00	0.00E+00	TR score	none	0.00E+00	TR score	0.00E+00	none	1.00E+00	1.00E+00	
TNCA_A	1	Fresh Water Supply	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2

Targets

Not displayed -for testing same data as Benchmarks, but with _A suffix

Actuals

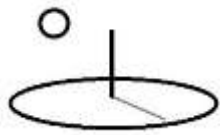
Not displayed -for testing same data as Benchmarks, but with _AA suffix

Indicator7.MathExpression

I7.Q1.factor1

Indicator7.MathResult

Benchmarks. The following results confirm that the socioeconomic Categorical Index, Working at 100% capacity, and its children Indicators are calculated using the MCDA formula, and all the



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environmental damage Categorical and Locational Indexes are calculated the same as regular LCIA.

label	location	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	factor12
TNCA		1 Fresh Wat	2.00E+00	5.00E-01	1.00E+01	daly/m3	none	production	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF1A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+01	amd	Q1*Q2*Q3
IF1B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3/ha	2.00E+00	m3m2	1.00E+02	amd	Q1*Q2*Q3
TNCB		1 Pollination	2.00E+00	5.00E-01	1.00E+01	bdp	triangular	production	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF2A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	ha	none	1.00E+00	effective h	2.00E+00	m2/year/k	1.00E+01	bdp	Q1*Q2*Q3
IF2B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	ha	normal	1.00E+00	effective h	2.00E+00	m2/year/k	1.00E+02	bdp	Q1*Q2*Q3
TNCC		1 Air quality	2.00E+00	5.00E-01	1.00E+01	daly/kg pm	none	production	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	pm10	none	1.00E+00	pm10	2.00E+00	kg PM25 ir	1.00E+01	deaths/kg	Q1*Q2*Q3
IF3B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	pm10	normal	1.00E+00	pm10	2.00E+00	kg PM25 ir	1.00E+02	deaths/kg	Q1*Q2*Q3
TNCD		1 Air quality	2.00E+00	5.00E-01	1.00E+01	GTP	none	production	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF3A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	kg N	none	1.00E+00	kg N	2.00E+00	NH4	1.00E+01	CO2 Equiv	Q1*Q2*Q3
IF3B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	kg N	normal	1.00E+00	kg N	2.00E+00	NH4	1.00E+02	CO2 Equiv	Q1*Q2*Q3
GNC		1 Natural Ca	0.00E+00	0.00E+00	0.00E+00	NC score	none	0.00E+00	NC score	0.00E+00	none	minmax	3.00E+00	none
TPCA		1 Flood Coni	2.00E+00	5.00E-01	1.00E+01	daly/1000	none	production	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF4A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	m3	none	1.00E+00	m3	2.00E+00	m3m2	1.00E+01	daly/1000	Q1*Q2*Q3
IF4B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	m3	normal	1.00E+00	m3	2.00E+00	m3m2	1.00E+02	daly/1000	Q1*Q2*Q3
GPC		1 Physical Ca	0.00E+00	0.00E+00	0.00E+00	PC score	none	0.00E+00	PC score	0.00E+00	none	minmax	3.00E+00	none
TECA		1 Employee	2.00E+00	5.00E-01	1.00E+01	hci per em	none	production	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	Q1*Q2
IF5A		1 Indicator 1	1.00E+01	5.00E+00	2.00E+01	percent er	none	1.00E+00	percent en	2.00E+00	qol/emplo	1.00E+01	hci/emplo	Q1*Q2*Q3
IF5B		1 Indicator 2	1.00E+00	5.00E-01	2.00E+00	percent su	normal	1.00E+00	percent su	2.00E+00	qol/emplo	1.00E+02	hci/emplo	Q1*Q2*Q3
EC		1 Economic	0.00E+00	0.00E+00	0.00E+00	EC score	none	0.00E+00	EC score	0.00E+00	none	minmax	3.00E+00	none
TR01		1 Social Perf	0.00E+00	0.00E+00	0.00E+00	TR score	none	0.00E+00	TR score	0.00E+00	none	1.00E+00	1.00E+00	none

QTMost	QTLow	QTHigh	QTMost2	QTLow2	QTHigh2	PercentTo	certainty1	certainty2
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	50.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
6336.000	875.200	57850.000	1056.000	583.500	1928.000	64.920	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
1712.000	241.700	15280.000	285.300	161.200	509.500	17.540	2.000	3.000
570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
200.000	100.000	400.000	200.000	100.000	400.000	35.050	0.000	0.000
85.320	61.160	109.500	85.320	61.160	109.500	14.950	0.000	0.000
1712.000	241.700	15280.000	285.300	161.200	509.500	17.540	2.000	3.000
9760.000	1359.000	88420.000	1627.000	905.800	2947.000	0.000	2.000	3.000



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The Indicator.QTMost column for the row, IF5A. Legal Frameworks, is calculated as follows:

Math Expression: “none” (don’t run mathematical calculations prior to normalization)

$$12.5 = (50: \text{Indicator.QTM} * 2: \text{weight}) / 8: \text{sum of Indicator weights}$$

The CategoricalIndex.QTMost column for the row, ECA. Working at 100% Capacity, is calculated as follows:

Math Expression: “mcda:Q1*Q2” (normalize and weight the children Indicators (mcda:) and then multiply the sum of the Indicators (Q1) by CategoricalIndex.QTM (Q2)

$$50 = 50: \text{sum of Indicator.QTM for the 4 children Indicators} * 1: \text{CategoricalIndex.QTM} * 0.25: \text{normalization factor} * 4: \text{weight}$$

E. Communication and Interpretation

Indicators

Although the references don’t provide good examples of communication aids that summarize the results of S-LCA, the following 2 images (The Sustainability Consortium, 2017) gives an example of the ingredients found in “toolkits” that use Indicators for P-LCIA, O-LCIA, and S-LCA for coffee suppliers. In terms of the images displayed in Examples 3 and 3A for this section, additional socioeconomic impact categories, or S-LCA subcategories, are added to the Indicator reports. The second image also demonstrates the use of quantitative measurements. Many “explanatory mixed methods” approaches combine quantitative and qualitative data –the dataset used in this example uses qualitative data for the S-LCA categories and quantitative data for the O-LCIA categories.



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Coffee

Category Sustainability Profile

Version 03.02.10.001



About the Coffee Product Category

This Category Sustainability Profile is part of a Product Sustainability Toolkit produced by The Sustainability Consortium. The Coffee Toolkit covers roasted and unroasted coffee beans and beverages made from coffee beans. Product types covered include ground coffee, whole bean coffee, instant coffee, cold brew coffee, ready-to-drink coffee, and single serve coffee pods. This Toolkit is not meant to cover coffee substitutes and complex products containing coffee as an ingredient, for example, chicory coffee, roasted barley coffee, coffee ice cream, and coffee-flavored candies.

This Category Sustainability Profile is relevant for global markets.

Introduction

This Category Sustainability Profile (CSP) details key performance indicators (KPIs) that can be used to track and measure the sustainability performance of a brand manufacturer, as well as the set of science-based environmental and social hotspots that support the KPIs. The Sustainability Consortium® (TSC®) has created this CSP through its multi-stakeholder development process with members and partners, including manufacturers, retailers, suppliers, service providers, NGOs, civil society organizations, governmental agencies, and academics, each bringing valuable perspectives and expertise.

TSC is a global [organization](http://www.sustainabilityconsortium.org) dedicated to improving the sustainability of consumer products that also offers a portfolio of services to help drive effective implementation. For more information please visit www.sustainabilityconsortium.org.

Contents

Key performance indicators – Quick reference list	2
Key performance indicators – Guidance	5
Hotspots	35
Improvement opportunities	39
References	44



DevTreks –social budgeting that improves lives and livelihoods



Coffee
Key Performance Indicators
Category Sustainability Profile



Key Performance Indicators

QUESTION	RESPONSE OPTION
1. Crop Supply Mapping For what percentage of your crop supply can you identify the country, region, or farm of origin?	A. We are unable to determine at this time. B. The following percentages represent the origins of our crop supply: B1. _____% is the portion of our crop supply for which we are unable to determine the origin. B2. _____% is the portion of our crop supply for which we have identified the country of origin. B3. _____% is the portion of our crop supply for which we have identified the region of origin. B4. _____% is the portion of our crop supply for which we have identified the farm of origin.
2. Access to Opportunities for Smallholder Farmers What percentage of your smallholder farmer-sourced crop supply, by mass, was sourced from smallholder farmers that are supported by a program to increase opportunities for agricultural training, inputs, and services?	A. Not applicable. We do not source our supply from smallholder farmers. B. We are unable to determine at this time. C. The following percentage of our smallholder farmer-sourced crop supply, by mass, was sourced from smallholder farmers that are supported by a program to increase opportunities for agricultural training, inputs, and services: C1. _____%.
3. Child Labor Use - On-farm What are the outcomes of the risk assessments for the worst forms of child labor performed on your crop supply?	A. We are unable to determine at this time. B. The following percentages, by mass purchased, represent the outcomes of our risk assessment(s) for the worst forms of child labor for our crop supply: B1. _____% of crop supply came from low-risk countries with corrective actions taken for any known high-risk sites. B2. _____% of crop supply came from high-risk countries that have high-risk sites for which we took corrective actions. B3. _____% of crop supply came from high-risk countries, but an audit determined the site risk to be low.
4. Deforestation and Land Conversion - On-farm What percentage of your crop supply, by mass, has been determined to be grown on fields that are low risk for conversion to non-forest use. have had zero conversion of High	A. We are unable to determine at this time. B. We are able to report the following percentages for our crop supply: B1. _____% of our crop supply is grown on fields that have been determined to be low risk for conversion to non-forest use. B2. _____% of our crop supply has been determined to be grown on fields that

Scores and Hotspots Analysis

The following image (UNSETACe) confirms that LCA practitioners are going “beyond LCA” to more fully assess social, economic, and good governance, impact categories in LCA and Hotspots studies. In the context of the UN’s multi-sector SDG Sustainability Assessment Indicator system, the authors state: “Hotspots Analysis can be used to identify and prioritise actions for each of [the UNs Sustainability Development goals] at a product category / sector / city / nation or other level”. Example 5 through 8 in SPA3 fully address the integration of SDG and sustainable accounting business data systems.



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A1.4 Hotspots Analysis and the Sustainable Development Goals

At the United Nations Sustainable Development Summit on 25th September 2015, world leaders adopted the 2030 Agenda for Sustainable

Goal 11 on sustainable cities and communities is implicitly linked to identifying poverty hotspots and addressing these in an inclusive and participatory manner. Goal 12, in particular target 12.8 aimed at ensuring that people everywhere

15 <http://socialhotspot.org/>

16 <http://bookshop.europa.eu/en/social-sustainability-in-trade-and-development-policy-pbLBNA26483/>



Figure 19: UN Sustainable Development Goals

UNSETACe use the following statement to further confirm the role that S-LCA and Hotspots Analysis can play in fuller sustainability assessments. Annex 3 in that publication summarizes how more than 20 diverse organizations are applying those techniques (i.e. the National Cattlemen’s Beef Association Hotspots Analysis).



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“The outputs from [S-LCA and Hotspots] analysis can then be used to identify and prioritise potential actions around the most significant economic, environmental and social sustainability impacts or benefits associated with a specific country, city, industry sector, organization, product portfolio, product category or individual product or service.”

The following image displays part of the Score.MathResult that will be used in the same manner as explained in Example 3 to conduct Hotspots Analysis. The S-LCA data was only added to the second Indicator, or Indicator 7.

label	locatic	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
RCA3	na	Indicator 1	RCA3	na	Indicator 1	0	0	0	0	0	0	0	0
TNCA	1	Fresh Water Supply	0	cf04	5.00E-01	daly/m3	daly/m3	low units	production	high units	2	production	EDF
TNCB	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	production	high units	triangular	production	EDG
TNCC	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	production	high units	2	production	EDE
TNCD	1	Air quality -climate	0	cf04	5.00E-01	GTP	GTP	low units	production	high units	2	production	ECB
TPCA	1	Flood Control	0	cf04	5.00E-01	daly/1000	daly/1000	low units	production	high units	2	production	PCB
TECA	1	Employee Management	0	cf04	5.00E-01	hci per em	hci per em	low units	production	high units	2	production	HCA
TNCA_A	1	Fresh Water Supply	0	cf04	5.00E-01	daly/m3	daly/m3	low units	production	high units	2	production	EDF
TNCB_A	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	production	high units	triangular	production	EDG
TNCC_A	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	production	high units	2	production	EDE
TNCD_A	1	Air quality -climate	0	cf04	5.00E-01	GTP	GTP	low units	production	high units	2	production	ECB
TPCA_A	1	Flood Control	0	cf04	5.00E-01	daly/1000	daly/1000	low units	production	high units	2	production	PCB
TECA_A	1	Employee Management	0	cf04	5.00E-01	hci per em	hci per em	low units	production	high units	2	production	HCA
TNCA_AA	1	Fresh Water Supply	0	cf04	5.00E-01	daly/m3	daly/m3	low units	production	high units	2	production	EDF
TNCB_AA	1	Pollination	0	cf04	5.00E-01	bdp	bdp	low units	production	high units	triangular	production	EDG
TNCC_AA	1	Air quality	0	cf04	5.00E-01	daly/kg pr	daly/kg pr	low units	production	high units	2	production	EDE
TNCD_AA	1	Air quality -climate	0	cf04	5.00E-01	GTP	GTP	low units	production	high units	2	production	ECB
TPCA_AA	1	Flood Control	0	cf04	5.00E-01	daly/1000	daly/1000	low units	production	high units	2	production	PCB
TECA_AA	1	Employee Management	0	cf04	5.00E-01	hci per em	hci per em	low units	production	high units	2	production	HCA
RCA5	na	Indicator 2	RCA5	na	Indicator 2	0	0	0	0	0	0	0	0
TNCA	1	Fresh Water Supply	0	cf04	5.00E-01	daly/m3	daly/m3	low units	production	high units	2	production	EDF



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factor12	QTMost	QTLow	QTHigh	QTMost2	QTLow2	QTHigh2	PercentTo	certainty1	certainty2
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	400.000	50.000	4000.000	200.000	100.000	400.000	18.940	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	27.020	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	100.000	2.000	3.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4.000	570.600	80.580	5095.000	285.300	161.200	509.500	25.000	2.000	3.000

F. Decisions

The following image derives from the O-LCIA comparison demonstrated in Example 3A, Section G. The data illustrates how firms use both S-LCA and O-LCIA Hotspots Analysis data to conduct Scenario Analysis for stakeholder tradeoff analysis. The Categorical Index, ECA8. Working at 100% Capacity, for Indicator 2 came from this example's S-LCA dataset. The labels with “_A” and “_AA” now represent 2 additional stakeholder groups. The data supports the study of potential tradeoffs among 3 groups of stakeholders, 3 life cycle stages (Indicator 1, 2 and 3), and 2 production technologies (Organic and Conventional). Specifically, the analysis uses the S-LCA data to determine whether some of the technologies disproportionately impact some stakeholder groups more than others.



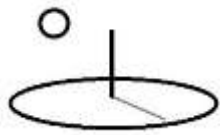
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Conventional Coffee Production				Organic Coffee Production									
label	risks_and_factor4	factor8	factor9	QTMost	QTLow	QTUp	label	risks_and_factor4	factor8	factor9	QTMost	QTLow	QTUp
RCA3	Indicator 1	0	0	0	0	0	RCA3	Indicator 1	0	0	0	0	0
NCA	Fresh Wat daly/m3	2	3	1284	181.3	11460	NCA	Fresh Wat daly/m3	2	3	570.6	80.58	5095
NCB	Pollination bdp	2	3	1284	181.3	11460	NCB	Pollination bdp	2	3	570.6	80.58	5095
NCC	Air quality daly/kg pr	2	3	1284	181.3	11460	NCC	Air quality daly/kg pr	2	3	570.6	80.58	5095
NCD	Air quality GTP	2	3	1284	181.3	11460	NCD	Air quality GTP	2	3	570.6	80.58	5095
PCA	Flood Con daly/1000	2	3	1284	181.3	11460	PCA	Flood Con daly/1000	2	3	570.6	80.58	5095
ECA	Employee hci per em	2	3	1284	181.3	11460	ECA	Employee hci per em	2	3	570.6	80.58	5095
NCA_A	Fresh Wat daly/m3	2	3	1284	181.3	11460	NCA_A	Fresh Wat daly/m3	2	3	570.6	80.58	5095
NCB_A	Pollination bdp	2	3	1284	181.3	11460	NCB_A	Pollination bdp	2	3	570.6	80.58	5095
NCC_A	Air quality daly/kg pr	2	3	1284	181.3	11460	NCC_A	Air quality daly/kg pr	2	3	570.6	80.58	5095
NCD_A	Air quality GTP	2	3	1284	181.3	11460	NCD_A	Air quality GTP	2	3	570.6	80.58	5095
PCA_A	Flood Con daly/1000	2	3	1284	181.3	11460	PCA_A	Flood Con daly/1000	2	3	570.6	80.58	5095
ECA_A	Employee hci per em	2	3	1284	181.3	11460	ECA_A	Employee hci per em	2	3	570.6	80.58	5095
NCA_AA	Fresh Wat daly/m3	2	3	1284	181.3	11460	NCA_AA	Fresh Wat daly/m3	2	3	570.6	80.58	5095
NCB_AA	Pollination bdp	2	3	1284	181.3	11460	NCB_AA	Pollination bdp	2	3	570.6	80.58	5095
NCC_AA	Air quality daly/kg pr	2	3	1284	181.3	11460	NCC_AA	Air quality daly/kg pr	2	3	570.6	80.58	5095
NCD_AA	Air quality GTP	2	3	1284	181.3	11460	NCD_AA	Air quality GTP	2	3	570.6	80.58	5095
PCA_AA	Flood Con daly/1000	2	3	1284	181.3	11460	PCA_AA	Flood Con daly/1000	2	3	570.6	80.58	5095
ECA_AA	Employee hci per em	2	3	1284	181.3	11460	ECA_AA	Employee hci per em	2	3	570.6	80.58	5095
RCA5	Indicator 2	0	0	0	0	0	RCA5	Indicator 2	0	0	0	0	0
NCA	Fresh Wat daly/m3	2	3	1284	181.3	11460	NCA	Fresh Wat daly/m3	2	3	570.6	80.58	5095
NCB	Pollination bdp	2	3	1284	181.3	11460	NCB	Pollination bdp	2	3	570.6	80.58	5095
NCC	Air quality daly/kg pr	2	3	1284	181.3	11460	NCC	Air quality daly/kg pr	2	3	570.6	80.58	5095
NCD	Air quality GTP	2	3	1284	181.3	11460	NCD	Air quality GTP	2	3	570.6	80.58	5095
PCA	Flood Con daly/1000	2	3	1284	181.3	11460	PCA	Flood Con daly/1000	2	3	570.6	80.58	5095
ECA	Working a PercentW	2	3	75	37.5	135	ECA	Working a PercentW	2	3	50	25	90
NCA_A	Fresh Wat daly/m3	2	3	1284	181.3	11460	NCA_A	Fresh Wat daly/m3	2	3	570.6	80.58	5095

Example 5 in the Social Performance Analysis 3 reference, illustrates how to tie specific stakeholder populations, with socioeconomic attributes, to this subalgorithm's stakeholder categories, or Locational Indexes. That example demonstrates how to use complementary subalgorithms to complete more thorough sustainability assessments.

Footnotes

1. Recent US news reports confirm that professionals in this field can develop better Indicators. For example, some of those professionals have mentioned the need to monitor the effectiveness of punishments metered out to transgressors.
2. In general, although many S-LCA Indicators are used for the purpose of changing “bad actor” behavior, they should be reported in positive terms because the goal is “good actor” behavior (and actual company use).
3. The legitimacy of combining normalized socioeconomic data with normalized environmental damage data is explained in the Lippiatt (2007) reference and by Landert (2017) and RAND (2016) in Example 1. MCDA allows normalization and weighting among “apples and oranges” LCA Indicators. The Liqueste (2016) and Antioch et al



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(2017) references in Example 4B explain best practice techniques to employ when conducting professional MCDA.

Case Study References

Same as Example 3, plus:

The Sustainability Consortium. Coffee Category Sustainability Profile. Version 03.10.001. Arizona State University and University of Arkansas. 2017



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Example 4. Life Cycle Costs, or Benefits, (LCC or LCB) for Representative Small Scale Coffee Farms (RCA4)

Version 2.1.8 and 2.2.0. Version 2.1,8 introduced a new SDG Plan reference which provides a fuller context and additional examples for using LCC/LCB. Example 9 of that reference introduces new labeling requirements for these budgets. Version 2.2.0 introduced a new algorithm, subalgorithm21, for conducting LCC/LCB and refactored subalgorithm16 to make the 2 algorithms use consistent techniques. Example 12 changed this dataset by adding Adjusted Gross Living Wealth and Adjusted Sustainability scores. The SDG Plan reference can be found in the Social Performance Analysis tutorial.

URLs

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4/1553/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4/541/none>

The cloud datasets used Inputs rather than Outputs in order to mix things up a bit.

Resource Stock Assessment

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA4 Stock/2147397560/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA4 Stock/2141223487/none>

Monitoring and Evaluation Assessment

<https://www.devtreks.org/greentreks/preview/carbon/input/Coffee Firm RCA4 M and E/2147397562/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA4 M and E/2141223489/none>

Sample Coffee Farm Budget



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<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Crop>

Budget/2141223478/none

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm Crop>

Budget/2141223490/none

Sample Household Living Wage Budget

<https://www.devtreks.org/greentreks/preview/carbon/output/Living Wage HH>

Budget/2141223482/none

A. Introduction

This example uses the RCA4 LCC/LCB algorithm to carry out a LCC and LCB of Example 3's coffee farm. This algorithm can be used for stand-alone cost and benefit estimating or to add a cost and benefit dimension to the analyses demonstrated in other Examples used throughout this reference (i.e. as demonstrated in Example 4A, 4B, and 4C).

In order to add a social performance assessment perspective to this algorithm, the following budgets have been completed, or at least demonstrated, for this example:

1. **Coffee Farm Budget** – agricultural cost of production study
2. **Household Living Wage Budget** – household budget study
3. **Coffee Supply Chain Social Costs Budgets** – social cost of supply chain example
4. **Compliance Cost Effectiveness Analysis** – see Example 4A
5. **Country or Sector Cost Effectiveness Analysis** – see Example 4B (WHO, 2016, explains how to use cost estimates and budgets at country scale).
6. **LCIA Cost Effectiveness Analysis** – see example 4C

B. Indicator Thresholds

Given the agricultural context of this example, many agriculturalists may recognize that the underlying 4 Level Indicator hierarchy readily supports the standard 4 level budgeting data



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structure, or results chain, used for Operating/Capital Budget analysis in DevTreks. Level 4 supports Inputs and Outputs, Level 3 supports Outcomes/Operations/Components, Level 2 supports Time Periods, and Level 1 supports Budgets. Again, that’s a perfectly fine data structure to use –provided that it’s part of an underlying WBS.

C. Quality of Life Scenarios

These stakeholders derive the majority of their income from coffee farming. Their quality of life depends on the net income they derive from their company’s revenues and costs. Agricultural advisers are eager to assist their customers’ clubs desire to understand the impacts of their advice in terms of on-farm, and off-farm, costs, benefits, and performance.

Example 4A and 4B demonstrate typical uses of scenarios.

D. Social Performance Score

The following image and tables show that Indicator TEXT datasets store this firm’s initial Scoring system. To reinforce the LCC/LCB techniques introduced in the Life Cycle Calculation reference, this dataset uses that reference’s same “Examples”. We recommend sticking with a standard WBS for all of resource accounting. The goal of the WBS is uniform accounting, aggregation, and communication. This dataset holds the same 5 LCC examples as found in the Life Cycle Calculation reference.

The Indicator.URL TEXT datasets used with this algorithm have columns defined as follows. Although the algorithm doesn’t care about property names, DevTreks recommends using generic property names.

For Indicators, the final 11 columns of data are defined as follows:

- **factor1.** Most likely quantity of Indicator.
- **factor2.** Low quantity of Indicator.



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- **factor3.** High quantity of Indicator.
- **factor4.** Price of Q
- **factor5.** Unit of measurement for final LCC cost or LCB benefit ($P * Q$).
- **factor6:** Type of escalation or discounting as defined in the next paragraph
- **factor7:** Either an escalation rate used with the escalation type, or a multiplication factor representing a pre-discounted value
- **factor8:** number of years to use in discounting formulas
- **factor9:** recurrent times
- **factor10:** certainty1 of Indicator (same as Example 1's certainty1 column)
- **factor11:** certainty2 of Indicator (same as Example 1's certainty2 column)

For Categorical Indexes, the final 11 columns of data are defined as follows:

- **factor1:** see Example 4A and 4B (0 in this example). Setting factor1 and factor4 equal to zero tells this algorithm to calculate Categorical Indexes as summations of children Indicators. Otherwise, this algorithm will assume that the cost effectiveness analysis (CEA) demonstrated in Example 4A and 4B is being run. When CEA is run, performance indicators (QASYs) are discounted exactly the same as costs and benefits.
- **factor2:** see Example 4A and 4B (0 in this example).
- **factor3:** see Example 4A and 4B (0 in this example).
- **factor4.** see Example 4A and 4B (0 in this example)
- **factor5.** see Example 4A and 4B (none in this example)
- **factor6:** general multiplier, or allocation factor, applied to sum of Indicators (equivalent to OC.Amount in Operation/Component/Outcome base elements)
- **factor7: Planning Construction Years:** Number of years in the planning and construction period. Also known as the preproduction period.
- **factor8: Service Life:** The life span of the Input or Output.
- **factor9: Years from Base Date:** The base date is the Input or Output's date. The specific year within the Planning Construction Years when the Input is installed or Output's revenue received.
- **factor10:** Real discount rate (in digital format: 2.125)



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- **factor11:** Nominal discount rate

Several references (i.e. WHO 2003 in Example 4A) demonstrate using general demographic variables (i.e. age, education, gender, and race), applied using population models, with aggregated budgets. Example 5 in the Social Performance Analysis 3 reference illustrates how to integrate population algorithms with budget and performance algorithms. The Social Performance Analysis 4 tutorial demonstrates this further.

Escalation Type Options. The following options, which are defined in the Life Cycle Calculation reference, can be used for this column. Examples 4A and 4B’s cost effectiveness analyses derive from techniques used in the health care industry. That industry is particularly concerned about the impacts of price escalation on health care affordability.

- none = no escalation,
- upvtable = use the factor1 property as a multiplier (the factor has been pre-calculated from a discounting formula)
- spv = single present value,
- upv = uniform present value (based only on discounting years),
- caprecovery = capital recovery or amortized,
- caprecoveryspv = uses the Years from Base property to run a spv calculation and then uses the Service Life plus Planning Construction years to run the caprecovery calculation.
- uniform = uniform escalation (same techniques as NIST, including use of service years and planning construction years),
- geometric = geometric escalation (same techniques as NIST, including use of service years and planning construction years),
- linear = linear escalation (same techniques as NIST, including use of service years and planning construction years),
- exponential = exponential escalation (based only on discounting years),
- eaa = equivalent annual annuity



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The formulas documented in the Life Cycle Calculation and NIST 135 references are the exact same functions used with this algorithm with 1 exception. These TEXT datasets do not have a separate property for Salvage Value. Instead, Salvage Value is treated as a separate discounted cost. The current release supports these calculations for all Indicators.

1. Life Cycle Calculation Reference Budget

Indicator 1. LCC Meta (the scores are filled in automatically)



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Indicator 1	
<input type="text" value="Coffee Firm LCC Example"/>	
Indicator 1 Description	
<p>This example of a life cycle cost analysis can be found in the Social Performance Analysis reference.</p>	
Indicator 1 URL	
<input type="text" value="http://localhost:5000/resources/network_carbon/resourcepack_541/resource_1904/lnd1-LCC-LCB.csv"/>	
Label 1	Rel Label 1
<input type="text" value="RCA4"/>	<input type="text" value="RCA0"/>
Date 1	Dist Type 1
<input type="text" value="05/09/2017"/>	<input type="text" value="none"/>
Q1 1	Q1 Unit 1
<input type="text" value="2,487,645.7000"/>	<input type="text" value="target most score"/>
Q2 1	Q2 Unit 1
<input type="text" value="2,094,980.0844"/>	<input type="text" value="target low score"/>
Q3 1	Q3 Unit 1
<input type="text" value="2,878,281.6169"/>	<input type="text" value="target high score"/>
Q4 1	Q4 Unit 1
<input type="text" value="2,487,645.7000"/>	<input type="text" value="benchmark most score"/>
Q5 1	Q5 Unit 1
<input type="text" value="2,094,980.0844"/>	<input type="text" value="benchmark low score"/>
Math Operator 1	BaseIO 1
<input type="text" value="equalto"/>	<input type="text" value="none"/>
Math Expression 1	
<input type="text" value="I1.Q1.factor1 + I1.Q2. factor2 + I1.Q3. factor3"/>	
Math Result 1	
<p>rca results label,location,risks_and_indicators,factor1,factor2,factor3,factor4,QTMostUnit,factor6,factor7,factor8,factor9,factor10,factor11,QTMost,QTLow,QTUp NCA,1.00,NIST Table 52,0.00,0.00,0.00,0.0000,total cost,none,1.0000,20.0000,1.0000,3.0000,4.000 0,516391.0174,449959.2230,597461.4633 IF1A,1.00,Electricity,250000.00,225000.00,300</p>	

Indicator1.URL TEXT dataset

Benchmarks



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label	location	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
NCA	1.00	NIST Table 52	0.00	0.00	0.00	0.00	total cost	none	1.00	20.00	1.00	3.00	5.00
IF1A	1.00	Electricity	250000.00	225000.00	300000.00	0.08	kwh cost	upvtable	15.13	20.00	1.00	3.00	4.00
IF1B	1.00	OMR	1.00	0.75	1.10	7000.00	carbon cost	upv	0.00	20.00	1.00	3.00	4.00
IF1C	1.00	CO2 Equivalents	8500.00	7000.00	10000.00	0.02	total cost	none	0.00	0.00	1.00	3.00	4.00
IF1D	1.00	Plant Replacement	1.00	1.00	1.00	12000.00	total cost	spv	0.00	12.00	1.00	3.00	4.00
IF1E	1.00	Initial Investment	1.00	0.90	1.10	103000.00	total cost	none	0.00	0.00	1.00	3.00	4.00
IF1F	1.00	Residual Value	1.00	0.90	1.10	-3500.00	total cost	spv	0.00	20.00	1.00	3.00	4.00
NCB	1.00	NIST Table 54	0.00	0.00	0.00	0.00	total cost	none	2.00	20.00	1.00	3.00	5.00
IF2A	1.00	Replacement Fan	1.00	1.00	1.00	12000.00	total cost	spv	0.00	14.00	1.00	3.00	4.00
IF2B	1.00	Electricity	125000.00	110000.00	150000.00	0.08	kwh cost	upvtable	14.28	20.00	1.00	3.00	4.00
IF2C	1.00	Natural Gas	1700.00	1500.00	2000.00	5.93	gj cost	upvtable	17.03	20.00	1.00	3.00	4.00
IF2D	1.00	OMR	1.00	0.75	1.10	7000.00	total cost	uniform	0.00	0.00	1.00	3.00	4.00
IF2E	1.00	Second Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	2.00	1.00	3.00	4.00
IF2F	1.00	Plant Replacement	1.00	0.75	1.10	60000.00	total cost	spv	0.00	17.00	1.00	3.00	4.00
IF2G	1.00	Initial Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	1.00	1.00	3.00	4.00
IF2H	1.00	Residual Value	1.00	0.90	1.10	-20000.00	total cost	spv	0.00	22.00	1.00	3.00	4.00
NCC	1.00	LCC Example 3	0.00	0.00	0.00	0.00	total cost	none	2.00	20.00	1.00	3.00	5.00
IF3A	1.00	Replacement Fan	1.00	1.00	1.00	12000.00	total cost	spv	0.00	14.00	1.00	3.00	4.00
IF3B	1.00	Electricity	125000.00	110000.00	150000.00	0.08	kwh cost	uniform	0.00	0.00	1.00	3.00	4.00
IF3C	1.00	Natural Gas	1700.00	1500.00	2000.00	5.93	gj cost	upv	0.00	20.00	1.00	3.00	4.00
IF3D	1.00	OMR	1.00	0.75	1.10	7000.00	total cost	uniform	0.00	0.00	1.00	3.00	4.00
IF3E	1.00	Second Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	2.00	1.00	3.00	4.00
IF3F	1.00	Plant Replacement	1.00	0.75	1.10	60000.00	total cost	spv	0.00	17.00	1.00	3.00	4.00
IF3G	1.00	Initial Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	1.00	1.00	3.00	4.00
IF3H	1.00	Residual Value	1.00	0.90	1.10	-20000.00	total cost	spv	0.00	22.00	1.00	3.00	4.00
NC	1.00	Natural Capital Cost	0.00	0.00	0.00	0.00	total cost	0.00	0.00	1.00	1.00	3.00	5.00
PCA	1.00	LCC Example 4	0.00	0.00	0.00	0.00	total cost	none	2.00	20.00	1.00	3.00	4.00
IF4A	1.00	Replacement Fan	1.00	1.00	1.00	12000.00	total cost	spv	0.00	14.00	1.00	3.00	4.00
IF4B	1.00	Electricity	125000.00	110000.00	150000.00	0.08	kwh cost	linear	0.10	0.00	1.00	3.00	4.00
IF4C	1.00	Natural Gas	1700.00	1500.00	2000.00	5.93	gj cost	upv	0.00	20.00	1.00	3.00	4.00
IF4D	1.00	OMR	1.00	0.75	1.10	7000.00	total cost	uniform	0.00	0.00	2.00	3.00	4.00
IF4E	1.00	Second Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	2.00	1.00	3.00	4.00
IF4F	1.00	Plant Replacement	1.00	0.75	1.10	60000.00	total cost	spv	0.00	17.00	1.00	3.00	4.00
IF4G	1.00	Initial Investment	1.00	0.75	1.10	51500.00	total cost	spv	0.00	1.00	1.00	3.00	4.00
IF4H	1.00	Residual Value	1.00	0.90	1.10	-20000.00	total cost	spv	0.00	22.00	1.00	3.00	4.00
PC	1.00	Physical Capital Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
ECA	1.00	LCC Example 5	0.00	0.00	0.00	0.00	0.00	none	2.00	20.00	17.00	3.00	5.00
IF5A	1.00	Replacement Fan	1.00	1.00	1.00	12000.00	total cost	caprecovery	0.00	14.00	1.00	3.00	4.00
IF5B	1.00	Electricity	125000.00	110000.00	150000.00	0.08	kwh cost	spv	0.00	1.00	1.00	3.00	4.00
IF5C	1.00	Natural Gas	1700.00	1500.00	2000.00	5.93	gj cost	spv	0.00	1.00	1.00	3.00	4.00
IF5D	1.00	OMR	1.00	0.75	1.10	7000.00	total cost	spv	0.00	1.00	1.00	3.00	4.00
IF5E	1.00	Initial Investment	1.00	0.75	1.10	103000.00	total cost	caprecovery	0.00	20.00	1.00	3.00	4.00
IF5G	1.00	Plant Replacement	1.00	0.75	1.10	60000.00	total cost	aprecoveryspv	0.00	0.00	1.00	3.00	4.00
IF5H	1.00	Residual Value	1.00	0.90	1.10	-20000.00	total cost	caprecovery	0.00	20.00	1.00	3.00	4.00
EC	1.00	Economic Capital Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
TR	1.00	Total Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
NCA_A	1.00	NIST Table 52	0.00	0.00	0.00	0.00	total cost	none	1.00	20.00	1.00	3.00	5.00

