

Global Life Cycle Impact Assessment Method

Launch of GLAM stakeholder consultation

28 August 2024



Life Cycle Initiative

www.unep.org
www.lifecycleinitiative.org

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Agenda

1. Welcome and process over the 20 years of development
2. Overview of the GLAM method and framework
3. Short presentations of GLAM impact categories
 - Ecosystem quality
 - Human health
 - Ecosystem services and resource
 - Normalization and weighting
4. Delivery and format of GLAM beta characterization factors
5. Normalization and rice case study results
6. Consultation process and feedback

LCIA - Life Cycle Initiative

Meeting at UNEP office, Paris, April 14 1999

Present: Mrs. J. Aloisi de Larderel (UNEP)
 Mr. F. Balkau (UNEP)
 Mr. B. de Leeuw (UNEP)
 Mr. H.A. Udo de Haes (CML, the Netherlands)
 Mr. O. Jolliet (EPFL, Switzerland)

The subject of the meeting concerned the proposal put forward by Udo de Haes that UNEP will act as authoritative body for the endorsement of best practice in the field of life cycle impact assessment (LCIA).

The results of the meeting were the following:

1. In principle UNEP-TIE fully supports the initiative and will be active in carrying it forward. The activity fits well into the message of Mr. Kofi Annan, for the operationalisation of the RIO-Agenda 21 by industry.

2. It is regarded essential by Mrs. Aloisi de Larderel that the partner for UNEP will be SETAC as a whole, not only the European branch.

3. We will aim at a Memory Of Understanding (MOU) specifying the different aspects (aim, partners, organisation, tasks, funding, specific activities).

4. As to the content it is important that the proposed work will be clearly positioned in relation to other tools. First this includes a clear delineation of LCIA in relation to other tools; second, this includes the possibility of broader use of the results than just for LCIA purposes (including for instance technology assessment).

5. As to the organisational structure, the preference is for scientific work to be done by SETAC and the authorisation to be done by UNEP, with preferably an independent expert advisory committee, to be appointed by UNEP.



Life Cycle Initiative

LCIA guidance and work within the Life Cycle initiative

- 2002 – 2012 LCIA programme of the Life Cycle Initiative: LCIA Midpoint-Damage Framework, USEtox, WULCA
- 2012-2019 GLAM Phase 1 & 2: Consensus finding in multiple impact categories → 2 Pellston workshop™ but limited implementation. 2nd workshop provided a roadmap.



2019-2024 Creation of the Global Life Cycle Impact Assessment Method – GLAM

Establish a comprehensive, consistent and global Environmental Life Cycle Impact Assessment Method, covering classification, characterization, normalization and weighting to assess the life cycle impacts of products and services on human health, ecosystem and natural resources.

GLAM – Consensus and Intensive evaluation and testing

230 experts incl. impact category specific experts

2019 Scoping phase and consultation

2020-2023 GLAM Development

2023-2024 GLAM testing

8 May 2024 Launch of GLAM-beta version,
including all GLAM factors with documentation

28 August – 30 September 2024
Stakeholder consultation

21-23 October 2024 Launch of GLAM 1.0 version
at the LCA case study symposium in Göteborg,

March 2025 onwards
GLAM available in LCA software

2025 ff Dissemination, stewardship
and guidance for interpretation

- 11 half-day virtual consensus
workshops 22-26 May 2023

- In-person consensus workshop –
Copenhagen 30 May-1st June 2023
& Virtual workshop 21-22 May 2024



GLAM framework

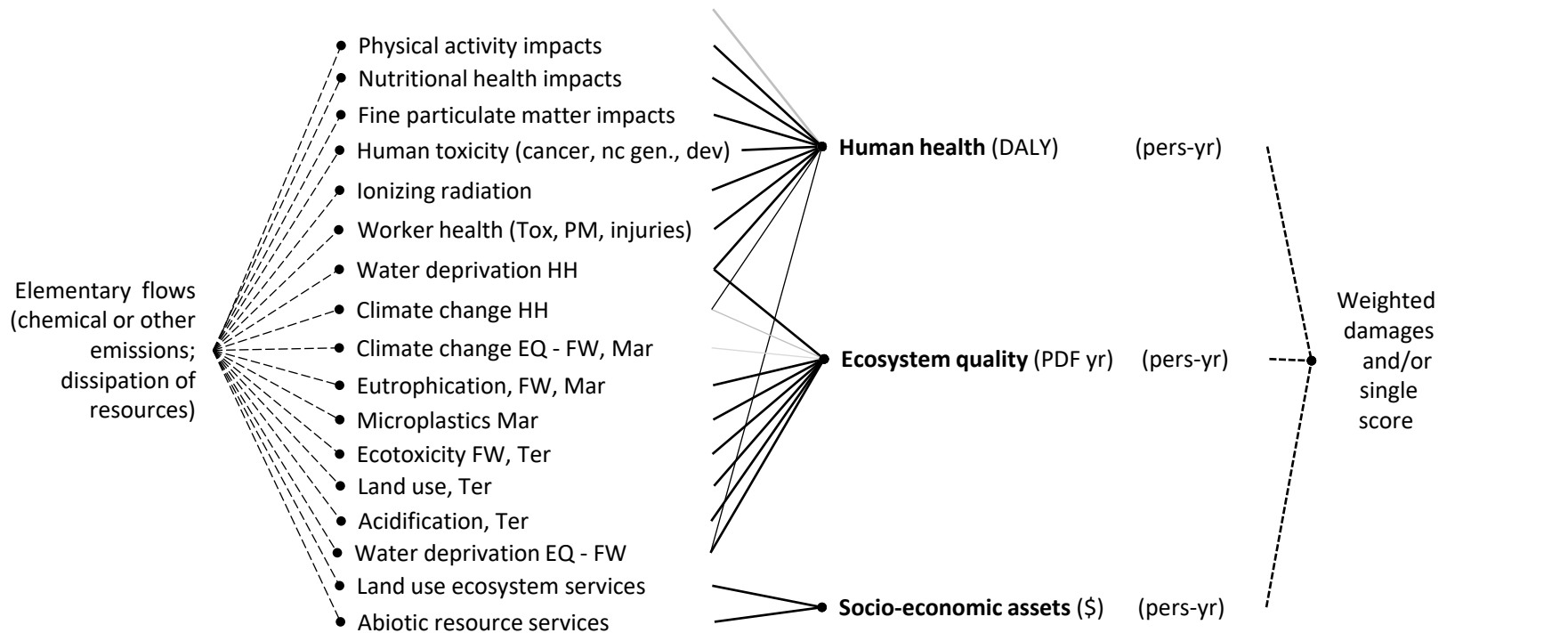
Environmental Interventions (LCI)

Individual impact categories

Damage level grouped by areas of protection

Normalised damage by area of protection

Weighted score



Ke

y

-----● Links elementary flows to impact categories

———● Aggregates impact categories at damage level into areas of protection

.....● Weights and aggregates damages on areas of protection

GLAM – Consensus and innovation!



Ecosystem quality: Vulnerability & Global Extinction
Probability, microplastics, terrestrial ecotoxicity, land use



Human health: fine particulate & human tox, incl. chemicals
in product and workers, accidents, nutrition impacts,
physical exercise



Natural resources & ecosystem services: Dissipation-based
framework for mineral resources, 6 ecosyst. services



Normalisation, Weighting & Cross-cutting Issues : Global
weighting factor, incl. low, middle & high income countries



Ecosystem Quality

Global LCIA guidance (GLAM) Phase 3

“Creation of a Global Life Cycle Impact Assessment Method”



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Ecosystem quality

- Endpoints for all, midpoints for some
- Indicator of choice: PDF (+ GEP)



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Ecosystem quality

Impact category	Modeling approach	Taxonomic coverage	Realm	Included effects	Native scale
Ecotoxicity	marginal and average	freshwater species as available in test data used for USEtox. No marine test data. Terrestrial test data and extrapolations from freshwater to terrestrial effect.	Freshwater and terrestrial	ecotoxicological impact of chemicals on freshwater and terrestrial species complemented with extrapolations for terrestrial species	Fate modeling into 24 regions, two soil archetypes (agricultural and natural) 5 environmental compartments at continental emission scale: freshwater, coastal seawater, agricultural soil, natural soil, rural air
Land use	marginal and average	plants, amphibians, birds, mammals, reptiles	terrestrial	land occupation, land transformation	terrestrial ecoregions
Freshwater eutrophication	marginal and average	freshwater fish Cartilaginous fish; Ray-finned fishes; Crustaceans; Cnidarians; Echinoderms	freshwater	P and N enrichment	0.5x0.5 arc degree resolution
Marine eutrophication	average	freshwater fish, marine, terrestrial	marine	Species loss (through e.g., growth, reproduction, mobility issues) due to hypoxia	Large marine ecosystems 5 arcminutes (freshwater), 200 km (marine, terrestrial)
Climate change	average	...	...	...	...
Water consumption	marginal and average	freshwater fish	freshwater	river flow reduction	entire river basin
Aquatic microplastics	marginal (and possibly average)	aquatic vertebrates, invertebrates, algae	marine and freshwater	Impact of microplastics on growth, reproduction, and mortality on water- and sediments-dwelling organisms	N/A (only global CFs)
Terrestrial acidification		Vascular plants	terrestrial	decline in vascular plant species richness due to lower soil pH	Life Cycle Initiative 2 x 2.5°



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Important points

- 8 impact categories
- 6 of them spatially explicit
- Model novelties
 - E.g. including fragmentation and land use intensity



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Development of GEP:

- Vulnerability Score → Verones et al. 2013
- Global extinction probability (GEP) → Kuipers et al. 2019
- Updated Global extinction probability (GEP) → Verones et al. 2022
 - improving methods
 - Extending taxonomic coverage
 - Aligning spatial/species coverage with LCIA



Ecological Indicators
Volume 142, September 2022, 109204



Original Articles

Global extinction probabilities of terrestrial, freshwater, and marine species groups for use in Life Cycle Assessment

[Francesca Verones^a](#)  , [Koen Kuipers^b](#), [Montserrat Núñez^c](#), [Francesca Rosa^d](#), [Laura Scherer^e](#), [Alexandra Marques^f](#), [Ottar Michelsen^g](#), [Valerio Barbarossa^{e,f}](#), [Benjamin Jaffe^h](#), [Stephan Pfister^d](#), [Martin Dorber^a](#)

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<https://doi.org/10.1016/j.ecolind.2022.109204>

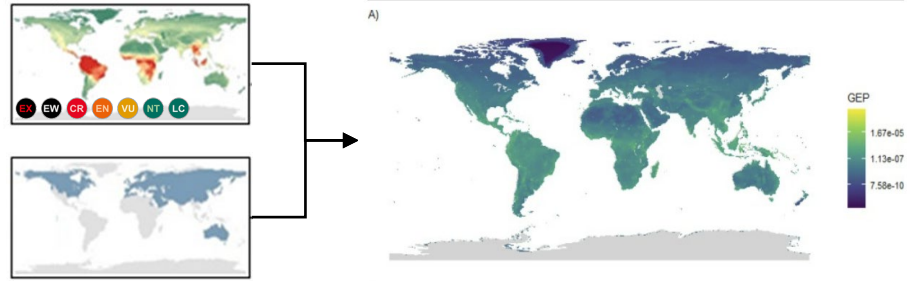
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Global extinction probability (GEP)

- Factor to translate regional species loss to global species loss

- Species richness
- weighted by IUCN threat category

- Species range size
- weighted by occurrence certainty



GLAM 2:

- We identified adaptive capacity and recovery potential as the key missing components of ecological vulnerability in most existing LCIA methods.*
- Endemism, threat level, and habitat rarity can be used as proxy indicators to incorporate adaptive capacity and recovery potential in LCIA**



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Species and spatial coverage

