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GreenDelta

SOCA – A database add-on for Life Cycle Sustainability Assessment

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Introduction

Sustainable Development Goals (SDG):

- To eradicate poverty and ensure human well-being three dimensions of sustainable development are interconnected and crucial
- Globalization → sustainability does not stop a national borders

→ Life Cycle approach necessary

Introduction: LCA

Environ-
mental LCC

Environ-
mental LCA
(E-LCA)

ecoinvent
Centre

GaBi
Database Content

USDA

Life Cycle
Costing
(LCC)

exiobase

SIRADOS®
BAUDATEN

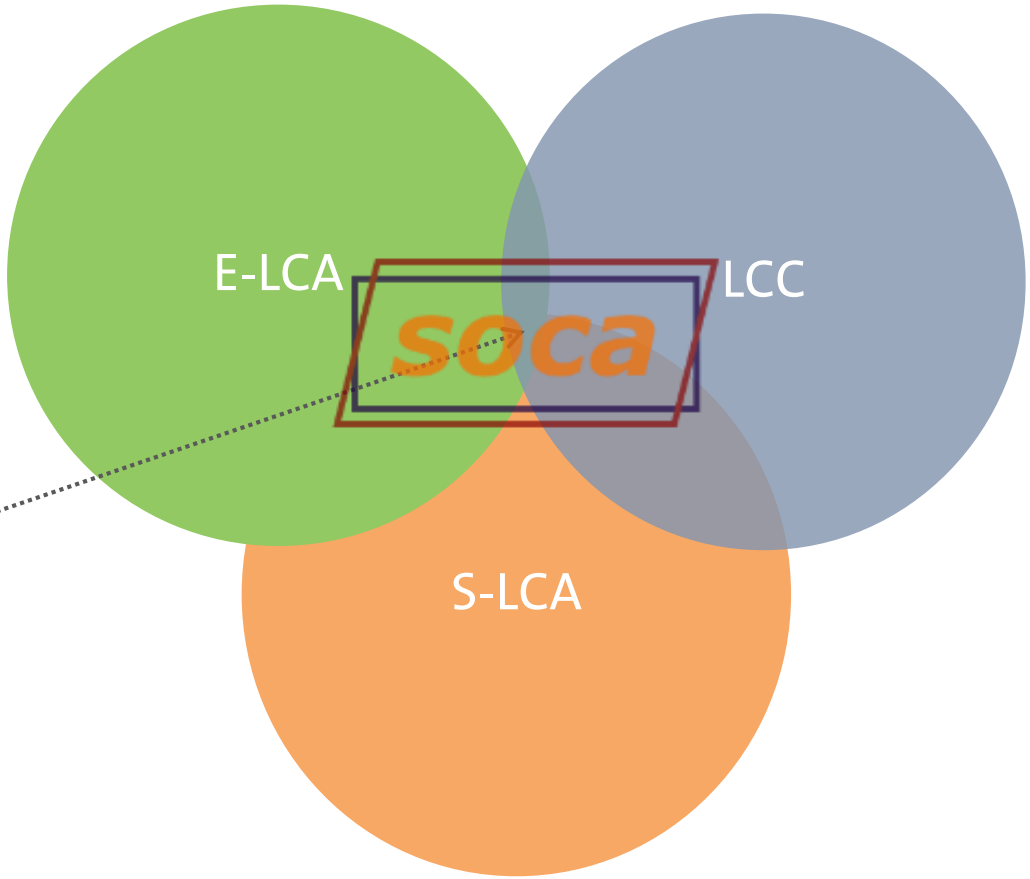
AGRIBALYSE

Social LCA
(S-LCA)