Target A [for testing same data as Benchmarks]



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PC_A	1.00	Physical Capital Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
ECA_A	1.00	LCC Example 5	0.00	0.00	0.00	0.00	0.00	none	2.00	20.00	17.00	3.00	5.00
IF5A_A	1.00	Replacement Fan	1.00	1.00	1.00	12000.00	total cost	caprecovery	0.00	14.00	1.00	3.00	4.00
IF5B_A	1.00	Electricity	125000.00	110000.00	150000.00	0.08	kwh cost	spv	0.00	1.00	1.00	3.00	4.00
IF5C_A	1.00	Natural Gas	1700.00	1500.00	2000.00	5.93	gj cost	spv	0.00	1.00	1.00	3.00	4.00
IF5D_A	1.00	OMR	1.00	0.75	1.10	7000.00	total cost	spv	0.00	1.00	1.00	3.00	4.00
IF5E_A	1.00	Initial Investment	1.00	0.75	1.10	103000.00	total cost	caprecovery	0.00	20.00	1.00	3.00	4.00
IF5G_A	1.00	Plant Replacement	1.00	0.75	1.10	60000.00	total cost	aprecoveryspv	0.00	0.00	1.00	3.00	4.00
IF5H_A	1.00	Residual Value	1.00	0.90	1.10	-20000.00	total cost	caprecovery	0.00	20.00	1.00	3.00	4.00
EC_A	1.00	Economic Capital Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
TR_A	1.00	Total Cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00

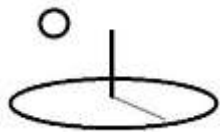
Indicator1.MathExpression

$I1.Q1.factor1 + I1.Q2.factor2 + I1.Q3.factor3 + I1.Q4.factor4 + I1.Q5.factor5 + I1.Q6.factor6 +$
 $I1.Q7.factor7 + I1.Q8.factor8 + I1.Q9.factor9 + I1.Q10.factor10 + I1.Q11.factor11$

Indicator1.MathResult

Benchmarks

These mathematical results differ slightly from the Examples shown in the Life Cycle Calculation reference because of rounding (i.e. Example 2's \$544,983 compared to NIST's \$545,035) and because those calculators treat Salvage Value differently. In the context of DevTreks, the first 4 of these examples correspond to Capital Budgets while the 5th applies to Operating Budgets.



DevTreks –social budgeting that improves lives and livelihoods

label	location	risks_and_factor1	factor2	factor3	factor4	QTMostUr	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
NCA	1 NIST Table	0	0	0	0	total cost	none	1	20	1	3	4	516391	449959.2	597461.5
IF1A	1 Electricity	250000	225000	300000	0.08	kwh cost	upvtable	15.13	20	1	3	4	302600	272340	363120
IF1B	1 OMR	1	0.75	1.1	7000	carbon cost	upv	0	20	1	3	4	104142.3	78106.74	114556.6
IF1C	1 CO2 Equiv	8500	7000	10000	0.02	total cost	none	0	0	1	3	4	170	140	200
IF1D	1 Plant Repl	1	1	1	12000	total cost	spv	0	12	1	3	4	8416.559	8416.559	8416.559
IF1E	1 Initial Inve	1	0.9	1.1	103000	total cost	none	0	0	1	3	4	103000	92700	113300
IF1F	1 Residual V	1	0.9	1.1	-3500	total cost	spv	0	20	1	3	4	-1937.87	-1744.08	-2131.65
NCB	1 NIST Table	0	0	0	0	total cost	none	2	20	1	3	4	544983.8	450441.8	626097.3
IF2A	1 Replaceme	1	1	1	12000	total cost	spv	0	14	1	3	4	7933.414	7933.414	7933.414
IF2B	1 Electricity	125000	110000	150000	0.08	kwh cost	upvtable	14.28	20	1	3	4	142800	125664	171360
IF2C	1 Natural Ga	1700	1500	2000	5.93	gj cost	upvtable	17.03	20	1	3	4	171679.4	151481.9	201975.8
IF2D	1 OMR	1	0.75	1.1	7000	total cost	uniform	0	0	1	3	4	98164.13	73623.1	107980.5
IF2E	1 Second Inv	1	0.75	1.1	51500	total cost	spv	0	2	1	3	4	48543.69	36407.77	53398.06
IF2F	1 Plant Repl	1	0.75	1.1	60000	total cost	spv	0	17	1	3	4	36300.99	27225.74	39931.09
IF2G	1 Initial Inve	1	0.75	1.1	51500	total cost	spv	0	1	1	3	4	50000	37500	55000
IF2H	1 Residual V	1	0.9	1.1	-20000	total cost	spv	0	22	1	3	4	-10437.9	-9394.07	-11481.6
NCC	1 LCC Exam	0	0	0	0	total cost	none	2	20	1	3	4	520718.7	429037.4	597489.7
IF3A	1 Replaceme	1	1	1	12000	total cost	spv	0	14	1	3	4	7933.414	7933.414	7933.414
IF3B	1 Electricity	125000	110000	150000	0.08	kwh cost	uniform	0	0	1	3	4	140234.5	123406.3	168281.4
IF3C	1 Natural Ga	1700	1500	2000	5.93	gj cost	upv	0	20	1	3	4	149979.8	132335.1	176446.9
IF3D	1 OMR	1	0.75	1.1	7000	total cost	uniform	0	0	1	3	4	98164.13	73623.1	107980.5
IF3E	1 Second Inv	1	0.75	1.1	51500	total cost	spv	0	2	1	3	4	48543.69	36407.77	53398.06
IF3F	1 Plant Repl	1	0.75	1.1	60000	total cost	spv	0	17	1	3	4	36300.99	27225.74	39931.09
IF3G	1 Initial Inve	1	0.75	1.1	51500	total cost	spv	0	1	1	3	4	50000	37500	55000
IF3H	1 Residual V	1	0.9	1.1	-20000	total cost	spv	0	22	1	3	4	-10437.9	-9394.07	-11481.6
NC	1 Natural Ca	0	0	0	0	total cost	0	0	1	1	6	9	1582093	1329438	1821048
PCA	1 LCC Exam	0	0	0	0	total cost	none	2	20	1	3	4	868853.9	735396.5	1015252
IF4A	1 Replaceme	1	1	1	12000	total cost	spv	0	14	1	3	4	7933.414	7933.414	7933.414
IF4B	1 Electricity	125000	110000	150000	0.08	kwh cost	linear	0.1	0	1	3	4	488369.7	429765.4	586043.7
IF4C	1 Natural Ga	1700	1500	2000	5.93	gj cost	upv	0	20	1	3	4	149979.8	132335.1	176446.9
IF4D	1 OMR	1	0.75	1.1	7000	total cost	uniform	0	0	2	3	4	98164.13	73623.1	107980.5
IF4E	1 Second Inv	1	0.75	1.1	51500	total cost	spv	0	2	1	3	4	48543.69	36407.77	53398.06
IF4F	1 Plant Repl	1	0.75	1.1	60000	total cost	spv	0	17	1	3	4	36300.99	27225.74	39931.09
IF4G	1 Initial Inve	1	0.75	1.1	51500	total cost	spv	0	1	1	3	4	50000	37500	55000
IF4H	1 Residual V	1	0.9	1.1	-20000	total cost	spv	0	22	1	3	4	-10437.9	-9394.07	-11481.6
PC	1 Physical C	0	0	0	0	0	0	0	1	1	3	4	868853.9	735396.5	1015252
ECA	1 LCC Exam	0	0	0	0	0	none	2	20	17	3	4	36698.3	30145.18	41981.21
IF5A	1 Replaceme	1	1	1	12000	total cost	caprecove	0	14	1	3	4	1062.316	1062.316	1062.316
IF5B	1 Electricity	125000	110000	150000	0.08	kwh cost	spv	0	1	1	3	4	9708.738	8543.689	11650.49
IF5C	1 Natural Ga	1700	1500	2000	5.93	gj cost	spv	0	1	1	3	4	9787.379	8635.922	11514.56
IF5D	1 OMR	1	0.75	1.1	7000	total cost	spv	0	1	1	3	4	6796.117	5097.087	7475.728
IF5E	1 Initial Inve	1	0.75	1.1	103000	total cost	caprecove	0	20	1	3	4	6923.218	5192.413	7615.54
IF5G	1 Plant Repl	1	0.75	1.1	60000	total cost	caprecove	0	0	1	3	4	3764.844	2823.633	4141.328
IF5H	1 Residual V	1	0.9	1.1	-20000	total cost	caprecove	0	20	1	3	4	-1344.31	-1209.88	-1478.75
EC	1 Economic	0	0	0	0	0	0	0	1	1	3	4	36698.3	30145.18	41981.21
TR	1 Total Cost	0	0	0	0	0	0	0	1	1	4	5.6667	2487646	2094980	2878282

Target A

PC_A	1 Physical C	0	0	0	0	0	0	0	1	1	3	4	868853.9	735396.5	1015252
ECA_A	1 LCC Exam	0	0	0	0	0	none	2	20	17	3	4	36698.3	30145.18	41981.21
IF5A_A	1 Replaceme	1	1	1	12000	total cost	caprecove	0	14	1	3	4	1062.316	1062.316	1062.316
IF5B_A	1 Electricity	125000	110000	150000	0.08	kwh cost	spv	0	1	1	3	4	9708.738	8543.689	11650.49
IF5C_A	1 Natural Ga	1700	1500	2000	5.93	gj cost	spv	0	1	1	3	4	9787.379	8635.922	11514.56
IF5D_A	1 OMR	1	0.75	1.1	7000	total cost	spv	0	1	1	3	4	6796.117	5097.087	7475.728
IF5E_A	1 Initial Inve	1	0.75	1.1	103000	total cost	caprecove	0	20	1	3	4	6923.218	5192.413	7615.54
IF5G_A	1 Plant Repla	1	0.75	1.1	60000	total cost	caprecove	0	0	1	3	4	3764.844	2823.633	4141.328
IF5H_A	1 Residual V	1	0.9	1.1	-20000	total cost	caprecove	0	20	1	3	4	-1344.31	-1209.88	-1478.75
EC_A	1 Economic	0	0	0	0	0	0	0	1	1	3	4	36698.3	30145.18	41981.21
TR_A	1 Total Cost	0	0	0	0	0	0	0	1	1	4	5.6667	2487646	2094980	2878282

2. Coffee Farm Budget Math Result (1*)



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This following farm budget comes from the Fleming et al (1998) reference. No WBS was available for classifying this data –social networks must provide uniform guidance to all of their clubs before these budgets can be used for professional work. The Fairtrade International (2011) reference provides further guidance for developing agricultural cost of production studies applicable to “sustainability reporting”. The latter organization requires adding a \$0.30/pound premium to the revenue line items to account for their certification requirements (as of June, 2017).

The objective of most agricultural cost of production studies is to derive a final Net Return per Hectare calculated by subtracting expenses from revenues. This algorithm can’t distinguish expenses from revenues –the algorithm considers them be generic cost or benefit indicators that get cumulatively summed up the hierarchy chain. The following example demonstrates using negative prices for the cost items, which means their costs will be correctly subtracted from revenues in the final Net Return calculation. A positive Net Return signals profits, a negative Net Return signals losses.

Indicator1.MathResult



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label	location_risks_and_indicators	factor1	factor2	factor3	factor4	QTMostU	factor1	factor7	factor9	factor10	factor11	QTMost	QTLow	QTUp
ECA	1 Crop Revenue	0	0	0	0	revenue p none	1	1	1	4	5	11521.48	11268	11905
IFOA	1 Coffee Cherry	9200	9000	9500	1.25	lbs per acre none	0	1	1	4	5	11500	11250	11875
IFOB	1 Processed	3.58	3	5	6	lbs per acre none	0	1	1	4	5	21.48	18	30
ECB	1 Nutrient Management	0	0	0	0	cost per acre none	0	1	1	4	5	-347.5	-295.5	-371
IF1A	1 Super Ammonium Phospho	1875	1600	2000	-0.18	pounds per acre none	0	1	1	4	5	-337.5	-288	-360
IF1B	1 Labor	1	0.75	1.1	-10	hours per acre none	0	1	1	4	5	-10	-7.5	-11
ECC	1 Weed Management	0	0	0	0	cost per acre none	0	1	1	4	5	-401	-352.5	-455.25
IF2A	1 Roundup	2	1.75	2.25	-75	gallons per acre none	0	1	1	4	5	-150	-131.25	-168.75
IF2B	1 Sticker	5.6	5	7	-10	gallons per acre none	0	1	1	4	5	-56	-50	-70
IF2C	1 Spraying Labor	16	14	18	-10	hours per acre none	0	1	1	4	5	-160	-140	-180
IF2D	1 Mowing Labor	2	2	2	-10	hours per acre none	0	1	1	4	5	-20	-20	-20
IF2E	1 Equipment and Fuel	1	0.75	1.1	-15	hours per acre none	0	1	1	4	5	-15	-11.25	-16.5
ECD	1 Wildlife Management	0	0	0	0	cost per acre none	0	1	1	4	5	-69.25	-67.4	-71.1
IF3A	1 Rat Bait	5	4	6	-1.85	lbs per acre none	0	1	1	4	5	-9.25	-7.4	-11.1
IF3B	1 Labor	6	6	6	-10	hours per acre none	0	1	1	4	5	-60	-60	-60
EDE	1 Pest Management	0	0	0	0	cost per acre none	0	1	1	4	5	-34	-34	-34
IF4A	1 Sunspray	1	1	1	-24	gals per acre none	0	1	1	4	5	-24	-24	-24
IF4B	1 Labor	1	1	1	-10	hours per acre none	0	1	1	4	5	-10	-10	-10
EDF	1 Irrigation Water Managem	0	0	0	0	cost per acre none	0	1	1	4	5	-466	-411.5	-520.5
IF5A	1 Water	2	1.75	2.25	-178	\$ per month none	0	1	1	4	5	-356	-311.5	-400.5
IF5B	1 Labor	11	10	12	-10	hours per acre none	0	1	1	4	5	-110	-100	-120
EDG	1 Orchard Management	0	0	0	0	cost per acre none	0	1	1	4	5	-1005	-890	-1120
IF6A	1 Pruning Major Labor	67	60	75	-10	hours per acre none	0	1	1	4	5	-670	-600	-750
IF6B	1 Pruning Sucker Labor	21	18	24	-10	hours per acre none	0	1	1	4	5	-210	-180	-240
IF6C	1 Mulching Labor	2	2	1	-10	hours per acre none	0	1	1	4	5	-20	-20	-10
IF6D	1 Equipment and Fuel	7	6	8	-15	hours per acre none	0	1	1	4	5	-105	-90	-120
EDH	1 Harvest Management	0	0	0	0	cost per acre none	0	1	1	4	5	-4484.75	-4388.75	-4628.75
IF7A	1 Picking Labor	9200	9000	9500	-0.38	\$ per lb per acre none	0	1	1	4	5	-3496	-3420	-3610
IF7B	1 Labor Overhead	9200	9000	9500	-0.1	& revenue none	0	1	1	4	5	-920	-900	-950
IF7C	1 Bags and Labor	55	55	55	-1.25	\$ per bag per acre none	0	1	1	4	5	-68.75	-68.75	-68.75
EDI	1 Marketing	0	0	0	0	cost per acre none	0	1	1	4	5	-191.6	-180.6	-190.6
IF8A	1 Hauling	6	5	5	-5	trips per acre none	0	1	1	4	5	-30	-25	-25
IF8B	1 Labor	4.6	4	5	-10	cost per acre none	0	1	1	4	5	-46	-40	-50
IF8C	1 Excise Tax	0.01	0.01	0.01	-11560	& revenue none	0	1	1	4	5	-115.6	-115.6	-115.6
EC	1 Economic Capital Cost	0	1	1	0	cost per acre none	0	0	0	4	5	4522.38	4647.75	4513.8
HCA	1 Farm Management	0	0	0	0	cost per acre none	0	1	1	4	5	-1019.2	-1019.2	-1019.2
IF9A	1 Management Labor	0.05	0.05	0.05	-11560	& revenue none	0	1	1	4	5	-578	-578	-578
IF9B	1 Office Overhead	0.02	0.02	0.02	-11560	& revenue none	0	1	1	4	5	-231.2	-231.2	-231.2
IF9C	1 Operating Interest	10	10	10	-21	\$ per month none	0	1	1	4	5	-210	-210	-210
HC	1 Human Capital Cost	0	1	1	0	cost per acre none	0	0	0	4	5	-1019.2	-1019.2	-1019.2
PCA	1 Installation Equipment an	0	0	0	0	cost per acre none	0	1	1	4	5	-3360.98	-3360.98	-3360.98
IF10A	1 Initial Planting	4000	4000	4000	-1	cost per acre caprec	0	10	1	4	5	-596.118	-596.118	-596.118
IF10B	1 Other Improvements	2500	2500	2500	-1	cost per acre caprec	0	20	1	4	5	-254.631	-254.631	-254.631
IF10C	1 Trucks	5000	5000	5000	-1	cost per acre caprec	0	5	1	4	5	-1252.28	-1252.28	-1252.28
IF10D	1 Other Machinery	1000	1000	1000	-1	cost per acre caprec	0	7	1	4	5	-192.072	-192.072	-192.072
IF10E	1 Irrigation System	3000	3000	3000	-1	cost per acre caprec	0	10	1	4	5	-447.089	-447.089	-447.089
IF10F	1 Equipment	500	500	500	-1	cost per acre caprec	0	10	1	4	5	-74.5147	-74.5147	-74.5147
IF10G	1 Bldgs	1250	1250	1250	-1	cost per acre caprec	0	5	1	4	5	-313.071	-313.071	-313.071
IF10H	1 OMR	0.02	0.02	0.02	-11560	& revenue none	0	1	1	4	5	-231.2	-231.2	-231.2
PCB	1 Land	0	0	0	0	cost per acre none	0	1	1	4	5	-250	-250	-250
IF11A	1 Rental Fee	1	1	1	-250	rent per acre none	0	1	1	4	5	-250	-250	-250
PC	1 Physical Capital Cost	0	1	1	0	cost per acre none	0	0	0	4	5	-3610.98	-3610.98	-3610.98
TR	1 Net Returns	0	3	3	0	cost per acre none	0	0	1	4	5	-107.797	17.5731	-116.377

3. Coffee Farm Household Living Wage Math Result (2*)

The Global Living Wage Coalition (ERC, 2017) defines living wages as follows:

“Remuneration received for a standard work week by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family. Elements of a decent



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standard of living include food, water, housing, education, health care, transport, clothing, and other essential needs including provision for unexpected events.”

ERC (2017) calculates living wages using household budget data based on “a nutritious low-cost diet, basic acceptable housing, [...] non-food non-housing costs, unforeseen events, and statutory payroll deductions and taxes.” They use the following images to summarize these components of a living wage. Anker (2011, 2013) developed this methodology because of shortfalls relying solely on secondary household survey data for household budgeting. [The Ankers’ 2017 reference charges fees, which has limited usefulness in the public goods context of DevTreks.]

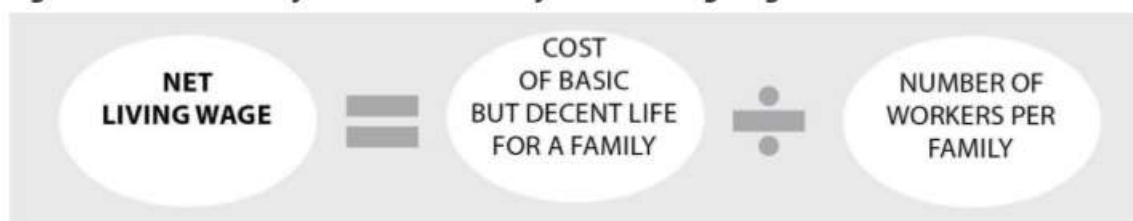


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Figure 6.1. Components of a basic but decent life for a family



Figure 6.2. From cost of basic but decent life to net living wage



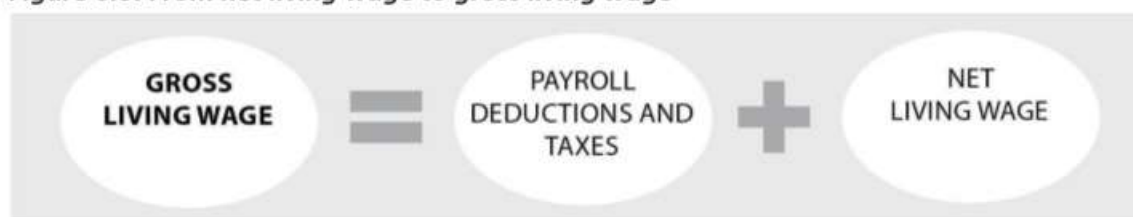
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Under the Aegis of Fairtrade International, Forest Stewardship Council, GoodWeave International, Rainforest Alliance, Social Accountability International, Sustainable Agriculture Network, and UTZ, in partnership with ISEAL Alliance and Richard Anker and Martha Anker

11

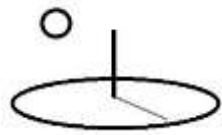
Living Wage Report for Rural Vietnam with focus on Seafood Processing Industry

Figure 6.3: From net living wage to gross living wage



Source: Anker and Anker (2017).

The following household budget TEXT dataset calculates monthly living wages for Vietnamese seafood industry workers. The general methodology is applicable for any household, including farm household living wages (4*). The Anker (2011, 2013) and ERC references (2017) explain



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the calculations in depth. This budget had to alter some of their methods, especially wage adjustments, to account for the cumulative sums accruing in these budgets. The Sustainable Food Lab (2016 in Example 1) and Shipman et al (2016) demonstrate techniques to apply when this type of household is also the farmer (4*).

Benchmarks

label	locati	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
SCA	1	Food	0.00	0.00	0.00	0.00	monthly cost	120.00	0.00	0.00	0.00	2.00	4.00
IF1A	1	Plain Rice	415.00	311.25	518.75	10.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1B	1	Sticky Rice	35.00	26.25	43.75	13.50	grams	none	0.00	1.00	1.00	3.00	3.00
IF1C	1	Noodles	9.00	6.75	11.25	50.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1D	1	Bread	6.00	4.50	7.50	20.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1E	1	Potato	20.00	15.00	25.00	10.60	grams	none	0.00	1.00	1.00	3.00	3.00
IF1F	1	Tofu	17.00	12.75	21.25	19.70	grams	none	0.00	1.00	1.00	3.00	3.00
IF1G	1	Peanuts	14.00	10.50	17.50	55.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1H	1	UHT milk	90.00	67.50	112.50	36.70	ml	none	0.00	1.00	1.00	3.00	3.00
IF1J	1	Eggs (duck)	58.00	43.50	72.50	32.30	grams	none	0.00	1.00	1.00	3.00	3.00
IF1K	1	Pork	21.00	15.75	26.25	65.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1L	1	Fish	88.00	66.00	110.00	25.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1M	1	Morning glory	140.00	105.00	175.00	12.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1N	1	Tomato	77.00	57.75	96.25	8.70	grams	none	0.00	1.00	1.00	3.00	3.00
IF1O	1	Mustard green	88.00	66.00	110.00	6.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1P	1	Banana	78.00	58.50	97.50	5.90	grams	none	0.00	1.00	1.00	3.00	3.00
IF1Q	1	Watermelon	96.00	72.00	120.00	7.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1R	1	Oil	20.00	15.00	25.00	22.50	grams	none	0.00	1.00	1.00	3.00	3.00
IF1S	1	Sugar	16.00	12.00	20.00	16.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1T	1	Tea	50.00	37.50	62.50	13.80	grams	none	0.00	1.00	1.00	3.00	3.00
IF1X	1	Fish sauce	16.00	12.00	20.00	20.00	grams	none	0.00	1.00	1.00	3.00	3.00
IF1Y	1	Additional Staple	0.14	0.12	0.20	21100.00	total cost	none	0.00	1.00	1.00	3.00	3.00
SCB	1	Housing	0.00	0.00	0.00	0.00	monthly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF2A	1	Electricity	122000.00	91500.00	152500.00	0.10	kwh/month	none	0.00	1.00	1.00	3.00	3.00
IF2B	1	Piped Water	70000.00	52500.00	87500.00	1.00	m3/month	none	0.00	1.00	1.00	3.00	3.00
IF2C	1	Garbage collection	1.00	0.75	1.25	10000.00	monthly cost	none	0.00	1.00	1.00	3.00	3.00
IF2D	1	Gas for cooking	80000.00	60000.00	100000.00	1.00	l/month	none	0.00	1.00	1.00	3.00	3.00
IF2E	1	Public lighting	1.00	0.75	1.25	5000.00	total cost	none	0.00	1.00	1.00	3.00	3.00
IF2F	1	Rent	1.00	0.75	1.25	800000.00	total cost	none	0.00	1.00	1.00	3.00	3.00
SCC	1	NFNH	0.00	0.00	0.00	0.00	monthly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF3A	1	Food Cost Ratio	0.794	0.596	0.993	2896332.000	nual food ra	none	0.000	1.000	1.000	3.000	3.000
SCD	1	Miscellaneous	0.00	0.00	0.00	0.00	monthly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF4A	1	Unexpected events	0.050	0.038	0.063	6173219.608	nual food ra	none	0.000	1.000	1.000	3.000	3.000
SC	1	Household Expendables	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
ECA	1	Gross Monthly Wage Adjustments	0.00	0.00	0.00	0.00	ntly living w	1.00	0.00	0.00	0.00	2.00	4.00
IF1A	1	Net takehome pay	0.470	0.353	0.588	-6481880.588	1/fte/mont	none	0.000	1.000	1.000	3.000	3.000
IF1B	1	Mandatory deductions	0.105	0.079	0.131	3046483.877	nual food ra	none	0.000	1.000	1.000	3.000	3.000
ECB	1	Benefits	0.00	0.00	0.00	0.00	monthly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF2A	1	In kind benefits (lunch)	1.000	0.750	1.250	-358800.000	onthly bene	none	0.000	1.000	1.000	3.000	3.000
IF2B	1	Cash allowances and bonus	1.000	0.750	1.250	-448333.000	onthly bene	none	0.000	1.000	1.000	3.000	3.000
EC	1	Wage Adjustments	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
TR	1	Adjusted Gross Living Wage	0.000	0.000	0.000	0.000	0.000	none	0.000	1.000	1.000	0.000	0.000

Actuals (partially displayed; testing purposes used benchmarks, but with only 2 digits of accuracy in the spreadsheet used to generate the TEXT dataset; Example 3 shows that although Version 2.1.2 now supports scientific notation, this algorithm was not upgraded because very few budgets use that data format)



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SC_AA	1	Household Expendables	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
ECA_AA	1	Gross Monthly Wage Adjustments	0.00	0.00	0.00	0.00	ntly living w	1.00	0.00	0.00	0.00	2.00	4.00
IF1A_AA	1	Net takehome pay	0.47	0.35	0.59	-6481880.59	1/fte/mont	none	0.00	1.00	1.00	3.00	3.00
IF1B_AA	1	Mandatory deductions	0.11	0.08	0.13	3046483.88	hual food ra	none	0.00	1.00	1.00	3.00	3.00
ECB_AA	1	Benefits	0.00	0.00	0.00	0.00	monthly cost	1.00	0.00	0.00	0.00	2.00	4.00
IF2A_AA	1	In kind benefits (lunch)	1.00	0.75	1.25	-358800.00	onthly bene	none	0.00	1.00	1.00	3.00	3.00
IF2B_AA	1	Cash allowances and bonus	1.00	0.75	1.25	-448333.00	onthly bene	none	0.00	1.00	1.00	3.00	3.00
EC_AA	1	Wage Adjustments	0.00	0.00	0.00	0.00	total cost	none	0.00	1.00	1.00	0.00	0.00
TR_AA	1	Adjusted Gross Living Wage	0.00	0.00	0.00	0.00	0.00	none	0.00	1.00	1.00	0.00	0.00