- >98,000 species

Freshwater	Marine	Terrestrial
Amphibians (n = 4,680)	Cartilaginous fish (n = 1,158)	Birds (n = 10,966)
Birds (n = 2,384)	Lobsters (n = 246)	Amphibians (n = 7,081)
Freshwater fish (n = 14,507)	Mammals (n = 129)	Mammals (n = 5,720)
Freshwater plants (n = 1,722)	Ray-finned fish (n = 4,173)	Reptiles (n = 7,723)
Malacostracans (n = 2,476)	Reptiles (n = 95)	Vascular plants (n = 26,976)
Mammals (140)	Seacucumbers (n = 389)	
Molluscs (n = 2,469)	Seagrasses (n = 72)	
Odonata (n = 3,800)	Stony corals (n = 842)	
Reptiles (n = 427)		

- 8 spatial administrative units

Freshwater	Marine	Terrestrial
Grid cells (0.05°)	Grid cells (0.05°)	Grid cells (0.05°)
Freshwater ecoregions (n = 426)	Marine ecoregions (n = 232)	Terrestrial ecoregions (n = 825)
Hydrobasins (n = 20,317)	Large marine ecosystems (n = 66)	Countries (n = 192)
Countries (n = 192)	Major fishing areas (n = 27)	

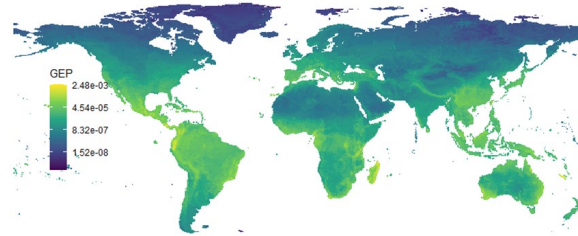


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Example Results

Minor region (grid cell)

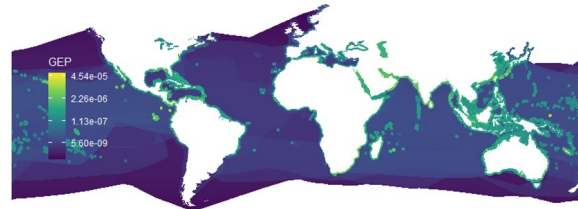
Terrestrial vascular plants



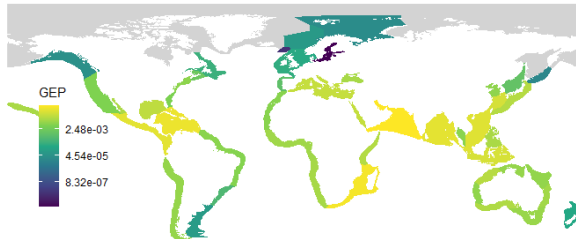
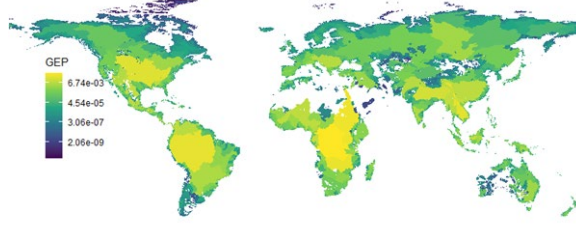
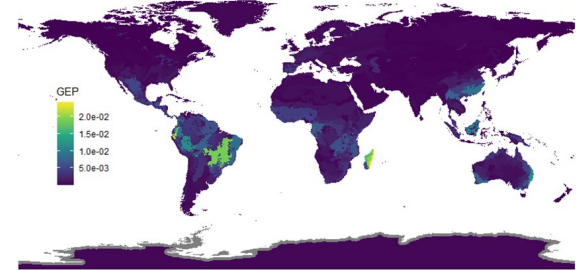
Freshwater fish



Marine (bony) fish



Major region (ecoregion, basin, LME)



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Human health Impact Categories

- **Human health**



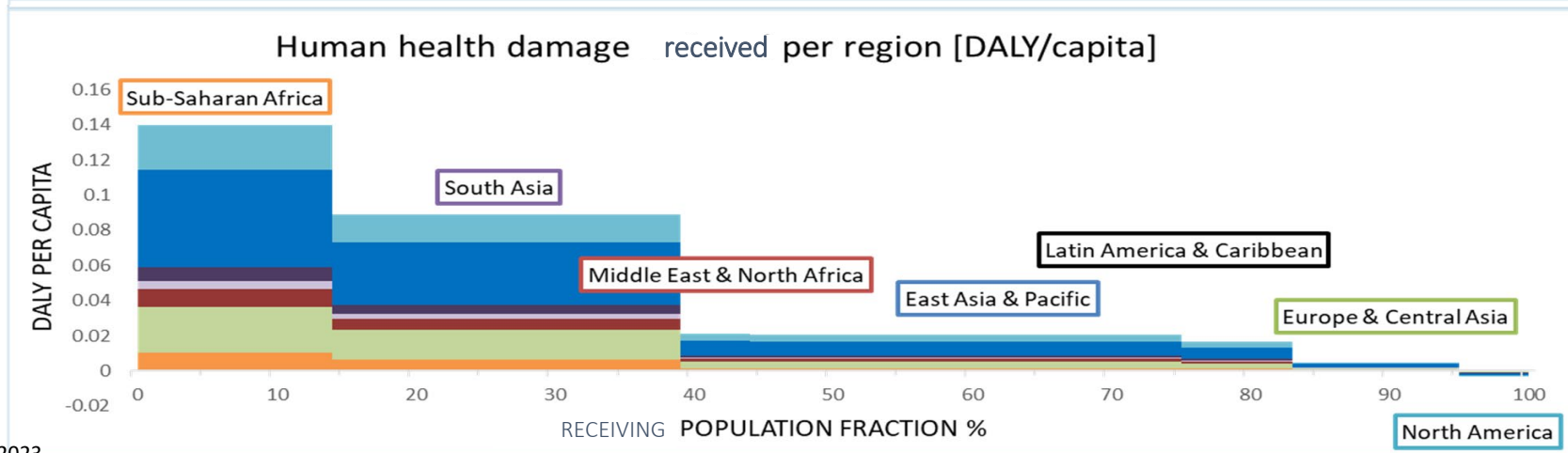
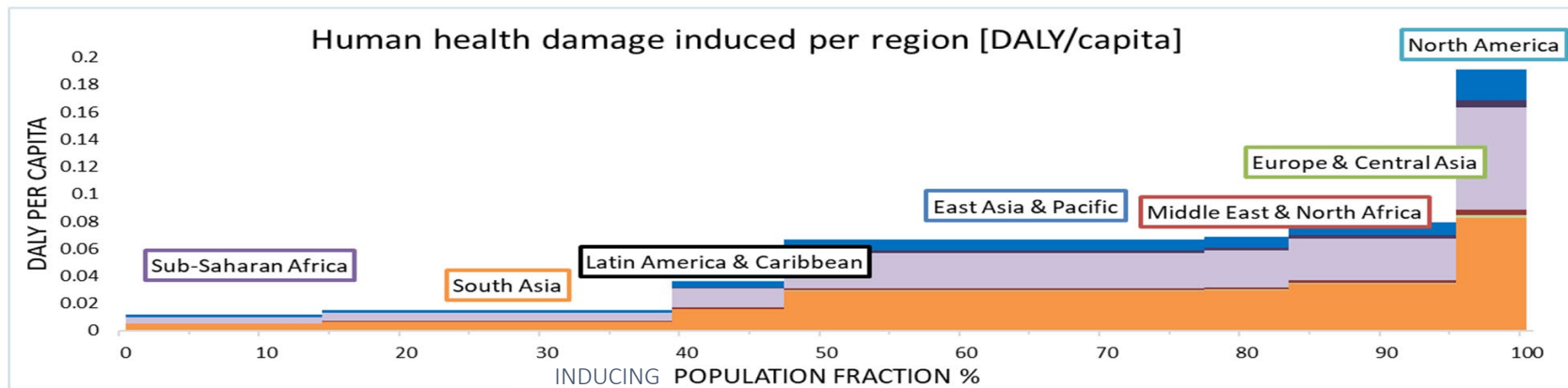
1. Climate change
2. Fine particulate matter (PM)
3. Human toxicity
4. Worker health impacts (Tox, injuries, PM)
5. Ionizing radiation
6. Water scarcity
7. Lifestyle impacts:
 - Nutrition
 - Physical activity

Most have midpoint, all have damage (endpoint)

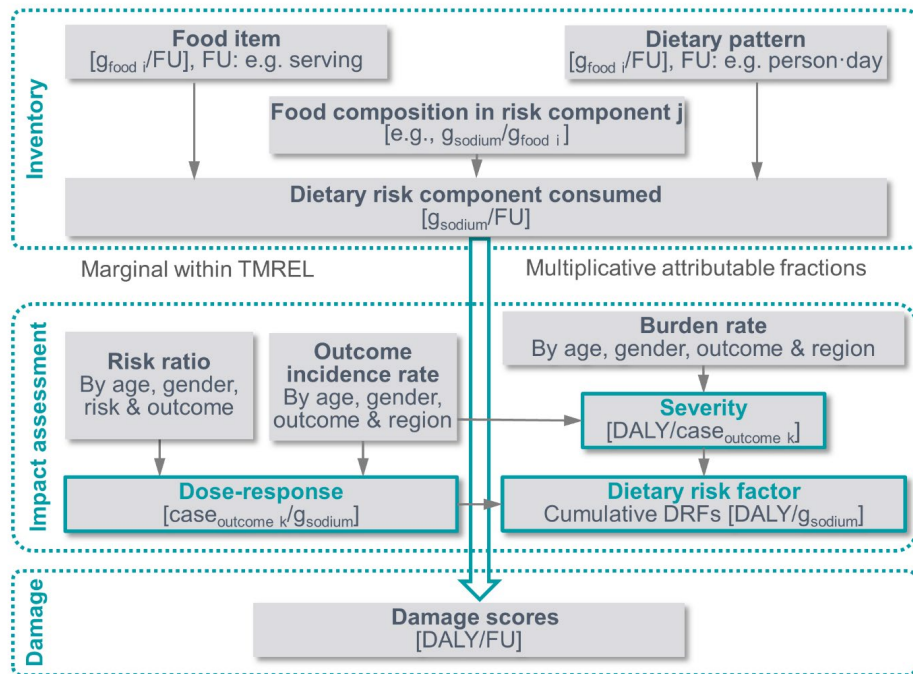


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Disparities: Climate change impacts of heat and cold on health

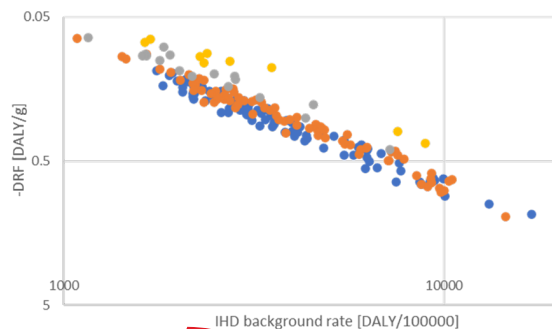


Nutrition impacts – 15 risks factors



Dietary risk factors	$\mu\text{DALY}/g$
vegetables	-0.0867
calcium	-4.99182
fibre	-2.41152
fruits	-0.25097
legumes	-0.30886
milk	-0.00663
procmeat	0.765668
redmeat	0.584259
wgrains	-0.42378
transfat	19.5786
nuts	-4.76471
pufa	-1.56749
w3	-17.1937
ssb	0.032517
sodium	0.861588
sodium-sbp	16.09
sodium total	16.95

Variability across 204 countries



USEtox: Chemicals in consumer products



USEtox

USEtox Framework

11 environmental compartments
14 product compartments
5000+ substances



Building
materials



Environmental
emissions



Personal care
products

Food contact materials



Pesticides



Paints



Toys, incl.
mouthing





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Natural resource use



Masaharu Motoshita, Ryosuke Yokoi, Titouan Greffe, Olivier Jolliet,
Rodrigo Alvarenga, Antoine Beylot, Johannes Drielsma, Manish Kumar,
Stephen Northey, Mikołaj Owsianiak, Amandine Pastor, Charlotte
Pradinaud, Stephan Pfister, Rita Schulze, Timothy Grant