social hotspots database

PSILCA

Introduction:
LCSA

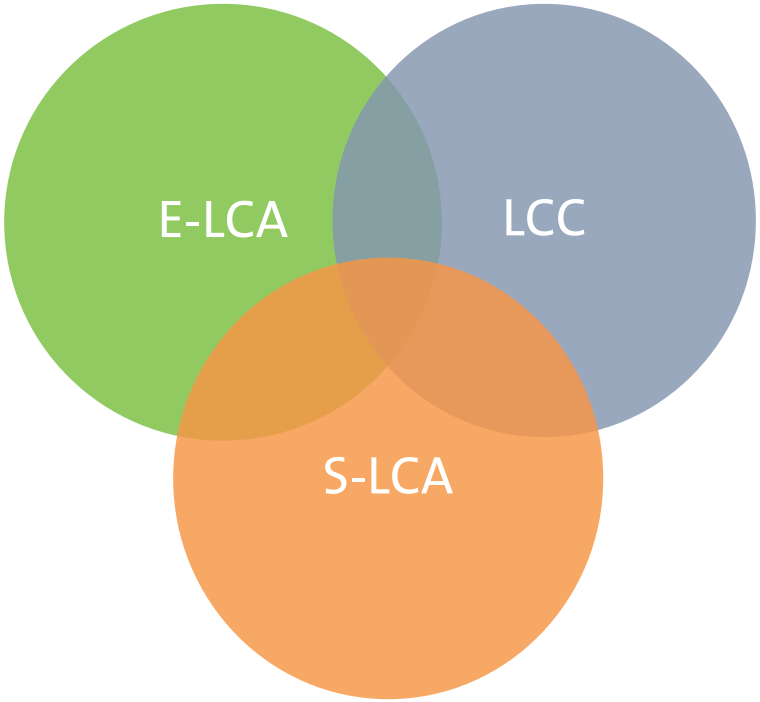


Life Cycle Sustainability Assessment (LCSA)

- Aim: contribute to research of Life Cycle Sustainability Assessment (LCSA) by providing a tool

→ combine 3 elements in a database

Introduction: LCSA with soca



Impact category	Result
Association and bargaining rights	1.28 med risk h
Fair Salary	39.41 med risk h
Violations of employment laws and regulations	5.05 med risk h
Indigenous rights	0.99 med risk h
Climate change - GWP100	5.45 kg CO2-Eq
Freshwater eutrophication - FEP	0.003 kg P-Eq
Human toxicity - HTPinf	2.07 kg 1,4-DCB-Eq
Total value added	1.19 USD
…	…

Methodology: Database

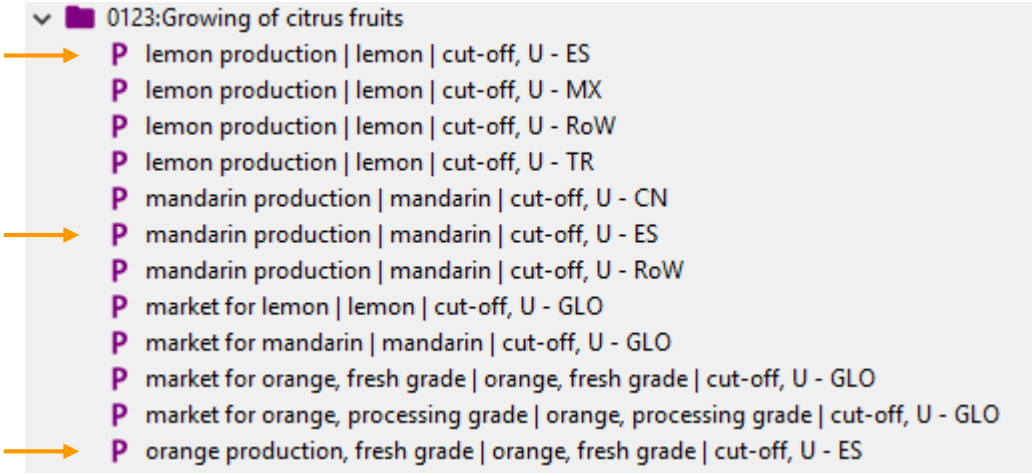
- Develop add-on containing social inventory information for ecoinvent v.3.3
- Ecological inventory data and costs are based on ecoinvent v.3.3
- Social inventory data based on PSILCA