Indicator.MathResults - Benchmarks

label	location	risks_and	factor1	factor2	factor3	factor4	QTMostUn	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
SCA	1.0000	Food	0.0000	0.0000	0.0000	0.0000	monthly co	120.0000	0.0000	0.0000	0.0000	3.0000	3.0000	2896332.0000	2210229.0000	3683715.0000
IF1A	1.0000	Plain Rice	415.0000	311.2500	518.7500	10.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	498000.0000	373500.0000	622500.0000
IF1B	1.0000	Sticky Rice	35.0000	26.2500	43.7500	13.5000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	56700.0000	42525.0000	70875.0000
IF1C	1.0000	Noodles	9.0000	6.7500	11.2500	50.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	54000.0000	40500.0000	67500.0000
IF1D	1.0000	Bread	6.0000	4.5000	7.5000	20.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	14400.0000	10800.0000	18000.0000
IF1E	1.0000	Potato	20.0000	15.0000	25.0000	10.6000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	25440.0000	19080.0000	31800.0000
IF1F	1.0000	Tofu	17.0000	12.7500	21.2500	19.7000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	40188.0000	30141.0000	50235.0000
IF1G	1.0000	Peanuts	14.0000	10.5000	17.5000	55.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	92400.0000	69300.0000	115500.0000
IF1H	1.0000	UHT milk	90.0000	67.5000	112.5000	36.7000	ml	none	0.0000	1.0000	1.0000	3.0000	3.0000	396360.0000	297270.0000	495450.0000
IF1J	1.0000	Eggs (duck	58.0000	43.5000	72.5000	32.3000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	224808.0000	168606.0000	281010.0000
IF1K	1.0000	Pork	21.0000	15.7500	26.2500	65.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	163800.0000	122850.0000	204750.0000
IF1L	1.0000	Fish	88.0000	66.0000	110.0000	25.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	264000.0000	198000.0000	330000.0000
IF1M	1.0000	Morning gl	140.0000	105.0000	175.0000	12.9000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	216720.0000	162540.0000	270900.0000
IF1N	1.0000	Tomato	77.0000	57.7500	96.2500	8.7000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	80388.0000	60291.0000	100485.0000
IF1O	1.0000	Mustard gr	88.0000	66.0000	110.0000	6.9000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	72864.0000	54648.0000	91080.0000
IF1P	1.0000	Banana	78.0000	58.5000	97.5000	5.9000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	55224.0000	41418.0000	69030.0000
IF1Q	1.0000	Watermelk	96.0000	72.0000	120.0000	7.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	80640.0000	60480.0000	100800.0000
IF1R	1.0000	Oil	20.0000	15.0000	25.0000	22.5000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	54000.0000	40500.0000	67500.0000
IF1S	1.0000	Sugar	16.0000	12.0000	20.0000	16.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	30720.0000	23040.0000	38400.0000
IF1T	1.0000	Tea	50.0000	37.5000	62.5000	13.8000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	82800.0000	62100.0000	103500.0000
IF1X	1.0000	Fish sauce	16.0000	12.0000	20.0000	20.0000	grams	none	0.0000	1.0000	1.0000	3.0000	3.0000	38400.0000	28800.0000	48000.0000
IF1Y	1.0000	Additional	0.1400	0.1200	0.2000	21100.0000	total cost	none	0.0000	1.0000	1.0000	3.0000	3.0000	354480.0000	303840.0000	506400.0000
SCB	1.0000	Housing	0.0000	0.0000	0.0000	0.0000	monthly co	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	977200.0000	732900.0000	1221500.0000
IF2A	1.0000	Electricity	122000.0000	91500.0000	152500.0000	0.1000	kwh/month	none	0.0000	1.0000	1.0000	3.0000	3.0000	12200.0000	9150.0000	15250.0000
IF2B	1.0000	Piped Wat	70000.0000	52500.0000	87500.0000	1.0000	m3/month	none	0.0000	1.0000	1.0000	3.0000	3.0000	70000.0000	52500.0000	87500.0000
IF2C	1.0000	Garbage cl	1.0000	0.7500	1.2500	10000.0000	monthly cc	none	0.0000	1.0000	1.0000	3.0000	3.0000	10000.0000	7500.0000	12500.0000
IF2D	1.0000	Gas for co	80000.0000	60000.0000	100000.0000	1.0000	l/month	none	0.0000	1.0000	1.0000	3.0000	3.0000	80000.0000	60000.0000	100000.0000
IF2E	1.0000	Public light	1.0000	0.7500	1.2500	5000.0000	total cost	none	0.0000	1.0000	1.0000	3.0000	3.0000	5000.0000	3750.0000	6250.0000
IF2F	1.0000	Rent	1.0000	0.7500	1.2500	800000.0000	total cost	none	0.0000	1.0000	1.0000	3.0000	3.0000	800000.0000	600000.0000	1000000.0000
SCC	1.0000	NFNH	0.0000	0.0000	0.0000	0.0000	monthly co	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	2299687.6080	1726213.8720	2876057.6760
IF3A	1.0000	Food Cost	0.7940	0.5960	0.9930	2896332.0000	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	2299687.6080	1726213.8720	2876057.6760
SCD	1.0000	Miscellane	0.0000	0.0000	0.0000	0.0000	monthly co	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	308660.9804	234582.3451	388912.8353
IF4A	1.0000	Unexpecte	0.0500	0.0380	0.0630	6173219.6080	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	308660.9804	234582.3451	388912.8353
SC	1.0000	Househol	0.0000	1.0000	1.0000	0.0000	total cost	none	0.0000	0.0000	0.0000	3.0000	3.0000	6481880.5884	4903925.2171	8170185.5113
ECA	1.0000	Gross Mor	0.0000	0.0000	0.0000	0.0000	monthly livir	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	-2726603.0693	-2047431.6213	-3412256.3979
IF1A	1.0000	Net takeh	0.4700	0.3530	0.5880	-6481880.5880	1/fte/mont	none	0.0000	1.0000	1.0000	3.0000	3.0000	-3046483.8764	-2288103.8476	-3811345.7857
IF1B	1.0000	Mandator	0.1050	0.0790	0.1310	3046483.8770	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	319880.8071	240672.2263	399089.3879
ECB	1.0000	Benefits	0.0000	0.0000	0.0000	0.0000	monthly cos	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	-807133.0000	-605349.7500	-1008916.2500
IF2A	1.0000	In kind ber	1.0000	0.7500	1.2500	-358800.0000	monthly be	none	0.0000	1.0000	1.0000	3.0000	3.0000	-358800.0000	-269100.0000	-448500.0000
IF2B	1.0000	Cash allow	1.0000	0.7500	1.2500	-448333.0000	monthly be	none	0.0000	1.0000	1.0000	3.0000	3.0000	-448333.0000	-336249.7500	-560416.2500
EC	1.0000	Wage Adj	0.0000	1.0000	1.0000	0.0000	total cost	none	0.0000	0.0000	0.0000	3.0000	3.0000	-3533736.0693	-2652781.3713	-4421172.6479
TR	1.0000	Adjusted G	0.0000	2.0000	2.0000	0.0000	0.0000	none	0.0000	0.0000	1.0000	3.0000	3.0000	2948144.5191	2251143.8458	3749012.8634

Indicator.MathResults – Actuals (2 digits of accuracy makes a difference when the magnitude of numbers is this high)

IF3A_AA	1.0000	Food Cost	0.7900	0.6000	0.9900	2896332.0000	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	2288102.2800	1737799.2000	2867368.6800
SCD_AA	1.0000	Miscellane	0.0000	0.0000	0.0000	0.0000	monthly cos	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	308660.9805	246928.7844	370393.1766
IF4A_AA	1.0000	Unexpecte	0.0500	0.0400	0.0600	6173219.6100	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	308660.9805	246928.7844	370393.1766
SC_AA	1.0000	Household	0.0000	1.0000	1.0000	0.0000	total cost	none	0.0000	0.0000	0.0000	3.0000	3.0000	6470295.2605	4927856.9844	8142976.8566
ECA_AA	1.0000	Gross Mor	0.0000	0.0000	0.0000	0.0000	monthly livir	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	-2711370.6505	-2024939.4961	-3428266.6437
IF1A_AA	1.0000	Net takeh	0.4700	0.3500	0.5900	-6481880.5900	1/fte/mont	none	0.0000	1.0000	1.0000	3.0000	3.0000	-3046483.8773	-2268658.2065	-3824309.5481
IF1B_AA	1.0000	Mandator	0.1100	0.0800	0.1300	3046483.8800	annual foo	none	0.0000	1.0000	1.0000	3.0000	3.0000	335113.2268	243718.7104	396042.9044
ECB_AA	1.0000	Benefits	0.0000	0.0000	0.0000	0.0000	monthly cos	1.0000	0.0000	0.0000	0.0000	3.0000	3.0000	-807133.0000	-605349.7500	-1008916.2500
IF2A_AA	1.0000	In kind ber	1.0000	0.7500	1.2500	-358800.0000	monthly be	none	0.0000	1.0000	1.0000	3.0000	3.0000	-358800.0000	-269100.0000	-448500.0000
IF2B_AA	1.0000	Cash allow	1.0000	0.7500	1.2500	-448333.0000	monthly be	none	0.0000	1.0000	1.0000	3.0000	3.0000	-448333.0000	-336249.7500	-560416.2500
EC_AA	1.0000	Wage Adj	0.0000	1.0000	1.0000	0.0000	total cost	none	0.0000	0.0000	0.0000	3.0000	3.0000	-3518503.6505	-2630289.2461	-4473182.8937
TR_AA	1.0000	Adjusted G	0.0000	2.0000	2.0000	0.0000	0.0000	none	0.0000	0.0000	1.0000	3.0000	3.0000	2951791.6105	2975767.7383	3705793.9624

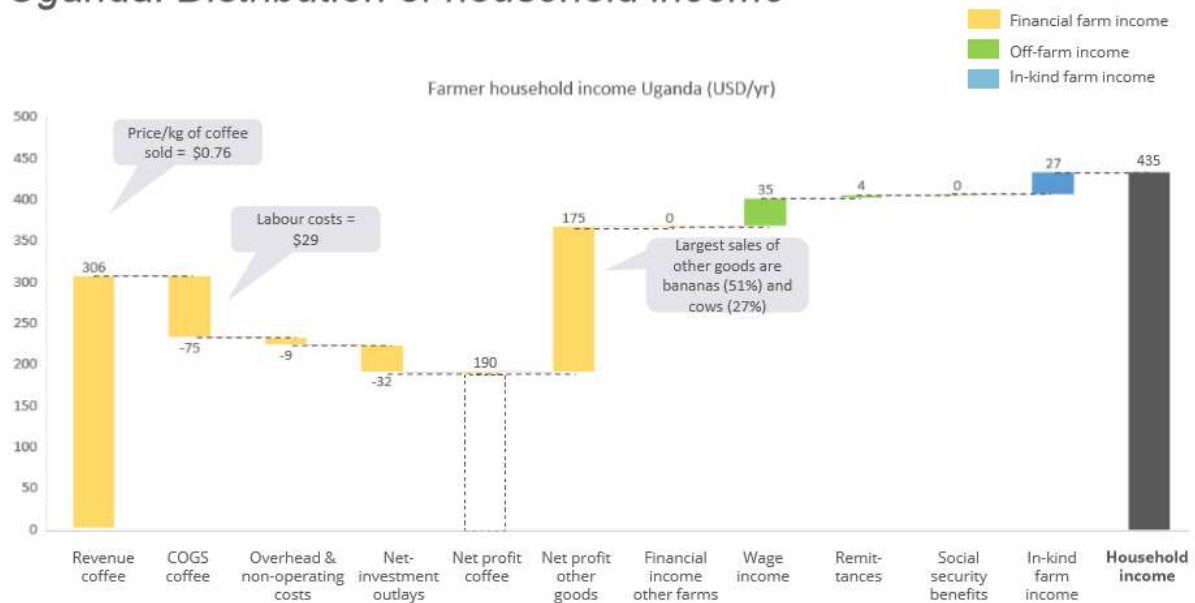


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4. Coffee Supply Chain Social Costs Budget

The following image (True Price, 2017) summarizes household budgets for Ugandan coffee producers.

Uganda: Distribution of household income



Copyright 2017 True Price. All rights reserved.

21

The following images (IDH and True Price, 2017) summarize household and supply chain budgets for coffee production. The first image demonstrates how this organization calculates the social costs, such as water pollution and child labor, associated with agricultural products. The second image demonstrates how they determine social costs for full supply chains (3*). Loconto et al (2014, in Example 1) also discuss using supply chains to figure out which supply chain participants benefit from compliance with certification standards, and by extension, the credibility of the claims made by the standard bearers (i.e. producers capture most benefits).



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2.2 What is a true price?

The true price of a product reflects the visible as well as the hidden costs of its production. It is defined as the sum of the retail price and the unpaid environmental and social costs.



Figure 3 Reducing the true price of a product

These environmental and social costs are monetized in various ways. The main techniques can be separated into damage costs approaches (monetizing the welfare effects of an externality) and abatement costs approaches (monetizing the costs to prevent or restore a negative externality).

For environmental costs, one can mostly use existing approaches. For example, the impact of greenhouse gas emissions on society is often monetized by multiplying the kg of CO₂ equivalent emissions by a Social Cost of Carbon (SCC). The



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also reduces air pollution. 15% of the reduction



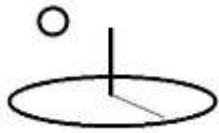
Figure 6 Division of external costs over the coffee supply chain

These studies did not include the underlying raw data which explains why no budgets have been prepared. This reference tries to convey the message that raw, standardized, TEXT datasets, referenced with URIs, should always be included in Social Performance Assessments. That way, authors of these studies don't have to keep using terms such as "futile" (10*).

Optional Indicators 2 to 8. Additional Life Cycle Stages

Example 3 explained that Version 2.1.0 was upgraded to permit subalgorithm15 to be used with Indicators 1 to 15 so that up to 8 life cycle stages could be evaluated for supply chains.

Subalgorithm16 has also been upgraded for that purpose, or any other purpose. For testing purposes, the same data used in Indicator 1 produced the following result for Indicators 2 and 3.



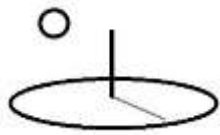
Performance Analysis reference.

Indic 2 Name: Coffee Firm LCC Example Label: RCA2
 Date: 07/12/2017 Rel Label: none
 Math Type: algorithm1 Dist Type: none
 Math Sub Type: subalgorithm16 Base IO: none
 Q1 Amount: 2,487,645.7000 Q1 Unit: target most score
 Q2 Amount: 2,094,980.0844 Q2 Unit: target low score
 Q3 Amount: 2,878,281.6169 Q3 Unit: target high score
 Q4 Amount: 2,487,645.7000 Q4 Unit: benchmark most score
 Q5 Amount: 2,094,980.0844 Q5 Unit: benchmark low score
 Math Express: I2.Q1.mostQ + I2.Q2.lowQ + I2.Q3.highQ + I2.Q4.pQ + I2.Q5.unitQTM + I2.Q6.factorT + I2.Q7.factor1 + I2.Q8.factor2 + I2.Q9.factor3 + I2.Q10.factor4 + I2.Q11.factor5 Math Operator: equalto
 QT Amount: 2,878,281.6169 QT Unit: benchmark high score
 QT D1 Amount: 0.0000 QT D1 Unit:
 QT D2 Amount: 0.0000 QT D2 Unit:
 QT Most Amount: 2,487,645.7000 QT Most Unit: actual most score
 QT Low Amount: 2,094,980.0844 QT Low Unit: actual low score
 QT High Amount: 2,878,281.6169 QT High Unit: actual high score
 Indic 2 Description: This example of a life cycle cost analysis can be found in the Social Performance Analysis reference.

Indic 3 Name: Coffee Firm LCC Example Label: RCA8
 Date: 07/12/2017 Rel Label: none
 Math Type: algorithm1 Dist Type: none
 Math Sub Type: subalgorithm16 Base IO: none
 Q1 Amount: 2,487,645.7000 Q1 Unit: target most score
 Q2 Amount: 2,094,980.0844 Q2 Unit: target low score
 Q3 Amount: 2,878,281.6169 Q3 Unit: target high score
 Q4 Amount: 2,487,645.7000 Q4 Unit: benchmark most score
 Q5 Amount: 2,094,980.0844 Q5 Unit: benchmark low score
 Math Express: I3.Q1.mostQ + I3.Q2.lowQ + I3.Q3.highQ + I3.Q4.pQ + I3.Q5.unitQTM + I3.Q6.factorT + I3.Q7.factor1 + I3.Q8.factor2 + I3.Q9.factor3 + I3.Q10.factor4 + I3.Q11.factor5 Math Operator: equalto
 QT Amount: 2,878,281.6169 QT Unit: benchmark high score
 QT D1 Amount: 0.0000 QT D1 Unit:
 QT D2 Amount: 0.0000 QT D2 Unit:
 QT Most Amount: 2,487,645.7000 QT Most Unit: actual most score
 QT Low Amount: 2,094,980.0844 QT Low Unit: actual low score
 QT High Amount: 2,878,281.6169 QT High Unit: actual high score
 Indic 3 Description: This example of a life cycle cost analysis can be found in the Social Performance Analysis reference.

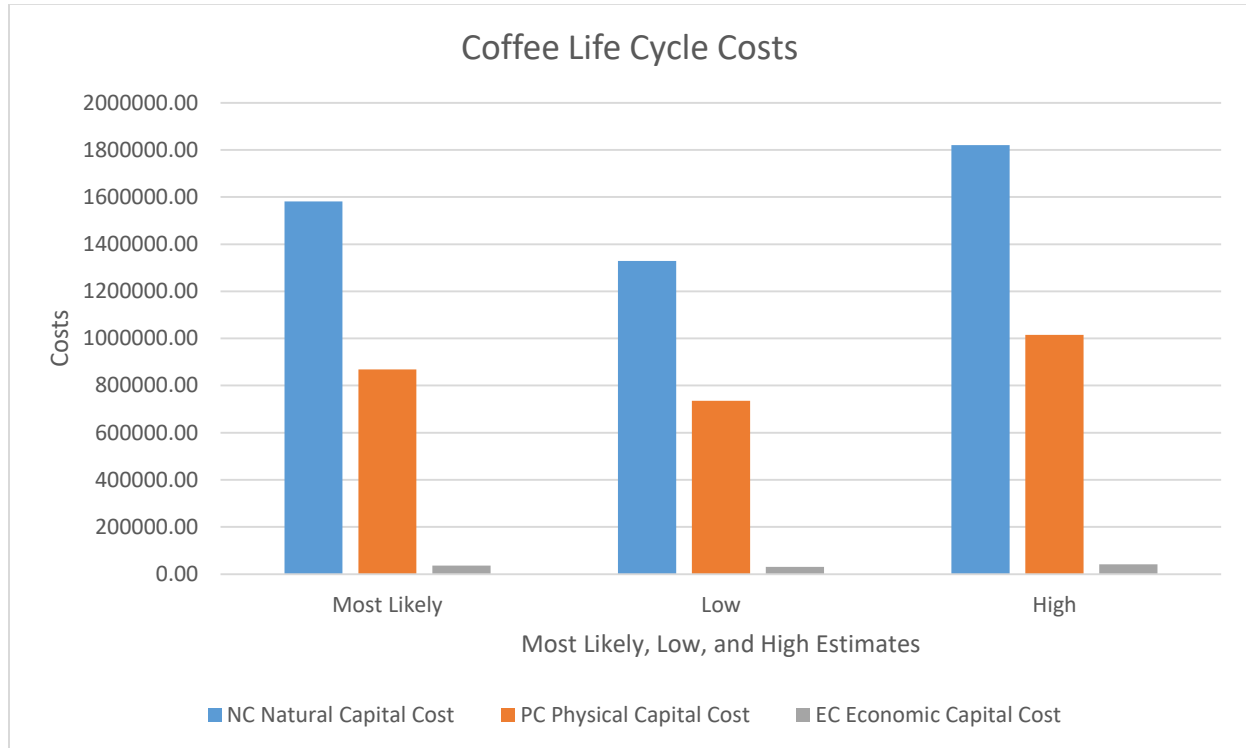
Output Series : Coffee Firm RCA4 M and E

E. Communication



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The firm uses the following types of communication aids to help managers interpret the raw data.



F. Decisions

The coffee firm mostly uses LCC/LCB to support on-farm financial and economic decision making, such as calculating the return on investment of new coffee plantations (i.e. Capital Budgets), or the projected profitability in the coming year (i.e. Operating Budgets). The first 4 cost estimates in the “NIST” example demonstrate the former. The coffee farm budget (Fleming et al, 1998) demonstrates the latter decision support.

Resource conservationists use the “true price”, or social cost of production, studies, to help farmers receive fair compensation for adoption of improved mitigation and adaptation conservation practices. If needed, they also use those budgets to make the consequences of bad actor behavior fully transparent to the impacted communities, investors, supply chain buyers, and



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end product consumers. They use the household living wage budgets to assist public entities carry out social protection actions that target rural households.

Footnotes

1. The author has completed several hundred farm budgets, using a variety of techniques, but prefers the LCC/LCB methodology, especially the basic, standardized, RCA TEXT datasets.
2. The author has completed several hundred household budgets, mostly for farmworkers, using much simpler techniques, but prefers the Anker methodology, especially applied with the basic, standardized, RCA TEXT datasets.
3. Social networks are assumed to have enough knowledge of economics, or access to someone who does, to understand the difficulties of fully monetizing social benefits and costs (i.e. especially using conventional approaches). Hence Examples 4A, 4B, and 4C.
4. Version 220 discovered the Voorend et al. Guatemalan coffee household budget. Please use that budget to understand smallholder farm budget.

Case Study References

Richard Anker. Estimating a living wage: A methodological review. Conditions of Work and Employment Series No. 29. International Labor Office. 2011

Emily Shipman (Sustainable Food Lab), Gabriela Soto (COSA), Jessica Mullan (COSA), Marta Maireles González (ISEAL Alliance), and Stephanie Daniels (Sustainable Food Lab). Measuring guidance document of the Committee on Sustainability Assessment (COSA), the ISEAL Alliance and the Sustainable Food Lab. Version 1.0. October 2016

Fairtrade International. Guideline for Estimating Costs of Sustainable Production. 2011

IDH and True Price. Joint report by IDH (Sustainable Trade Initiative) and True Price. The True Price of Coffee from Vietnam. 2016



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Kent D. Fleming, H. C. “Skip” Bittenbender, and Virginia Easton Smith. The Economics of Producing Coffee in Kona. Cooperative Extension Service. University of Hawaii at Moanoa. 1998 (finding a more recent, complete, coffee crop budget proved “futile” **10***)

Marianna Lena Kambanou, Mattias Lindahl. A Literature Review of Life Cycle Costing in the Product-Service System Context. ScienceDirect, December, 2016

Research Center for Employment Relations (ERC). Living Wage Report Rural Vietnam Soc Trang to Thai Binh Context Provided in the Seafood Processing Industry. Series 1, Report 11. Prepared for: The Global Living Wage Coalition June 2017

TruePrice. Assessing coffee farmer household income. Executive Summary. (last accessed July, 2017: www.trueprice.org)

UNEP/SETAC. Guidelines for Social Life Cycle Assessment of Products. 2009 (primarily covers SLCA but also includes a section on LCC –they published a reference on this subject in 2011 but charge fees which means the reference has limited usefulness in the public goods context of DevTreks)

U.S. Department of Commerce, National Institute for Standards and Technology. Handbook 135, Life-Cycle Costing Manual. 1996 Edition.

U.S. Department of Energy. Life Cycle Cost Handbook. Guidance for Life Cycle Cost Estimation and Analysis. Office of Acquisition and Project Management U.S. Department of Energy Washington, DC, 2014

U.S. Government Accountability Office. Applied Research and Methods. GAO Cost Estimating and Assessment Guide. Best Practices for Developing and Managing Capital Program Costs. March, 2009.



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U.S. General Services Administration. 1.8. Life Cycle Costing.

<https://www.gsa.gov/portal/content/101197> (last accessed May, 2017)

Koen Voorend, Richard Anker and Martha Anker. Living Wage Report. Rural Guatemala Central Departments: Context Provided in the Coffee Sector. Series 1, March 2018. First released 2016.

World Health Organization. Strategizing national health in the 21st century: a handbook. 2016. Chapters 7 and 8 cover cost estimating and budgeting at national scale.



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Example 4A. Coffee Farm RCA4 Compliance Cost Effectiveness Analysis (CEA) (RCA5)

URLs

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4A/1555/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4/541/none>

Resource Stock Assessment and Monitoring and Evaluation Assessment

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA4A Both/2141223479/none>

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA4A Both/2141223493/none>

A. Introduction

This example uses the RCA4 (LCC/LCB) algorithm to carry out a Cost Effectiveness Analysis (CEA) for a representative coffee farm. This example analyzes the cost effectiveness of complying with certification programs. It also illustrates how to “harmonize” different sustainability WBSs. In this example, typical crop budget WBSs will be harmonized with an agricultural sustainability WBS, GLOBALG.A.P., summarized as GG in this example, which certifies the social soundness of agricultural buyers and producers.

The following techniques will be demonstrated simplistically in this example:

1. **Harmonized Indicator Systems:** The GG process allows alternative certification Indicators, with corresponding proof of compliance, to be written next to the GG “Indicators” on a spreadsheet checklist. This example uses a modification of Example 4’s crop budget as the alternative scheme. The point is not to endorse 1 standard system over



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another, but to understand real, alternative, ways to harmonize Indicator systems and apply different algorithms.

2. **Crop Budgets and Cost Effectiveness Analysis (CEA):** Unlike Example 4, where the point was to understand crop Net Returns, Return on Investment, and household Gross Adjusted Income, the point of this example is to understand basic cost effectiveness analysis. Example 4's results are used as the numerator in the CEA formula, cost or benefit per unit of performance.
3. **Compliance Scenarios and Incremental Cost Effectiveness Ratios (ICERs).** Example 1, 2, or 3's results are used as the denominator in the CEA formula, resulting in a total cost or total benefit per unit performance score. Subalgorithms 13 and 14 calculate TR Indexes as averages, while subalgorithm15 uses totals. Example 4's final Net Returns are replaced with Net Return per Unit (Average or Total) Performance. Scenarios use ICERs to demonstrate the cost effectiveness of complying with different degrees of certification compliance, or social performance interventions.

The CEA references used with this Example come from the health care industry because they apply CEA very practically, seriously, and with full decision support context. In terms of agricultural sustainability, the Sustainable Food Lab (in Example 1, 2016) discusses CEA as follows: “Alongside the increased investment in smallholder sourcing is interest—and even urgency—in finding cost-effective approaches to better understanding farm-level conditions and sustainability”.

B. Indicator Thresholds

GG is an accreditation organization, based in Germany, which certifies the social soundness of food buyers and producers. They (2016) describe their farm production certification process as follows:



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“GG is the internationally recognized standard for farm production. By complying with a single harmonized global standard for safe and sustainable food production, producers can show their commitment to Good Agricultural Practices [G.A.P.]”

The following image (GLOBALG.A.P., 2017) shows part of the certification assessment spreadsheet, or checklist, completed by farm companies and verified by trained assessors (i.e. Resource Conservationists). The assessments define Control Points and associated Compliance Criteria, which producers must comply with for certification. In practice, the buyers of agricultural products require these types of certifications from their farm producers. Many of the buyers also supervise overall certification compliance. Separate checklists are available for all farms, all crop production, fruit and orchard “subscope”, aquaculture subscope, tea subscope, and food processing firms.

The SAFA system refers to these types of Indicators, or Criteria, as “Practice Indicators” because they don’t measure performance directly, such as quantity of GHG emissions. Instead, performance is assumed to be the result of the best management practices defined by the Indicators, such as proof that the manager is keeping records proving energy efficiency. In addition, the majority of the Indicators, or Compliance Criteria, focus on food safety and worker welfare.



GLOBALG.A.P. Control Points and Compliance Criteria - Fruit and Vegetables

GLOBALG.A.P. Control Points and Compliance Criteria - Fruit and Vegetables

(Version 5.1_July17)

	Clause No.	Control Points (CP) & Compliance Criteria (CC)	Level
	FV	FRUIT AND VEGETABLES	
	FV 1	SITE MANAGEMENT	
	FV 1.1	Risk Assessment	
CP	FV 1.1.1	Does the risk assessment for the farm site carried out as identified in AF 1.2.1. make particular reference to microbial contamination?	Major Must
CC	FV 1.1.1	As part of their risk assessment for the farm site (see AF 1.2.1.), producers shall identify the locations of nearby commercial animal operations, composting and potential sources for ingress by domestic and wild animals, and other contamination routes such as floodwater intrusion and dust.	Major Must
CP	FV 1.1.2	Has a management plan that establishes and implements strategies to minimize the risks identified in FV 1.1.1. been developed and implemented?	Major Must
CC	FV 1.1.2	A management plan addresses the risks identified in FV 1.1.1 and describes the hazard control procedures that justify that the site in question is suitable for production. This plan shall be appropriate to the products being produced and there shall be evidences of its implementation and effectiveness.	Major Must
	FV 2	SOIL MANAGEMENT (N/A if no soil fumigation is practiced)	
	FV 2.1	Soil Fumigation (N/A if no soil fumigation)	
CP	FV 2.2.1	Is there a written justification for the use of soil fumigants?	Minor Must
CC	FV 2.2.1	There is written evidence and justification for the use of soil fumigants including location, date, active ingredient, doses, method of application and operator. The use of Methyl Bromide as a soil fumigant is not permitted.	Minor Must
CP	FV 2.2.2	Is any pre-planting interval complied with prior to planting?	Minor Must
CC	FV 2.2.2	Pre-planting interval shall be recorded.	Minor Must
	FV 3	SUBSTRATES (N/A if substrates are not used)	
CP	FV 3.1	Does the producer participate in substrate recycling programs for substrates where available?	Recom.
CC	FV 3.1	The producer keeps records documenting quantities recycled and dates. Invoices/loading dockets are acceptable. If there is no participation in a	Recom.

GG's checklists use 3 thresholds –Major Must that require 100% compliance, Minor Must whose Criteria must sum to 95% compliance, and Recommended which must be included in the assessment but not rated. These thresholds have been replaced with the SAFA 5 threshold and scoring system demonstrated in Example 1 and 1A. The top SAFA threshold, best, is the only threshold that actually complies with GG. The GG recognizes that many producers already use other types of “certification schemas”, such as SAFA. Their spreadsheet checklist includes



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separate columns that allow the existing certification Indicators to be listed next to their respective GG Indicators.

A full example of standards harmonization should employ the techniques demonstrated in Example 1A –showing the GG Criteria next to their related SAFA Indicators. That technique will not be demonstrated again because the goal of this example is to demonstrate cost effectiveness by using Example 4’s budgets with the performance data from subalgorithms 13, 14, or 15.

In fairness, the GG is not a true WBS nor is it used as a complete scoring system. WBSs typically have both names and descriptions for Indicators. GG uses descriptions but not names. Their descriptions have been truncated to 100 characters for the purpose of using a name in this example’s TEXT datasets. They use duplicate labels for both Control Points and Compliance Criteria, which were retained, but would be typically handled by making the Criteria children Indicators of the Control Point Categorical Indexes. Some of their labels were changed slightly to accommodate DevTreks character length conventions (2, 3, or ≥ 4).

GG also supports the social, cultural, human, and institutional capitals with a separate checklist, the Risk-Assessment on Social Practice (GRASP, 2016). This example includes that checklist in the full WBS and treats it like another TR Index. The following image (GRASP, 2015) demonstrates how South Africa has interpreted that checklist for the needs of their country. Example 4B explains the pros and cons of including these type of “context-specific” Indicators in CEA –in many cases, the results of CEA can be so demonstrably efficient, that some countries are better off not making CEAs overly dependent on single locations, or single companies.



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Control Point		Compliance Criteria	Interpretation for South Africa
EMPLOYEES' REPRESENTATIVE(S)			
1	Is there at least one employee or an employees' council to represent the interests of the staff to the management through regular meetings where labor issues are addressed?	Documentation is available which demonstrates that a clearly identified, named employees' representative(s) or an employees' council representing the interests of the employees to the management is elected or in exceptional cases nominated by all employees and recognised by the management. The election or nomination takes place in the ongoing year or production period and is communicated to all employees. The employees' representative(s) shall be aware of his/her/their role and rights and be able to discuss complaints and suggestions with the management. Meetings between employees' representative(s) and the management occur at accurate frequency. The dialogue taking place in such meetings is duly documented. N/A if the company employs less than 5 employees.	The employee's representative is not a management representative, but clearly represents the interests of the employees. It is suggested that the size of the employee's council shall reflect the total number of employees working on the farm (e.g. one representative per 50 employees), as well as the gender and race of the workforce. It is recommended to give training to management and employees / committee members on the functions of such committees, meeting procedures, leadership, etc.
COMPLAINT PROCEDURE			
2	Is there a complaint and suggestion procedure available and implemented in the company through which employees can make a complaint or suggestion?	A complaint and suggestion procedure appropriate to the size of the company exists. The employees are regularly informed about its existence, complaints and suggestions can be made without being penalized and are discussed in meetings between the employees' representative(s) and the management. The procedure specifies a time frame to answer complaints and suggestions and take corrective actions. Complaints, suggestions and follow-up solutions from the last 24 months are documented.	All employees are protected by the Labour Relations Act No.66 of 1995, and Chapter 2, Section 9, specifically refer to grievance procedures. Employees must first try to solve their dispute internally, and if it is unsatisfied they can refer the dispute to the CCMA. It is recommended that employees (and management) are trained in both the grievance and disciplinary procedures of the company.

The following 2 images illustrates a GG – SAFA Indicator Thresholds system. The top image shows complete Compliance Points and Certifications. The second image demonstrates actual GG TEXT datasets that could be used directly in other Social Performance Assessments demonstrated in this reference. These TEXT datasets can be found in the URLs.