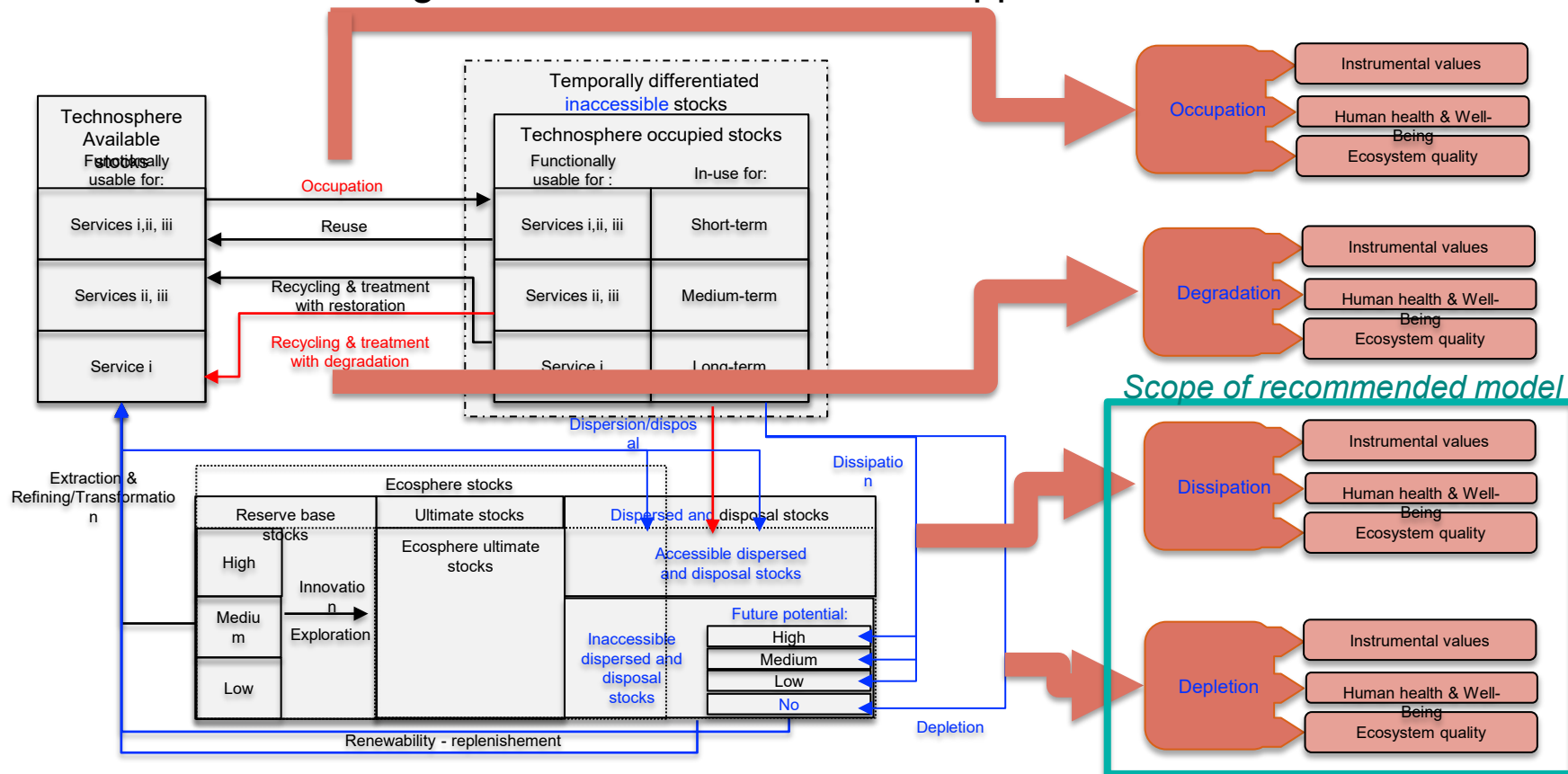
1. Definition of safeguard subject

*How can I quantify **the consequences of temporary or permanent loss of the functional values** of natural resources caused by its use in a product system?*

*The consequences can be **the requirements of additional efforts to compensate** lost values or **the lost values per se** as externalities of natural resource use.*

2. Description of impact pathways

How does the damage of natural resource use happen?



3. Recommended model: Future welfare loss method

As a result of extensive literature review and evaluation...

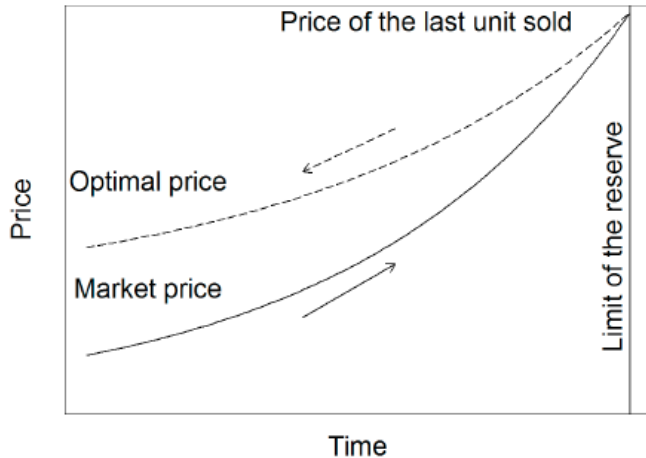
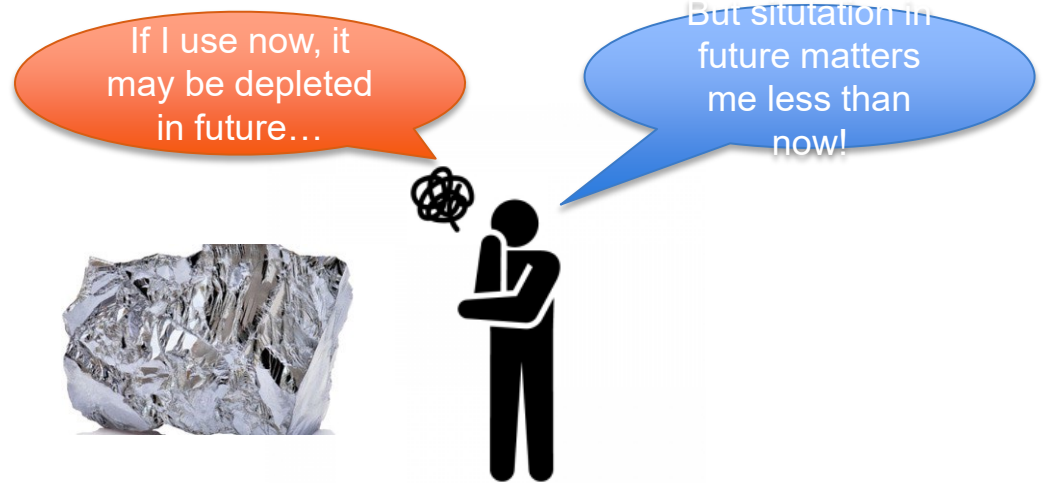


Figure 1. Model 1: principle of the method.

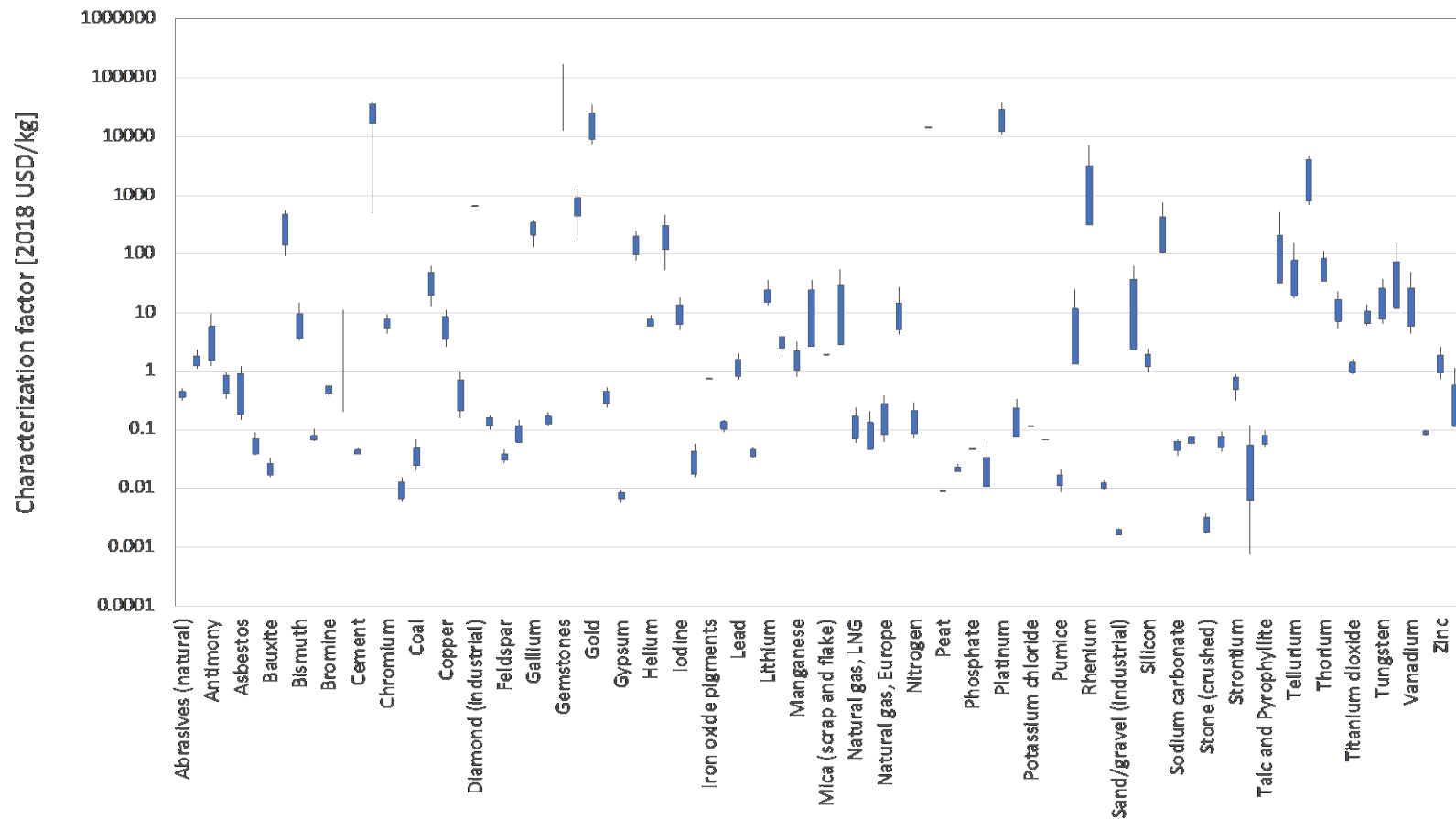


Underestimation of the market price results in overuse.

=> Externality cost due to the price estimation is the damage of resource use.