Dibyangshu Sarkar/AFP/Getty Images

Methodology: **Database mapping (1/2)**

- Assigning risk-assessed indicators from PSILCA country-specific-sectors to ecoinvent categories

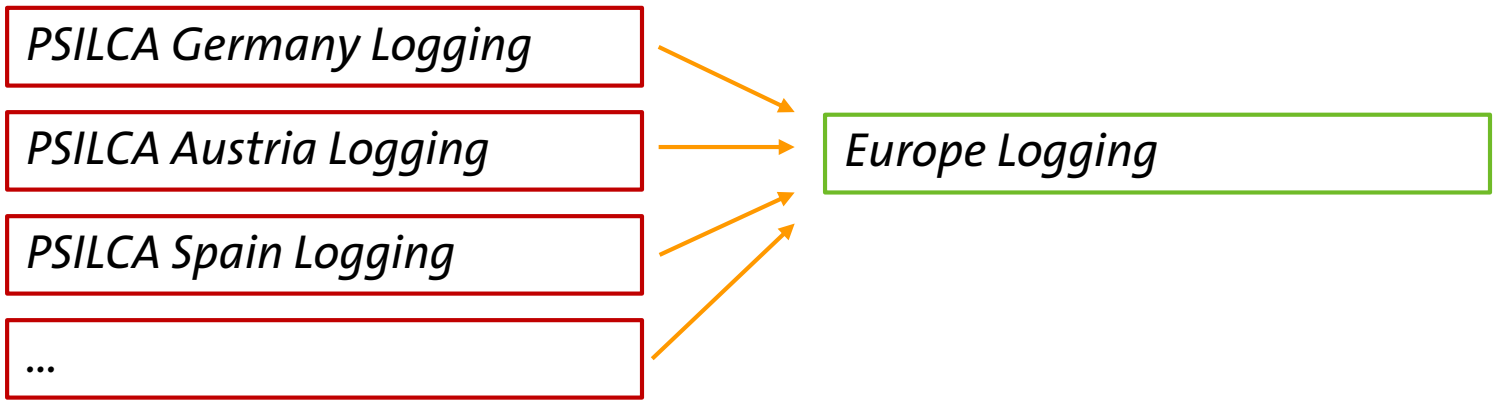
PSILCA "Spain: Products of agriculture" → *ecoinvent "Spain: Growing of citrus fruits"*



- Exception: market processes, activities for administration and database modelling

Methodology: **Database mapping (2/2)**

- Ecoinvent processes of trans-national (or global) regions get an average of same/similar sectors of all related countries in PSILCA



- Ecoinvent processes of "Rest-of-World" regions get an average of similar/same sectors of all countries in PSILCA not covered individually for these activities

Methodology: **Activity variable (1/2)**

- Worker hours

= Working time/USD sector output * cost of reference product

- Average of PSILCA working times assumed for global and regional processes

Outputs

Flow	Category	Amount	Unit	Costs/Revenues
barley grain, feed, organic	011:Growing of non-perennial crops/0111:Gro...	1.00000	kg	0.15900 EUR
Children in employment, total; no risk	Workers/Child labour	0.00185	h	
Human rights issues faced by indigenous people; not appli...	Local Community/Respect of indigenous rights	0.00185	h	
Living wage, per month; high risk	Workers/Fair Salary	0.00185	h	
Minimum wage, per month; very high risk	Workers/Fair Salary	0.00185	h	
Presence of indigenous population; no risk	Local Community/Respect of indigenous rights	0.00185	h	
Rate of fatal accidents at workplace; low risk	Workers/Health and Safety (Workers)	0.00185	h	
Sector average wage, per month; very low risk	Workers/Fair Salary	0.00185	h	
Water	Emission to air/unspecified	0.05040	kg	

Screenshot from openLCA

Methodology: **Activity variable (2/2)**

- For ecoinvent activities without costs, parameters were defined (for each production unit)