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Global.G.A.P - SAFA Indicator Thresholds		best	good	moderate	limited	unaccepta
		80 to 100	60 to 80	40 to 60	20 to 40	0 to 20
A11	Site History					
A111	Is there a reference system for each field, orchard, greenhouse, yard, plot, livestock building/pen, and/or other area/location used in production?	Major Must				
A111	Compliance shall include visual identification in the form of: - A physical sign at each field/orchard, greenhouse/yard/plot/livestock building/pen, or other farm area/location; or - A farm map, which also identifies the location of water sources, storage/handling facilities, ponds, stables, etc. and that could be cross-referenced to the identification system. No N/A.	Major Must				
A112	Is a recording system established for each unit of production or other area/location to provide a record of the livestock/aquaculture production and/or agronomic activities undertaken at those locations?	Major Must				
A112	Current records shall provide a history of GLOBALG.A.P. production of all production areas. No N/A.	Major Must				
A12	Site Management					
A121	Is there a risk assessment available for all sites registered for certification (this includes rented land, structures and equipment) and does this risk assessment show that the site in question is suitable for production, with regards to food safety, the environment, and health and welfare of animals in the scope of the livestock and aquaculture certification where applicable?	Major Must				
A121	A written risk assessment to determine whether the sites are appropriate for production shall be available for all sites. It shall be ready for the initial inspection and maintained updated and reviewed when new sites enter in production and when risks for existing ones have changed, or at least annually, whichever is shorter. The risk assessment may be based on a generic one but shall be customized to the farm situation. Risk assessments shall take into account: - Potential physical, chemical (including allergens) and biological hazards - Site history (for sites that are new to agricultural production, history of five years is advised and a minimum of one year shall be known) - Impact of proposed enterprises on adjacent stock/crops/ environment, and the health and safety of animals in the scope of the livestock and aquaculture certification. (See AF Annex 1 and AF Annex 2 for guidance on risk assessments. FV Annex 1 includes guidance regarding flooding)	Major Must				



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label	locat name	01_01_20	01_01_20	01_01_20	01_01_20	01_01_20	01_01_20	01_01_20	01_01_20	01_01_20	certainty1	certainty2	norm	weight
A11	1 Site History	0	0	0	0	0	0	0	0	0	0	0	none	1
A111	1 Is there a reference system for each field,	110	100	100	70	50	30	25	5	3	weight			3
A111	1 Compliance shall include visual identification in the form of:- A physical sign at each field/orcha													
A112	1 Is a recording system established for each unit of production or other area/location to provide a re													
A112	1 Current records shall provide a history of GLOBALG.A.P. production of all production areas. No N/A.													
A12	1 Site Management													
A121	1 Is there a risk assessment available for all sites registered for certification (this includes rente													
A121	1 A written risk assessment to determine whether the sites are appropriate for production shall be ava													
A122	1 Has a management plan that establishes strategies to minimize the risks identified in the risk asses													
A122	1 A management plan addresses the risks identified in AF 1.2.1 and describes the hazard control proced													
A1	1 SITE HISTORY AND SITE MANAGEMENT													
A21	1 Record Management													
A211	1 Are all records requested during the external inspection accessible and kept for a minimum period of													
A211	1 Producers shall keep up-to-date records for a minimum of two years. Electronic records are valid and													
A221	1 Does the producer take responsibility to conduct a minimum of one internal self-assessment per year													
A221	1 There is documented evidence that in Option 1 an internal self-assessment has been completed under t													
A231	1 Have effective corrective actions been taken as a result of non-conformances detected during the int													
A231	1 Necessary corrective actions are documented and have been implemented. N/A only in the case no non-c													
A2	1 RECORD KEEPING AND INTERNAL SELF-ASSESSMENT/INTERNAL INSPECTION													
A31	1 Hygiene Management													
A311	1 Does the farm have a written risk assessment for hygiene?													
A311	1 The written risk assessment for hygiene issues covers the production environment. The risks depend o													
A321	1 Does the farm have a documented hygiene procedure and visibly displayed hygiene instructions for all													
A321	1 The farm shall have a hygiene procedure addressing the risks identified in the risk assessment in AF													
A331	1 Have all persons working on the farm received annual hygiene training appropriate to their activitie													
A331	1 An introductory training course for hygiene shall be given in both written and verbal form. All new													
A341	1 Are the farm's hygiene procedures implemented?													
A341	1 Workers with tasks identified in the hygiene procedures shall demonstrate competence during the insp													
A3	1 HYGIENE													
A41	1 Health and Safety													
A411	1 Does the producer have a written risk assessment for hazards to workers' health and safety?													

The following image demonstrates using the GG process directly to harmonize their Compliance Points and Certifications WBS with a WBS for crop budgets.



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Global.G.A.P			Related Farm Budget WBS	
label	compliance points and criteria	level	label	english translation
A11	Site History		PCA	Farm management record keeping
A111	Is there a reference system for each field, orchard, greenhouse, yard, plot, livestock building/pen,	major must	PCA1	Farm management labor
A111	Compliance shall include visual identification in the form of:	major must	PCA2	Professional farm management services
A112	Is a recording system established for each unit of production or	major must		
A112	Current records shall provide a history of GLOBALG.A.P.	major must		
A12	Site Management			
A121	Is there a risk assessment available for all sites registered for	major must		
A121	A written risk assessment to determine whether the sites are	major must		
A122	Has a management plan that establishes strategies to minimize	major must		
A122	A management plan addresses the risks identified in AF 1.2.1 and	major must		
A1	SITE HISTORY AND SITE MANAGEMENT		PC	Physical Capital
A21	Record Management		ECB	Farm financial accounting record keeping labor
A211	Are all records requested during the external inspection accessible	major must	ECB1	Farm management labor
A211	Producers shall keep up-to-date records for a minimum of two	major must	ECB2	Professional bookkeeping services
A221	Does the producer take responsibility to conduct a minimum of	major must		
A221	There is documented evidence that in Option 1 an internal self-	major must		
A231	Have effective corrective actions been taken as a result of non-	major must		
A231	Necessary corrective actions are documented and have been	major must		
A2	RECORD KEEPING AND INTERNAL SELF-ASSESSMENT/INTERNAL		EC	Economic Capital
A31	Hygiene Management		HCA	Hygiene management
A311	Does the farm have a written risk assessment for hygiene?	major must	HCA1	Farm safety manager labor
A311	The written risk assessment for hygiene issues covers the	major must	HCA2	Professional farm safety services
A321	Does the farm have a documented hygiene procedure and visibly	major must		
A321	The farm shall have a hygiene procedure addressing the risks	major must		
A331	Have all persons working on the farm received annual hygiene	major must		
A331	An introductory training course for hygiene shall be given in both	major must		
A341	Are the farm's hygiene procedures implemented?	major must		
A341	Workers with tasks identified in the hygiene procedures shall	major must		
A3	HYGIENE		HC	Human Capital
A41	Health and Safety			already included in EC and PC
A411	Does the producer have a written risk assessment for hazards to			
A411	The written risk assessment can be a generic one but it shall be			
A412	Does the farm have written health and safety procedures			
A412	The health and safety procedures shall address the points			
A413	Have all people working on the farm received health and safety			
A413	All workers, including subcontractors, can demonstrate			
A42	Training			Human Capital
A421	Is there a record kept for training activities and attendees?			

This table points to at least two ways for relating RCA4 budgets to RCA1, RCA2, and RCA3, Social Performance Assessments. The first is to complete a partial budget, completing revenue and cost “line items” for every category in the Assessment. That’s feasible, especially if hourly labor costs are recorded for the compliance work, but probably overkill.

The second is to reorganize the GG WBS into the typical capital categories demonstrated throughout this reference and then use a lump sum partial budget to assess the aggregated GG



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Indexes. The second approach may be more practical, because administrative expenses, such as record keeping and professional administrative services, are usually lumped together in farm budgets. The lump sum expenses can be allocated to different Indexes by using the Categorical Index.factor6 property. This example demonstrates the second approach. This approach ignores Loconto et al's (2014, in Example 1) conclusion that, in practice, compliance costs are often paid by buyers, not producers.

C. Quality of Life Scenarios

Agricultural advisers are eager to assist their customers' clubs to understand the incremental, or marginal cost and benefits, of achieving greater certification compliance levels. Specifically, will increased revenues or decreased costs, offset compliance costs? Will reduction in social costs result in higher price premiums because of supply chain buyer or end product consumer satisfaction? The sibling Performance Analysis 1 reference refers to this analysis technique as Incremental Cost Effectiveness Analysis or Incremental Cost Effectiveness Ratios (ICERs).

The following 4 Scenarios are evaluated for 2 separate Indicators. The first Indicator will focus only on changes in costs, the convention for most CEAs. The second Indicator adds changes in revenues along with the changes in costs. Although these scenarios suggest that it's possible to precisely judge the effect of compliance on benefits and costs, in practice, precision is unlikely. The datasets used with these scenarios reflect the imprecision.

Scenario 1 or Alternative 1: Benchmark, or No Certification, Costs and Benefits: many current certification requirements have limited or unacceptable ratings.

Scenario 2 or Alternative 2: 50% Compliance, Certification Costs and Benefits: all certification requirements are completed to at least the 50% Threshold Level, or moderate rating.

Scenario 3 or Alternative 3: 70% Compliance, Certification Costs and Benefits: all certification requirements are completed to at least the 70% Threshold Level, or good rating.

Scenario 4 or Alternative 4: 100% Compliance, Certification Costs and Benefits: all certification requirements are completed to at least the 100% Threshold Level, or best rating.



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The terms “Alternative” are also used because formal Project Analysis often study the cost effectiveness of project alternatives. The Alternatives are usually proposed as part of an overall decision support process explained in Appendix A, Part I, Decision Making Processes and Valuations. The PR&G references in SPA1 demonstrate that federal agencies often complete these types of assessments (i.e. the author has completed them). This example displays the results of a simple cost effectiveness for each scenario.

The analyst has to then use that data for more advanced decision support. WHO (2003) describes the general CEA approach that will be used in Examples 4A and 4B, as follows (1*):

“The approach of generalized CEA (GCEA) proposed in this Guide seeks to provide analysts with a method of assessing whether the current mix of interventions is efficient as well as whether a proposed new technology or intervention is appropriate. It also seeks to maximize the generalizability of results across settings.

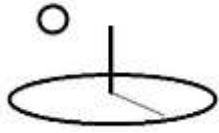
... GCEA proposes the evaluation of interventions against the counterfactual of “doing nothing”, thereby providing decision-makers with information on what could be achieved if they could start again to build the health system, i.e. reallocate all health resources.”

D. Social Performance Score

Example 4 demonstrated that subalgorithm16 employs 22 generic factor properties stored in the Indicator and Categorical Index TEXT data rows. This example demonstrates how to use the first five properties of the Categorical Index to carry out Cost Effectiveness Analysis (CEA).

The first 5 Categorical Index columns of data are defined as follows.

- **factor1:** Most likely quantity of the corresponding CategoricalIndex.QTMost from either subalgorithm 13, 14, or 15. Setting factor1 and factor4 equal to zero tells this algorithm to calculate Categorical Indexes as summations of children Indicators as demonstrated in Example 4. Otherwise, this algorithm will assume that the cost effectiveness analysis (CEA) demonstrated in Example 4A is being run and will calculate Categorical Indexes by dividing the calculated LCC/LCB Categorical Index.QTM, by factor1. When CEA is



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run, performance indicators (QASYs) are discounted exactly the same as costs and benefits.

- **factor2:** Low quantity of the corresponding CategoricalIndex.QTLow from either subalgorithm 13, 14, or 15.
- **factor3:** High quantity of the corresponding CategoricalIndex.QTUp from either subalgorithm 13, 14, or 15.
- **factor4:** Certainty of Categorical Index from the corresponding Categorical Index certainty score, or certainty calculation, from either subalgorithm 13, 14, or 15.
- **factor5:** Unit of measurement for the corresponding Categorical Index.QTM from either subalgorithm 13, 14, or 15.

Indicator1.URL TEXT dataset (using partial budget)

The purpose of Indicator 1 is to demonstrate traditional cost effectiveness where costs, and costs alone, are divided by performance scores.

Benchmarks



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label	locatic_risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
PCA	1 Farm management record keeping	75.00	93.75	56.25	4.50	average performance score	none	0.00	1.00	1.00	8.00	10.00
PCA1	1 Farm management labor	1.00	1.25	0.75	50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PCA2	1 Professional farm management services	2.00	2.50	1.50	75.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PC	1 Physical Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
ECA	1 Farm financial accounting record keeping labor	100.00	125.00	75.00	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
ECA1	1 Farm management labor	1.00	1.25	0.75	50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
ECA2	1 Professional bookkeeping services	2.00	2.50	1.50	10.00	annual fee per acre	none	0.00	1.00	1.00	4.00	5.00
EC	1 Economic Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
HCA	1 Hygiene management	95.00	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCA1	1 Hygiene labor	1.00	1.25	0.75	25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCA2	1 Hygiene facilities	2.00	2.50	1.50	50.00	facilities per acre	none	0.00	1.00	1.00	4.00	5.00
HCB	1 Worker Safety Management	95.00	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCB1	1 Farm safety manager labor	1.00	0.31	0.19	25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCB2	1 Professional farm safety services	2.00	0.06	0.04	50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HC	1 Human Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
TR	1 Cost per Unit Performance	0.00	0.00	0.00	0.00	net return per unit compliance	none	0.00	0.00	0.00	0.00	0.00

Alternatives

HCA_AC	1 Hygiene management	326.04	407.55	244.53	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCA1_AC	1 Hygiene labor	1.80	2.25	1.35	25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCA2_AC	1 Hygiene facilities	3.60	4.50	2.70	50.00	facilities per acre	none	0.00	1.00	1.00	4.00	5.00
HCB_AC	1 Worker Safety Management	326.04	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCB1_AC	1 Farm safety manager labor	1.80	0.31	0.19	25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCB2_AC	1 Professional farm safety services	3.60	0.06	0.04	50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HC_AC	1 Human Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
TR_AC	1 Cost per Unit Performance	0.00	0.00	0.00	0.00	net return per unit compliance	none	0.00	0.00	0.00	0.00	0.00

Indicator2.URL TEXT dataset (using partial budget)

The purpose of Indicator 2 is to demonstrate nuanced cost effectiveness where revenues, costs, and net returns, are factored into the cost effectiveness analysis. With this Indicator, the second Categorical Index property, factor6, is a general multiplier = 0.5. Oftentimes, “lump sum” farm budget expenses, especially administrative expenses such as record keeping, must be allocated in



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a similar manner to specific enterprises, or in this case, Categorical Indexes within enterprises. It's less typical to allocate revenues, as done here.

Benchmarks

label	locatic	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
ECA	1	Crop Revenue	50.00	37.50	65.00	4.80	average performance score	none	1.00	1.00	1.00	8.00	10.00
IFOA	1	Coffee Cherry Premium	5000.00	3750.00	6500.00	0.30	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
IFOB	1	Processed Cherry Premium	500.00	375.00	650.00	0.05	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
ECB	1	Processed Product Revenue	10.00	7.50	13.00	4.80	average performance score	0.50	1.00	1.00	1.00	8.00	10.00
IF1A	1	Product 1 Premium	5.00	3.75	6.50	1.00	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
IF1B	1	Product 2 Premium	1.00	0.75	1.30	0.10	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
EC	1	Change in Revenue	0.00	0.00	0.00	0.00	revenue per unit compliance average performance score	none	0.00	0.00	0.00	0.00	0.00
PCA	1	Farm management record keeping	75.00	93.75	56.25	4.50	average performance score	none	0.00	1.00	1.00	8.00	10.00
PCA1	1	Farm management labor	1.00	1.25	0.75	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PCA2	1	Professional farm management services	2.00	2.50	1.50	-75.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PC	1	Physical Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance average performance score	none	0.00	0.00	0.00	0.00	0.00
ECA	1	Farm financial accounting record keeping labor	100.00	125.00	75.00	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
ECA1	1	Farm management labor	1.00	1.25	0.75	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
ECA2	1	Professional bookkeeping services	2.00	2.50	1.50	-10.00	annual fee per acre	none	0.00	1.00	1.00	4.00	5.00
EC	1	Economic Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance average performance score	none	0.00	0.00	0.00	0.00	0.00
HCA	1	Hygiene management	95.00	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCA1	1	Hygiene labor	1.00	1.25	0.75	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCA2	1	Hygiene facilities	2.00	2.50	1.50	-50.00	facilities per acre	none	0.00	1.00	1.00	4.00	5.00
HCB	1	Worker Safety Management	95.00	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCB1	1	Farm safety manager labor	1.00	0.31	0.19	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCB2	1	Professional farm safety services	2.00	0.06	0.04	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HC	1	Human Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
TR	1	Net Return per Unit Performance	0.00	0.00	0.00	0.00	net return per unit compliance	none	0.00	0.00	0.00	0.00	0.00

Indicator 2 Alternatives (partial display, AA = scenario 2, AB = scenario 3, and AC = scenario 4)



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ECA_AC	1	Crop Revenue	171.60	128.70	223.08	4.80	average performance score	none	1.00	1.00	1.00	8.00	10.00
IFOA_AC	1	Coffee Cherry Premium	9438.00	7078.50	12269.40	0.30	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
IFOB_AC	1	Processed Cherry Premium	943.80	707.85	1226.94	0.05	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
ECB_AC	1	Processed Product Revenue	34.32	25.74	44.62	4.80	average performance score	0.50	1.00	1.00	1.00	8.00	10.00
IF1A_AC	1	Product 1 Premium	9.44	7.08	12.27	1.00	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
IF1B_AC	1	Product 2 Premium	1.89	1.42	2.45	0.10	lbs per acre	none	0.00	1.00	1.00	4.00	5.00
EC_AC	1	Change in Revenue	0.00	0.00	0.00	0.00	revenue per unit compliance	none	0.00	0.00	0.00	0.00	0.00
PCA_AC	1	Farm management record keeping	257.40	321.75	193.05	4.50	average performance score	none	0.00	1.00	1.00	8.00	10.00
PCA1_AC	1	Farm management labor	1.80	2.25	1.35	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PCA2_AC	1	Professional farm management services	3.60	4.50	2.70	-75.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
PC_AC	1	Physical Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
ECA_AC	1	Farm financial accounting record keeping labor	343.20	429.00	257.40	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
ECA1_AC	1	Farm management labor	1.80	2.25	1.35	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
ECA2_AC	1	Professional bookkeeping services	3.60	4.50	2.70	-10.00	annual fee per acre	none	0.00	1.00	1.00	4.00	5.00
EC_AC	1	Economic Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
HCA_AC	1	Hygiene management	326.04	407.55	244.53	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCA1_AC	1	Hygiene labor	1.80	2.25	1.35	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCA2_AC	1	Hygiene facilities	3.60	4.50	2.70	-50.00	facilities per acre	none	0.00	1.00	1.00	4.00	5.00
HCB_AC	1	Worker Safety Management	326.04	118.75	71.25	5.00	average performance score	none	0.00	1.00	1.00	8.00	10.00
HCB1_AC	1	Farm safety manager labor	1.80	0.31	0.19	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HCB2_AC	1	Professional farm safety services	3.60	0.06	0.04	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
HC_AC	1	Human Capital Cost	0.00	0.00	0.00	0.00	cost per unit compliance	none	0.00	0.00	0.00	0.00	0.00
TR_AC	1	Net Return per Unit Performance	0.00	0.00	0.00	0.00	net return per unit compliance	none	0.00	0.00	0.00	0.00	0.00

Math Expressions

Same as Example 4.

Math Results

The MathResults display cost effectiveness ratios in the final 3 columns for each hierarchical Index. These ratios are calculated as follows:

1. **Categorical Indexes:** The Categorical Index LCC or LCB monetary sum, demonstrated in Example 4, will be divided by the Categorical Index factor properties (factor1, factor2, and factor3) to derive a cost or benefit per quantity of factor. The resultant cost effectiveness calculations support decisions associated with “degree of compliance” or degree of social performance. Simplistic, but a starting point. Unlike the Locational and TR Indexes, the columns QTMost2, QTLow2, and QTHigh2, do not display the Total



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Costs used as the numerator in their CEA ratios because 1) the base data in those columns, such as allocation multiplier, is more important, and 2) eyeball, or calculator, Total Costs estimates can be easily made by summing the Indicator Total Cost data.

2. **Locational Indexes:** The sum of the Categorical LCC or LCB calculations will be divided by the sum of the Categorical Index factors, to derive a cost or benefit per quantity of factor. Subalgorithms 13, 14, and 15 normalize and weight all of the Indicators within a Locational Index, not for each separate Categorical Index, supporting “apples with apples” Indicator assessments.
3. **Total Risk (TR) Indexes:** Uses the same techniques as Locational Indexes, except uses all of the Categorical Indexes within a Total Risk Index. Given that each Locational Index uses separate normalized Indicator values, this row is suspect –the Indicators in one Locational Index have been normalized differently than the Indicators in all sibling Locational Indexes (i.e. “apples with oranges”). For convenience, this example ignores that possibility, but Example 4B will introduce an approach for handling this issue.
4. **Final CEA Ratios:** In the following images, the TR Index column (last) displays the sum of the Categorical Index performance scores in the factor1, factor2, and factor3 columns. The QTMost2, QTLow2, and QTHigh2 columns display the sum of the Indicator QTMost, QTLow, and QTUp, LCC/LCB calculations. The column QTMost is the CEA ratio calculated: Indicator 1: $1.42 \text{ (QTMost)} = 520 \text{ (factor7)} / 365 \text{ (factor1)}$, and Indicator 2: $3.35 = 1423.3 / 425$. The column, factor4, is the average certainty score for the Categorical Index performance scores. The columns, factor10 and factor11, are the average certainty scores for the Indicator LCC/LCB calculations. The combination of certainty scores are used to assess the uncertainty of the CEA ratios.

Indicator 1.MathResult

Benchmarks (better data, or better data assumptions, will result in better Most, Low, and High ratios)



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label	locat	risks_and_indicators	factor1	factor2	factor3	factor4	QTMostU	factor6	factor7	factor8	factor9	factor1	factor1	QTMost	QTLow	QTUp
PCA	1	Farm management record keeping	75	93.75	56.25	4.5	average per none		0	1	1	4	5	2.6667	2.6667	2.6667
PCA1	1	Farm management labor	1	1.25	0.75	50	hours per none		0	1	1	4	5	50	62.5	37.5
PCA2	1	Professional farm management services	2	2.5	1.5	75	hours per none		0	1	1	4	5	150	187.5	112.5
PC	1	Physical Capital Cost	75	93.75	56.25	4.5	cost per unit none		200	250	150	4	5	2.6667	2.6667	2.6667
ECA	1	Farm financial accounting record keeping	100	125	75	5	average per none		0	1	1	4	5	0.7	0.7	0.7
ECA1	1	Farm management labor	1	1.25	0.75	50	hours per none		0	1	1	4	5	50	62.5	37.5
ECA2	1	Professional bookkeeping services	2	2.5	1.5	10	annual fee none		0	1	1	4	5	20	25	15
EC	1	Economic Capital Cost	100	125	75	5	cost per unit none		70	87.5	52.5	4	5	0.7	0.7	0.7
HCA	1	Hygiene management	95	118.75	71.25	5	average per none		0	1	1	4	5	1.3158	1.3158	1.3158
HCA1	1	Hygiene labor	1	1.25	0.75	25	hours per none		0	1	1	4	5	25	31.25	18.75
HCA2	1	Hygiene facilities	2	2.5	1.5	50	facilities per none		0	1	1	4	5	100	125	75
HCB	1	Worker Safety Management	95	118.75	71.25	5	average per none		0	1	1	4	5	1.3158	0.0905	0.0947
HCB1	1	Farm safety manager labor	1	0.31	0.19	25	hours per none		0	1	1	4	5	25	7.75	4.75
HCB2	1	Professional farm safety services	2	0.06	0.04	50	hours per none		0	1	1	4	5	100	3	2
HC	1	Human Capital Cost	190	237.5	142.5	5	cost per unit none		250	167	100.5	4	5	1.3158	0.7032	0.7053
TR	1	Cost per Unit Performance	365	456.25	273.75	4.8333	net return none		520	504.5	303	4	5	1.4247	1.1058	1.1068

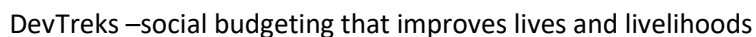
Indicator 2.MathResult

Benchmarks

label	location	risks_and_indicators	factor1	factor2	factor3	factor4	QTMostUnit	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
ECA	1.00	Crop Revenue	50.00	37.50	65.00	4.80	average performance	none	1.00	1.00	1.00	4.00	5.00	30.50	30.50	30.50
IFOA	1.00	Coffee Che	5000.00	3750.00	6500.00	0.30	lbs per acre	none	0.00	1.00	1.00	4.00	5.00	1500.00	1125.00	1950.00
IFOB	1.00	Processed	500.00	375.00	650.00	0.05	lbs per acre	none	0.00	1.00	1.00	4.00	5.00	25.00	18.75	32.50
ECB	1.00	Processed	10.00	7.50	13.00	4.80	average performance	0.50	1.00	1.00	1.00	4.00	5.00	0.26	0.26	0.26
IF1A	1.00	Product 1	5.00	3.75	6.50	1.00	lbs per acre	none	0.00	1.00	1.00	4.00	5.00	2.50	1.88	3.25
IF1B	1.00	Product 2	1.00	0.75	1.30	0.10	lbs per acre	none	0.00	1.00	1.00	4.00	5.00	0.05	0.04	0.07
EC	1.00	Change in	60.00	45.00	78.00	4.80	revenue per unit	none	1527.55	1145.66	1985.82	4.00	5.00	25.46	25.46	25.46
PCA	1.00	Farm management	75.00	93.75	56.25	4.50	average performance	none	0.00	1.00	1.00	4.00	5.00	-2.67	-2.67	-2.67
PCA1	1.00	Farm management labor	1.00	1.25	0.75	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-50.00	-62.50	-37.50
PCA2	1.00	Professional	2.00	2.50	1.50	-75.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-150.00	-187.50	-112.50
PC	1.00	Physical Capital	75.00	93.75	56.25	4.50	cost per unit cost	none	-200.00	-250.00	-150.00	4.00	5.00	-2.67	-2.67	-2.67
ECA	1.00	Farm financial	100.00	125.00	75.00	5.00	average performance	none	0.00	1.00	1.00	4.00	5.00	-0.70	-0.70	-0.70
ECA1	1.00	Farm management labor	1.00	1.25	0.75	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-50.00	-62.50	-37.50
ECA2	1.00	Professional	2.00	2.50	1.50	-10.00	annual fee per ac	none	0.00	1.00	1.00	4.00	5.00	-20.00	-25.00	-15.00
EC	1.00	Economic	100.00	125.00	75.00	5.00	cost per unit cost	none	-70.00	-87.50	-52.50	4.00	5.00	-0.70	-0.70	-0.70
HCA	1.00	Hygiene management	95.00	118.75	71.25	5.00	average performance	none	0.00	1.00	1.00	4.00	5.00	-1.32	-1.32	-1.32
HCA1	1.00	Hygiene labor	1.00	1.25	0.75	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-25.00	-31.25	-18.75
HCA2	1.00	Hygiene facilities	2.00	2.50	1.50	-50.00	facilities per acre	none	0.00	1.00	1.00	4.00	5.00	-100.00	-125.00	-75.00
HCB	1.00	Worker Safety	95.00	118.75	71.25	5.00	average performance	none	0.00	1.00	1.00	4.00	5.00	-1.32	-0.09	-0.09
HCB1	1.00	Farm safety manager	1.00	0.31	0.19	-25.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-25.00	-7.75	-4.75
HCB2	1.00	Professional	2.00	0.06	0.04	-50.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00	-100.00	-3.00	-2.00
HC	1.00	Human Capital	190.00	237.50	142.50	5.00	cost per unit cost	none	-250.00	-167.00	-100.50	4.00	5.00	-1.32	-0.70	-0.71
TR	1.00	Net Return	425.00	501.25	351.75	4.83	net return per unit	none	1007.55	641.16	1682.82	4.00	5.00	2.37	1.28	4.78

The following image displays Indicator 1. The Benchmark scores come directly from the previous image's TR Index row. The Actual scores derive from the alternative with the lowest CEA ratio in the TRIndex.QTMost column. As will become clear in the next section, when Indicator 2's Revenues are included in the analysis, the alternative with the lowest CEA ratio may not be the best one. Rather than lower CEA ratios reflecting lower cost per unit, higher CEA ratios reflecting higher net returns per unit are desired.

Indicator 1. CEA Meta (the scores are filled in automatically)



E. Communication



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HIQA, Ireland (2010) recommends: “the results for cost-utility analysis should be presented as incremental cost effectiveness ratios (ICERs). ICERs present the cost per unit of outcome, e.g. the expected additional total cost to the expected additional QALYs (LYG) [, or Performance Indexes,] and are calculated as follows:

$$\text{ICER} = (\text{cost A} - \text{cost B}) / (\text{outcome of A} - \text{outcome of B})$$

As the ICER becomes larger, the intervention is said to be less cost effective. Where more than two technologies are being compared, the results should be reported in tabular form, presented in the order of increasing costs. Technologies that may be excluded on the basis of simple dominance (they are more costly and less effective than the alternatives) are eliminated from further calculations. The initial ICER should then be calculated by comparing each programme with the one above it, excluding those programmes that are dominated. The final ICER is then calculated after eliminating technologies that are subject to extended dominance (other alternatives available that are more effective and more costly, but provide better value for money as identified by the initial ICER).”

The following image (HIQA, 2010) demonstrates an example.



benefits, and comparing each scenario with no screening, the incremental cost per QALY gained was smallest for FSIG (€589), followed by FIT (€1,696) and then guaiac-based faecal occult blood test (gFOBT) (€4,428). These ICERs would indicate that any of these technologies would be considered highly cost-effective compared to a policy of 'no screening'.

Table 5.1: Incremental cost-effectiveness ratios (ICER), based on QALYs, for three screening scenarios for colorectal cancer compared to a policy of no-screening

Scenario	Cost of screening and CRC management per person	Incremental cost per person ¹	Expected QALYs per person	Incremental QALYs per person ¹	ICER - Incremental cost per QALY gained
No screening	€ 1,074.19	-	10.96	-	-
FSIG once at 60 years	€ 1,077.62	€ 3.43	10.97	0.0058	€ 589
gFOBT at 55-74 years	€ 1,107.82	€ 33.63	10.97	0.0076	€ 4,428 ²
FIT at 55-74 years	€ 1,114.36	€ 40.17	10.98	0.0237	€ 1,696

CRC=colorectal cancer; FIT=faecal immunochemical test; FSIG= flexible sigmoidoscopy; gFOBT=guaiac-based faecal occult blood test; QALY=quality-adjusted life year. Costs and outcomes discounted at 4%

¹ Each incremental value compares value for that strategy to common baseline of no screening

² gFOBT considered dominated by a combination of FIT and FSIG

Source: Adapted from Health Information and Quality Authority (2009) *Health technology assessment (HTA) of a population-based colorectal screening programme in Ireland*.

They recommend the following types of graphics to communicate the results of Cost Effectiveness Analysis:

- “cost-effectiveness plane to present the incremental costs and effects of two (or more) comparator technologies



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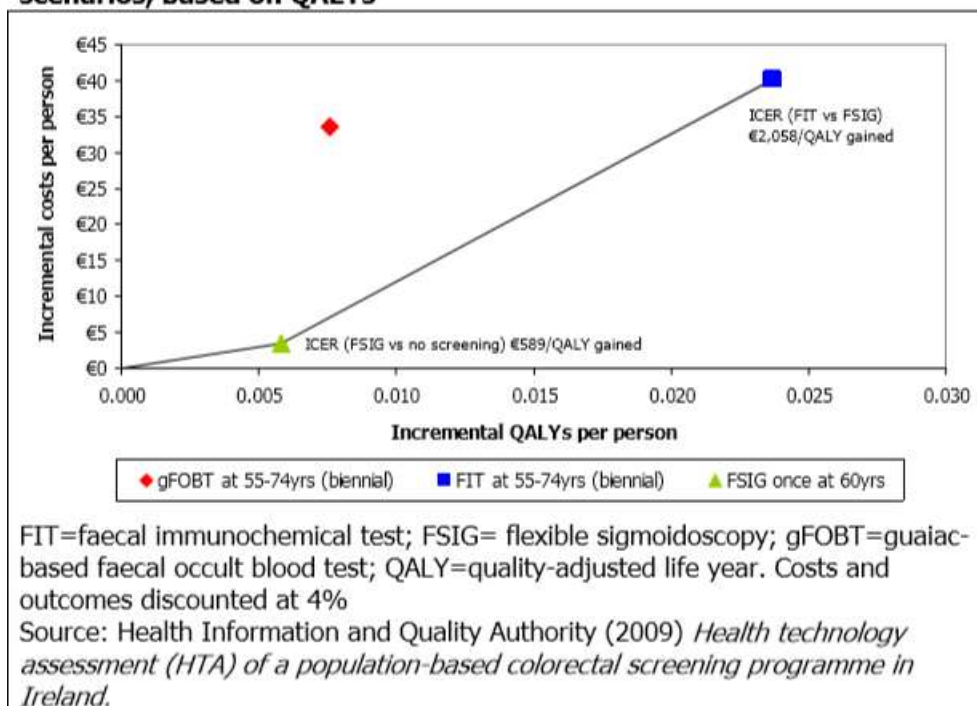
- tornado diagrams to display the results of subgroup effects and one-way sensitivity analysis
- scatter plots to present ICER results from probabilistic sensitivity analysis of two comparator technologies on the cost-effectiveness plane
- cost-effectiveness acceptability curve to present the probability that a technology is more cost-effective than its comparator. In a study comparing more than two technologies, it should present the probability that a technology is the most cost-effective as a function of the threshold willingness to pay for one additional unit of benefit.”