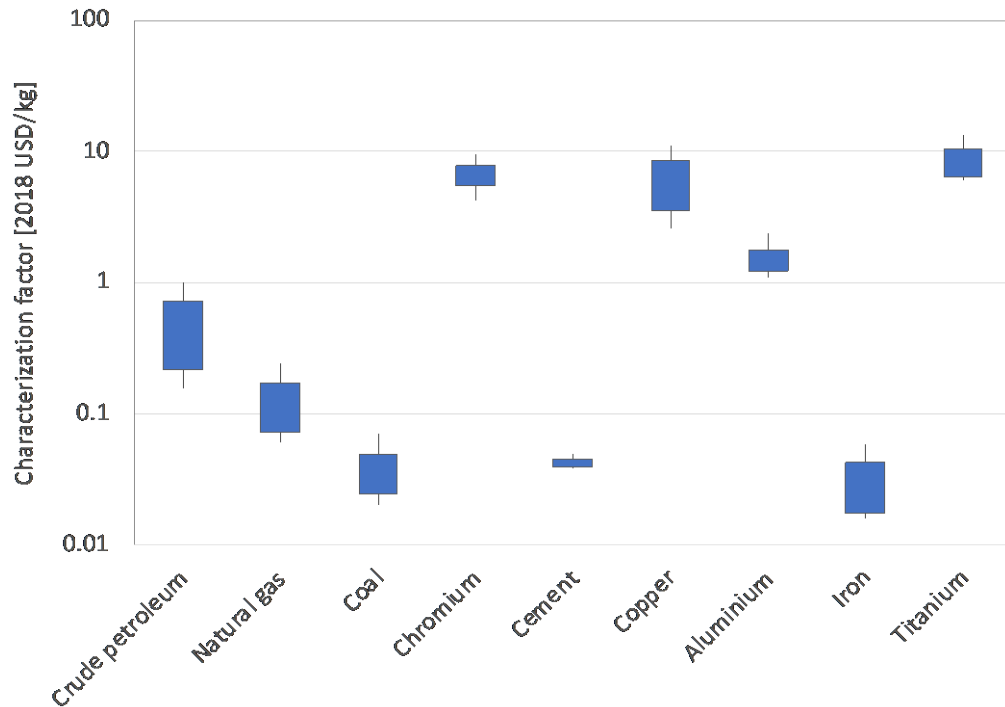
$$\text{Externality cost of exhaustion} = [\text{price correction factor}] \times [\text{net resource price}]$$

CFs covering 81 minerals and 5 energy carriers

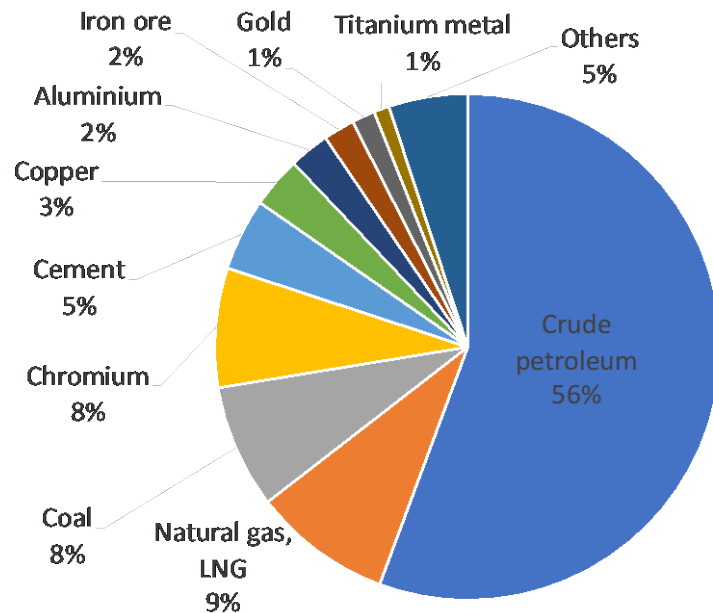


CFs of major commodities and normalization results

CFs of major commodities in normalization



Normalization results (2018)



*3,755 Billion USD
(around 4% of world GDP in 2018)*

Land Use Ecosystem Service Impacts

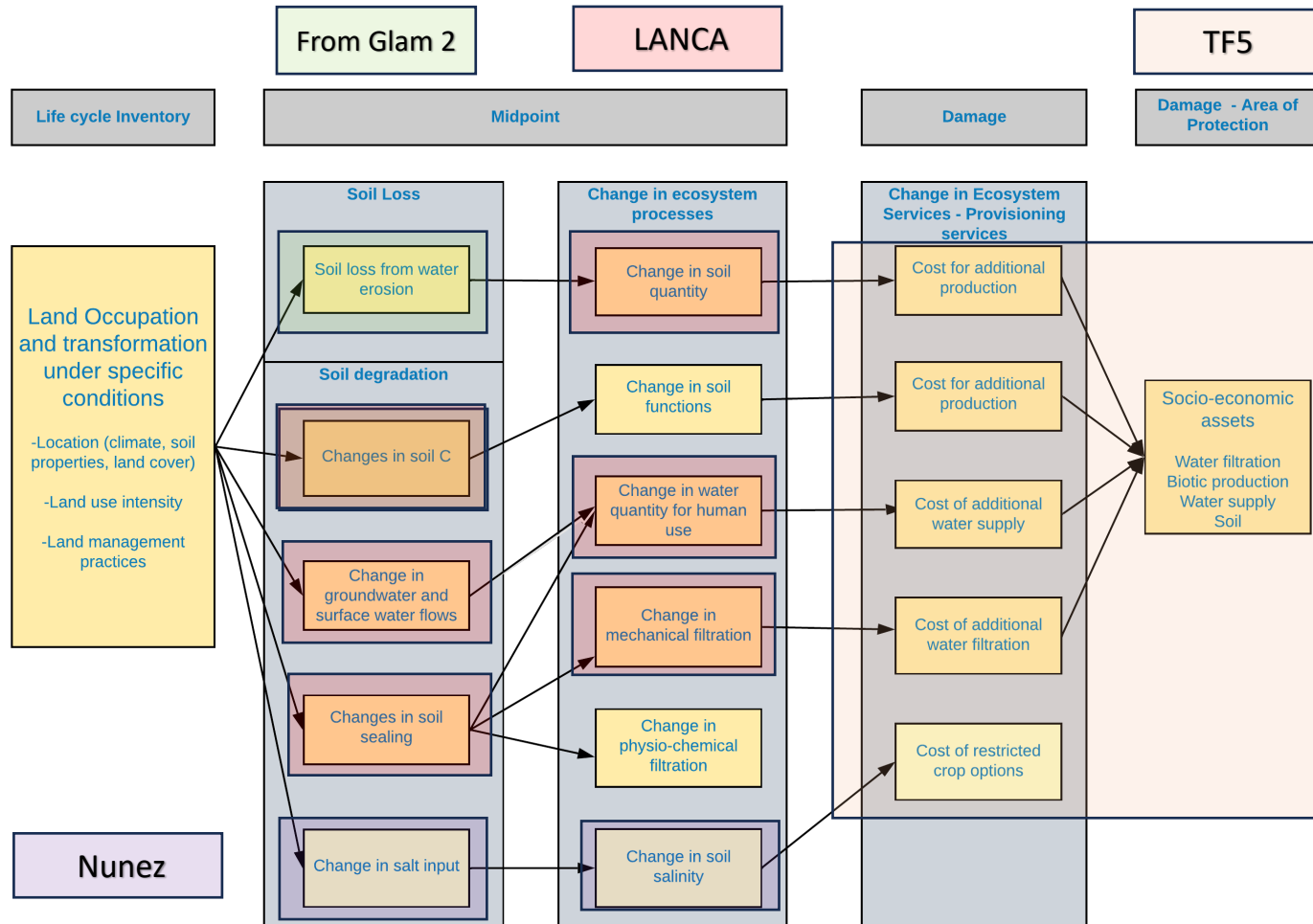
Timothy Grant¹, Rafael Horn², Valeria de Laurentiis³ Laura Debarre³, Amandine Pastor⁵, Stephan Pfister⁶, Paola Guzman-luna⁵ Masaharu Motoshita⁷,
Stephanie Maier², Mattia Damiani⁴

1 Lifecycles, 2 IABP/Fraunhofer IBP, 3 CIRAIG, 4 JRC-ISPRA, 5 INRAE, 6 ETH Zurich, 7 AIST



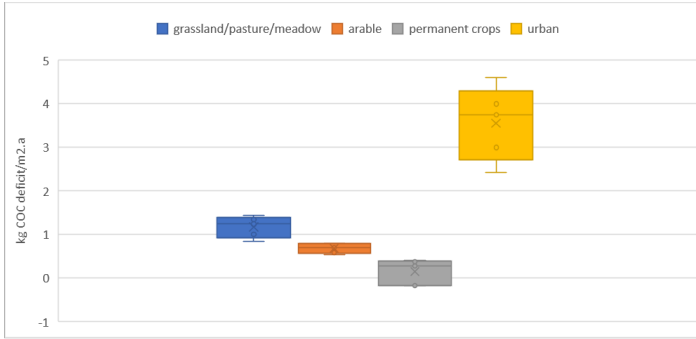
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6 midpoint pathways identified

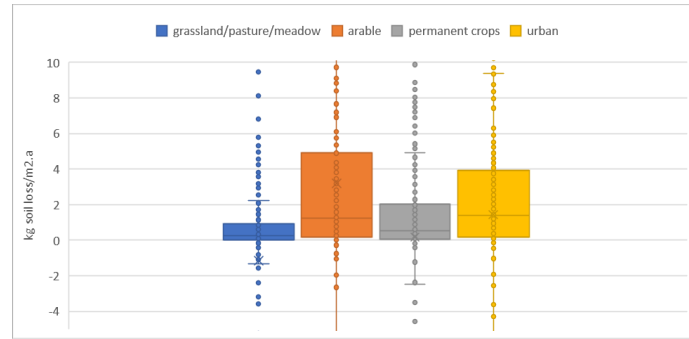


Spread of midpoints by country

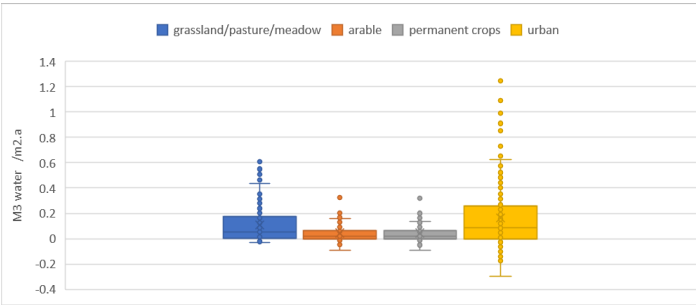
Soil organic carbon



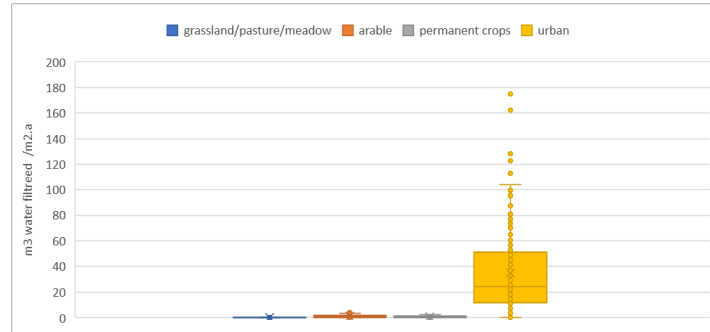
Erosion



Groundwater regeneration

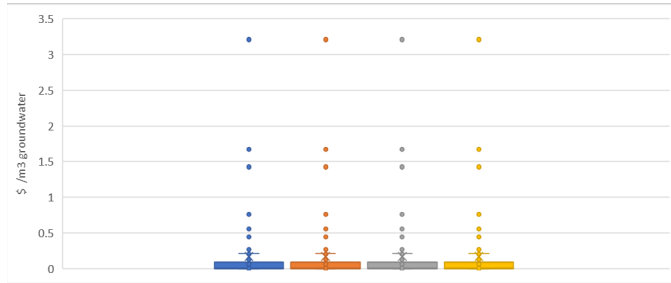
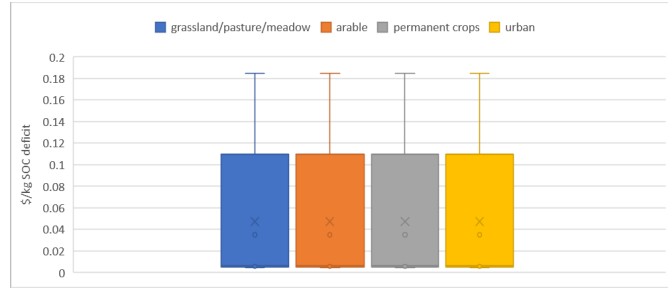