Outputs

Flow	Category	Amount	Unit
Sulfur dioxide	Emission to air/high population density	0.00088	kg
Calcium	Emission to air/high population density	2.37770E-6	kg
NMVOC, non-methane volatile organic compounds, unspecifie...	Emission to air/high population density	2.28130E-6	kg
Molybdenum	Emission to water/ground water, long-term	1.11560E-7	kg
Copper, ion	Emission to water/surface water	9.71220E-6	kg
Chromium	Emission to soil/agricultural	4.30130E-6	kg
Zinc, ion	Emission to water/surface water	3.38050E-5	kg
Lead	Emission to water/surface water	9.48660E-7	kg
Cyanide	Emission to air/high population density	5.99520E-7	kg
Rate of fatal accidents at workplace; medium risk	Workers/Health and Safety (Workers)	1*WH_m3	h
Presence of indigenous population; no risk	Local Community/Respect of indigenous rights	1*WH_m3	h
Human rights issues faced by indigenous people; not applicable	Local Community/Respect of indigenous rights	1*WH_m3	h
Minimum wage, per month; very high risk	Workers/Fair Salary	1*WH_m3	h
Living wage, per month; high risk	Workers/Fair Salary	1*WH_m3	h
Sector average wage, per month; very low risk	Workers/Fair Salary	1*WH_m3	h
Children in employment, total; no risk	Workers/Child labour	1*WH_m3	h

Screenshot from openLCA

Methodology: **Data quality**

- Data quality assessment is basically transferred from PSILCA original data
- regarding geographical and technical conformance assessment, mapping and data attribution procedures were considered

Forced Labour						
Goods produced by forced labour		No data	5.19122E-4			
Frequency of forced labour	1.5 [‰]	Very low risk	5.19122E-4	(2;4;3;3;2)		ILO 2012: Forced Labour
Trafficking in persons	1 [Tier]	Very low risk	5.19122E-4	(2;1;1;1;4)		U.S. Department of State 2014: Trafficking in Persons
Fair Salary						
Living wage, per month	883.913486 [USD]	High risk	5.19122E-4	(2;2;4;2;2)	Mean over differe...	WageIndicator 2014: Living wage
Minimum wage, per month	1400 [USD]	Very low risk	5.19122E-4	(2;3;1;1;2)	Data scope: count...	WageIndicator 2014: Minimum wage
Sector average wage, per month	6759.4144 [USD]	Very low risk	5.19122E-4	(2;2;2;1;2)	Risk level referrin...	ILOstat 2014

Screenshot from openLCA

Results and discussion

soca

- S-LCA add-on for ecoinvent v3.3 → LCSA database
- Complements environmental and cost data by social risk information:

Workers, Local communities, Value chain actors, Society

↓

17 sub-categories

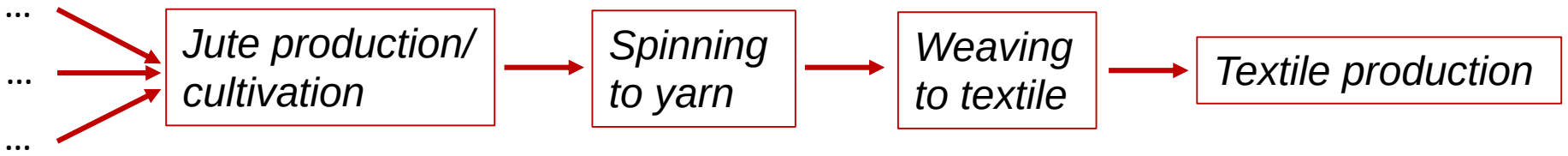
↓

53 indicators

- "Social aspects": raw values, data quality, sources…

Results and discussion: **Application**

- LCSA of 1kg woven textile fabrics of jute in India
- From cradle-to-gate:



- System model: *Allocation, cut-off by classification*

Dibyangshu Sarkar/AFP/Getty Images

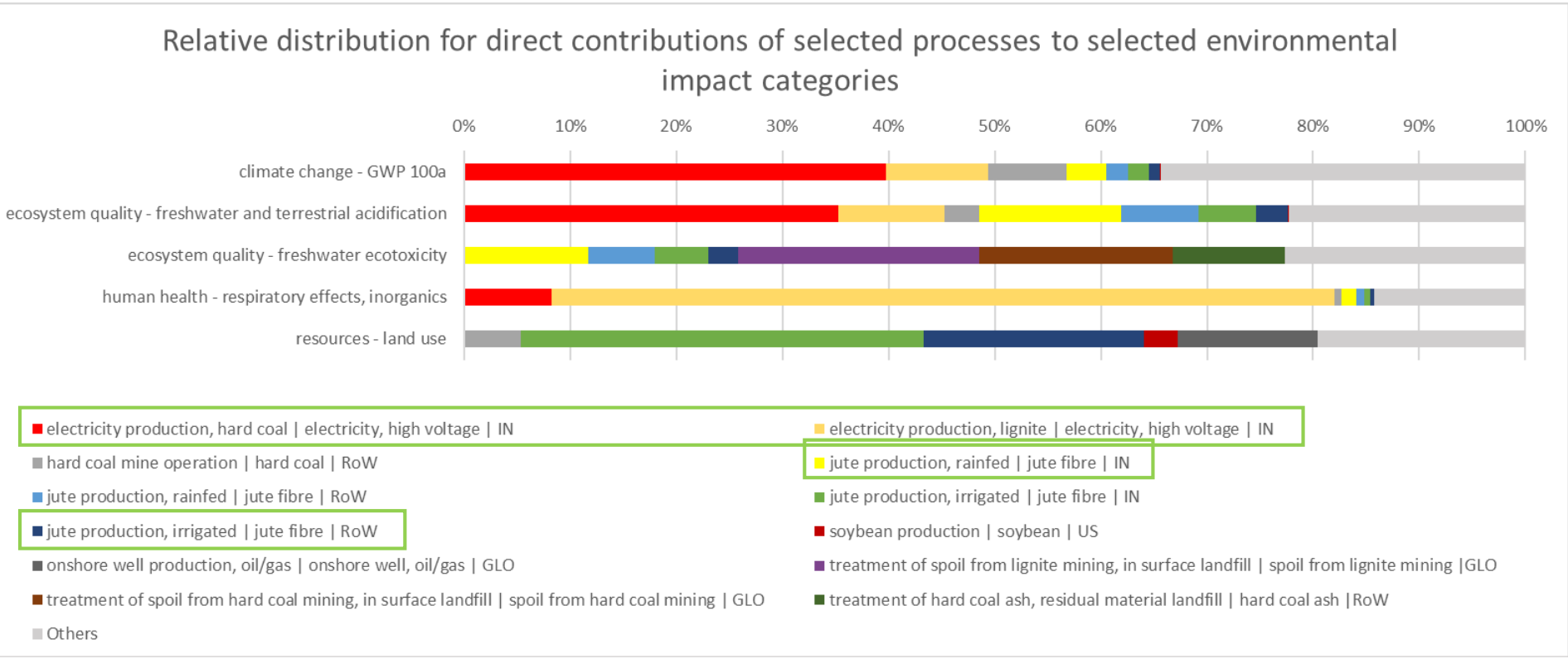
Results and discussion: **Application**

Impact Assessment:

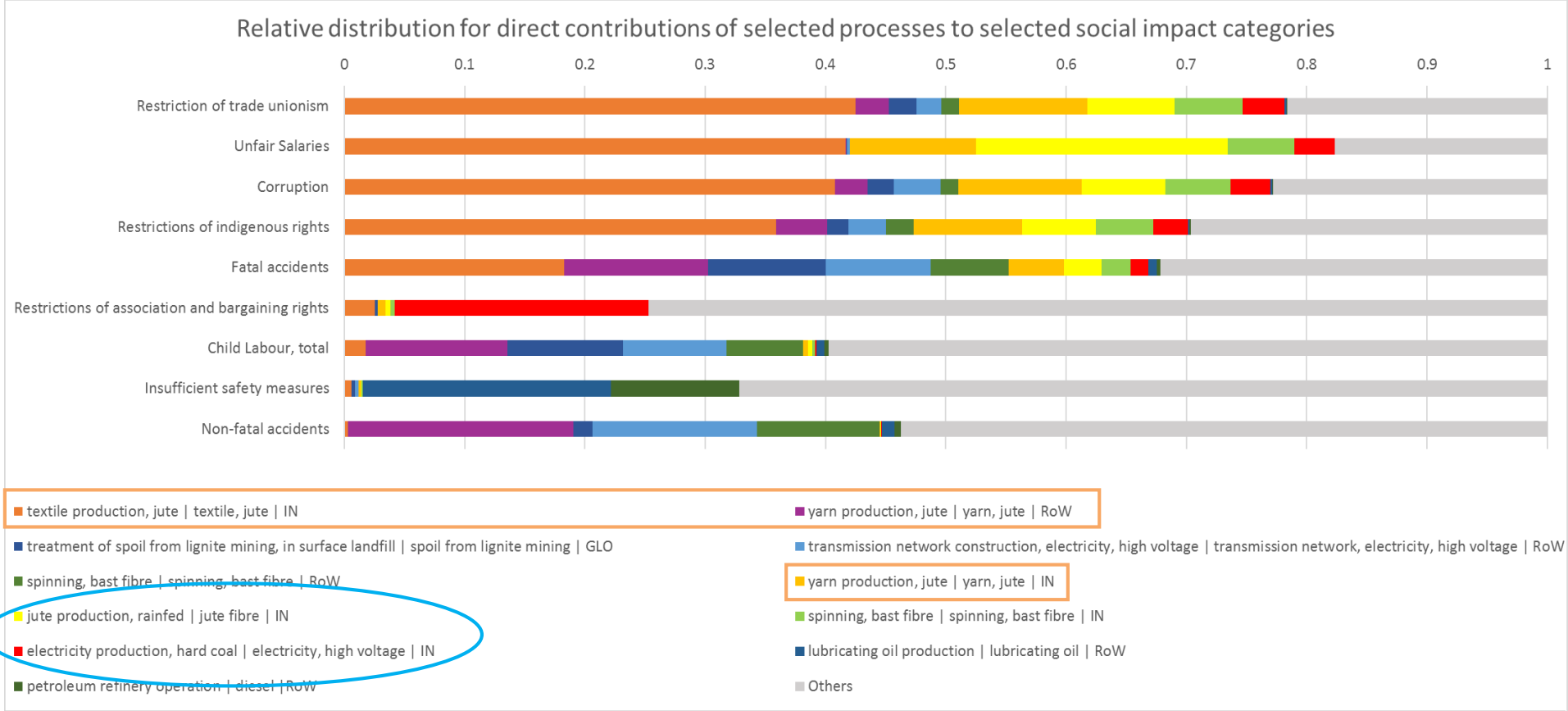
- ReCiPe Midpoint (H)
- Rudimentary method for social impacts (exponential relation between impact factors)
- Value added approach by Moreau and Weidema (2015)