Ireland HIQA (2010) provides the following example of a cost effectiveness plane.



cost-effectiveness plane in Figure 5.2. The ICERs for FSIG and FIT can be connected with a line of lower slope than a line connecting any other two scenarios (indicating a lower cost-effectiveness ratio). A screening intervention that has an ICER above the line joining FSIG and FIT, as is the case for gFOBT, would be considered dominated (i.e., to be more costly and less effective than one, or a combination, of the other strategies). Although less costly than FIT, gFOBT is also less effective. It would therefore be considered to be eliminated by extended dominance, that is, its costs and benefits are improved by a mixed strategy of the two other alternatives FSIG and FIT.

Figure 5.2 Incremental Cost-effectiveness Plane for core screening scenarios, based on QALYs



Since FIT was associated with the greatest health gain compared to no screening, but FSIG was less costly, the decision to adopt FIT in preference to FSIG would depend on the willingness-to-pay of the decision maker. Investing in FIT as compared to FSIG would result in an increase in the total costs of €36.74 (i.e., €40.17 - €3.43) and in the QALYs of 0.0179 (i.e., 0.0237 - 0.0058), yielding an ICER of €2,058 per QALY gained. This would be considered highly cost-effective.

The following 2 analyses apply these techniques. Scenario 1 is considered the No Certification Compliance benchmark from which Alternatives AA, AB, and AC are compared. The Locational Index CEA results (PC, EC, and HC) have been included in the dataset but will not be used in this example. They are used in more advanced analysis to better understand the “drivers” of cost



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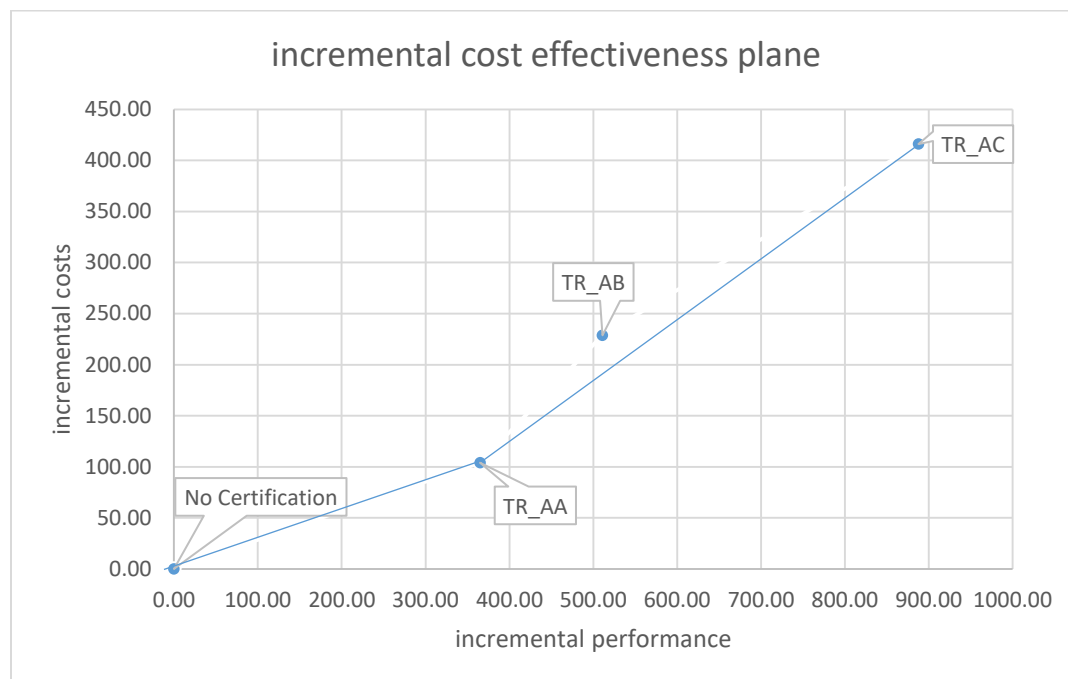
and performance (i.e. which capitals are most cost effective? which least? why?). The health care industry's cost utility analysis approach, based on QALYs and DALYs, rather than this example's Performance Impacts, will be fully addressed in Example 4B.

Indicator 1. Costs Only (2*)

The Indicator1.MathResults were rearranged in a spreadsheet to produce the following table. The objective is to select low ICERS with low costs per unit performance.

label	location	risks_and_indicators	Most Likely					Low Estimate					High Estimate				
			costs	incremental	performance	incremental	icer	costs	incremental	performance	incremental	icer	costs	incremental	performance	incremental	icer
PC	1.00	Physical Capital	200.00		75.00			250.00		93.75			200.00		56.25		
EC	1.00	Economic	70.00		100.00			87.50		125.00			70.00		75.00		
HC	1.00	Human Capital	250.00		190.00			167.01		237.50			250.00		142.50		
TR	1.00	Cost per Unit	520.02		365.00			504.52		456.25			519.99		273.75		
PC_AA	1.00	Physical Capital	240.00	40.00	150.00	75.00	0.53	180.00	-70.00	112.50	18.75	-3.73	240.00	39.99	112.50	56.25	0.71
EC_AA	1.00	Economic	84.00	14.00	200.00	100.00	0.14	63.00	-24.50	150.00	25.00	-0.98	84.00	14.00	150.00	75.00	0.19
HC_AA	1.00	Human Capital	300.01	50.01	380.00	190.00	0.26	225.01	58.00	285.00	47.50	1.22	300.00	50.00	213.75	71.25	0.70
TR_AA	1.00	Cost per Unit	624.00	103.99	730.00	365.00	0.28	468.00	-36.52	547.50	91.25	-0.40	623.98	103.99	476.25	202.50	0.51
PC_AB	1.00	Physical Capital	288.00	88.00	180.00	105.00	0.84	360.00	110.00	225.00	131.25	0.84	288.00	87.99	135.00	78.75	1.12
EC_AB	1.00	Economic	100.80	30.80	240.00	140.00	0.22	126.00	38.50	300.00	175.00	0.22	100.80	30.80	180.00	105.00	0.29
HC_AB	1.00	Human Capital	360.01	110.01	456.00	266.00	0.41	235.75	68.74	403.75	166.25	0.41	360.01	110.01	242.25	99.75	1.10
TR_AB	1.00	Cost per Unit	748.80	228.79	876.00	511.00	0.45	721.73	217.21	928.75	472.50	0.46	748.78	228.79	557.25	283.50	0.81
PC_AC	1.00	Physical Capital	360.00	160.00	257.40	182.40	0.88	450.00	200.00	321.75	228.00	0.88	360.00	160.00	193.05	136.80	1.17
EC_AC	1.00	Economic	125.99	55.99	343.20	243.20	0.23	157.49	69.99	429.00	304.00	0.23	126.00	56.00	257.40	182.40	0.31
HC_AC	1.00	Human Capital	450.00	200.00	652.08	462.08	0.43	291.99	124.98	526.30	288.80	0.43	449.99	199.98	315.78	173.28	1.15
TR_AC	1.00	Cost per Unit	936.00	415.99	1252.68	887.68	0.47	899.55	395.03	1277.05	820.80	0.48	936.03	416.04	766.23	492.48	0.84

The cost effectiveness plane reflects the least cost combination of alternatives. In the following graphic, the horizontal axis, with zero costs, is interpreted to be the most efficient frontier. At first glance, TR_AB appears dominated because its slope starts to increase, relative to TR_AA and TR_AC.



WHO (Hutubessy, 2003) discusses in detail why the No Certification alternative has to be included in these analyses: “it can identify current allocative inefficiencies as well as the efficiency of opportunities presented by new interventions”.

Indicator 2. Revenues Included

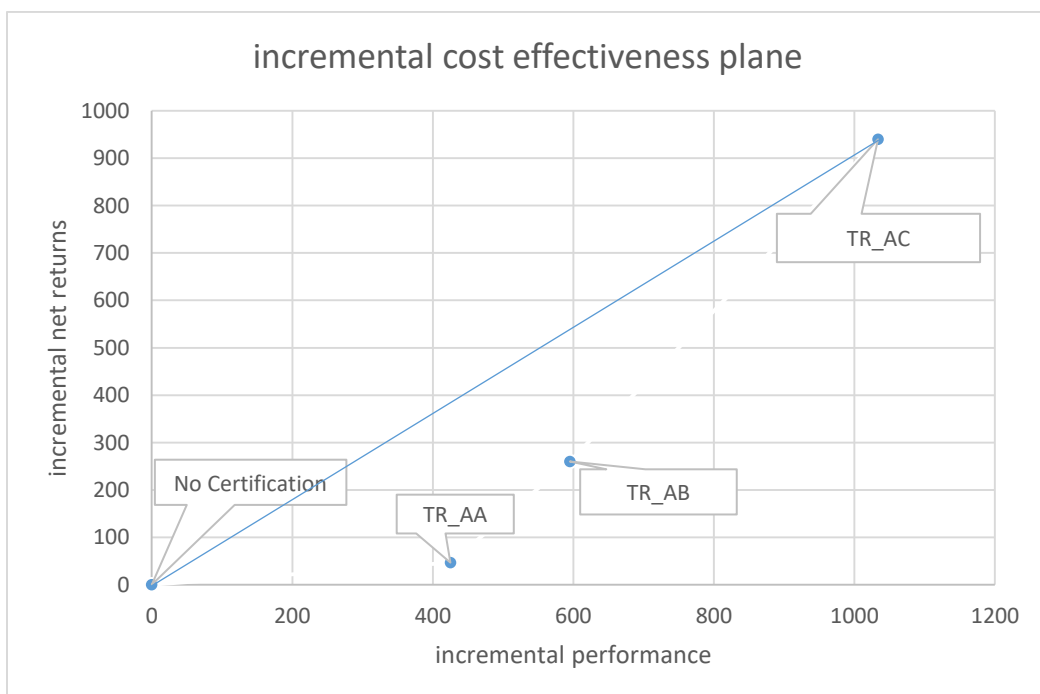
The Indicator2.MathResults were rearranged in a spreadsheet to produce the following table. The objective is to select high ICERS with high net returns per unit performance. Alternative AC has the highest Net Return ICER and may be the most cost effective alternative. The next section discusses using the low and high estimates and the certainty scores to base final decisions.

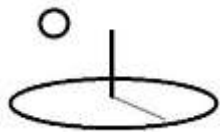


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		Most Likely					Low Estimate					High Estimate				
label	risks_and indicato	revenues, costs, nets	incremental	performance score	increment	icer-most	revenues, costs,	incremen t	performa nce score	incremen t	icer-low	revenues, costs,	incremen t	performa nce score	incremen t	icer-high
EC	Change in	1527.55		60			1145.663		45			1985.815		78		
PC	Physical Ca	-200		75			-250		93.75			-150		56.25		
EC	Economic	-70		100			-87.5		125			-52.5		75		
HC	Human Ca	-250		190			-167		237.5			-100.5		142.5		
TR	Net Return	1007.55		425			641.1625		501.25			1007.55		351.75		
EC_AA	Change in	1678.1875	150.6375	120	60	2.510625	1258.643	112.9808	90	45	2.510684	2181.644	195.8288	156	78	27.96979
PC_AA	Physical Ca	-240	-40	150	75	-0.533333	-180	70	112.5	18.75	3.733333	-180	-30	112.5	56.25	-3.2
EC_AA	Economic	-84	-14	200	100	-0.14	-63	24.5	150	25	0.98	-63	-10.5	150	75	-0.84
HC_AA	Human Ca	-300	-50	380	190	-0.26316	-225	-58	285	47.5	-1.22105	-119.25	-18.75	213.75	71.25	-1.67368
TR_AA	Net Return	1054.1875	46.6375	850	425	0.109735	790.6433	149.4808	637.5	136.25	1.097107	1054.188	46.6375	632.25	280.5	3.758244
EC_AB	Change in	2016.366	488.816	144	84	5.819238	1512.275	366.612	108	63	5.819238	2621.276	635.461	187.2	109.2	24.00436
PC_AB	Physical Ca	-288	-88	180	105	-0.8381	-360	-110	225	131.25	-0.8381	-216	-66	135	78.75	-2.74286
EC_AB	Economic	-100.8	-30.8	240	140	-0.22	-126	-38.5	300	175	-0.22	-75.6	-23.1	180	105	-0.72
HC_AB	Human Ca	-360	-110	456	266	-0.41353	-235.75	-68.75	403.75	166.25	-0.41353	-141.75	-41.25	242.25	99.75	-1.42105
TR_AB	Net Return	1267.566	260.016	1020	595	0.437002	790.5245	149.362	1036.75	535.5	0.278921	1267.566	260.016	744.45	392.7	3.227823
EC_AC	Change in	2883.4045	1355.8545	205.92	145.92	9.291766	2162.554	1016.891	154.44	109.44	9.291767	3748.425	1762.61	267.7	189.7	19.75975
PC_AC	Physical Ca	-360	-160	257.4	182.4	-0.87719	-450	-200	321.75	228	-0.87719	-270	-120	193.05	136.8	-1.97368
EC_AC	Economic	-126	-56	343.2	243.2	-0.23026	-157.5	-70	429	304	-0.23026	-94.5	-42	257.4	182.4	-0.51809
HC_AC	Human Ca	-450	-200	652.08	462.08	-0.43283	-292	-125	526.3	288.8	-0.43283	-175.5	-75	315.78	173.28	-1.01281
TR_AC	Net Return	1947.4045	939.8545	1458.6	1033.6	0.909302	1263.054	621.891	1431.49	930.24	0.668527	1947.405	939.8545	1033.93	682.18	2.854678

The cost effectiveness plane reflects the point that both higher net returns and higher performance scores are desired. A line bisecting the graph from origin to top right corner is interpreted to be the ideal efficiency frontier (i.e. highest performance and highest net returns). In the following graph, TR_AC has the best slope in relation to the efficiency frontier and appears to dominate TR_AA and TR_AB. If the budget permits “2 alternatives”, TR_AB appears preferable over TR_AA because its slope increases more.





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F. Decisions

Decision making focuses on the risk and uncertainty associated with the ICER ratios presented in the previous section. These analyses accommodate uncertainty with 3 metrics:

1. high and low cost and performance estimates,
2. average certainty (factor4) rating for the performance scores which derives from 2 uncertainty ratings in the base Social Performance Analysis,
3. average certainty1 (factor10) and certainty2 (factor11) rating for the LCC/LCB calculations.

For testing purposes, the datasets set the certainty factors equal for all Indicators and Indexes. The resultant average values can still support decisions based on their full values, but not their incremental differences. The following examples use fictitious certainty factors to illustrate incremental uncertainty. The author is not familiar with studies that apply the same ICER techniques to certainty values. Use their full values if that approach proves questionable.

Indicator 1. Cost Uncertainty ICERS

The following table applies the ICER techniques to the certainty scores. The low and high ICERS reflect summaries. The descriptions, or interpretation, of the certainty averages, derive from approaches introduced in Appendix A.

alternative	incremental cost	incremental performance	icer-most	icer-low	icer-high	avg cost certainty1	interpretation	avg cost certainty2	interpretation	incremental	performance certainty		incremental
No Certification	0.000	0.000				4.000	very likely	5.000	very high confidence		4.830	well established	
TR_AA	103.989	365.000				4.000	likely	5.000	very high confidence	0.000	3.500	established but incomplete	-1.330
TR_AB	228.789	511.000				3.500	likely	4.000	high confidence	-0.500	3.000	established but incomplete	-1.830
AA-AB	124.801	146.000	0.855	0.662	1.556					-0.500			-0.500
TR_AC	415.987	887.680				3.000	likely	3.000	medium confidence	3.000	2.500	inconclusive	-2.330
AA-AC	311.998	522.680	0.597	-0.100	1.043					-1.000			-1.000
AB-AC	187.198	376.680	0.497	-0.937	0.854					-0.500			-0.500

Discussion



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The most cost effective alternative combination, AB-AC, is most likely to have an ICER = 0.497, with a high estimate of 0.854, and low estimate of -0.939. This alternative has total costs = 1,684 and total performance = 2,129. The risk and uncertainty associated with this alternative is substantially higher than the other possibilities, because the costs have “low confidence” and the performance is “inconclusive”. We recommend this alternative only for decisions where risk and uncertainty are not of primary concern. Otherwise, AA-AB should be chosen because the costs have “high confidence” and the performance is “established but incomplete”. When risk and uncertainty is the primary decision criteria, Alternative AA, alone, should be chosen because the costs are “likely” and the performance is “well established”.

Final Summary

In practice, a table similar to following image (Kim et al, 2016), is presented to decision makers. These authors use Mean and Standard Error statistics to communicate uncertainty to decision makers. For this example, a single uncertainty “Index” could be developed in a way that supports Appendix A’s “qualitative communication of performance”. This table will be revisited in Example 4B. In the meantime, the full article, and the related book, are good examples of why this [hard] work should be completed by social networks and clubs.



March 11, 2016

Table 15.5. Reference Case Cost-Effectiveness Results (Time Horizon: Lifetime; Costs and Health Effects Discounted at 3%)

Alternative	Total Costs ^Ω Mean (SE)	Total QALYs Mean (SE)	Incremental Cost [†]	Incremental Effectiveness [†] (QALYs)	NMB* Mean (SE)	Incremental NMB [†]	ICER [†] (Incr. Cost / Incr. QALY)
HEALTHCARE SECTOR PERSPECTIVE							
MM + Naltrexone	\$250,745 (6,191)	15.01 (0.64)	-	-	\$1,250,239 (66,599)	-	-
MM + Acamprosate	\$251,817 (6,246)	14.97 (0.65)	\$1,072	-0.04	\$1,244,704 (65,876)	-\$5,535	Dominated [‡]
MM + Naltrexone + Acamprosate	\$252,802 (6,335)	14.93 (0.65)	\$985	-0.04	\$1,240,052 (64,972)	-\$4,652	Dominated [‡]
MM Only	\$252,938 (6,246)	14.91 (0.66)	\$136	-0.02	\$1,238,119 (66,963)	-\$1,933	Dominated [‡]
CBI Only	\$254,085 (6,380)	14.89 (0.67)	\$1,147	-0.02	\$1,234,822 (68,308)	-\$3,297	Dominated [‡]
SOCIETAL PERSPECTIVE							
MM + Naltrexone	-\$55,195 (20,181)	15.01 (0.64)	-	-	\$1,556,178 (68,324)	-	-
MM + Acamprosate	-\$54,213 (20,382)	14.97 (0.65)	\$982	-0.04	\$1,550,734 (69,208)	-\$5,444	Dominated [‡]
MM + Naltrexone + Acamprosate	-\$53,379 (20,564)	14.93 (0.65)	\$834	-0.04	\$1,546,233 (69,984)	-\$4,501	Dominated [‡]
MM Only	-\$53,373 (20,747)	14.91 (0.66)	\$6	-0.02	\$1,544,430 (70,410)	-\$1,803	Dominated [‡]
CBI Only	-\$52,219 (20,956)	14.89 (0.67)	\$1,164	-0.02	\$1,541,126 (71,617)	-\$3,304	Dominated [‡]

Indicator 2. Revenues Included

Alternative AA is a good example of the importance of low and high estimates. AA's Low ICER=1.097 is almost double Alternative AC's Low ICER = 0.667. These types of clear differences must be pointed out to decision makers. Example 4B will relate Net Returns to the more comprehensive Net Benefits (NMB) displayed in the previous image.

Example 4B discusses the importance of using CEA at appropriate scales and scopes. Specifically, if too location, or context, specific, the results may not be able to be used to allocate resources efficiently in regions and sectors. Example 4B addresses these concerns.

Case Study Footnotes

1. Prior to Version 2.1.0, the Technology Assessment 2 reference actually explained WHO's approach to cost effectiveness incompletely. The CEA calculations are accurate



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in that reference because they are extremely basic, but WHO recommends comparing Alternatives against a “Doing Nothing” Alternative, not a Current Practice Alternative. Refer to Footnote 11 in this reference and Footnotes 6 and 10 in the CTAP reference. DevTreks is a software development company, which happens to be run by an economist. Our role is to introduce basic tools and algorithms applied using concrete, modern, open source code. Your role is to figure out how to do it better.

2. These ICERS reflect calculations that were run prior to fully debugging this algorithm – the High Estimates are all wrong. This footnote is added because of the importance that the CEA references place on replicating CEA results (i.e. in the context of DevTreks, by clicking on, or touching, a Calculator.Run button).

References

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David D. Kim, Anirban Basu, Sarah Q. Duffy, Gary A. Zarkin. Worked Example 1: The Cost-Effectiveness of Treatments for Individuals with Alcohol Use Disorders: A Reference Case Analysis. ResearchGate. November, 2016. (last accessed August, 2017: <https://www.researchgate.net/publication/309591908>)

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Gillian Sanders Schmidler, Duke University. Slide Presentation on 2nd Panel on CEA. 2016

World Health Organization. Guide to Cost-Effectiveness Analysis. 2003



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Example 4B. Generalized Cost Effectiveness Analysis (GCEA) with Quality Adjusted Stock Years (QASYs) (RCA5)

URLs

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4B/1556/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4/541/none>

Resource Stock Assessment and Monitoring and Evaluation Assessment

<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA4B Both/2141223494/none>

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA4B Both/2141223480/none>

A. Introduction

This example uses the RCA4 (LCC/LCB) algorithm to carry out a Cost Effectiveness Analysis (CEA) of conservation technologies designed to improve private and public social performance at country or sector scale. Rather than using the health care industry's Quality Adjusted Life Years (QALYs) or Disability Adjusted Years (DALYs) to measure health care outcome performance, this example demonstrates how to use the more generic Quality Adjusted Stock Years (QASYs) for measuring the more generic public service outcome performance.

The following techniques will be demonstrated in this example:

- 1. Generalized Cost Effectiveness Analysis (GCEA) of Sustainability:** The Hutubessy et al (2003) and WHO (2003) references discuss the importance of applying CEA techniques to allocate resources efficiently in the health care sectors of countries. In



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effect, the overriding purpose behind the RCA framework, except RCA assesses the sustainability of technologies in all sectors of economies.

2. **Harmonized Indicator Systems:** WHO’s standardized, harmonized, international, Performance Indicator system (WHO, 2015) provides the initial “ideal standards system” that will be used in this example. That system, which is treated as an industry-specific supplement to a multi-sector Performance Indicator System (i.e. SDG), will be supplemented by another industry-specific multi-capital supplement, in this example, for assessing environmental and socioeconomic performance. The health care industry’s Societal Perspective (2nd Panel on CEA, 2016) will be changed to Public Capital Perspective. Their Health Care Perspective is replaced by a Natural Capital Care Perspective. A resultant Social Performance Assessment completed using the RCA1 algorithm will be harmonized with one or more EU budgets completed using the RCA4 algorithm for CEA and Budget Impact Analysis.
3. **Cost-Utility Analysis using QASY Outcomes (1*):** This example replaces the single capital stock characteristic, health, used in QALYs and DALYs, with the multi-stock characteristic, quality of life, used in QASYs. SPA1 explains that the fundamental goal of the RCA framework is to increase human quality of life by protecting and improving the services generated by the 7 public capital stocks. Appendix 1, Cost Effectiveness Analysis 3.0, to this example explains the relation of QASYs to QALYs/DALYs in CEA.
4. **Scenarios and Stakeholder Tradeoff Assessments:** Scenarios will demonstrate CEA tradeoff analysis for different technologies and “societal perspectives”. The health care industry’s Impacts Inventory (2nd Panel on CEA, 2016) demonstrated in Appendix 2, will be adapted for public capital impacts.
5. **Structured Abstract Format:** This example demonstrates how to apply the 2nd Panel on CEA’s (2016) recommendations for reporting. Appendix 3. Report Checklist, illustrates including the checklist with the analysis (Smidler, 2016). Although not applied in this example, Antioch et al (2017) discuss the use of similar checklists to verify the quality of health care economic evaluations.



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The CEA references used with this Example come from the health care industry because they apply CEA very practically, seriously, and with full decision support context (albeit in their own silo). And because they supply the initial model that other public service agents and community service organizations should be following to reduce societal risks, such as climate change, in transparent and affordable ways. Chapters 7, 8, 9, and 12 in WHO (2016), explain national costing, budgeting, M&E, and intersectoral (i.e. multi-sectoral and multi-capital) assessment, and should be read prior to this example (i.e. because that’s how DevTreks should be used).

A: Objective

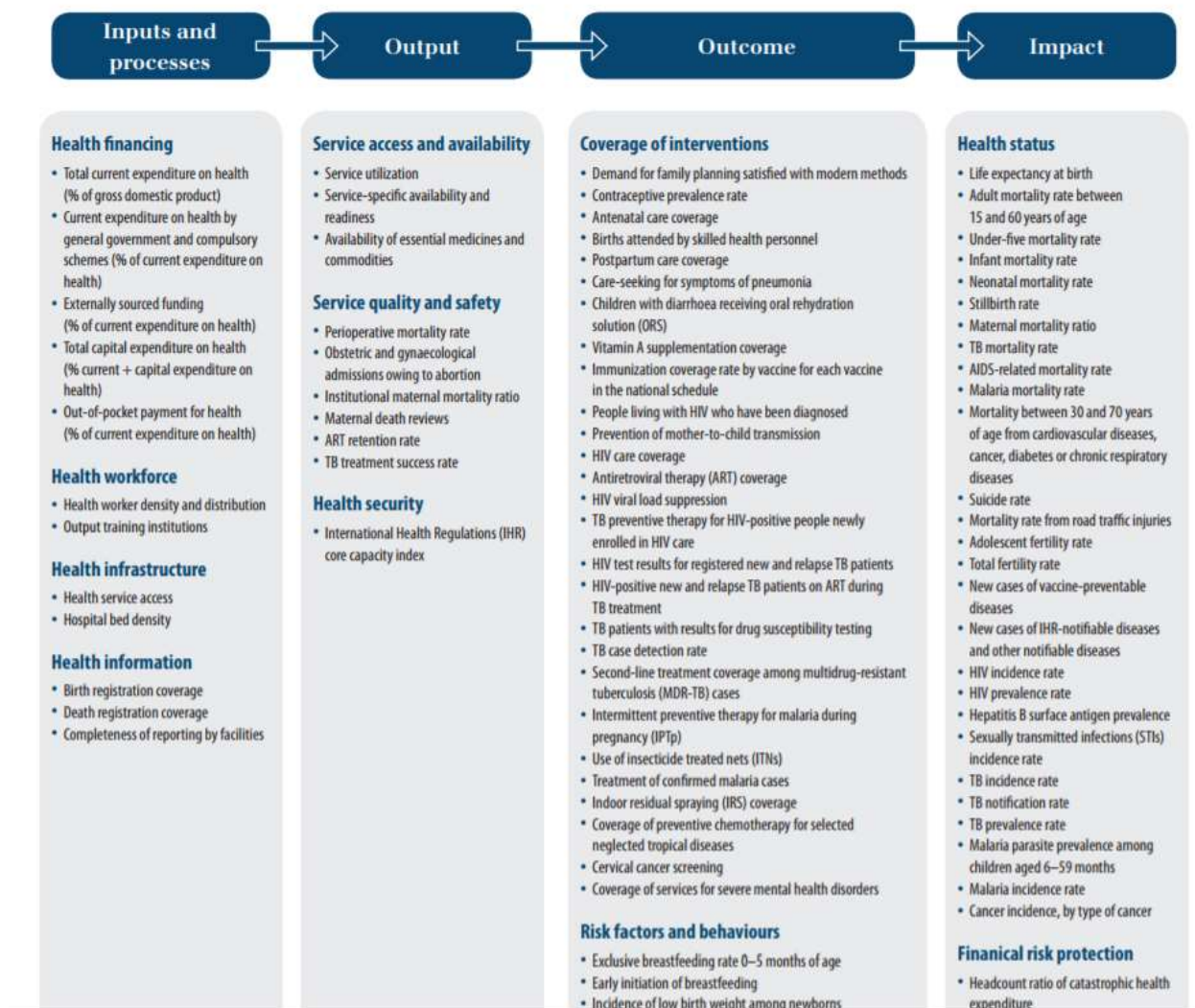
This country’s citizens and businesses want biodiversity protected, climate change mitigated, and social discord-based migration handled fairly. During their scoping analysis, their scientists, with assistance from citizen and business stakeholders, formulated 4 Performance Measures to achieve these objectives. The objective of this study is to assess the cost effectiveness of these approaches, decide whether to apply one or more of the actions, and if enacted, monitor and evaluate their performance to ensure actual risks get reduced.

An objective, science-based, social network (i.e. EU Resource Conservation Value Accounting Network) has developed an Indicator Threshold system that their clubs can follow when developing resource conservation accounting and financial reports. The network started by harmonizing the immense number of indicator systems, assessment approaches, and indicator reporting instruments used by its individual member countries, industries, and affiliated international organizations (as discussed by Schroter et al, 2016) .

They decided to adopt the Performance Indicator system recommended by the international health care community and summarized in the following 2 images (WHO, 2015). The images demonstrate using a “results chain” applied using a surmised “explanatory mixed methods” approach, measured using 100 standard Performance Indicators, enforced with “international norms of good reporting behavior”, and harmonized across countries, to improve health care reporting and performance.



100 Core Health Indicators by results chain





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Global partners should aspire to the following behaviours

- a. Use of core indicators for rationalizing reporting requirements: focus results reporting requirements on *The Global Reference List*, including disaggregation (by gender, age, socioeconomic status, place of residence), and the related M&E system strengthening investments.
- b. Align reporting cycles: rationalize reporting requirements in terms of contents and frequency and progressively align with countries' own monitoring practices.
- c. Ensure global data collection investments meet country health data and M&E systems needs, including data quality, in the most efficient manner.
- d. Include a significant proportion of investments for country institutional capacity and M&E system strengthening, including government and non-government actors.
- e. Broaden monitoring to focus on measuring overall country results, which may include specific contributions to collective results.

Good behaviours at the country level (with examples of actions)

- a. Countries lead and invest in strengthening their M&E and review platforms that have the key attributes and characteristics of the IHP+ monitoring framework. Examples include:
 - existence of a good quality comprehensive costed national M&E plan;
 - adequate and qualified staffing of the M&E system, centrally and sub-nationally;
 - institutionalization of routine mechanisms to independently assess data quality, including transparent accessible quality databases and explicit mechanisms for data sharing and use by state and non-state actors;
 - regular system of household surveys;
 - high quality timely results reports for national joint annual health reviews and other accountability processes;
 - systematic use of common, sustainable and interoperable digital solutions where feasible and appropriate; and
 - existence of an effective country-led coordination mechanism for M&E and review with active involvement and support of relevant development partners, civil society and other non-state actors.
- b. Development partners support the strengthening of a single country-led platform for information and accountability, as described in the IHP+ framework for monitoring national health strategies. Examples include:
 - support for the country M&E plan, including a process for progressive alignment of program-specific monitoring and reviews with the overall health strategy, using the same indicators, data collection, and time cycles;

They then adapted the WHO system to carry out all other capital stock assessments in the EU, including this Example's Public Capital Stock Assessment, as follows:

1. **Public Capital Stock Indicator System:** The WHO Indicator system is treated as an industry-specific supplement to a more general Public Capital Stock Indicator System. SPA1 introduced the SDG, Sendai DRR, GSSB, SASB, and EMAS Indicator systems as examples of multi-sector Sustainability Assessment Indicator systems. The WHO's



health care system is part of a more generic system focused on Public Capital Stocks (Kieny et al, 2017 and WHO 2017 demonstrate using the SDG, Chapter 12 in WHO 2016 provides an overview of “intersectoral” assessment), and for this example, supplemented with a Natural Capital Care system. This supplemental system addresses issues identified as highly important to the network’s citizens and businesses, including their concerns with protection of biodiversity and mitigation and adaptation to climate change. An additional socioeconomic concern, balanced migration, has been added to reinforce the importance of multi-capital stock assessment.