Mechanical filtration



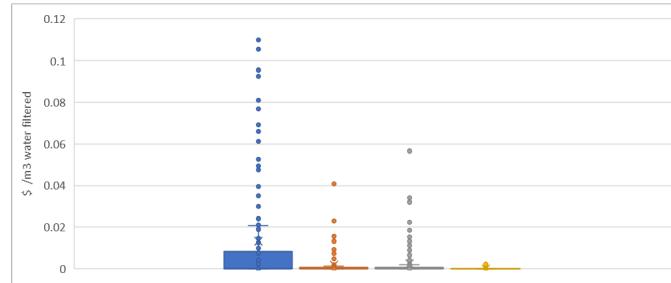
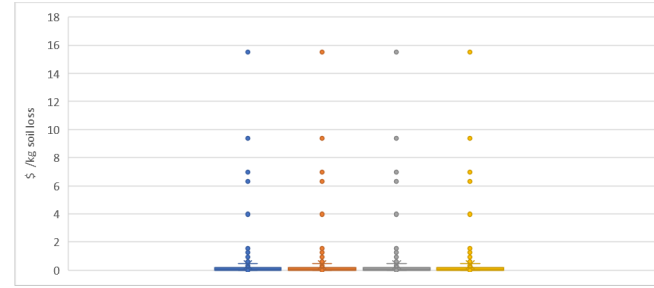
Effect factor by country

Soil organic carbon



Groundwater regeneration

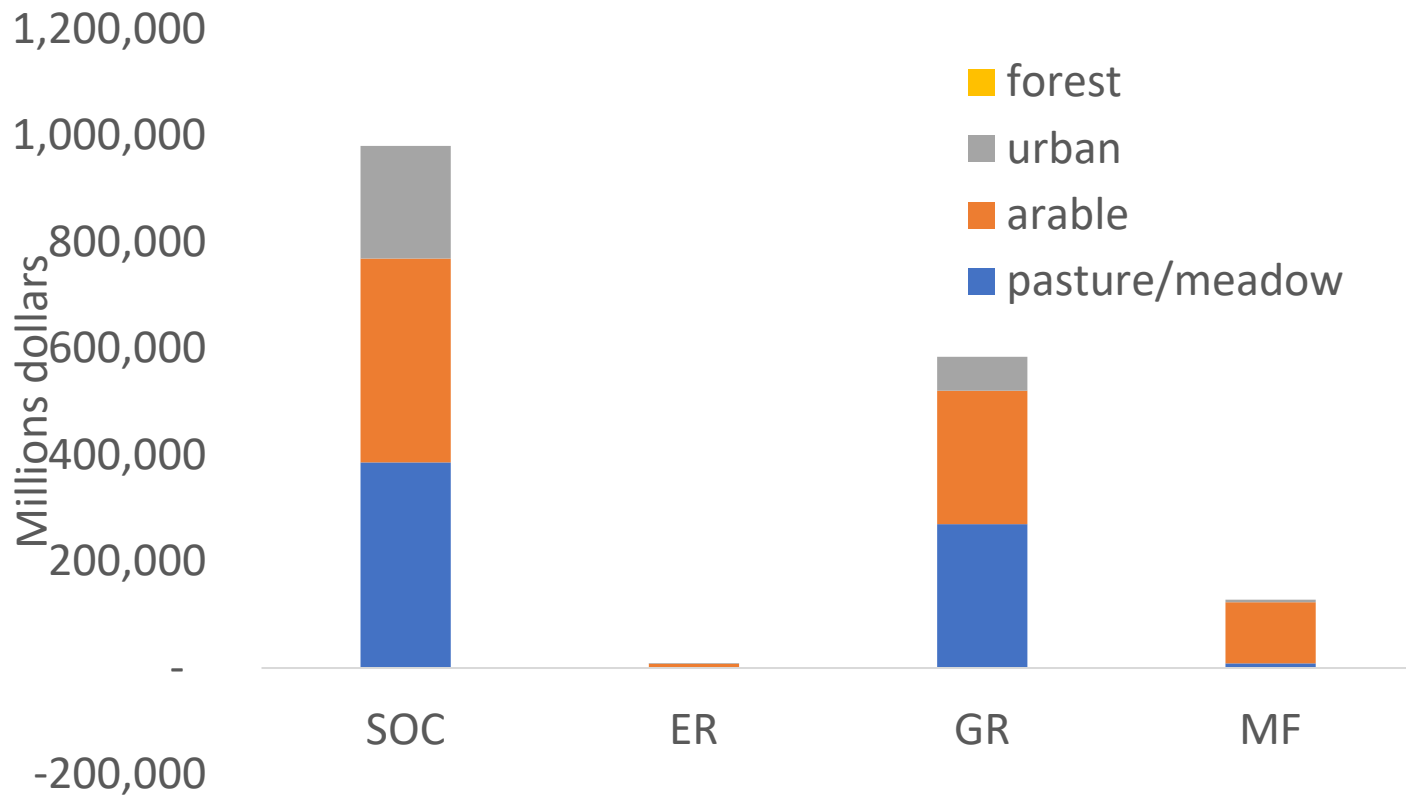
Erosion



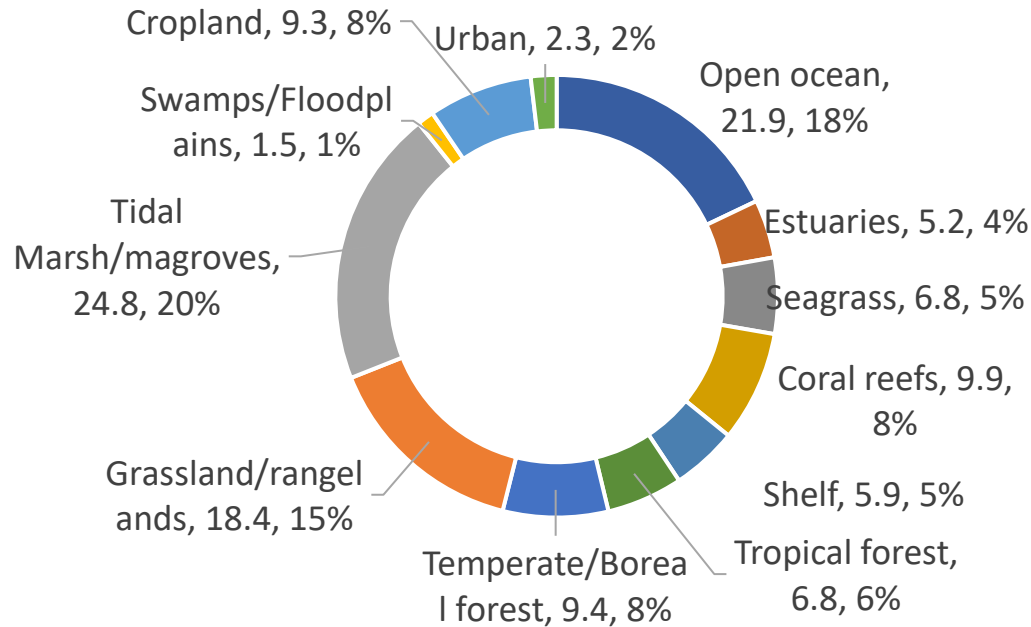
Mechanical filtration

Annual ecosystem service damage

1,700,000 Million US dollars



Value of ecosystem services 2011 (Trillion of US2007 dollars)



Costanza, Robert, Rudolf De Groot, Paul Sutton, Sander Van der Ploeg, Sharolyn J Anderson, Ida Kubiszewski, Stephen Farber, and R Kerry Turner. 2014. 'Changes in the global value of ecosystem services', *Global Environmental Change*, 26: 152-58.

A new set of weights for life cycle assessment

GLAM stakeholders' consultation



**Universiteit
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Cecilia Askham, Norwegian Institute for Sustainability Research (NORSUS), cecilia@norsus.no

1. Weighting subtask objectives



1. Build a consistent set of **deterministic weights** covering **all impact categories** of the **GLAM LCIA** methodology. The primary focus will be to derive such weights at **endpoint/damage level**
2. **Characterize uncertainties** of the proposed weights

2. The survey

Set 1

Instructions

You will be shown **9 different choice tasks** (i.e., sets of scenarios), which are a combination of possible impact levels for the three areas of protection.

For each set, you will be asked to state whether you prefer the Reference scenario or one of the other 2 scenarios that will be shown to you.



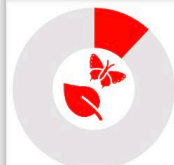
東京都市大学
TOKYO CITY UNIVERSITY



Reference



55 days of healthy life lost per person per year in the world due to disability or early death, which equals 15% loss in healthy life expectancy for the world population



12% of global terrestrial species (mammals, amphibians, birds, reptiles, and vascular plants) are put at risk of extinction



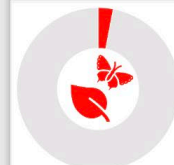
3398 USD loss of natural resource and services from the ecosystems per person per year, which equals 7.5% of the value of goods and services produced every year in the economy



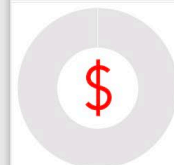
Scenario 1



82 days of healthy life lost per person per year in the world due to disability or early death, which equals 22% loss in healthy life expectancy for the world population



3% of global terrestrial species (mammals, amphibians, birds, reptiles, and vascular plants) are put at risk of extinction



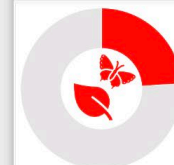
0 USD loss of natural resource and services from the ecosystems per person per year, which equals 0% of the value of goods and services produced every year in the economy



Scenario 2



14 days of healthy life lost per person per year in the world due to disability or early death, which equals 4% loss in healthy life expectancy for the world population



24% of global terrestrial species (mammals, amphibians, birds, reptiles, and vascular plants) are put at risk of extinction



6796 USD loss of natural resource and services from the ecosystems per person per year, which equals 15% of the value of goods and services produced every year in the economy



3. Survey distribution and representativity

- Face 2 face (**high sampling quality = 36.8%**): Uganda, Burkina Faso & Turkey
- Survey company (**medium sampling quality = 42%**): Japan, China, India
- Snowball (**low sampling quality = 21.2%**): mostly high-income countries

	Total	Face-to-Face	Survey Company	Snowball
High	795		447	348
Upper middle	950	250	419	281
Lower middle	513		487	26
Low	940	940		
TOTAL	3198	1190	1353	655

4. The weights

	HH	Range		EQ	Range		NR&ES	Range	
Econometric models	Weight	Low	High	Weight	Low	High	Weight	Low	High
All responses equal	0.42	0.41	0.43	0.31	0.30	0.32	0.26	0.25	0.28
Population share adjusted global weights	0.37	0.36	0.39	0.34	0.33	0.35	0.29	0.27	0.30
MCDAs models	Weight	Low	High	Weight	Low	High	Weight	Low	High
All responses equal	0.41	0.40	0.42	0.32	0.32	0.33	0.27	0.26	0.27
Population share adjusted global weights	0.39	0.38	0.40	0.33	0.31	0.34	0.29	0.27	0.30

5. Who are the GLAM weights for?



- The GLAM weights are appropriate for those projects where **no weights are elicited from the decision-makers**:
 1. The problem owners (a company deciding between different ways to manufacture a product) would **rather not use their personal preferences**. They would rather use external weights, in this case weights that represent the preferences of the respondents of a large global survey
 2. There are **no problem owners** involved in the analysis (e.g., researchers assessing some products who want to synthesize the LCA impact as a way of offering general conclusions)
 3. **Resources** (time, money) are **insufficient**