Dibyangshu Sarkar/AFP/Getty Images

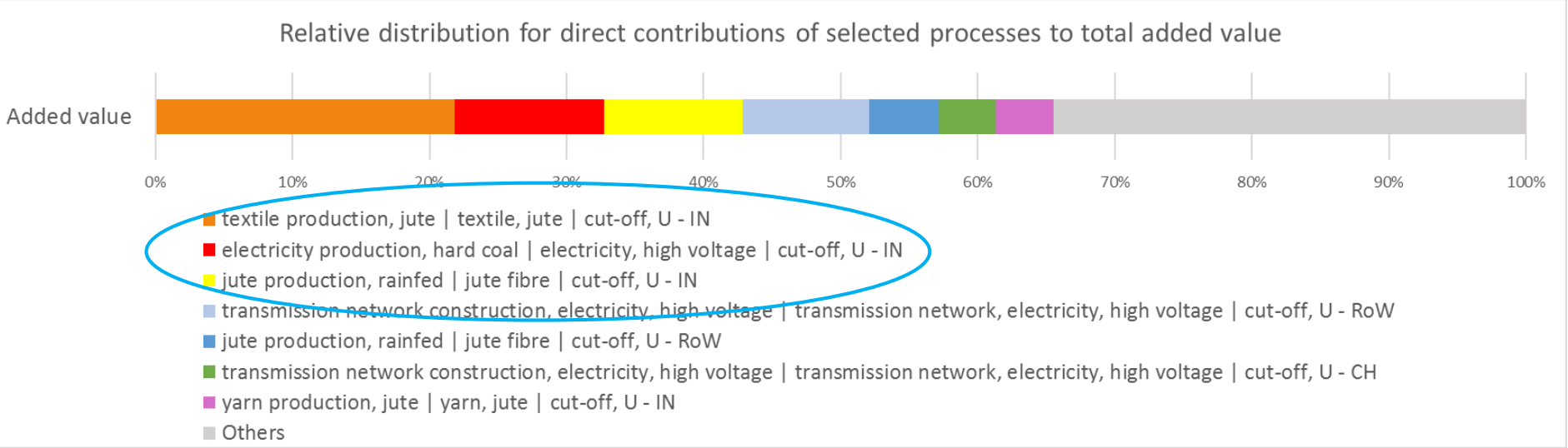
Results and discussion: **E-LCA**



Results and discussion: **S-LCA**



Results and discussion: **LCC**



Costs $¥ Added value

Contribution	Process	Amount	Unit
21.41%	textile production, jute | textile, jute | cut-off, U - IN	0.25549	USD
10.59%	electricity production, hard coal | electricity, high voltage | cut-off, U - IN	0.12639	USD
09.67%	jute production, rainfed | jute fibre | cut-off, U - IN	0.11541	USD
08.89%	transmission network construction, electricity, high voltage | transmission network, electricity, high voltage | cut-off, U - RoW	0.10613	USD
05.28%	jute production, rainfed | jute fibre | cut-off, U - RoW	0.06306	USD
04.42%	transmission network construction, electricity, high voltage | transmission network, electricity, high voltage | cut-off, U - CH	0.05274	USD
04.18%	yarn production, jute | yarn, jute | cut-off, U - IN	0.04992	USD
02.89%	jute production, irrigated | jute fibre | cut-off, U - IN	0.03452	USD

Results and discussion: **Analysis**

Reasons for different hotspots regarding sustainability aspects:

- Different absolute risks
- Different impact calculation approaches
  - LCC = sum of value added over LC (scaled to target amount)
  - EI = scaled (e.g. by mass) and characterized emissions over LC
  - SI = scaled (e.g. by mass and worker hours) and characterized social risks over LC
- Eco-efficiency hotspots may provide new insights

Conclusions: soca

Soca is first database allowing complete, comprehensive LCSA

+ automated, efficient calculation of social and environmental impacts and costs for several LC stages
+ three sustainability dimensions can be evaluated for the same product system simultaneously, and
+ independently of process connection types
+ clear visualizations and comparisons of results showing different environmental, social and cost hotspots

Conclusions: soca – next steps

- Mapping from input/output database to LCA database

→ Average social risks for all activities of same category

- Prices are global averages for many activities → not only distorts overall costs but also worker hours (hence social impacts)

- Environmental and social inventory data, and especially costs should be much more country- and process-specific

Conclusions: **SDG**

- Importance & necessity of LCSA emphasized in SDG
- Core feature of SDGs: strong focus on means of implementation, a.o. capacity-building and technology, as well as data and institutions
- Urgent action is needed to achieve most targets

→ soca = tool contributing to achievement of goals

- Promising advance for LCSA
- Starting point for further developments and studies in the field

Muchas gracias!

GreenDeLTa
sustainability consulting + software

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