2. **Public Capital Service Outcome Measurement:** The RCA framework requires materiality impact measurements dealing with costs, benefits, and performance (3*). As further explained in Appendix 1, Cost Effectiveness Analysis 3.0, the common metrics used by the health care industry to measure outcomes and impacts, QALYs and DALYs, are replaced by the more generic, QASY (or Example 12’s Subjective Well Beings).
3. **Indicator Thresholds.** Example 1’s SAFA Indicator Thresholds will be adapted for this Indicator System.
4. **Discounted Indicators.** Several of the CEA QALY references demonstrate using a real discount rate of 3% to discount both costs and QALYs. The CEA techniques introduced in Example 4A have been upgraded to also discount QASYs.
5. **Index-based Results Chain.** This study employs a mixed methods qualitative explanatory path approach, applied using a results chain, for the analysis. They use the Outcome Indicator in that pathway as “ecosystem services” because of the importance their “natural capital care industry” places on the natural capital stressors. Furthermore, rather than Example 1’s 1:1 relation between Performance Indicators, a 1:1 relationship is defined only for the Performance Indexes. [For convenience, this release uses generic Indicators, such as Indicator 1 and Indicator 2 in the Indexes. Given that this example’s main point is to understand how to carry out CEAs, only the final Impacts Indicator dataset is used with the RCA1 algorithm.]
6. **Public Capital Perspective, Natural Capital Care Perspective, Stakeholder Group A Perspective, and Impacts Inventory:** The 2nd Panel on CEA’s (2016) recommendations to include a Health Care Perspective, Societal Perspective, Payer Perspective, and Impact



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Inventory in the final analysis, are adapted for this example’s primary stressors. The Societal Perspective is replaced by a Public Capital Perspective. The Health Care Perspective is replaced by a Natural Capital Care Perspective. The Payer Perspective is replaced by a Stakeholder Group A Perspective.

7. **Decision Making with CEA QASY Thresholds:** The American Heart Association (Anderson et al. 2014) recommends applying the following image’s CEA Thresholds in clinical guideline recommendations. IPSOR (2017) discusses alternative CEA Thresholds. This Example adapts the same Thresholds, but replaces the term QALY with the term QASY. These 2 publications provide a good overview of the “why and how” being addressed by practitioners of resource stock conservation (i.e. who work in community service organizations, such as health clinics and RCA Districts).



As noted above, the present writing committee defined high, intermediate, and low value according to the WHO-CHOICE (*Choosing Interventions that are Cost-Effective*) project <http://www.who.int/choice/cost-effectiveness/en/>, which provides a framework for cost-effectiveness thresholds that can be applied globally to a wide range of health interventions.^{21,36,38} The 3 categories of cost-effectiveness are highly cost-effective (less than GDP per capita), cost-effective (between 1 and 3 times GDP per capita), and not cost-effective (>3 times GDP per capita).²⁴ In adapting these WHO-CHOICE recommended thresholds, the values shown in Table 2 were selected by the

Table 2. Proposed Integration of Level of Value Into Clinical Guideline Recommendations*

Level of Value
High value: better outcomes at lower cost or ICER <\$50 000 per QALY gained
Intermediate value: \$50 000 to <\$150 000 per QALY gained
Low value: ≥\$150 000 per QALY gained
Uncertain value: value examined but data are insufficient to draw a conclusion because of no studies, low-quality studies, conflicting studies, or prior studies that are no longer relevant
Not assessed: value not assessed by the writing committee
Proposed abbreviations for each value recommendation: <i>Level of Value: H to indicate high value I, intermediate value; L, low value; U, uncertain value; and NA, value not assessed</i>
*Figures used in this table are based on US GDP data from 2012 and were obtained from WHO-CHOICE Cost-Effectiveness Thresholds. ²⁴
GDP indicates gross domestic product; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year; and WHO-CHOICE, World Health Organization Choosing Interventions that are Cost Effective.

B: Intervention

This country, or club, chose to use the following General Scenario for the purpose of building a disaster risk reduction and resiliency plan. The plan helps them understand the primary risks that may impact the country's 7 capitals, and the quality of life of their businesses and citizens, over their planning horizon. They use the plan and their Social Performance Score to identify needed investments in mitigation and adaptation performance measures. These measures are summarized in the 4 Scenarios listed below. They use a full M&E system, with short term Social



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Monitoring Assessments, to monitor and evaluate how well the selected portfolio actually reduces risks.

General Scenario

Threatened Quality of Life: High GHG result in 1.5 degree temperature increase with higher incidence of biodiversity loss, droughts, severe heat waves, crop and livestock production risks, air pollution, floods, migration, and social discord.

Targeted Stakeholder Groups: see Section C. Target Populations

Targeted Social Performance Stressors: Habitat Change, Climate Change, Overexploitation, Invasive Alien Species, Pollution and Nutrient Enrichment, and Migration (refer to the EEA references in SPA1, and this example’s ecosystem services references, such as Schroter et al, 2016)

Mitigation and Adaptation Actions: Portfolio 1 consists of a) ..., b)...., and c)....

Scenario 1 or Performance Measure 1: Benchmark, or No Mitigation and Adaptation, Performance:

Scenario 2 or Performance Measure 2: Stakeholder Group A with Mitigation and Adaptation Portfolio A:

Scenario 3 or Performance Measure 3: Stakeholder Group A with Mitigation and Adaptation Portfolio B:

Scenario 4 or Performance Measure 4: Stakeholder Group A with Mitigation and Adaptation Portfolio C:

The term “Performance Measure” is also used because Appendix 1 explains that the health care industry refers to these actions, or Alternatives, as “performance measures” used for clinical practice guidelines, and recommend using CEA to assess their efficiency (Anderson et al, 2014).

C: Target Populations



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The populations targeted by the 4 proposed Performance Measures include:

EU member states; trading partners; this country’s citizens and businesses; Supply chain buyers and end product consumers concerned that companies proactively address biodiversity loss, climate change, and migration in their business practices; Companies concerned about investors, supply chain buyers, and end product consumers who want independent verification of company compliance with socially sound business practices; Developing country citizens migrating because of social discord; European citizens concerned about social discord-caused migration.

Example 4 discusses the need for additional population algorithms to fully address population and stakeholder metrics in GCEA (i.e. refer to the 2nd Panel on CEA or WHO references).

Examples 5 through 8 in the Social Performance Analysis 3 reference addresses this need.

D: Perspectives

The analysis bases its costs and performance estimates based on the following perspectives:

- a. Natural Capital Care Perspective:** IPSOR (2017) describes this perspective in terms of the 2nd Panel on CEA recommended health care perspective:

“The health care sector perspective includes “formal health care sector (medical) costs borne by third party payers or paid for out-of-pocket by patients.” This includes “current and future health costs, related and unrelated to the condition under consideration.”

Notably, it does not include patient time costs, or the future benefits and costs of other types of consumption associated with increased longevity. In contrast, the more narrowly-construed “payer perspective” does not include patient out-of-pocket costs because they are not borne by payers.”

This example adapts the health care perspective to a natural capital care perspective. In practice, this example demonstrates applying this technique by using a natural capital care budget that focuses mostly on ecosystem service outcomes and impacts.



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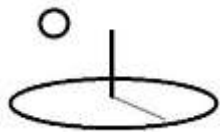
- b. Public Capital Perspective:** IPSOR (2017) describes this perspective in terms of the 2nd Panel on CEA recommended societal perspective:

“Societal perspective is very broad, adding time costs and effects on future productivity and consumption as well as relevant non-health impacts in other sectors, such as education and criminal justice”.

This example adapts this societal perspective to a public capital perspective. In practice, this example demonstrates applying this technique by using a public capital budget that focuses mostly on broad social welfare outcome impacts, particularly related to migration.

- c. Stakeholder Group A Perspective:** Westrich (2016) and Sorenson et al (2017) criticize several health care value frameworks currently being developed in the health care sector for not being “patient-centric”, which in terms of CEA, translates in to not putting priority on patient perspectives. ICER (2017) demonstrates how to institutionalize patient engagement in health care economic evaluations. The latter organization endorses allowing the patients, or their representatives, to complete this type of perspective. WHO (2017) provides international perspective on the importance of this perspective. Jacobs et al (2016) discusses the importance of this perspective in natural capital care assessments.

In practice, this example uses a household budget based on Stakeholder Group A together with a Social Assessment focusing on impacts to that targeted group, as demonstrated in Example 3B. The RCA3 algorithm, applied using S-LCA, is used for this purpose and treated as 1 Performance Monitoring Assessment observation that feeds into the other 2 perspectives, or Impact Evaluations, via M&E.



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Neuman et al (2016) describes the Appendix B. Impact Inventory that is used with this example in the following statement. Examples of summary “Impact Inventories” can be found in the Impact TEXT datasets used throughout this reference.

“Our panel further recommends inclusion of an “impact inventory,” a structured table listing the health and non–health-related effects of an intervention that should be considered in a societal reference-case analysis. When interventions have substantial effects beyond the formal health care sector (e.g., effects on economic productivity, social services, legal or criminal justice, education, housing, or the environment), such an inventory allows analysts to clarify those consequences for decision makers.”

E: Time Horizon

This country employs a 200 year planning horizon, similar to GHG emission life, for societal planning.

F: Discount Rates

Costs and QASYs have been discounted using a real rate of 3% and a nominal rate of 5%.

QASYs, or Example 4A’s Performance Indicators, are discounted, and/or escalated, exactly the same as LCCs and LCBs.

Because the main purpose of this example is to introduce a “big picture” view of applied GCEA, none of the LCC/LCB escalation options introduced in Example 4 have been used. However, the health care industry is quite concerned about health care affordability given probable future price escalations. The LCC/LCB-style price and QASY escalations will need to evolve as these industries reach consensus on how to deal with projected future price escalations. Especially important in special interest group-dominated countries characterized by a small number of



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companies exercising market domination. The potentially disastrous future effects of this example’s stressors require similar evolution in escalation techniques.

G: Costing Year

The selected Performance Measure will be applied at the start of 2018. For the purposes of eyeball metrics, costs and QASYs have not been discounted for this example. The full lifetime of the natural capital stressor Indicators, such as GHG that lasts more than 100 years, requires careful use of the LCC/LCB techniques.

H: Study Design (4*)

This study employed a mixed methods qualitative explanatory path approach, applied using a WHO-style results chain, to assess outcome performance and impact consequence. The nature of this study’s stressors meant that ecosystem services, and more general public services, had to be fully addressed because of the importance their “natural and institutional capital care industries” place on the natural capital, and institutional capital, stressors. In practice, the Outcome Indicators used in this example’s results chain are used for that purpose. Migration is considered an institutional capital stressor because sound QOL development institutions may thwart the stress (i.e. the S-LCA references in Example 3B have a specific category for migration).

Example 1, Section G, Impact Evaluation, explains how results chains relate Performance Assessments, Impact Evaluations, and Monitoring and Evaluation systems. In summary, the Monitoring and Evaluation system links short term Performance Assessments to long term Impact Evaluations. Appendix 1 further explains how QASYs fit into the metrics.

Example 4A, Footnote 1, explains that DevTreks’ role is practical application, not perfection. This example applies that reality in a simplistic manner. This example’s Social Performance Assessment uses the RCA1 subalgorithm as a meta-data summary derived from COSA-like



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Impact Evaluations (i.e. QOL surveys), which in turn, derive from RCA2-like Performance Monitoring Assessments.

The overall M&E system will not be demonstrated in this example. However, the following table (Schroter et al, 2016) hints at how to apply a more thorough M&E system. The table demonstrates how the EU currently assesses trends for this study’s ecosystem [and socioeconomic] stressors. The table shows that trends have been assessed for 9 separate resource stock states and 6 primary pressures. The EU may use a combination of trial-based experiments and simulation-based models to assess these trends. When possible, scientists conduct field experiments, and, with assistance from trained volunteers, conduct field measurements to further verify the trends. That initial data, which can be stored using the RCA2 Trends subalgorithm, is then added to EU-wide simulation models that can be used for EU-wide GIS mapping.

Table 5.9 Trends in pressures on ecosystems

Ecosystem type	Habitat changes	Climate change	Overexploitation	Invasive alien species	Pollution and nutrient enrichment
Urban	↗	↑	↗	↗	↑
Cropland	↗	↑	↗	↗	↑
Grassland	↗	↑	↗	↗	↑
Woodland and forest	↘	↑	→	→	↗
Heathland, shrub and sparsely vegetated land	→	↑	→	↗	↗
Wetlands	→	↑	→	↗	↘
Freshwater (rivers and lakes)	→	↑	→	↗	↘
Marine (transitional and marine waters, combined)	↗	↑	→	↗	→

Key:

Projected future trends in pressure			
↘	→	↗	↑
Decreasing	Continuing	Increasing	Very rapid increase

Observed impact on biodiversity to date			
Low	Moderate	High	Very high



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In effect, RCA2-style and RCA3-style instruments are used for the M&E's short term Performance Assessments and an RCA1-style instrument is used for the long term Impact Evaluations. The COSA references used throughout this tutorial demonstrate that, in practice, more advanced algorithms are used to conduct Impact Evaluations (i.e. as introduced in the SPA3 reference). Antioch et al (2017) also discuss advanced algorithms, such as Markov cohort simulations and Reference-level modeling, employed in the health sector.

I: Data Sources

The EEA has EU-wide responsibility for collecting the data used in these analyses. The references demonstrate that individual countries collect and maintain supplemental data using their environmental agencies.

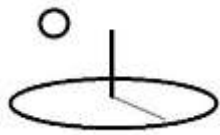
J. Outcome Measurement

Appendix 1. Cost Effectiveness 3.0, verifies that QASYs are used to measure outcome performance. Appendix 2. Impact Inventory, summarizes the full impacts being measured in this analysis.

In line with the CEA recommendations (via Kim et al, 2016) this study used the following approach for outcome measurement: “Incremental cost-effectiveness ratios (ICERs) and net monetary benefits (NMBs) were used as primary outcome measures. For the NMB, we used \$100,000 per QALY as a willingness-to-pay (WTP) threshold in the base-case analysis.”

The 2nd Panel on CEA discusses supplemental outcome measurements to include in these analyses, including intermediate health outcomes, disaggregated results, and measures of robustness.

K: Results of Base Case Analysis



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The following table illustrates the stylized Indicator Threshold system applied by this network. All of the numbers used in this analysis are stylized because either data does not exist, or it's the role of complete social networks and clubs to figure the numbers out (Liquete et al, 2016, demonstrate the type of “real” data used in these analyses). They use the SAFA system for scoring, but translate the results to QALY-style 0-1 ratings before being analyzed. In practice, the health care industry's techniques for either HRQol-QALY or expert-DALY must be adapted for this QASY scoring system.



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Resource Conservation Accounting Capital Stock Scenario Thresholds							
label	loc	risks_and_indicators	80 to 100 best	60 to 80 good	40 to 60 moderate	20 to 40 limited	0 to 20 unacceptabl
NA1	1	Habitat Change Factor 1					
NA1A	1	indicator1					
NA1B	1	indicator2					
NA2	1	Habitat Change Factor 2					
NA2A	1	indicator1					
NA2B	1	indicator2					
NA	1	Habitat Change					
NB1	1	Climate Change Factor 1					
NB1A	1	indicator1					
NB1B	1	indicator2					
NB2	1	Climate Change Factor 2					
NB2A	1	indicator1					
NB2B	1	indicator2					
NB	1	Climate Change					
NC1	1	Overexploitation Factor 1					
NC1A	1	indicator1					
NC1B	1	indicator2					
NC2	1	Overexploitation Factor 2					
NC2A	1	indicator1					
NC2B	1	indicator2					
NC	1	Overexploitation					
ND1	1	Invasive Alien Species Factor 1					
ND1A	1	indicator1					
ND1B	1	indicator2					
ND2	1	Invasive Alien Species Factor 2					
ND2A	1	indicator1					
ND2B	1	indicator2					
ND	1	Invasive Alien Species					
SC1	1	Pollution and Nutrient Enrichment Factor 1					
SC1A	1	indicator1					
SC1B	1	indicator2					
SC2	1	Pollution and Nutrient Enrichment Factor 2					
SC2A	1	indicator1					
SC2B	1	indicator2					
SC	1	Pollution and Nutrient Enrichment					
IA1	1	Migration Factor 1					
IA1A	1	indicator1					
IA1B	1	indicator2					
IA2	1	Migration Factor 2					
IA2A	1	indicator1					
IA2B	1	indicator2					
IA	1	Migration					
TR	1	Social Performance Score					



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The following table illustrates harmonizing this Performance Indicator system with an EU budget. The Indicator system was developed by EU scientists with active feedback from concerned, or more accurately, informed, citizens and businesses. WHO (2016) uses the term “Performance Budgeting” to describe tying government budget revenues and expenditures to Performance Indicators and Indexes in this manner.

RCA-EU Budget Harmonization				EU Budget			
label	loc	risks_and_indicators	QTMMost	label	locatic	risks_and_indicators	Unit
NA1	1	Habitat Change Factor 1		NA1	1	Habitat Change Factor 1	total cost or revenue
NA1A	1	indicator1		NA1A	1	costorrevenue1	euro per unit
NA1B	1	indicator2		NA1B	1	costorrevenue2	euro per unit
NA2	1	Habitat Change Factor 2		NA2	1	Habitat Change Factor 2	total cost or revenue
NA2A	1	indicator1		NA2A	1	costorrevenue1	euro per unit
NA2B	1	indicator2		NA2B	1	costorrevenue2	euro per unit
NA	1	Habitat Change		NA	1	Habitat Change	total cost or revenue
NB1	1	Climate Change Factor 1		NB1	1	Climate Change Factor 1	total cost or revenue
NB1A	1	indicator1		NB1A	1	costorrevenue1	euro per unit
NB1B	1	indicator2		NB1B	1	costorrevenue2	euro per unit
NB2	1	Climate Change Factor 2		NB2	1	Climate Change Factor 2	total cost or revenue
NB2A	1	indicator1		NB2A	1	costorrevenue1	euro per unit
NB2B	1	indicator2		NB2B	1	costorrevenue2	euro per unit
NB	1	Climate Change		NB	1	Climate Change	total cost or revenue
NC1	1	Overexploitation Factor 1		NC1	1	Overexploitation Factor 1	total cost or revenue
NC1A	1	indicator1		NC1A	1	costorrevenue1	euro per unit
NC1B	1	indicator2		NC1B	1	costorrevenue2	euro per unit
NC2	1	Overexploitation Factor 2		NC2	1	Overexploitation Factor 2	total cost or revenue
NC2A	1	indicator1		NC2A	1	costorrevenue1	euro per unit
NC2B	1	indicator2		NC2B	1	costorrevenue2	euro per unit
NC	1	Overexploitation		NC	1	Overexploitation	total cost or revenue
ND1	1	Invasive Alien Species Factor 1		ND1	1	Invasive Alien Species Factor 1	total cost or revenue
ND1A	1	indicator1		ND1A	1	costorrevenue1	euro per unit
ND1B	1	indicator2		ND1B	1	costorrevenue2	euro per unit
ND2	1	Invasive Alien Species Factor 2		ND2	1	Invasive Alien Species Factor 2	total cost or revenue
ND2A	1	indicator1		ND2A	1	costorrevenue1	euro per unit
ND2B	1	indicator2		ND2B	1	costorrevenue2	euro per unit
ND	1	Invasive Alien Species		ND	1	Invasive Alien Species	total cost or revenue
SC1	1	Pollution and Nutrient Enrichment Factor 1		SC1	1	Pollution and Nutrient Enrichment Factor 1	total cost or revenue
SC1A	1	indicator1		SC1A	1	costorrevenue1	euro per unit
SC1B	1	indicator2		SC1B	1	costorrevenue2	euro per unit
SC2	1	Pollution and Nutrient Enrichment Factor 2		SC2	1	Pollution and Nutrient Enrichment Factor 2	total cost or revenue
SC2A	1	indicator1		SC2A	1	costorrevenue1	euro per unit
SC2B	1	indicator2		SC2B	1	costorrevenue2	euro per unit
SC	1	Pollution and Nutrient Enrichment		SC	1	Pollution and Nutrient Enrichment	total cost or revenue
IA1	1	Migration Factor 1		IA1	1	Migration Factor 1	total cost or revenue
IA1A	1	indicator1		IA1A	1	costorrevenue1	euro per unit
IA1B	1	indicator2		IA1B	1	costorrevenue2	euro per unit
IA2	1	Migration Factor 2		IA2	1	Migration Factor 2	total cost or revenue
IA2A	1	indicator1		IA2A	1	costorrevenue1	euro per unit
IA2B	1	indicator2		IA2B	1	costorrevenue2	euro per unit
IA	1	Migration		IA	1	Migration	total cost or revenue
TR	1	Social Performance Score		TR	1	Social Performance Net	total cost or revenue



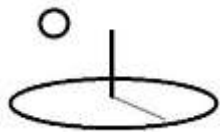
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The goal of full Impact Evaluation is to use full explanatory paths to understand cause and effect. Given that the goal of this example is to understand GCEA, Indicator 1 to 3 in the results chain are not completed for the 3 Perspectives. Instead, Indicator 1 illustrates the completion of the RCA1 probability distributions for Impacts alone, Indicator 2 illustrates an EU budget for these interventions, and Indicator 3 demonstrates the GCEA. For the sake of brevity, tables are not shown for the Public Capital and Stakeholder A Perspectives.

The following Social Performance Scoring system is completed for 1 ecosystem, or 1 location. Similar Scores are developed for the remaining ecosystems. As explained in Section H: Study Design, an RCA2-style instrument uses the same Indicators and Indexes for short term M&E. This instrument strictly serves as a stylized Impact Evaluation that evaluates Scenarios 1 to 4.

Natural Capital Care Perspective

Indicator 1. RCA1 Social Performance Assessment MathResult



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label	location	risks_and_distribtype	QTMost	QTMostUr	QTLow	QTLowUni	QTUp	QTUpUnit	certainty1	certainty2	norm	weight
NA1		1 Habitat Ch none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NA1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NA1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NA2		1 Habitat Ch none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NA2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NA2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NA		1 Habitat Ch none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
NB1		1 Climate Ch none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NB1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NB1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NB2		1 Climate Ch none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NB2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NB2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NB		1 Climate Ch none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
NC1		1 Overexplo none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NC1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NC1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NC2		1 Overexplo none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
NC2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
NC2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
NC		1 Overexplo none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
ND1		1 Invasive Al none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
ND1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
ND1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
ND2		1 Invasive Al none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
ND2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
ND2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
ND		1 Invasive Al none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
SC1		1 Pollution a none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
SC1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
SC1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
SC2		1 Pollution a none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
SC2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
SC2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
SC		1 Pollution a none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
IA1		1 Migration none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
IA1A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
IA1B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
IA2		1 Migration none	3.7675	most	3.73	low ci	3.805	high ci	3.25	3.75	weights	1
IA2A		1 indicator1 normal	2.5125	mean	2.4857	lower 80 %	2.5393	upper 80 %	2.5	4	weights	1
IA2B		1 indicator2 normal	1.255	mean	1.2443	lower 80 %	1.2657	upper 80 %	4	3.5	weights	1
IA		1 Migration none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1
TR		1 Social Perf none	7.535	performar	7.46	low ci	7.61	high ci	3.25	3.75	none	1

Indicator 2. EU Budget MathResult



DevTreks –social budgeting that improves lives and livelihoods

label	location	risks_and	factor1	factor2	factor3	factor4	QTMostUr	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
NA1		1 Habitat Ch	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
NA1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NA1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NA2		1 Habitat Ch	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
NA2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NA2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NA		1 Habitat Ch	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
NB1		1 Climate Ch	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
NB1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NB1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NB2		1 Climate Ch	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
NB2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NB2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NB		1 Climate Ch	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
NC1		1 Overexplo	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
NC1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NC1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NC2		1 Overexplo	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
NC2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NC2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NC		1 Overexplo	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
ND1		1 Invasive Al	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
ND1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
ND1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
ND2		1 Invasive Al	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
ND2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
ND2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
ND		1 Invasive Al	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
SC1		1 Pollution a	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
SC1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
SC1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
SC2		1 Pollution a	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
SC2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
SC2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
SC		1 Pollution a	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
IA1		1 Migration	0	0	0	0	total QASY	none	1	1	1	4	5	2250	1687.5	2875
IA1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
IA1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
IA2		1 Migration	0	0	0	0	total QASY	none	1	1	1	4	5	4500	3375	5750
IA2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
IA2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
IA		1 Migration	0	0	0	0	cost per Q	none	0	0	0	4	5	6750	5062.5	8625
TR		1 Social Perf	0	0	0	0	cost per Q	none	0	0	1	4	5	40500	30375	51750
NA1_AA		1 Habitat Ch	0	0	0	0	total QASY	none	1	1	1	4	5	2475	1856.25	3162.5

Indicator 3. GCEA MathResult



DevTreks –social budgeting that improves lives and livelihoods

label	location	risks_and	factor1	factor2	factor3	factor4	QTMostUr	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
NA1		1 Habitat Ch	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NA1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NA1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NA2		1 Habitat Ch	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NA2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NA2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NA		1 Habitat Ch	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
NB1		1 Climate Ch	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NB1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NB1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NB2		1 Climate Ch	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NB2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NB2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NB		1 Climate Ch	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
NC1		1 Overexplo	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NC1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
NC1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
NC2		1 Overexplo	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
NC2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
NC2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
NC		1 Overexplo	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
ND1		1 Invasive Al	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
ND1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
ND1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
ND2		1 Invasive Al	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
ND2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
ND2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
ND		1 Invasive Al	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
SC1		1 Pollution a	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
SC1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
SC1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
SC2		1 Pollution a	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
SC2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
SC2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
SC		1 Pollution a	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
IA1		1 Migration	50	37.5	65	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
IA1A		1 indicator1	5000	3750	6500	0.25	total cost	none	0	1	1	4	5	1250	937.5	1625
IA1B		1 indicator2	1000	750	1250	1	total cost	none	0	1	1	4	5	1000	750	1250
IA2		1 Migration	100	75	130	4.8	total QASY	none	1	1	1	4	5	45	45	44.2308
IA2A		1 indicator1	10000	7500	13000	0.25	total cost	none	0	1	1	4	5	2500	1875	3250
IA2B		1 indicator2	2000	1500	2500	1	total cost	none	0	1	1	4	5	2000	1500	2500
IA		1 Migration	150	112.5	195	4.8	cost per Q	none	6750	5062.5	8625	4	5	45	45	44.2308
TR		1 Social Perf	900	675	1170	4.8	cost per Q	none	40500	30375	51750	4	5	45	45	44.2308

Natural Capital Care Perspective ICER

The previous table's MathResults were edited in a spreadsheet to produce the following table.

The table shows that even stylized analyses need careful data input (and that the multiplicative law of mathematics works).



DevTreks –social budgeting that improves lives and livelihoods

label	risks_and	Most Likely					Low Estimate					High Estimate				
		costs	incremental	qasy	increment	icer-most	costs	increment	qasy	increment	icer-low	costs	increment	qasy	increment	icer-high
NA	Habitat Ch	6750.00		150.00			5062.50		112.50			8625.00		195.00		
NB	Climate Ch	6750.00		150.00			5062.50		112.50			8625.00		195.00		
NC	Overexplo	6750.00		150.00			5062.50		112.50			8625.00		195.00		
ND	Invasive Al	6750.00		150.00			5062.50		112.50			8625.00		195.00		
SC	Pollution a	6750.00		150.00			5062.50		112.50			8625.00		195.00		
IA	Migration	6750.00		150.00			5062.50		112.50			8625.00		195.00		
TR	Social Perl	40500.00		900.00			30375.00		675.00			51750.00		1170.00		
NA_AA	Habitat Ch	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
NB_AA	Climate Ch	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
NC_AA	Overexplo	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
ND_AA	Invasive Al	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
SC_AA	Pollution a	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
IA_AA	Migration	7425.00	675.00	165.00	15.00	45.00	5568.75	506.25	123.75	11.25	45.00	9487.50	862.50	214.50	19.50	44.23
TR_AA	Social Perl	44550.00	4050.00	990.00	90.00	45.00	33412.50	3037.50	742.50	67.50	45.00	56925.00	5175.00	1287.00	117.00	44.23
NA_AB	Habitat Ch	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
NB_AB	Climate Ch	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
NC_AB	Overexplo	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
ND_AB	Invasive Al	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
SC_AB	Pollution a	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
IA_AB	Migration	9281.25	2531.25	206.25	56.25	45.00	6960.94	1898.44	154.69	42.19	45.00	11859.38	3234.38	268.13	73.13	44.23
TR_AB	Social Perl	55687.50	15187.50	1237.50	337.50	45.00	41765.63	11390.63	928.13	253.13	45.00	71156.25	19406.25	1608.75	438.75	44.23
NA_AC	Habitat Ch	16242.19	9492.19	360.94	210.94	45.00	12181.64	7119.14	270.70	158.20	45.00	20753.91	12128.91	469.22	274.22	44.23
NB_AC	Climate Ch	18562.50	11812.50	412.50	262.50	45.00	13921.88	8859.38	309.38	196.88	45.00	23718.75	15093.75	536.25	341.25	44.23
NC_AC	Overexplo	18562.50	11812.50	412.50	262.50	45.00	13921.88	8859.38	309.38	196.88	45.00	23718.75	15093.75	536.25	341.25	44.23
ND_AC	Invasive Al	18562.50	11812.50	412.50	262.50	45.00	13921.88	8859.38	309.38	196.88	45.00	23718.75	15093.75	536.25	341.25	44.23
SC_AC	Pollution a	18562.50	11812.50	412.50	262.50	45.00	13921.88	8859.38	309.38	196.88	45.00	23718.75	15093.75	536.25	341.25	44.23
IA_AC	Migration	18562.50	11812.50	412.50	262.50	45.00	13921.88	8859.38	309.38	196.88	45.00	23718.75	15093.75	536.25	341.25	44.23
TR_AC	Social Perl	109054.69	68554.69	2423.44	1523.44	45.00	81791.02	51416.02	1817.58	1142.58	45.00	139347.66	87597.66	3150.47	1980.47	44.23

Given that this example’s primary purpose is to illustrate adapting respected health care industry valuation techniques to the RCA Framework, this example chose not to change the stylized data used to generate these ICERs. The data still supports “eyeball” evidence that this algorithm works. Instead, the table’s costs and QASY’s were changed to show a constant incremental increase in performance, as illustrated in the following table.



DevTreks –social budgeting that improves lives and livelihoods

label	risks_and	costs	Most Likely				Low Estimate					High Estimate				
			incrementa	qasy	increment	icer-most	costs	increment	qasy	increment	icer-low	costs	increment	qasy	increment	icer-high
NA	Habitat Ch	1000.00		1.50			500.00		1.13			2000.00		2.25		
NB	Climate Ch	2000.00		2.00			1000.00		1.50			4000.00		3.00		
NC	Overexplo	3000.00		2.50			1500.00		1.88			6000.00		3.75		
ND	Invasive Al	4000.00		3.00			2000.00		2.25			8000.00		4.50		
SC	Pollution a	5000.00		3.50			2500.00		2.63			10000.00		5.25		
IA	Migration	6000.00		4.00			3000.00		3.00			12000.00		6.00		
TR	Social Peri	21000.00		16.50			10500.00		12.38			42000.00		24.75		
NA_AA	Habitat Ch	1100.00	100.00	1.73	0.23	444.44	550.00	50.00	1.29	0.17	296.30	2200.00	200.00	2.59	0.34	592.59
NB_AA	Climate Ch	2200.00	200.00	2.30	0.30	666.67	1100.00	100.00	1.73	0.23	444.44	4400.00	400.00	3.45	0.45	888.89
NC_AA	Overexplo	3300.00	300.00	2.88	0.38	800.00	1650.00	150.00	2.16	0.28	533.33	6600.00	600.00	4.31	0.56	1066.67
ND_AA	Invasive Al	4400.00	400.00	3.45	0.45	888.89	2200.00	200.00	2.59	0.34	592.59	8800.00	800.00	5.18	0.68	1185.19
SC_AA	Pollution a	5500.00	500.00	4.03	0.52	952.38	2750.00	250.00	3.02	0.39	634.92	11000.00	1000.00	6.04	0.79	1269.84
IA_AA	Migration	6600.00	600.00	4.60	0.60	1000.00	3300.00	300.00	3.45	0.45	666.67	13200.00	1200.00	6.90	0.90	1333.33
TR_AA	Social Peri	23100.00	2100.00	18.98	2.48	848.48	11550.00	1050.00	14.23	1.86	565.66	46200.00	4200.00	28.46	3.71	1131.31
NA_AB	Habitat Ch	1200.00	200.00	1.95	0.45	444.44	600.00	100.00	1.46	0.34	296.30	2400.00	400.00	2.93	0.68	592.59
NB_AB	Climate Ch	2400.00	400.00	2.60	0.60	666.67	1200.00	200.00	1.95	0.45	444.44	4800.00	800.00	3.90	0.90	888.89
NC_AB	Overexplo	3600.00	600.00	3.25	0.75	800.00	1800.00	300.00	2.44	0.56	533.33	7200.00	1200.00	4.88	1.13	1066.67
ND_AB	Invasive Al	4800.00	800.00	3.90	0.90	888.89	2400.00	400.00	2.93	0.68	592.59	9600.00	1600.00	5.85	1.35	1185.19
SC_AB	Pollution a	6000.00	1000.00	4.55	1.05	952.38	3000.00	500.00	3.41	0.79	634.92	12000.00	2000.00	6.83	1.58	1269.84
IA_AB	Migration	7200.00	1200.00	5.20	1.20	1000.00	3600.00	600.00	3.90	0.90	666.67	14400.00	2400.00	7.80	1.80	1333.33
TR_AB	Social Peri	25200.00	4200.00	21.45	4.95	848.48	12600.00	2100.00	16.09	3.71	565.66	50400.00	8400.00	32.18	7.43	1131.31
NA_AC	Habitat Ch	1250.00	250.00	1.95	0.45	555.56	625.00	125.00	1.46	0.34	370.37	2500.00	500.00	2.93	0.68	740.74
NB_AC	Climate Ch	2500.00	500.00	2.60	0.60	833.33	1250.00	250.00	1.95	0.45	555.56	5000.00	1000.00	3.90	0.90	1111.11
NC_AC	Overexplo	3750.00	750.00	3.25	0.75	1000.00	1875.00	375.00	2.44	0.56	666.67	7500.00	1500.00	4.88	1.13	1333.33
ND_AC	Invasive Al	5000.00	1000.00	3.90	0.90	1111.11	2500.00	500.00	2.93	0.68	740.74	10000.00	2000.00	5.85	1.35	1481.48
SC_AC	Pollution a	6250.00	1250.00	4.55	1.05	1190.48	3125.00	625.00	3.41	0.79	793.65	12500.00	2500.00	6.83	1.58	1587.30
IA_AC	Migration	7500.00	1500.00	5.20	1.20	1250.00	3750.00	750.00	3.90	0.90	833.33	15000.00	3000.00	7.80	1.80	1666.67
TR_AC	Social Peri	26250.00	5250.00	21.45	4.95	1060.61	13125.00	2625.00	16.09	3.71	707.07	52500.00	10500.00	32.18	7.43	1414.14

Public Capital Care Perspective ICER

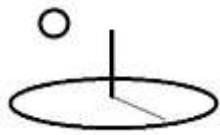
The use of stylized data doesn't actually contribute much to this introduction to GCEA. This will be completed when better data can be found.