Avoid the use of equal weights or some default weights

GLAM characterization factors

Ecosystem Quality - Damage level (Country+ Global scale)	Originally submitted		GLAM Practitioner Version		
Impact Category	CFs	Unique Flows	New Flows(EF-list)	CFs	Unique Flows
Climate Change	1443	207	11	636	210
Freshwater Ecotoxicity	360828	6444	2185	451514	6440
Terrestrial Ecotoxicity	20898	366	35	27042	366
Freshwater Eutrophication	15696	4	0	8856	33
Land use	178048	19	9	34320	165
Marine Eutrophication	2316	3	0	9644	14
MicroPlastic	948	252	0	1356	252
Terrestrial acidification	7416	3	1	4326	7
Water consumption	1656	1	0	2277	10

Human Health - Damage level (Country + Global scale)	Originally submitted		GLAM Practitioner Version		
Impact Category	CFs	Unique Flows	New Flows(EF-list)	CFs	Unique Flows
Climate Change	5852	209	11	1917	211
Fine Particulate Matter	243947	5	0	39169	9
Humantoxicity	611292	6444	2180	191664	6435
Ionising Radiation	1840	115	0	2508	114
Nutritional impacts	8316	22	22	4158	22
Physical activity	7901	832	832	3747	832
Work environment impacts	397	397	397	20644	397
Water consumption	188	1	0	2085	11

GLAM characterization factors

Socio economic assets - Damage level (Country + Global scale)	Originally submitted		GLAM Practitioner Version		
	CFs	Unique Flows	New Flows(EF-list)	CFs	Unique Flows
Erosion Potential	64148	58	0	74472	117
Groundwater Regeneration Reduction Potential	64148	62	0	74472	117
Infiltration Reduction Potential	49416	58	0	74472	117
Physicochemical Filtration Reduction Potential	37062	58	0	62060	117
Minerals+Fossils	88	88	25	89	87
Soil Organic Carbon Reduction Potential	64148	58	0	74472	117

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Stakeholder consultation

21-23 October 2024 Launch of GLAM 1.0 version
at the LCA case study symposium in Göteborg,

March 2025 onwards
GLAM available in LCA software

2025 ff Dissemination, stewardship
and guidance for interpretation

CF factors and implementation

Martin Dorber

Contact person:

Martin Dorber, NTNU

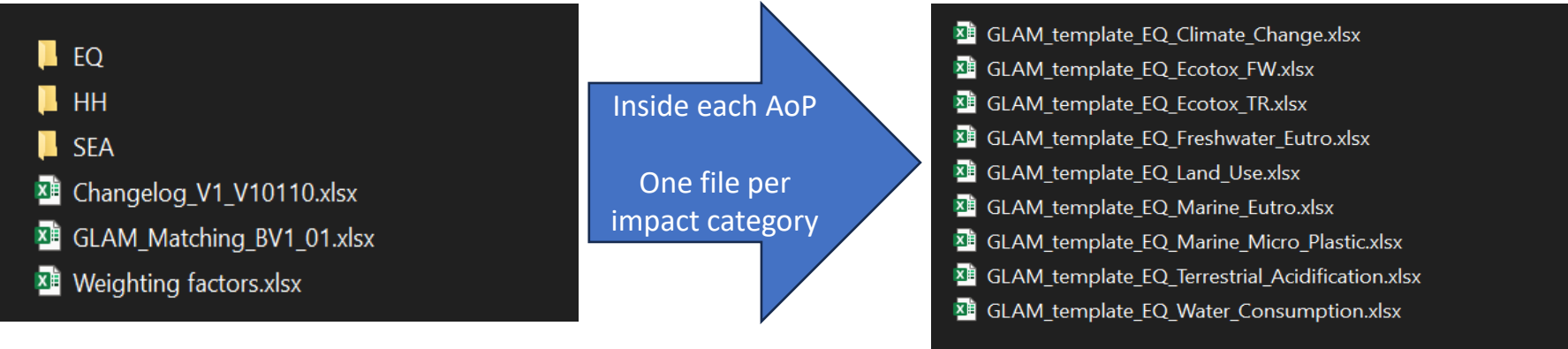
martin.dorber@ntnu.no



Life Cycle Initiative

GLAM Beta Version 1.01.10

→ <https://ntnu.box.com/s/3p0ua87ookd2to2pbcx4gk8wh0qvxqkq>



- EQ
- HH
- SEA
- Changelog_V1_V10110.xlsx
- GLAM_Matching_BV1_01.xlsx
- Weighting factors.xlsx

Inside each AoP

One file per
impact category

- GLAM_template_EQ_Climate_Change.xlsx
- GLAM_template_EQ_Ecotox_FW.xlsx
- GLAM_template_EQ_Ecotox_TR.xlsx
- GLAM_template_EQ_Freshwater_Eutro.xlsx
- GLAM_template_EQ_Land_Use.xlsx
- GLAM_template_EQ_Marine_Eutro.xlsx
- GLAM_template_EQ_Marine_Micro_Plastic.xlsx
- GLAM_template_EQ_Terrestrial_Acidification.xlsx
- GLAM_template_EQ_Water_Consumption.xlsx



Life Cycle Initiative

GLAM_Template Structure

LCIAMethods | FLOW_class | LCIAMethod_location | **lciamethods_CF** | lciamethods_CF_GLAM

“lciamethods_CF” = Research Version

All original submitted CFs formatted to the same standardized excel-sheet

FLOW_name_org	FLOW_casnumber	LCIAMethod_location	LCIAMethod_location_name	CF	Unit	CF_Uncertainty_Lower	CF_Uncertainty_Higher	FLOW_class0	FLOW_class1	FLOW_class2	Species	LCIAMethod_realm	LCIAMethod_mathematical Approach	Scenario	CF_derivation	LCIAMethod_type	LCIAMethod_name
Cropland_Intense		GLO	Global	3,75E-12	Regional PDF/m2			Land use	Land occupation		Plants	Terrestrial	Average	original_weighting_land_use	Original	Damage level	Land use
Cropland_Intense		GLO	Global	2,40E-11	Regional PDF/m2			Land use	Land occupation		Plants	Terrestrial	Average	proxy_weighting_ecoregion_area	Original	Damage level	Land use
Cropland_Intense		GLO	Global	3,13E-15	Global PDF/m2			Land use	Land occupation		Animalia	Terrestrial	Average	original_weighting_land_use	Original	Damage level	Land use
Cropland_Intense		GLO	Global	2,97E-15	Global PDF/m2			Land use	Land occupation		Plantae	Terrestrial	Average	original_weighting_land_use	Original	Damage level	Land use
Cropland_Intense		GLO	Global	1,14E-14	Global PDF/m2			Land use	Land occupation		Aggregated	Terrestrial	Marginal	original_weighting_land_use	Original	Damage level	Land use

- Original flow name + FLOW_class
- Several CFs per FLOW_name_org, Location and FLOW_class combination
 - E.g. different Scenario, Species



Life Cycle Initiative

GLAM_Template Structure

FLOW_class | LCIAMethod_location | Iciamethods_CF | Iciamethods_CF_GLAM

“Iciamethods_CF_GLAM” = Practitioner Version

FLOW_uuid	FLOW_name	LCIAMethod_location	LCIAMethod_location_name	LCIAMethod_location_ISO2	CF	Unit	FLOW_class0	FLOW_class1	Species	LCIAMethod_realm	LCIAMethod_mathematical Approach	Scenario	CF_derivation	Matching_CF	Matching_Compartment	LCIAMethod_type	LCIAMethod_name
	Plantation_forest_Intense	AFG	Afghanistan	AF	1,3188E-15	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	original	Matched	New	None	Damage level	Land use
	Plantation_forest_Light	AFG	Afghanistan	AF	1,1461E-15	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	proxy_partial	Matched	New	None	Damage level	Land use
	Plantation_forest_Minimal	AFG	Afghanistan	AF	1,5475E-16	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	proxy_type	Matched	New	None	Damage level	Land use
e1d56d4e-afe3-4b92-bd51-0a21f75e50a8	agriculture	AFG	Afghanistan	AF	4,5011E-16	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	proxy_partial	Matched	Matching assumed	None	Damage level	Land use
1d443c61-ff6f-419a-99a8-9ff3055f4922	agriculture, mosaic	AFG	Afghanistan	AF	3,4713E-16	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	original	Matched	Clear matching	None	Damage level	Land use
b88d3b6d-229e-477e-bce1-e16376f75c7b	arable	AFG	Afghanistan	AF	4,5011E-16	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	proxy_partial	Matched	Matching assumed	None	Damage level	Land use
8681540b-cc15-40e7-9801-6f5bcd4d540	arable, fallow	AFG	Afghanistan	AF	3,4713E-16	Global PDF/m2	Land use	Land occupation	Aggregated	Terrestrial	Average	original	Matched	Matching assumed	None	Damage level	Land use

- FLOW_name and FLOW_lass0-2 matched with the EF-list nomenclature
 - GLAM_Matching_BV1_01.xlsx
- Only one value per FLOW, Location and FLOW_class combination

*FLOW_casnumber, CF_Uncertainty_Lower, CF_Uncertainty_Higher, FLOW_class2 are hidden



Life Cycle Initiative

GLAM_Template Structure

LCIAMethods | FLOW_class | LCIAMethod_location | Iciamethods_CF | Iciamethods_CF_GLAM

→ Spatial resolution: Country or Global level

→ Locations covered are defined in this sheet

→ If applicable link to native scale

LCIAMethod_location_class0	LCIAMethod_location_class1	LCIAMethod_location_name	Comments
Native	Terrestrial Ecoregion		https://zenodo.org/records/10114493



Life Cycle Initiative

GLAM_Matching_BV1_01.xlsx

Comp_Overview Stat EQ_Flow EQ_Comp HH_Flow HH_Comp SEA_Flow SEA_Comp

- Comp Overview: covered FLOW_classes0-2
- Stat: Number of CFs and covered flows
- XX_Flow: Flow matching
- XX_Comp: Compartment matching

→ Why are there compartments in XX_Flow

- Added due to flow matching
- Coding reasons
- Use “Comp Overview” as summary



Life Cycle Initiative

Mapping to other inventories:

[Home](#) > [The International Journal of Life Cycle Assessment](#) > Article

Elementary flow mapping across life cycle inventory data systems: A case study for data interoperability under the Global Life Cycle Assessment Data Access (GLAD) initiative

DATA AVAILABILITY, DATA QUALITY | [Open access](#) | Published: 12 March 2024

Volume 29, pages 789–802, (2024) | [Cite this article](#)

[Download PDF](#) 

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[GLAD-ElementaryFlowResources](#) / [Mapping](#) / [Output](#) / [Mapped_files](#) / 

 **AntValente** Fixed outputs and inputs labels 

Name

..