Stakeholder Group A Perspective ICER

This will be completed when better data can be found.

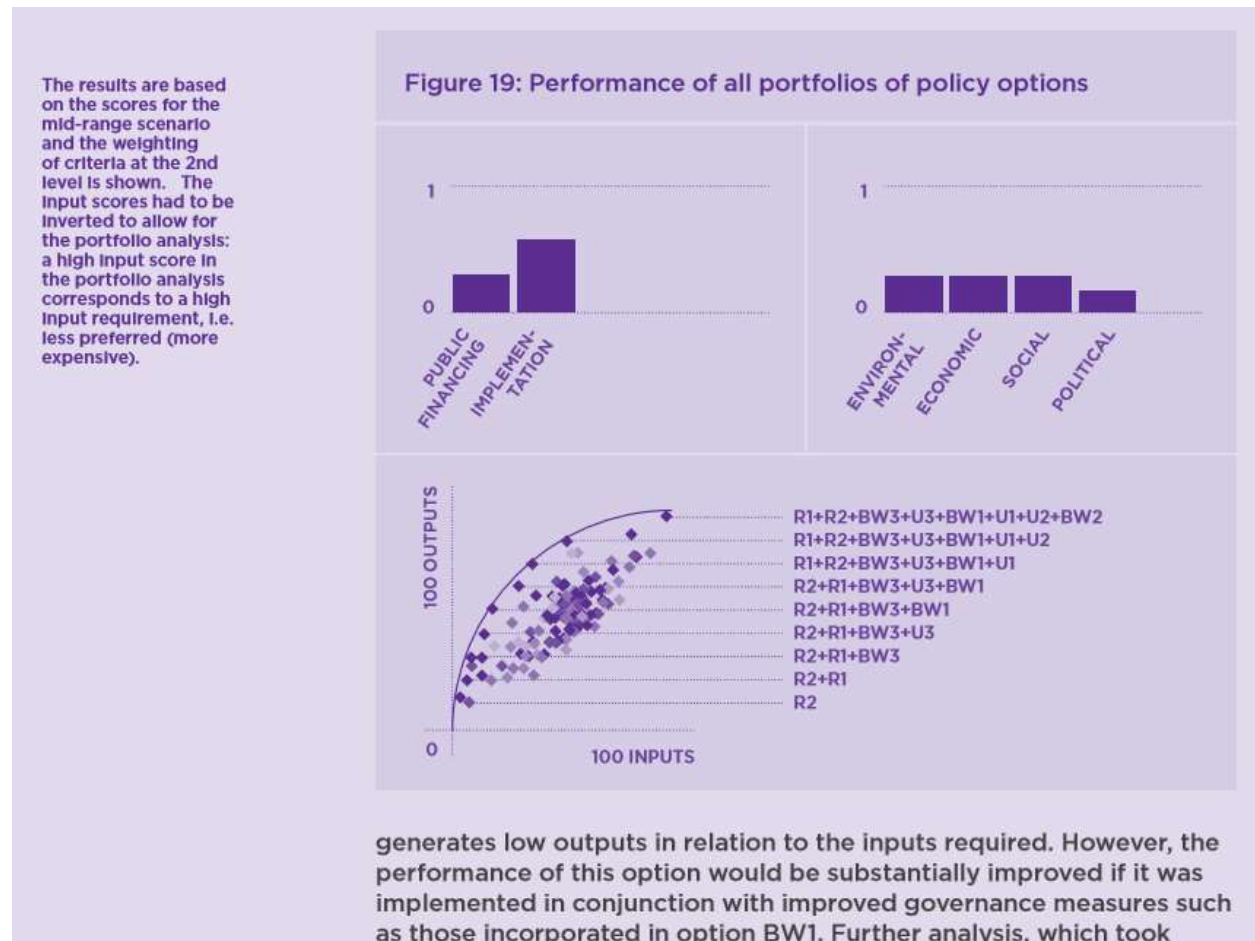
The goal of this country's conservation efforts, and their overall Social Performance Assessment, is to increase the quality of life for their stakeholders. In order to do so, they must understand the interactions, linkages, and cause-effect relationships, between the 9 resource stock states and the 6 pressures. Their resultant knowledge of the tradeoffs that must be made between services, mitigation actions and impacts, and stakeholder values, assists them to achieve their societal performance goals.

The following image demonstrates how UNEP (2011) uses MCDA to understand tradeoffs better in the natural capital care sector, specifically to address climate change. This example adapts this



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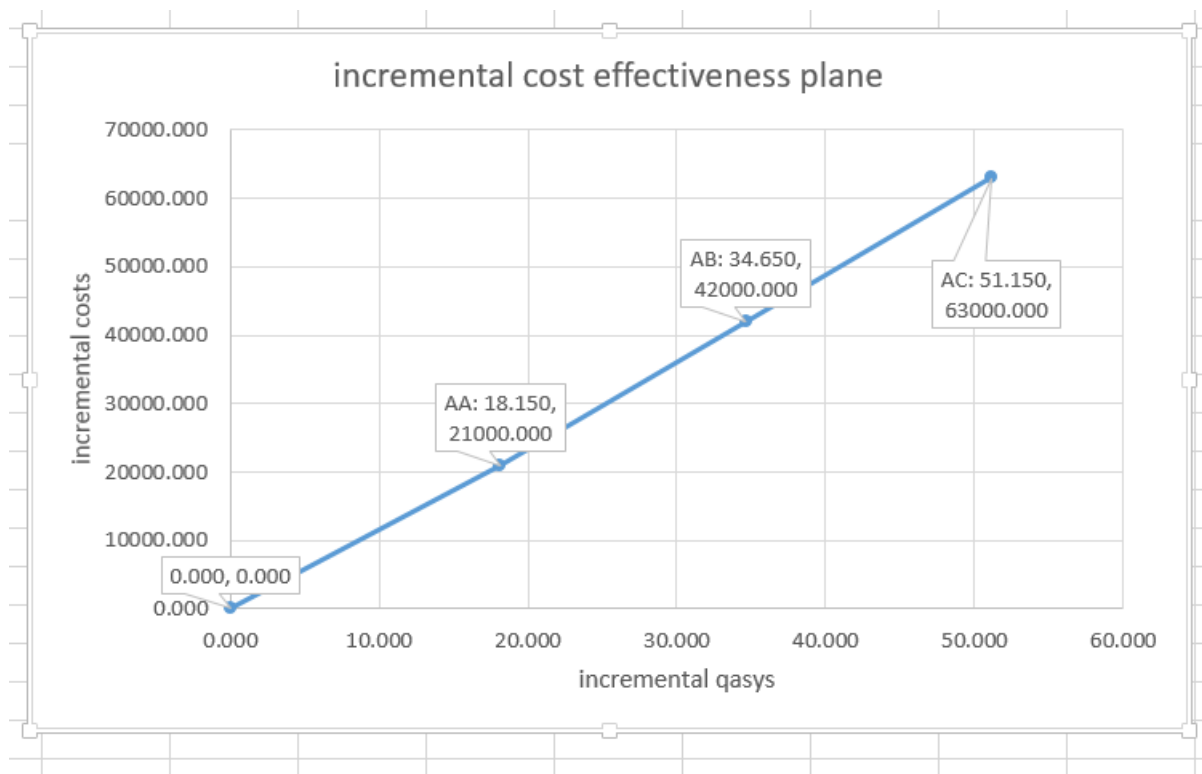
technique for explanatory mixed methods assessments. Specifically, outputs are replaced by QASY measurements taken from Impact Indicators. Inputs are replaced by Cost measurements derived from the EU budget.



The following image displays the resultant cost effectiveness plane for the 3 scenarios in this example. The stylized data results in a linear plane suggesting that, without budget constraints, consideration of CEA Thresholds, or the Uncertainty Indexes, Scenario AC should be chosen.



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L: Results of Uncertainty Analysis

The following table comes from Example 4A and illustrates the uncertainty metrics available with this algorithm. Kim et al (2016) describe this type of uncertainty analysis in statements such as: “Results were robust across a range of WTP thresholds and across plausible ranges of remission rates and health-related quality of life (HRQoL) in the AUD state. However, substantial uncertainty in final estimates indicates [a] large value of future research on this topic.” Of course, this reference corrects the last 8 words as follows: “large value of applied IT and effective research and on this topic.”



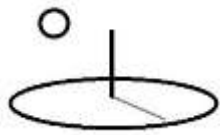
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alternative	incremental cost	incremental performance	icer-most	icer-low	icer-high	avg cost certainty1	interpretation	avg cost certainty2	interpretation	incremental	performance certainty		incremental
No Certification	0.000	0.000				4.000	very likely	5.000	very high confidence		4.830	well established	
TR_AA	103.989	365.000				4.000	likely	5.000	very high confidence	0.000	3.500	established but incomplete	-1.330
TR_AB	228.789	511.000				3.500	likely	4.000	high confidence	-0.500	3.000	established but incomplete	-1.830
AA-AB	124.801	146.000	0.855	0.662	1.556					-0.500			-0.500
TR_AC	415.987	887.680				3.000	likely	3.000	medium confidence	3.000	2.500	inconclusive	-2.330
AA-AC	311.998	522.680	0.597	-0.100	1.043					-1.000			-1.000
AB-AC	187.198	376.680	0.497	-0.937	0.854					-0.500			-0.500

The results of the RCA4 algorithm supported completion of the following Reference Case Cost Effectiveness Results table (5*). For this example, 2 uncertainty “Indexes” have been developed from the previous table to support Appendix A’s “qualitative communication of performance” (i.e. Uncertainty Index 3 = established but incomplete). Similar tables are produced from the Low and High Estimates.

Reference Case Cost Effectiveness Results (Time Horizon = 200 years; Costs and QASYS Discount Rate = 3%; Escalation Type = none; CEA Threshold = 100,000; Confidence Interval = 80%;									
Alternative	Most Likely Total Costs	Uncertainty Index	Most Likely QASYS	Uncertainty Index	Incremental Costs	Incremental Effectiveness (QASYS)	NMB	Incremental NMB	ICER (Inc Cost / Inc QASY)
Stakeholder Group A Perspective									
No Mitigation and Adapt.									
AA	to be completed when data becomes available								
AB									
AC									
Natural Capital Care Perspective									
No Mitigation and Adapt.									
AA	21,000.00	4.00	16.50	4.50			1,629,000.00		
AA	23,100.00	3.50	18.98	2.50	21,000.00	18.15	1,874,400.00	245,400.00	1,157.02
AB	25,200.00	3.00	21.45	2.00	42,000.00	34.65	2,119,800.00	245,400.00	1,212.12
AC	26,250.00	4.25	21.45	4.50	63,000.00	51.15	2,118,750.00	(1,050.00)	1,231.67
Public Capital Care Perspective									
No Mitigation and Adapt.									
AA	to be completed when data becomes available								
AB									
AC									

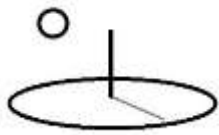
These results show that all scenarios generate substantial Net Monetary Benefits (NMB), but Scenario AA has the lowest incremental cost per incremental QASY and is considered most efficient. Once the Uncertainty Indexes are considered, Scenario AC’s costs and performance are substantially more certain than the other Scenarios. Given AC’s substantial NBM, regardless of the negative Incremental NMB, Scenario AC should receive strong consideration for funding from decision makers.



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Jacobs et al (2016) provide an overview of the importance of the Stakeholders perspective in natural capital care assessments. A strong focus on those perspectives ensure that, at the very least, these assessments introduce decision makers to “socially acceptable paths forward”. The authors also warn of the danger to equity these approaches pose when “some social actors [capture] more power” in the overall decision making process. A particular danger in special interest group dominated countries.

The following image (EPA, 2016) illustrates additional decision support that can be derived using the Uncertainty Index-style metrics shown in the previous table. The USEPA applied a mixed methods evaluation at city-scale for this analysis.



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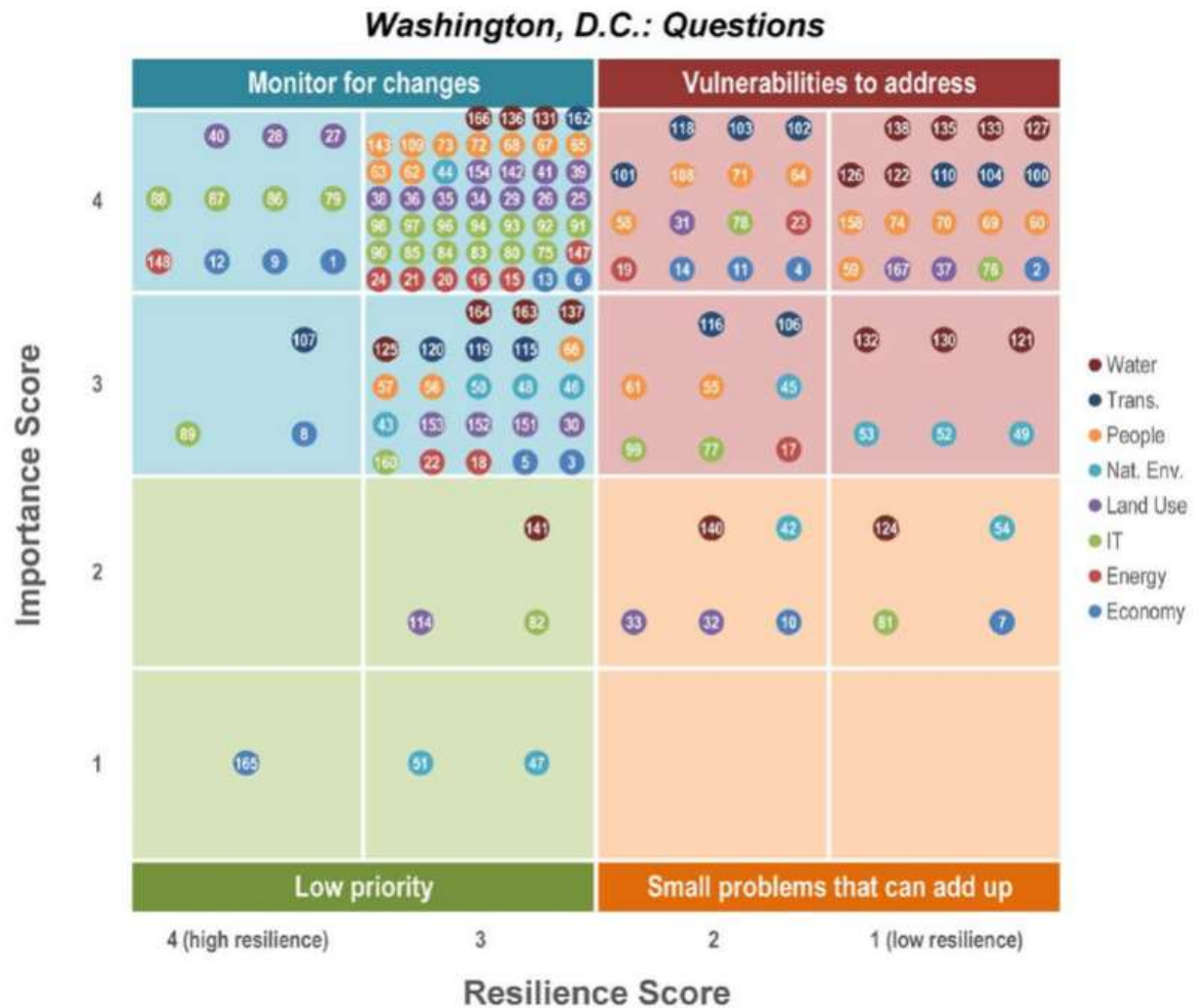


Figure 5. Washington, DC. Question quadrant mapping.

M: Limitations

The following image (WHO, 2017) demonstrates how the international health care sector sets priorities for improving health systems performance.



Health system performance dimensions

Equity. Equitable access to needed services and protection against financial hardship are the key dimensions of UHC and health system performance. The focus on equity in access and financing implies that progress towards UHC cannot be assessed based only on national averages; rather, disaggregated data are important to understand the extent to which there are systematic disparities in access, effective coverage and the financial burden associated with health services (for example, by sex, age, geographical area, education, income, ethnicity, disability, migrant status). A robust but sensitive monitoring system is essential for assessing whether equity is being achieved. The UHC monitoring framework, developed by WHO and the World Bank, covers promotion, prevention, treatment, rehabilitation and palliative services. The monitoring framework also assesses protection against financial hardship caused by high household expenditures on health, using the incidence of catastrophic payments and of impoverishing expenditures¹⁶.

Quality. Quality of health care is “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge”^{17 18}. Shortfalls in quality - in terms of safety, effectiveness, patient-centeredness and timeliness - result in avoidable risks for patients and under-performance of health systems relative to what can be achieved with available resources.

Responsiveness. The concept of responsiveness refers to the extent to which a health system meets people’s expectations and preferences concerning non-health matters, including the importance of respecting people’s dignity, socio-cultural beliefs and preferences, autonomy and the confidentiality of information, besides responding to the needs and demand of patients. Although measurement and systematic benchmarking within and across countries present unresolved challenges, responsiveness is widely acknowledged as a key dimension of health system performance.

Efficiency. At the broadest level, health system efficiency is concerned with the extent to which available inputs (for example, expenditures and other health system resources) generate the highest possible level of health outcomes. Inefficiencies in a health system may be related to waste or poor operational performance in the production of health services or outcomes (technical inefficiency) or a sub-optimal choice of inputs, such as a mix of labor skills (allocative inefficiency). Either way, the result is that the health system is under-performing relative to what could potentially be achieved.

Resilience. Recent public health emergencies have highlighted the importance of health system resilience. Although resilience lacks a formally accepted definition, it is referred to here as “the capacity of health actors, institutions, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and, informed by lessons learned during the crisis, reorganize if conditions require it.”¹⁹

These are the same dimensions needed to improve the public service “delivery models” summarized in this reference. Given that the conventional institutions in some countries appear incapable of understanding, let alone applying, these common sense dimensions, social networks and clubs may need to take independent action.



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Besides institutional failure, possibly originating in special interest group-dominated institutions, the CEA references discuss further limitations that must be addressed in these analyses. They include the importance of counterfactual evidence, alternative ways to devise social weights to address equity, the use of international units, patient population heterogeneity versus patient population averages, and the need for additional sensitivity analysis (i.e. weights, discount rates, life of project). This reference would be remiss without pointing out the importance of putting priority on funding IT that applies “effective research” as contrasted to “conventional research”.

N: Conclusions

Hutubessy et al (2003) describe why GCEA is applied at country and sector scales:

“Most country applications focus on local and marginal improvements in technical efficiency. The term allocative efficiency, on the other hand, is typically used in health economics to refer to the distribution of resources among different programmes or interventions in order to achieve the maximum possible socially desired outcome for the available resources. By definition, addressing issues of allocative efficiency in health requires a broader, sectoral approach to evaluation”

WHO (Example 4, 2016, chapters 7 and 8) explain the use of cost estimates and budgets further and use the following definitions to define efficiency in the health care sector of countries.

“Allocative efficiency. This concerns the “what” – i.e. the health service package that is being provided, and whether changing the composition of services within the package (subsidized by public funds) would bring more value for money. Here, cost-effectiveness analysis is a useful tool to assess efficiency. In the case of a budget reduction for health, important decisions would need to be made whether to restrict access and/ or increase co-payment for some services and/ or populations and if so, which ones.”



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“Technical efficiency. This relates to “how” resources are used, and whether the same set of services could be delivered more efficiently. Potential strategies may include shifting tasks from one type of health worker cadre to another, changing purchasing strategies for drugs and medicines in order to obtain lower prices, and shifting from inpatient to outpatient care where this can be safely and effectively done.”

This “allocative efficiency” and “technical efficiency” explanations for GCEA at country or sector scale are further explained in the Performance Analysis 1 reference. Example 4B demonstrates that these techniques, with additional social network work, can also be used to reduce serious societal risks, including climate change, biodiversity loss, migration, and civil rights protection. This “mainstreaming a new culture of valuation” (Jacobs et al, 2016) may help people to improve their lives and livelihoods.

M: Compliance Labelling

The following DevTreks logo illustrates how to relate this example to compliance standards. This logo, or compliance label, is used when complete GCEA and M&E systems have been fully implemented at country or sector scale to assess public service improvement technologies. The label signifies that countries or industries fully comply with using transparent and affordable resource conservation actions to reduce serious societal risks, such as climate change. Citizens hold their public officials accountable for failure to comply. Consumers hold their industry executives accountable for failure to comply. Supply chain buyers hold their producers accountable for failure to comply. Investors hold their companies accountable for failure to comply. In practice, social networks work through the ISEAL Alliance, producer organizations, and local communities, for similar purposes.



Footnotes



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1. The author recently spent several hours reviewing the Second Panel on Cost Effectiveness in Health and Medicine’s 2016 youtube presentation summarizing their recent publication on CEA in the health care sector (i.e. they charge fees for the book which has limited usefulness in the public goods context of DevTreks). First impressions were that their single-capital recommendations for Societal Perspectives, Impact Inventories, and multi-stakeholder impact analysis, could be addressed more directly using the multi-capital and multi-sector approaches introduced in this tutorial. In fact, the author believed that the health care industry “missed the boat” and should have started with a clear mandate for a multi-capital approach (i.e. for a more complete Societal Perspective and a better QALY that could be used in multiple sectors). Closer inspection of their Working Examples and other applied uses found that their recommendations serve practical, if partial, purposes that could be adapted to the RCA’s multi-capital framework and this Example’s multi-sector CEA techniques (i.e. or WHO’s, 2017, health systems performance need).
2. The author acknowledges that as this stage of development, QASYs are “quasi-right” – they need more work, but Appendix 1 suggests that the work appears to be under development by several national and international organizations (even if for related purposes). The danger of social engineering hubris (i.e. rationing of health care) with this type of algorithm is avoided by focusing strongly on the health care sector’s Health Technology Assessment approach and DevTreks’ Conservation Technology Assessment approach. Society is not being engineered –technologies, including policies and management practices, are being evaluated for social soundness.
3. Version 2.1.0 changed the name of the Resource Conservation Accounting Framework to Resource Conservation Value Accounting (RCA) Framework because of the similarity to the current value frameworks being developed in the health care industry (IPSOR 2017, ICER 2017, Westrich 2016, ACC-AHA 2014). The objective of these value frameworks is to ensure that money spent on products and services, including health care and ecosystem services, generates cost effective value (i.e. measured using CEA and M&E-based Performance Monitoring and Impact Evaluation in this reference). Readers should



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recognize that most of those frameworks would be handled, or “harmonized”, using 1 or more subalgorithms in DevTreks. Implying exactly what it sounds like it implies.

4. Although this example demonstrates applying a stylized “mixed methods explanatory approach”, specifically results chains, explained throughout this tutorial, Appendix 1 points out that the health care industry appears to be “leaning towards” accepting straight Multi-Criteria Decision Analysis (MCDA) frameworks, alone. Social networks need to keep an eye out for developments in that field, especially when “ease of use” has to be a primary initial step during the adoption of these techniques. Example 4A demonstrates a simplified application of that technique. As a side note, after spending a considerable amount of time on this example, it occurred to the author that he probably could have come up with the same approach several decades ago, but may have become “obfuscated” somewhere along the way.
5. See Footnote 1 in Example 4A. DevTreks always recommends using professional references when completing these types of analyses (i.e. even if, as in the case of the 2nd Panel on Cost Effectiveness Analysis’ 2016 book, they charge fees).

References

Health Care QALY/DALY/QASY CEA (Additional QALY/DALY CEA References can be found in Example 4A.)

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Jacobs, Sanders , Nicolas Dendoncker , Berta Martín-López , David Nicholas Barton , Erik Gomez-Baggethun , Fanny Boeraeve, Francesca L. McGrath , Kati Vierikko , Davide Geneletti , Katharina J. Sevecke , Nathalie Pipart , Eeva Primmer , Peter Mederly , Stefan Schmidt, Alexandra Aragã, Himlal Baral , Rosalind H. Bark , Tania Briceno , Delphine Brogna , Pedro Cabral , Rik De Vreese , Camino Liqueste , Hannah Mueller, Kelvin S.-H. Peh , Anna Phelan, Alexander R. Rincón , Shannon H. Rogers, Francis Turkelboom, Wouter Van Reeth, Boris T. van Zanten, Hilde Karine Wam, Carla-Leanne Washbourne. A new valuation school: Integrating diverse values of nature in resource and land use decisions. *Ecosystem Services* 22 (2016) 213–220

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Appendix 1 to Example 4B. Cost Effectiveness Analysis 3.0 (Quality Adjusted Stock Years, or QASYs (1*))

Version 2.2.0: This release added Appendix C to the SDG Plan reference which explains the use of Subjective Well Being Valuations, or QASYs. The SDG Plan reference can be found in the Social Performance Analysis tutorial.

Ireland HIQA (2010) defines the use of a primary CEA technique used in the health care industry:

“A cost-utility analysis is the preferred evaluation type for the reference case. It is considered the gold standard method for conducting economic evaluations and is recommended by many expert and consensus groups. The preferred outcome measure to be used in the reference case is the quality-adjusted-life-year (QALY)”.

IPSOR (2017) uses the following example to clarify the principal terms used in this Appendix, including cost utility analysis, QALYs, QALY CEA thresholds, and net monetary benefits (NMB):

“As an example, suppose that patients with lung cancer can expect to live an average of 4 years. Suppose also that they value each year spent with lung cancer as equal to 6 months of life spent in perfect health. Thus, they experience 2 QALYs. Now suppose that a new drug is introduced that extends life expectancy to 4.5 years. Suppose further that it reduces some of the disabilities and comorbidities associated with lung cancer such that patients now value one year spent with lung cancer as being equal to 8 months of life spent in perfect health. When treated with this drug, therefore, patients experience 3 QALYs, and the incremental benefit of the drug is equal to 1 additional QALY.



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With the incremental QALY gain in hand, the next challenge lies in obtaining a monetary value that society, payers, consumers or patients place on each QALY. For example, if each QALY is worth \$150,000, the lung cancer drug in our example produces \$150,000 worth of incremental benefit. If that drug costs \$125,000, we would then conclude its net value or “net monetary benefit” is \$25,000 ($=\$150,000 - \$125,000$).”

In support of this reference’s use of generic, multi-capital, social performance assessments, the single sector, single capital, single service, health outcome measurements, QALY and DALY, are replaced by the multi-sector, multi-capital, multi-service, quality of life outcome measurement, QASY (Quality Adjusted Stock Year). The following table demonstrates that, strained grammar aside, almost every characteristic, and definition, applied to QALYs can be applied to QASYs. Quotes that use citations in the following table come directly from the Wikipedia definition for QALY. Essentially, every use of the term “health” is replaced by the term “quality of life” (i.e. the basis for QALYs to begin with). The term “health care intervention” is replaced by the term “public service intervention” (i.e. the basis for health care interventions to begin with).

Outcome Characteristic	QALY, Quality Adjusted Life Year	QASY, Quality Adjusted Stock Year
Relation to Capital Stocks	Health is considered a single capital stock characteristic of human capital stocks.	Quality of life is considered a multi capital stock characteristic of human, social, physical, institutional, economic, natural, and cultural, stocks.
Definition	“generic measure of disease burden, including both the quality and the quantity of life lived”	generic measure of quality of life experience, including both the quality and the quantity of ‘quality of life’ lived
QOL Basis	Quality of Life caused by personal experience of health state	Quality of Life caused by personal experience of public services state
Typical Use	“economic evaluation to assess the value for money [spent on] medical interventions”	economic evaluation to assess the value for money spent on public service improvement interventions



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Scoring system	“multiplies the utility value associated with a given state of health by the years lived in that state”	multiplies the utility value associated with a given state of quality of life by the years lived in that state
Weighting or Utility Multiplier: Time Trade Off	“Respondents are asked to choose between remaining in a state of ill health for a period of time, or being restored to perfect health but having a shorter life expectancy.”	Respondents are asked to choose between remaining in a state of poor quality of life for a period of time, or being restored to perfect quality of life but having a shorter life expectancy.
Weighting or Utility Multiplier: Standard Gamble	“Respondents are asked to choose between remaining in a state of ill health for a period of time or choosing a medical intervention which has a chance of either restoring them to perfect health, or killing them.”	Respondents are asked to choose between remaining in a state of poor quality of life for a period of time or choosing a public service improvement intervention which has a chance of either restoring them to a perfect quality of life, or permanently destroying their quality of life.
Weighting or Utility Multiplier: Visual Analog Scale	“Respondents are asked to rate a state of ill health on a scale from 0 to 100, with 0 representing being dead and 100 representing perfect health. This method has the advantage of being the easiest to ask, but is the most subjective.”	Respondents are asked to rate a state of poor quality of life on a scale from 0 to 100, with 0 representing a permanently destroyed quality of life and 100 representing perfect quality of life. This method has the advantage of being the easiest to ask, but is the most subjective.
Weighting or Utility Multiplier: Quality of Life (QOL) Survey Instruments	“standard descriptive systems such as the EuroQol Group's EQ-5D questionnaire, which categorises health states according to five dimensions: mobility, self-care, usual activities (e.g. work, study, homework or leisure activities), pain/discomfort and anxiety/depression”	Standard descriptive systems such as the Sustainable Food Lab's (2016) small scale Agricultural Sustainability Assessment which categorizes quality of life states according to 7 impact areas: livelihood and well-being, gender, environmental stewardship, farm production, access to services, trading relations, and next generation farmers.
Score = 0	“[Nonexistent quality of life caused by] death resulting from personal health state”	Nonexistent quality of life caused by permanently destroyed quality of life resulting from personal quality of life state



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Score = 1	“Excellent quality of life with no problems caused by experience of personal health state”	Excellent quality of life with no problems caused by experience of personal quality of life state
Score = 0.5	“1 year of life lived in a situation with utility 0.5 (e.g. bedridden, 1 year \times 0.5 Utility) is assigned 0.5 QALYs. Similarly, half a year lived in perfect health is equivalent to 0.5 QALYs (0.5 years \times 1 Utility)”	1 year of life lived in a situation with utility 0.5 (e.g. impoverished, 1 year \times 0.5 Utility) is assigned 0.5 QALYs. Similarly, half a year lived with perfect quality of life is equivalent to 0.5 QALYs (0.5 years \times 1 Utility)
Score = 0 Example 1	Persons who are dying from bad health care services in sections of Syria and South Sudan	Persons who are dying from sectarian violence in sections of Syria and South Sudan
Score = 0 Example 2	Ethiopian pastoralists dying from insufficient quantity and quality of health care services	Ethiopian pastoralists who are dying of hunger due to poor ecosystem services caused by poverty, drought, population increase, and land use degradation

The following table confirms that, in practice, QASYs are similar to a multi-capital DALY. They expand QALY’s emphasis on life expectancy to include the RCA Framework’s multi-capital emphasis on quality of life.