 FEDEFLv1.0.3-IDEAv2.2.xlsx

 FEDEFLv1.0.3-IDEAv2.3.xlsx

 FEDEFLv1.0.3-ILCD-EFv3.0.xlsx

 FEDEFLv1.0.3-ecoinventEFv3.7.xlsx

 IDEAv2.2-FEDEFLv1.0.3.xlsx

 IDEAv2.2-ILCD-EFv3.0.xlsx

 IDEAv2.2-ecoinventEFv3.7.xlsx

 IDEAv2.3-FEDEFLv1.0.3.xlsx

 IDEAv2.3-ILCD-EFv3.0.xlsx

 IDEAv2.3-ecoinventEFv3.7.xlsx

 ILCD-EFv3.0-FEDEFLv1.0.3.xlsx

 ILCD-EFv3.0-IDEAv2.2.xlsx

 ILCD-EFv3.0-IDEAv2.3.xlsx

 ILCD-EFv3.0-ecoinventEFv3.7.xlsx

 ecoinventEFv3.7-FEDEFLv1.0.3.xlsx

 ecoinventEFv3.7-IDEAv2.2.xlsx

 ecoinventEFv3.7-IDEAv2.3.xlsx

 ecoinventEFv3.7-ILCD-EFv3.0.xlsx

https://github.com/UNEP-Economy-Division/GLADElementaryFlowResources/tree/master/Mapping/Output/Mapped_files



Life Cycle Initiative



Coverage of flows and characterization factors

Ecosystem Quality - Damage level (Country+ Global scale)	Originally submitted		GLAM Practitioner Version		
Impact Category	CFs	Flows	New Flows	CFs	Flows
Climate Change	1443	207	11	636	210
Freshwater Ecotoxicity	309690	5749	1685	355908	5745
Terrestrial Ecotoxicity	20952	388	94	24056	388
Freshwater Eutrophication	15696	4	0	7103	33
Land use	178048	19	9	34145	165
Marine Eutrophication	2316	3	0	9495	14
MicroPlastic	1108	292	282	1602	282
Terrestrial acidification	7398	4	1	1442	7
Water consumption	1656	1	0	2028	11
Human Health - Damage level (Country + Global scale)	Originally submitted		GLAM Practitioner Version		
Impact Category	CFs	Flows	New Flows	CFs	Flows
Climate Change	836	209	11	424	211
Fine Particulate Matter	243947	5	0	14689	9
Humantoxicity	632598	5021	2293	276110	5018
Ionising Radiation	1840	115	68	2280	114
Nutritional impacts	30876	22	22	4158	22
Physical activity	9571	832	832	4582	832
Work environment impacts	420	420	420	21840	420
Water consumption	188	1	0	2085	11



Life Cycle Initiative

Coverage of flows and characterization factors

Socio economic assets - Damage level (Country + Global scale)	Originally submitted		GLAM Practitioner Version		
	CFs	Flows	New Flows	CFs	Flows
Erosion Potential	42224	58	0	37874	116
Groundwater Regeneration Reduction Potential	42224	62	0	40354	116
Infiltration Reduction Potential	42224	58	0	41202	116
Physicochemical Filtration Reduction Potential	31668	58	0	20770	116
Minerals+Fossils	86	86	25	87	87
Soil Organic Carbon Reduction Potential	42224	58	0	38118	116



Life Cycle Initiative

Normalization

Martin Dorber, Doris Wimmer, Roland Hischier



Life Cycle Initiative

Normalisation testing results

EQ		Recommended	Units
Climate change	FW	1,27E-01	PDF.yr/yr
	Mar	7,19E-03	PDF.yr/yr
	Terr	3,07E-03	PDF.yr/yr
Ecotox	FW	2,04E-01	PDF.yr/yr
	Terr	6,71E-03	PDF.yr/yr
Eutrophication	FW	2,96E-01	PDF.yr/yr
	Mar	1,92E-01	PDF.yr/yr
Land use	Terr	3,97E-01	PDF.yr/yr
Microplastics	Mar	9,51E-03	PDF.yr/yr
Acidification	Terr	4,23E-02	PDF.yr/yr
Water use	FW	1,47E-01	PDF.yr/yr
		4,77E-01	PDF.yr/yr
HH			
Climate change		2,64E+08	DALY/yr
PM		7,99E+06	DALY/yr
Human tox		4,03E+07	DALY/yr
Ionising radiation		5,45E+05	DALY/yr
Occupational		6,55E+07	DALY/yr
Nutrition		0,00E+00	DALY/yr
Physical	NA		DALY/yr
Water use		3,22E+07	DALY/yr
		4,10E+08	DALY/yr
		19,6	DAL-days/p/yr
SEA			
Erosion		5,67E+12	USD/yr
Groundwater		2,38E+11	USD/yr
Infiltration reduction		4,27E+10	USD/yr
Soil organic carbon		2,18E+11	USD/yr
Minerals & fossils		4,87E+11	USD/yr
		6,66E+12	USD/yr



Life Cycle Initiative

Rice-Case-Study

Martin Dorber, Doris Wimmer, Roland Hischier



Life Cycle Initiative

GLAM testing - Overview

- Starting point: Updated Rice Case Study Inventory
 - Update of the original Rice Case Study inventory to Ecoinvent 3 by Roland Hischier
 - New inventory generated and exported from SimaPro (9.5.0.1.) using ecoinvent version (3.9.1)
- Matching-file: GLAD matching file «ecoinventEFv3.7-ILCD-EFv3.0.xlsx»
- Inventory matched to GLAM Beta v 1.01.10
- Marine EQ_MicroPlastic, HH_Malnutrition, HH_Worker, HH_Nutritional Impacts, HH_Physical Activity Impact provided their own results
- No software → coding



Life Cycle Initiative

Results

EQ [global PDF*y]				
Realm	Impact Category	CH	CN	IN
freshwater	Water consumption FW	9,7E-12	5,2E-14	5,6E-14
freshwater	Eutrophication FW	2,9E-14	2,9E-14	3,0E-14
freshwater	Ecotox FW	4,1E-15	3,0E-15	8,0E-15
freshwater	Climate Change FW	1,9E-15	4,5E-15	4,1E-15
terrestrial	Land use TR	5,4E-15	5,3E-16	5,9E-15
terrestrial	Ecotox TR	2,0E-15	7,5E-15	7,5E-15
terrestrial	Climate Change TR	6,6E-17	1,2E-16	1,1E-16
terrestrial	Acidification TR	9,7E-16	1,9E-15	1,8E-15
marine	Eutrophication MA	5,8E-15	2,4E-14	2,4E-14
marine	Climate Change MA	1,3E-16	2,7E-16	2,4E-16
marine	Microplastic MA	1,7E-17	8,3E-15	1,5E-15

HH [DALY]			
Impact Category	CH	CN	IN
Ionizing Radiataion	4,0E-08	4,2E-08	3,0E-08
Nutritional Impacts	1,8E-05	3,1E-05	2,6E-05
Climate Change	3,2E-07	7,8E-06	6,4E-06
Water Consumption	3,6E-07	8,3E-08	1,1E-07
Fine Particulate Matter	1,5E-07	2,2E-07	3,4E-07
Malnutrition Impact	0,0E+00		0,0E+00
Physical Activity Impact	-6,7E-07	-4,3E-07	-4,6E-06
Human Tox	5,3E-07	9,8E-07	1,2E-06
Worker			

SEA [Dollar]			
Impact Category	CH	CN	IN
Erosion	5,1E+00	1,1E-02	-6,8E-02
Groundwater Regeneration	7,4E-02	9,9E-04	-2,4E-04
Infiltration Reduction	3,5E-02	3,2E-04	2,7E-03
Soil organic carbon	1,8E-01	2,1E-03	1,8E-03
Minerals+Fossils	8,0E-03	4,4E-03	6,1E-03
Physiochemical			



Life Cycle Initiative

Cross comparison between impact categories

→ Inside on country

HH [DALY]	
Impact Category	CH
Nutritional Impacts	1,8E-05
Human Tox	5,3E-07
Water Consumption	3,6E-07
Climate Change	3,2E-07
Fine Particulate Matter	1,5E-07
Ionizing Radiation	4,0E-08
Malnutrition Impact	0,0E+00
Physical Activity Impact	-6,7E-07
Worker	

- Between countries

HH [DALY]		
Impact Category	CH	CN
Nutritional Impacts	1,8E-05	3,1E-05
Human Tox	5,3E-07	9,8E-07
Water Consumption	3,6E-07	8,3E-08
Climate Change	3,2E-07	7,8E-06
Fine Particulate Matter	1,5E-07	2,2E-07
Ionizing Radiation	4,0E-08	4,2E-08
Malnutrition Impact	0,0E+00	
Physical Activity Impact	-6,7E-07	-4,3E-07
Worker		



Life Cycle Initiative

Cross comparsion between impact categories

→ Works for all AoPs

→ EQ has 3 realms

- Inside each realm PDF*y can be summed

EQ [global PDF*y]				
Realm	Impact Category	CH	CN	IN
freshwater	Water consumption FW	9,7E-12	5,2E-14	5,6E-14
freshwater	Eutrophication FW	2,9E-14	2,9E-14	3,0E-14
freshwater	Ecotox FW	4,1E-15	3,0E-15	8,0E-15
freswhater	Climate Change FW	1,9E-15	4,5E-15	4,1E-15
terrestrial	Land use TR	5,4E-15	5,3E-16	5,9E-15
terrestrial	Ecotox TR	2,0E-15	7,5E-15	7,5E-15
terrestrial	Climate Change TR	6,6E-17	1,2E-16	1,1E-16
terrestrial	Acidification TR	9,7E-16	1,9E-15	1,8E-15
marine	Eutrophication MA	5,8E-15	2,4E-14	2,4E-14
marine	Climate Change MA	1,3E-16	2,7E-16	2,4E-16
marine	Microplastic MA	1,7E-17	8,3E-15	1,5E-15

EQ [global PDF*y]	CH	CN	IN
freshwater PDF*y	9,8E-12	8,9E-14	9,8E-14
terrestrial PDF*y	8,46E-15	1,01E-14	1,54E-14
marine PDF*y	5,94E-15	3,27E-14	2,59E-14

→ Recommended to keep them at this aggregation level



Life Cycle Initiative

Aggregation

- Sum inside each AoP

	CH	CN	IN
freshwater PDF*y	9,8E-12	8,9E-14	9,8E-14
terrestrial PDF*y	8,46E-15	1,01E-14	1,54E-14
marine PDF*y	5,94E-15	3,27E-14	2,59E-14
DALY	1,83E-05	3,94E-05	2,95E-05
Dollar	5,35E+00	1,83E-02	-5,75E-02

Normalized Results	CH	CN	IN
EQ	6,84E-12	9,21E-14	9,73E-14
HH	4,46E-14	9,61E-14	7,2E-14
SEA	8,04E-13	2,75E-15	-8,63E-15
Normalization values			
EQ	4,77E-01	PDF.yr/yr	
HH	4,1E+08	DALY/yr	
SEA	6,66E+12	USD/yr	

Weighted results; Option 1		
CH	CN	IN
2,78E-12	6,76E-14	5,80E-14
Weighted results; Option 2		
3,10E-12	6,92E-14	6,10E-14

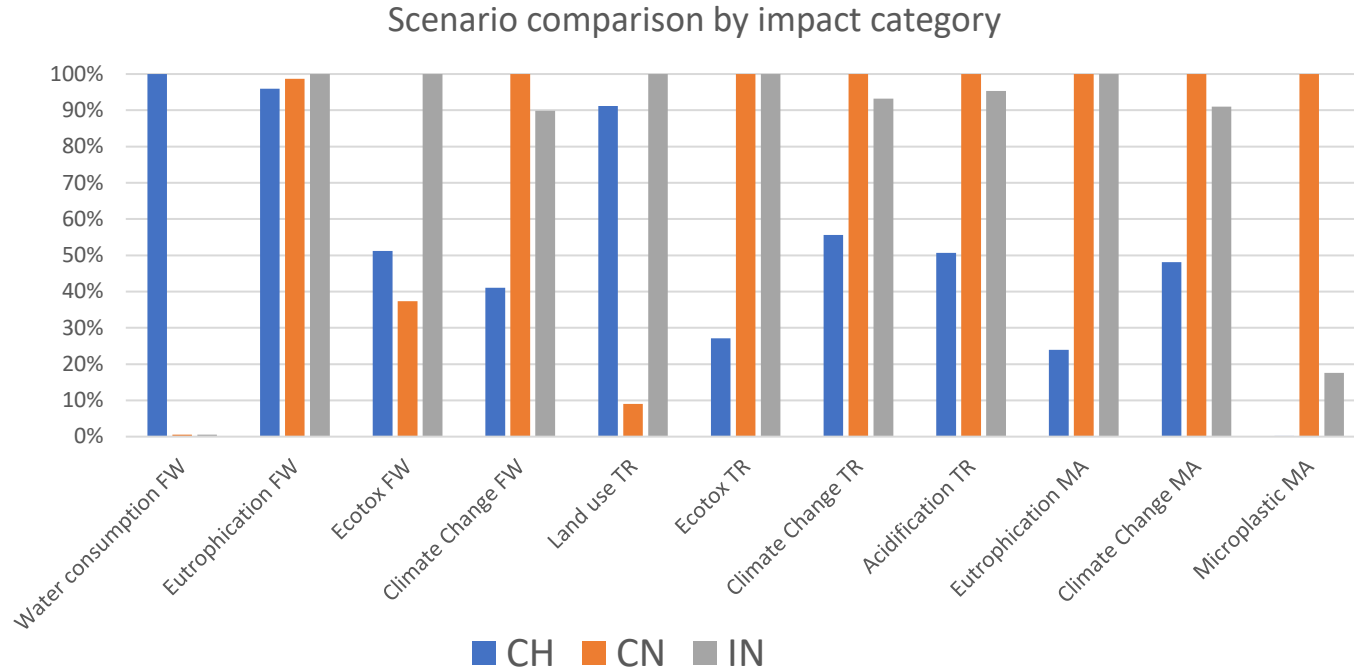
	CH	CN	IN
global PDF*y, equal realm weight	3,26E-12	4,39E-14	4,64E-14
DALY	1,83E-05	3,94E-05	2,95E-05
Dollar	5,35E+00	1,83E-02	-5,75E-02