Outcome Characteristic	DALY, Disability Adjusted Life Year	QASY, Quality Adjusted Stock Year
Relation to Capital Stocks	Disability is considered a single capital stock characteristic of human capital stocks.	Quality of life is considered a multi capital stock characteristic of human, social, physical, institutional, economic, natural, and cultural, stocks.
Definition	DALYs capture both mortality in terms of years of life lost (YLL) and morbidity in terms of years of life with disability (YLD)	QASYs capture both mortality in terms of years of life with destroyed quality of life (YLL) and morbidity in terms of years of life with impaired quality of life (YLD)

In regards to “cost-utility analysis”, or any utility-based economic measurement approach, QALYs appear to have wide acceptance because people have intimate knowledge of the worth



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they place on their personal health. In an economic sense, they know how much they are “willing to pay” to move from one health state to another. Formally, IPSOR (2017) describes this as “net value reflects the willingness to pay for the improvement in well-being minus the opportunity cost of resources used to produce that improvement”. The instruments used to measure QALYs, such as QOL Surveys and Weighting and Utility Scales, capture a population’s perception of how much they value their health, as the state of their health changes from health care interventions.

This reference argues that people also have intimate knowledge of the worth they place on their personal quality of life. They risk life and limb to migrate because they know how much they are “willing to pay” to move from one quality of life state to another. The reporting instruments introduced and referenced in Examples 1 to 4 guide people through recognition of the full worth of several multi-capital “impact areas” that directly impact their quality of life. Those impact areas serve the exact same purpose as the health care states categorized in the underlying QOL survey instruments used for measuring QALYs. The instruments used to measure QASYs, such as Social Performance Assessments or newly designed Weighting and Utility Scales, when applied to populations, capture people’s perception of how much they value their personal quality of life, as it changes from public service improvement interventions.

The health care industry (via Anderson et al, 2014) appears to agree with this “quality of life”, or QASY (or multi-capital DALY), valuation approach in the following statement:

“Another area of uncertainty is the incorporation of quality of life into value. Clearly, a treatment that improves quality of life at a reasonable cost has some value even if it does not improve life expectancy. Combining quality and length of life provides a more accurate estimate of the benefit of any intervention or program.”

The question appears to be whether or not “mixed methods qualitative explanatory paths” as applied in population-based, multi-capital, multi-sector, assessment techniques, such as Multi Criteria Decision Analysis, and the final outcome metric or Social Performance Score, QASY,



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have the same legitimacy as related single capital assessment techniques used to quantify QALYs and DALYs.

IPSOR (2017) believes that standard MCDA approaches alone, without QASYs, “elicit from the decision maker the tradeoff values to incorporate issues that cannot or have not been included in CEA or CBA. These models provide a unified single dimensional measure of value of alternative choices using a multi-attribute metric that combines the preference weights specified by “the decision maker” and the performance of alternative “candidates” along each of the dimensions of value.”

They qualify the use of MCDA approaches by endorsing MCDA as useful for capturing additional elements of value that CEA cannot capture, but reaffirm the centrality of QALY-based CEAs. Antioch et al (2017) concur with the IPSOR recommendations for MCDA. Although ICER (2017) does not endorse MCDA, they do endorse using qualitative, mixed methods-like, “contextual considerations” when conducting CEA.

Neither IPSOR, nor Antioch, fully address QASYs, or similar multi-capital QALY alternatives. Their extended and augmented QALYs use multi-dimensional, but not multi-capital, approaches. They also do not address the relation of “impact areas” and “health states” as a basis for quality of life measurements. It’s not clear whether the health care industry, with the exception of WHO, has “missed”, or “dismissed”, the advantages of “mixed methods explanatory approaches”, measured using the M&E-based Performance Monitoring Assessments and Impact Evaluations, explained by references used throughout this tutorial.

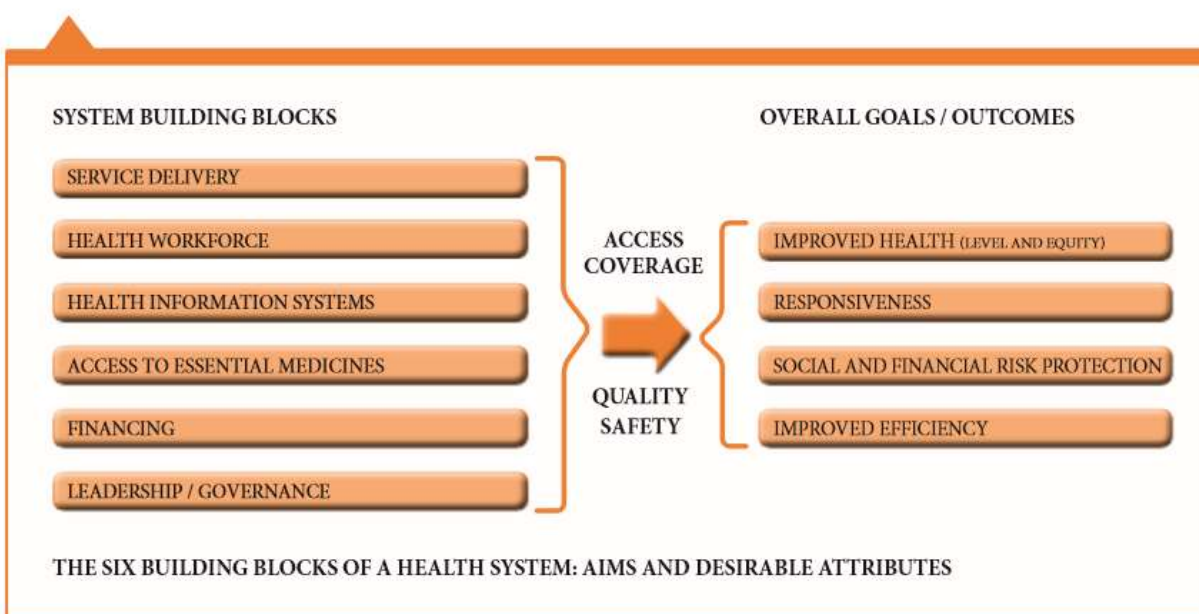
The final scientific answer to QASY’s legitimacy goes beyond the scope of this reference, but this reference sees answers starting to be supplied by organizations such as WHO, UNEP, IPSOR, and COSA (2*). In the natural capital sector, Jacob et al (2016) use the term “Integrated Valuation” to describe how these types of valuation approaches are starting to be applied by a “changing valuation culture”.



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WHO (2015), in fact, argues the merit of using qualitative explanatory mixed methods, specifically “results chains”, to measure health systems performance. The following image, and their images displayed in Section A, demonstrate that their Performance Assessment approach is similar to the SAFA, and other certification organization, approaches introduced in Examples 1 to 4. Their final outcomes, and their 100 Indicators, match the final impacts measured using this reference’s “impact pathways” and their related Indicators.

Figure 1. The WHO Health Systems Framework



Source: (3)

Can their [RCA] Framework also serve as the basis of “personal willingness to pay” to move from one quality of life state to another? Although WHO is reluctant to extend their framework to “actions that influence people’s personal behavior”, organizations such as COSA, suggest that, when based upon comprehensive, population-based, longer term, Impact Evaluations, possibly. The references suggest the following requirements for QASYs to serve the same purpose as QALYs and DALYs.

1. First, the Impact Evaluation has to measure how well specific stakeholders’ quality of life have been, or will be, changed by an intervention. Environmental, Economic, Social, and



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Corporate Governance sustainability must boil down to improvements in stakeholder quality of life. The SPA1 makes that case. Giovannucci (UNFSS, 2016) phrases this as follows: “Ultimately, the motivation for all standards is to improve the lives and livelihoods of farmers and the sustainability of their communities”.

2. Second, the Impact Evaluation’s quality of life (QOL) outcomes must be correctly identified and attributed to specific actions (i.e. clinical guideline performance measures) at population scale. Once attribution is known, those actions and impacts can serve as the basis for measuring “people’s personal behavior”, including their “willingness to pay” to achieve the known (QOL) outcomes.
3. Third, QOL-based, short term Performance Assessments must be based, initially, upon the results of the high quality, long term, Impact Evaluations. The Impact Evaluations help define the “impact areas” (i.e. including health care states) used in the Performance Assessments Indexes. Absent Impact Evaluations, the Sustainable Food Lab (2016) explains how to set up Item 4’s M&E systems to feed in to Impact Evaluations.
4. Fourth, the Performance Assessment results feedback, via formal Monitoring and Evaluation systems and adaptive learning, to improve subsequent Impact Evaluations, which in turn feedback

The agricultural sustainability sector’s (i.e. COSA) pursuit of “outcome [or impact] attribution” appears to parallel the health care industry’s pursuit of “performance measure attribution”.

Anderson et al (2014) summarize this pursuit in the following statement. Note that their “observational studies” must encompass the sustainability sectors’ qualitative mixed methods explanatory approaches.

“Once the evidence from randomized clinical trials and observational studies is summarized into clinical practice guidelines, the ACC/AHA Task Force on Performance Measures evaluates those



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recommendations with the strongest evidence to consider which should become a clinical performance measure.

...

The writing committee believes that it is important to consider both the cost-effectiveness and total cost burden of potential performance measures before selection. Although these may change over time, explicitly quantifying the cost-effectiveness of treatments at the time that performance measures are created is aligned with the Institute of Medicine (IOM) goal for a more efficient healthcare system and will minimize the likelihood that unintended economic consequences for society and hospitals emerge from adopting a measure.”

In terms of institutionalizing the QOL survey and Weighting and Utility Scale instruments for QASY measurement, UNEP (2011) demonstrates how to apply standardized MCDA instruments to support decisions related to multi-capital and multi-sector stocks at international scale.

USEPA (2016) demonstrates how to apply mixed methods evaluation techniques for the same purpose at city scale. The following image (Antioch et al, 2017) summarizes current efforts to institutionalize both MCDA and economic evaluation in the health care sector.

Table 3 ISPOR MCDA good practice guidelines checklist (Source: Marsh et al. [47])

Defining the decision problem	Develop a clear description of the decision problem Validate and report the decision problem
Selecting and structuring criteria	Report and justify the methods used to identify criteria Report and justify the criteria definitions Validate and report the criteria and the value tree
Measure performance	Report and justify the sources used to measure performance Validate and report the performance matrix
Scoring alternatives	Report and justify the methods used for scoring Validate and report scores
Weighting criteria	Report and justify the methods used for weighting Validate and report weights
Calculating aggregate scores	Report and justify the aggregation function used Validate and report results of the aggregation
Dealing with uncertainty	Report sources of uncertainty Report and justify the uncertainty analysis
Reporting and examining of findings	Report the MCDA method and findings Examine the MCDA findings

Once QASY's, and/or MCDAs, have been institutionalized, the Anderson et al (2014) statement can then be adapted to support Performance Measures dealing with climate change, biodiversity



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loss, migration, civil rights, and other multi-capital and multi-sector assessment purposes. As an example applied in the natural capital care sector, Lique et al (2016) demonstrate applying MCDA to value ecosystem services. A multi-sector task force, “RCA Task Force on Performance Measures”, provides the leadership and “clinical guidance” (i.e. see Chapter 12 in WHO 2016 and ICER 2017). Suggesting, once again, that social networks and clubs need to get busy.

The use of QASYs appears consistent with the ECHOOUTCOME (2013) recommendations for improving health outcome measurement, including their statement: “Alternative methodologies for assessing cost-effectiveness should be explored on a case-by-case basis”. In the case of this RCA Framework, and most of its principle references, algorithms need to emphasize “multis over singles”, including outcome metrics, if serious societal risks, such as climate change, are to be reduced.

The ECHOOUTCOME (2013) recommendation, “Cost-Effectiveness Analyses Should Be Expressed as Costs per Relevant Clinical Outcome”, appear similar to Example 4A’s technique of using the final “outcome or impact” Indicator from an “impact pathway” in the same manner as “Clinical Outcome”, but absent the relation to personal utility-based, or economic, valuation approaches.

The institutional consequences of fully adopting QASYs involve the same institutional improvements recommended throughout this reference. One reason for optimism, besides the source code, is that the use of QASYs and/or MCDAs, QALYs, or DALYs, may boil down to a matter of expanded perception of how to apply widely known, but only partially applied, techniques.



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Appendix 2 to Example 4B. Impacts Checklist (from Smidler, 2016)

Impact TEXT datasets can be supplemented with this type of checklist that has been customized for the industry being analyzed.

The Impact Inventory

Sector	Type of Impact (list category within each sector with unit of measure if relevant) ^a	Included in This Reference Case Analysis From... Perspective?		Notes on Sources of Evidence
		Health Care Sector	Societal	
Formal Health Care Sector				
Health	Health outcomes (effects)			
	Longevity effects	<input type="checkbox"/>	<input type="checkbox"/>	
	Health-related quality-of-life effects	<input type="checkbox"/>	<input type="checkbox"/>	
	Other health effects (eg, adverse events and secondary transmissions of infections)	<input type="checkbox"/>	<input type="checkbox"/>	
	Medical costs			
	Paid for by third-party payers	<input type="checkbox"/>	<input type="checkbox"/>	
	Paid for by patients out-of-pocket	<input type="checkbox"/>	<input type="checkbox"/>	
	Future related medical costs (payers and patients)	<input type="checkbox"/>	<input type="checkbox"/>	
Future unrelated medical costs (payers and patients)	<input type="checkbox"/>	<input type="checkbox"/>		
Informal Health Care Sector				
Health	Patient-time costs	NA	<input type="checkbox"/>	
	Unpaid caregiver-time costs	NA	<input type="checkbox"/>	
	Transportation costs	NA	<input type="checkbox"/>	
Non-Health Care Sectors (with examples of possible items)				
Productivity	Labor market earnings lost	NA	<input type="checkbox"/>	
	Cost of unpaid lost productivity due to illness	NA	<input type="checkbox"/>	
	Cost of uncompensated household production ^b	NA	<input type="checkbox"/>	
Consumption	Future consumption unrelated to health	NA	<input type="checkbox"/>	
Social Services	Cost of social services as part of intervention	NA	<input type="checkbox"/>	
Legal or Criminal Justice	Number of crimes related to intervention	NA	<input type="checkbox"/>	
	Cost of crimes related to intervention	NA	<input type="checkbox"/>	
Education	Impact of intervention on educational achievement of population	NA	<input type="checkbox"/>	
Housing	Cost of intervention on home improvements (eg, removing lead paint)	NA	<input type="checkbox"/>	
Environment	Production of toxic waste/pollution by intervention	NA	<input type="checkbox"/>	
Other (specify)	Other impacts	NA	<input type="checkbox"/>	

Columns of the Impact Inventory show:

- Sectors
- Types of impact
- Checklist for inclusion / exclusion
- Notes

Sections of the Impact Inventory divide consequences across:

- Formal healthcare sector
- Informal healthcare sector
- Non-healthcare sectors



Appendix 3 to Example 4B. Report Checklist (from Smidler, 2016)

Reporting Checklist

Introduction

- ☐ Background of the problem

Study Design and Scope

- ☐ Objectives
- ☐ Audience
- ☐ Type of Analysis
- ☐ Target population(s)
- ☐ Description of interventions & comparators
- ☐ Boundaries of the analysis (scope)
- ☐ Time horizon
- ☐ Analytic perspectives
- ☐ Whether this analysis meets the requirements of the reference case
- ☐ Analysis plan

Methods & Data

- ☐ Trial-based analysis or model based (plus additional descriptors)
- ☐ Key outcomes
- ☐ Complete information on data sources
- ☐ Methods for obtaining estimates of effectiveness /evidence synthesis
- ☐ Methods for estimating costs & preference weights
- ☐ Critique of data quality
- ☐ Costing year
- ☐ Method used to adjust costs
- ☐ Type of currency
- ☐ Source and methods for obtaining expert judgment
- ☐ Discount rate(s)



Reporting Checklist, cont.

Impact Inventory

- ☐ Full accounting of consequences within and outside of the health sector

Results

- ☐ Results of model validation
- ☐ Reference case results: total costs & effectiveness, incremental costs & effectiveness, ICERs, measure(s) of uncertainty
- ☐ Disaggregated results for important categories of costs and/or outcomes
- ☐ Sensitivity analysis, other estimates of uncertainty
- ☐ Graphical representation of cost-effectiveness results & uncertainty analysis
- ☐ Aggregate cost and effectiveness information
- ☐ Secondary analyses

Disclosures

- ☐ Statement of any potential conflicts of interest relating to funding source, collaborations, or outside interests

Discussion

- ☐ Summary of reference case results
- ☐ Summary of sensitivity of results to assumptions and uncertainties in the analysis
- ☐ Discussion of the study results in the context of related CEAs
- ☐ Discussion of ethical implications
- ☐ Distributive implications of an intervention
- ☐ Limitations of the study
- ☐ Relevance of study results to specific policy questions or decisions



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Example 4C. GCEA and LCIA (RCA5)

URLs

<https://www.devtreks.org/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4C/1557/none>

<http://localhost:5000/greentreks/preview/carbon/resourcepack/Coffee Firm RCA Example 4/541/none>

<https://www.devtreks.org/greentreks/preview/carbon/output/Coffee Firm RCA4C, CEA/2141223483/none>

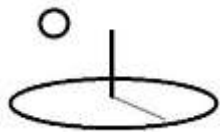
<http://localhost:5000/greentreks/preview/carbon/output/Coffee Firm RCA4C Stock, CEA/2141223498/none>

A. Introduction or Goal and Scope

This example combines LCIA data from Example 3B's S-LCA with Example 4's coffee crop budget. The initial budgets and LCIA's should be completed jointly to support the LCIA and CEA analysis introduced in this example.

B. Indicator Thresholds, or System Boundary and Resource Inventory

Example 3, 3A, and 3B, explain that Operating Budgets directly support the Resource Inventory Phase of LCIA's and Capital Budgets support LCIA Scenario Analyses. The following data comes from the Score.MathResults for Example 3B's Conventional Coffee Production. The column, factor7, stores the Production Processes needed to complete Hotspots Analysis. These Production Processes were taken directly from the Labels used in Example 4's coffee crop budget Categorical Indexes (i.e. EDF = Irrigation Water Management). The column, factor6, confirms that these CIs are associated with the life cycle stage, crop production. The column, factor4, represents the Elementary Flows, or Environmental Damages and S-LCA Socioeconomic SubCategories.



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label	location	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp	percent
RCA3	na	Indicator 1	RCA3	na	Indicator 1	0	0	0	0	0	0	0	0	0	0	0	0
NCA	1	Fresh Wat	4.28E+02	2.42E+02	7.64E+02	daly/m3	none	productior	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCB	1	Pollination	4.28E+02	2.42E+02	7.64E+02	bdp	triangular	productior	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCC	1	Air quality	4.28E+02	2.42E+02	7.64E+02	daly/kg pr	none	productior	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCD	1	Air quality	4.28E+02	2.42E+02	7.64E+02	GTP	none	productior	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
PCA	1	Flood Con	4.28E+02	2.42E+02	7.64E+02	daly/1000	none	productior	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
ECA	1	Employee	4.28E+02	2.42E+02	7.64E+02	hci per em	none	productior	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
NCA_A	1	Fresh Wat	4.28E+02	2.42E+02	7.64E+02	daly/m3	none	productior	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCB_A	1	Pollination	4.28E+02	2.42E+02	7.64E+02	bdp	triangular	productior	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCC_A	1	Air quality	4.28E+02	2.42E+02	7.64E+02	daly/kg pr	none	productior	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCD_A	1	Air quality	4.28E+02	2.42E+02	7.64E+02	GTP	none	productior	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
PCA_A	1	Flood Con	4.28E+02	2.42E+02	7.64E+02	daly/1000	none	productior	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
ECA_A	1	Employee	4.28E+02	2.42E+02	7.64E+02	hci per em	none	productior	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
NCA_AA	1	Fresh Wat	4.28E+02	2.42E+02	7.64E+02	daly/m3	none	productior	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCB_AA	1	Pollination	4.28E+02	2.42E+02	7.64E+02	bdp	triangular	productior	EDG	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCC_AA	1	Air quality	4.28E+02	2.42E+02	7.64E+02	daly/kg pr	none	productior	EDE	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
NCD_AA	1	Air quality	4.28E+02	2.42E+02	7.64E+02	GTP	none	productior	ECB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01
PCA_AA	1	Flood Con	4.28E+02	2.42E+02	7.64E+02	daly/1000	none	productior	PCB	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
ECA_AA	1	Employee	4.28E+02	2.42E+02	7.64E+02	hci per em	none	productior	HCA	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	1.00E+02
RCA5	na	Indicator 2	RCA5	na	Indicator 2	0	0	0	0	0	0	0	0	0	0	0	0
NCA	1	Fresh Wat	4.28E+02	2.42E+02	7.64E+02	daly/m3	none	productior	EDF	2.00E+00	3.00E+00	2.50E-01	4.00E+00	1.28E+03	1.81E+02	1.15E+04	2.50E+01

The following partial budget took Example 4’s coffee crop budget and removed any crop operations, or Categorical Indexes, that weren’t used in the previous image’s Hotspots Analysis. The previous image’s stylized QTMost, QTLow, and QTUp, certainty, and unit of measurement, columns were then transferred to the crop budget’s CategoricalIndex.factor1, factor2, factor 3, factor4, and factor5 properties. These columns measure normalized and weighted Elementary Flows and S-LCA-related subcategories.



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label	location	risks_and_indicators	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11
ECB	1	Nutrient Management	1284.00	181.30	11460.00	2.50	GTP	none	0.00	1.00	1.00	8.00	10.00
IF1A	1	Phosphate	1875.00	1600.00	2000.00	-0.18	pounds per acre	none	0.00	1.00	1.00	4.00	5.00
IF1B	1	Labor	1.00	0.75	1.10	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
EDE	1	Pest Management	1284.00	181.30	11460.00	2.50	daly/kg pm25	none	0.00	1.00	1.00	8.00	10.00
IF4A	1	Sunspray	1.00	1.00	1.00	-24.00	gals per acre	none	0.00	1.00	1.00	4.00	5.00
IF4B	1	Labor	1.00	1.00	1.00	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
EDF	1	Irrigation Water Management	1284.00	181.30	11460.00	2.50	daly/m3	none	0.00	1.00	1.00	8.00	10.00
IF5A	1	Water	2.00	1.75	2.25	-178.00	er month per a	none	0.00	1.00	1.00	4.00	5.00
IF5B	1	Labor	11.00	10.00	12.00	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
EDG	1	Orchard Management	1284.00	181.30	11460.00	2.50	bdp	none	0.00	1.00	1.00	8.00	10.00
IF6A	1	Pruning Major Labor	67.00	60.00	75.00	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
IF6B	1	Pruning Sucker Labor	21.00	18.00	24.00	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
IF6C	1	Mulching Labor	2.00	2.00	1.00	-10.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
IF6D	1	Equipment and Fuel	7.00	6.00	8.00	-15.00	hours per acre	none	0.00	1.00	1.00	4.00	5.00
EC	1	Economic Capital Cost	0.00	0.00	0.00	0.00	cost per acre	none	0.00	1.00	1.00	0.00	0.00
HCA	1	Farm Management	1284.00	181.30	11460.00	2.50	employee or st	none	0.00	1.00	1.00	8.00	10.00
IF9A	1	Management Labor	0.05	0.05	0.05	-11560.00	revenue per ac	none	0.00	1.00	1.00	4.00	5.00
IF9B	1	Office Overhead	0.02	0.02	0.02	-11560.00	revenue per ac	none	0.00	1.00	1.00	4.00	5.00
IF9C	1	Operating Interest	10.00	10.00	10.00	-21.00	er month per a	none	0.00	1.00	1.00	4.00	5.00
HC	1	Human Capital Cost	0.00	0.00	0.00	0.00	cost per acre	none	0.00	1.00	1.00	0.00	0.00
PCB	1	Land	1284.00	181.30	11460.00	2.50	daly/1000 peopl	none	0.00	1.00	1.00	8.00	10.00
IF11A	1	Rental Fee	1.00	1.00	1.00	-250.00	rent per acre	none	0.00	1.00	1.00	4.00	5.00
PC	1	Physical Capital Cost	0.00	0.00	0.00	0.00	cost per acre	none	0.00	1.00	1.00	0.00	0.00
TR	1	Net Returns	0.00	0.00	0.00	0.00	cost per acre	none	0.00	1.00	1.00	0.00	0.00

As explained in Example 3, when the LCIA includes multiple Damage Categories for each crop operation, such as Climate Change and Water Use Impacts, the Damages must be allocated, in some manner to the operation (or vice versa). One option is to use the LCIA's LocationalIndex.QTMost data, and base the allocation on the sum of the percent contribution of each child Categorical Index to the LI (see the last column in the first image). The CEA's CategoricalIndex.QTMost then measures Cost per Unit normalized, weighted, and allocated, LCIA Locational Damage Index. With this technique, the initial budgets should be supply chain budgets so that all life cycle stage damages can be evaluated.

The quantity of data generated by the LCIA techniques supports alternative techniques as well, such as completing a new budget that allocates crop operation budget data to each separate LCIA Categorical Index.

C. Indicators and Life Cycle Impact Assessment CEA



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The following Indicator.MathResults show the resultant CEA Analysis. In this example, The Categorical Index columns, QTMost, QTLow, and QTUp, measure Costs per unit Categorical Damage. Most analyses will not be this simple, because, as discussed in the last section, each crop operation will have multiple Damage Impact Categories.

label	locatio	risks_and	factor1	factor2	factor3	factor4	factor5	factor6	factor7	factor8	factor9	factor10	factor11	QTMost	QTLow	QTUp
ECB	1.00	Nutrient M	1284.00	181.30	11460.00	2.50	GTP	none	0.00	1.00	1.00	4.00	5.00	-0.27	-1.63	-0.03
IF1A	1.00	Super Amn	1875.00	1600.00	2000.00	-0.18	pounds per	none	0.00	1.00	1.00	4.00	5.00	-337.50	-288.00	-360.00
IF1B	1.00	Labor	1.00	0.75	1.10	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-10.00	-7.50	-11.00
EDE	1.00	Pest Mana	1284.00	181.30	11460.00	2.50	daly/kg pm	none	0.00	1.00	1.00	4.00	5.00	-0.03	-0.19	0.00
IF4A	1.00	Sunspray	1.00	1.00	1.00	-24.00	gals per ac	none	0.00	1.00	1.00	4.00	5.00	-24.00	-24.00	-24.00
IF4B	1.00	Labor	1.00	1.00	1.00	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-10.00	-10.00	-10.00
EDF	1.00	Irrigation V	1284.00	181.30	11460.00	2.50	daly/m3	none	0.00	1.00	1.00	4.00	5.00	-0.36	-2.27	-0.05
IF5A	1.00	Water	2.00	1.75	2.25	-178.00	\$ per mont	none	0.00	1.00	1.00	4.00	5.00	-356.00	-311.50	-400.50
IF5B	1.00	Labor	11.00	10.00	12.00	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-110.00	-100.00	-120.00
EDG	1.00	Orchard M	1284.00	181.30	11460.00	2.50	bdp	none	0.00	1.00	1.00	4.00	5.00	-0.78	-4.91	-0.10
IF6A	1.00	Pruning Ma	67.00	60.00	75.00	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-670.00	-600.00	-750.00
IF6B	1.00	Pruning Suc	21.00	18.00	24.00	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-210.00	-180.00	-240.00
IF6C	1.00	Mulching L	2.00	2.00	1.00	-10.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-20.00	-20.00	-10.00
IF6D	1.00	Equipment	7.00	6.00	8.00	-15.00	hours per	none	0.00	1.00	1.00	4.00	5.00	-105.00	-90.00	-120.00
EC	1.00	Economic C	5136.00	725.20	45840.00	2.50	cost per ac	none	-1852.50	-1631.00	-2045.50	4.00	5.00	-0.36	-2.25	-0.04
HCA	1.00	Farm Mana	1284.00	181.30	11460.00	2.50	hci per emj	none	0.00	1.00	1.00	4.00	5.00	-0.79	-5.62	-0.09
IF9A	1.00	Manageme	0.05	0.05	0.05	-11560.00	& revenue	none	0.00	1.00	1.00	4.00	5.00	-578.00	-578.00	-578.00
IF9B	1.00	Office Ove	0.02	0.02	0.02	-11560.00	& revenue	none	0.00	1.00	1.00	4.00	5.00	-231.20	-231.20	-231.20
IF9C	1.00	Operating	10.00	10.00	10.00	-21.00	\$ per mont	none	0.00	1.00	1.00	4.00	5.00	-210.00	-210.00	-210.00
HC	1.00	Human Cap	1284.00	181.30	11460.00	2.50	cost per ac	none	-1019.20	-1019.20	-1019.20	4.00	5.00	-0.79	-5.62	-0.09
PCB	1.00	Land	1284.00	181.30	11460.00	2.50	daly/1000	none	0.00	1.00	1.00	4.00	5.00	-0.19	-1.38	-0.02
IF11A	1.00	Rental Fee	1.00	1.00	1.00	-250.00	rent per ac	none	0.00	1.00	1.00	4.00	5.00	-250.00	-250.00	-250.00
PC	1.00	Physical Ca	1284.00	181.30	11460.00	2.50	cost per ac	none	-250.00	-250.00	-250.00	4.00	5.00	-0.19	-1.38	-0.02
TR	1.00	Net Return	7704.00	1087.80	68760.00	2.50	cost per ac	none	-3121.70	-2900.20	-3314.70	4.00	5.00	-0.41	-2.67	-0.05

D. Communication and Interpretation and Decisions

Example 3B illustrates using this data to conduct more thorough Hotspots Analysis that accounts for different stakeholder groups, life cycle stages, and production technologies. Example 4B demonstrates how to use Reference Case Cost Effectiveness Results to communicate the final results to decision makers. The Reference Case's Stakeholder Perspectives, in particular, demonstrate complementary LCIA-S-LCA-CEA techniques.

The complementary use of LCC/LCB budgets, CEA, and LCIA, provide other types of decision support as well. UNSETACd explains the results of O-LCIA can be “allocated”, based on economic factors such as price or revenue, to product categories. They use the following image to confirm that the results of these types of P-LCIA allocations allow more fine-tuned understanding of the actual environmental impacts associated with specific company products.



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Although Example 4's Crop Revenue Categorical Impact was removed from this example, it may be possible to use those Output and Revenue categories, with the children Indicators' product yields and revenues, for these types of product allocations.

Report 17. (Continued)

economic allocation, the environmental burden was higher, per kg, for breast fillet compared with whole bird.

The unspecified 'other produce' was used as input to model 'further processing' of chicken products. For the purpose of this study the chicken schnitzel product was allocated an average per kg impact from

further processing. The price for chicken schnitzels from further processing is approximately the same as the average overall per kg price of further processed products. It should be noted that, apart from the impacts from cradle to primary processing, additional impacts were added from non-chicken ingredients (e.g., batter and crumb).

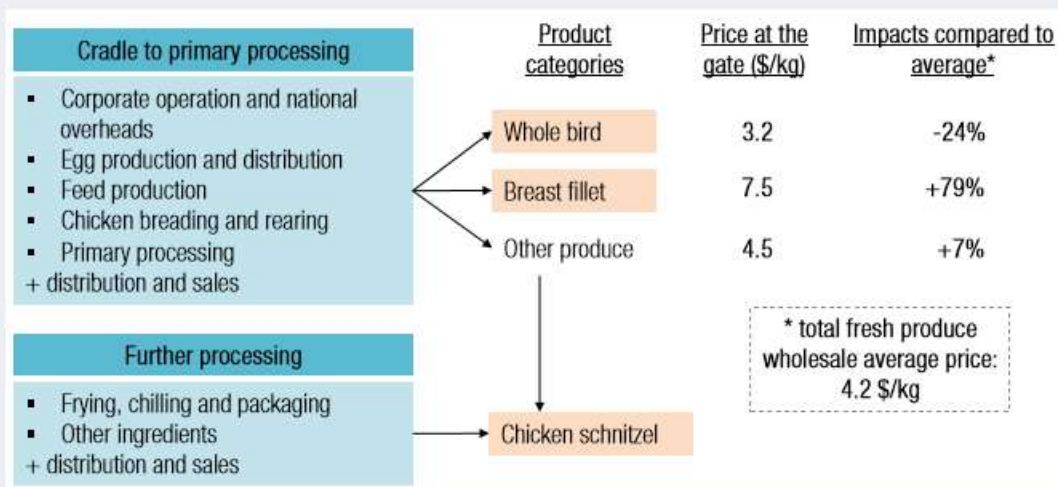
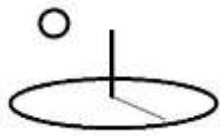


Figure 24. Inghams – Allocation keys for the three product categories. The prices shown here are fictitious and do not correspond to Inghams' reality.

Source: own elaboration from Edge Environment (2011).

References

Same as Examples 3, 4, 4A, and 4B



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Additional Examples

The next batch of examples can be found in the Social Performance Analysis 3 reference.