Weighing	EQ	HH	SEA
Option 1			
econometric, population adjusted	0,37	0,34	0,29
Option 2			
Econometric "all responses equal"	0,42	0,31	0,26



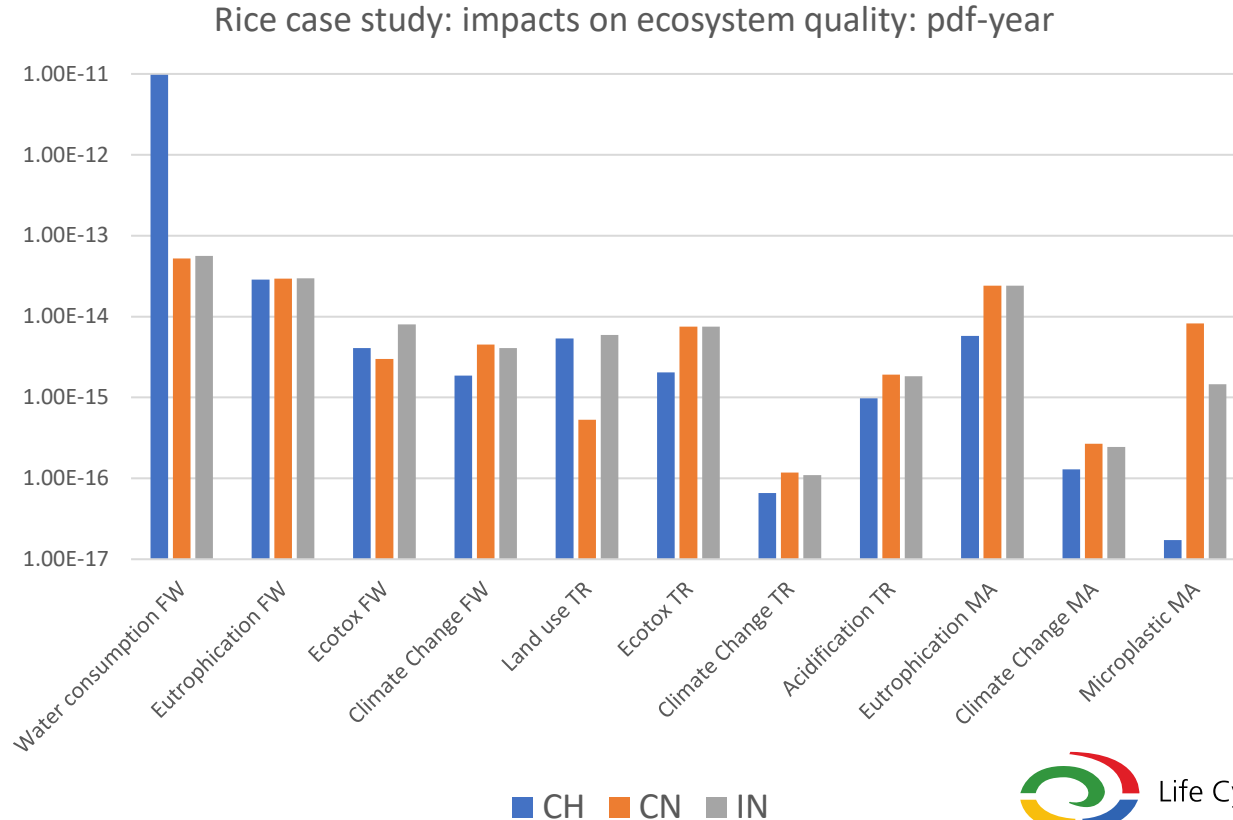
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Rice case study – individual category results in % highest scenario



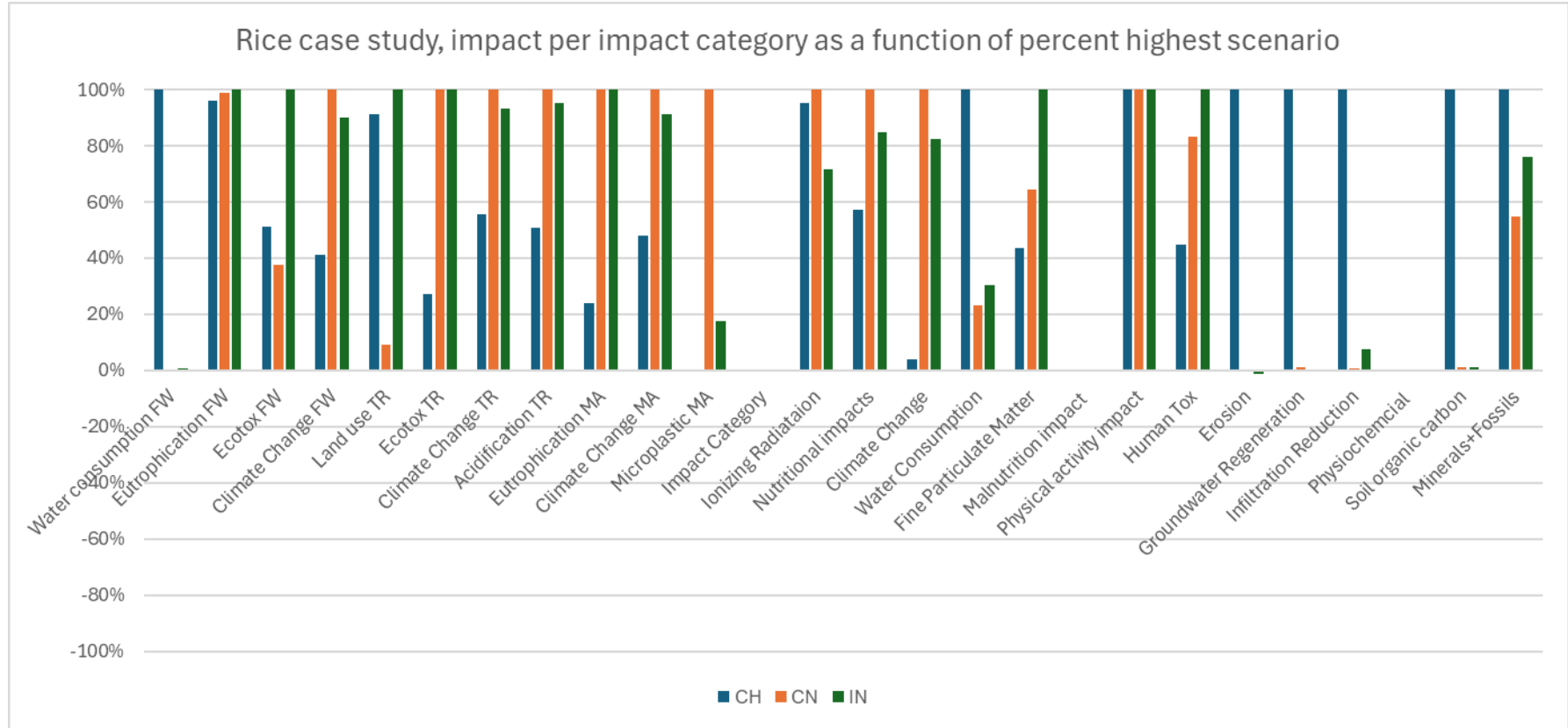
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Rice case study – individual category results at damage level



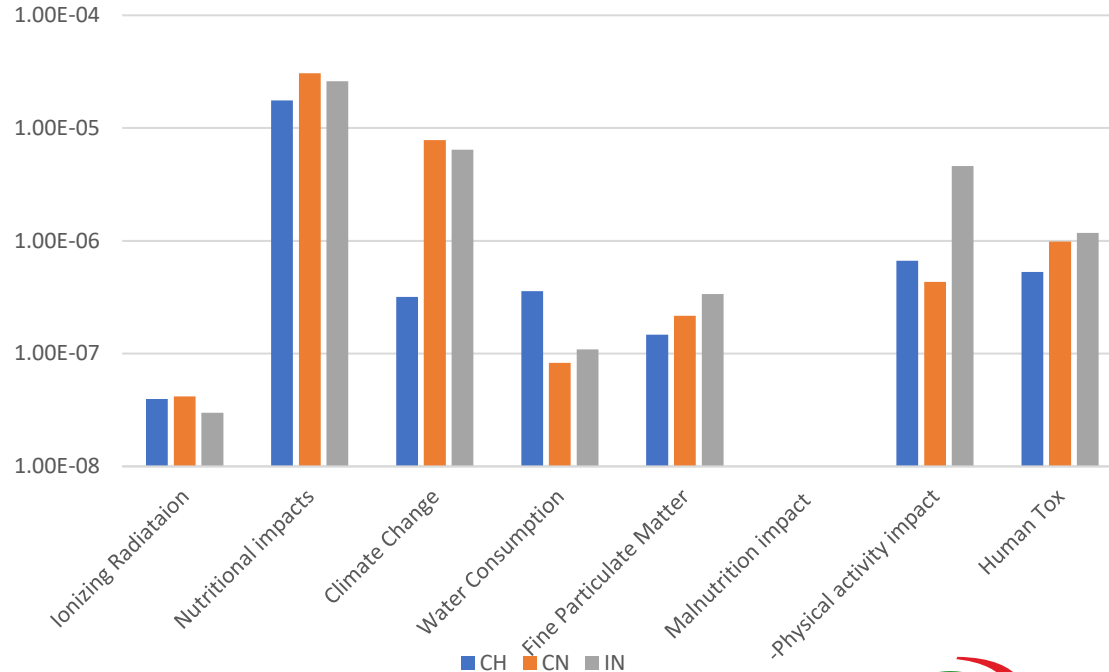
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Rice case study – individual category results in % highest scenario, all categories



Rice case study – individual category results at damage level HH – DALY/kg rice

Rice case study: impacts on Human health DALYs



Life Cycle Initiative

GLAM – Consensus and Intensive evaluation and testing

230 experts incl. impact category specific experts

2019 Scoping phase and consultation

2020-2023 GLAM Development

2023-2024 GLAM testing

8 May 2024 Launch of GLAM-beta version,
including all GLAM factors with documentation

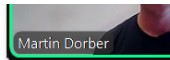
28 August – 30 September 2024
Stakeholder consultation

21-23 October 2024 Launch of GLAM 1.0 version
at the LCA case study symposium in Göteborg,

March 2025 onwards
GLAM available in LCA software

2025 ff Dissemination, stewardship
and guidance for interpretation

GLAM 28-08-2024 Stakeholder Consultation Feedback Form



The beta version of the Global Guidance for Life Cycle Impact Assessment Indicators and Methods (GLAM) was introduced on May 8th during the SETAC Symposium in Seville. Following this significant event, two workshops were conducted to finalize the recommendations, and the revised characterization factors were provided to select industries in early July, initiating the testing phase.

This Feedback Form offers stakeholders the opportunity to provide input on the GLAM method and the updated characterization factors. Please submit your feedback no later than 22th of September 2024. The form is divided into four main sections, each with relevant subcategories:

1. Impact Methodology
2. Characterization Factors (CFs) and their implementation
3. Development and Consultation Process
4. Additional Comments



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