GreenDelta

# SOCIAL LCA CASE STUDY

## Organic cotton sweater

openLCA Version: 2.0

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# Abbreviations

**D&R** Distribution and Retail

**E-LCA** Environmental LCA

**FWF** Fear Wear Foundation

**HS** Hooded Sweater

**LCI** Life Cycle Inventory

**S-LCA** Social LCA

# Introduction

Cotton is widely used for fabric for clothes, with over 20 million tons of cotton fibres produced every year worldwide (FAO, 2022). The most important producers of cotton are China, India and the United States. Even though the production of polyester dominates, cotton represents an important part of the market, estimated at 24% on 2020 (Textile Exchange, 2021). The production of conventional cotton has significant impacts on the environment, due to the large amounts of water and pesticides it requires. As most of consumers and manufacturers are becoming aware of those impacts, alternatives such as organic cotton are getting more and more popular. India is by far the most important producer of organic cotton, producing 50% of fibres worldwide, followed by China and Kirghizstan (Textile Exchange, 2021). The large volumes of cotton produced, and the low labour costs of the cotton garment sector makes India an attractive producing country for European retailers. However, these low prices often come at the expense of workers' conditions. Indeed, several social life cycle assessments report a decline of workers' wage over the past decades, repression against labour unions, discrimination against women (Almanza & Corona, 2020) as well as child labour, airborne and carcinogenic exposure (Roos, Zamani, Sandin, Peters, & Svanström, 2016). Noise pollution was also assessed as a significant risk to workers' health, causing fatigue and anxiety in addition to damaging the eardrum (Fibre2Fashion.com, 2007).

Social Life Cycle Assessment (S-LCA) is a holistic method used to quantify and analyse potential social impacts throughout the whole supply chain of products. This study assesses a hooded sweater (HS), produced in India and used in Germany, made with 100% organic cotton. An example of such garment is illustrated Figure 1.

*Figure 1: Organic cotton hooded sweater (source: https://en.zalando.de/)*

This case study complies with ISO 14040 (ISO, 2006), and thus consists of four major phases:

- Goal and Scope,
- Inventory Analysis,
- Impact Assessment,
- Interpretation and conclusions.

Moreover, the *Guidelines for social life cycle assessment of products* (Life Cycle Initiative, 2020) are followed to adapt to the specificities of S-LCA. The PSILCA database and documentation (Maister, Noi, Ciroth, & Srocka, 2020) are used for the openLCA model.

# I. Goal and Scope

## Goal

The goal of this study is to map the social impacts of the hooded sweater along its life cycle. This case is carried as an internal request from GreenDelta, to provide social LCA beginners with a methodology to carry an S-LCA using the PSILCA database.

In this study, the results cover the categories of the method Social Impacts Weighting Method from the PSILCA database (2020). The 55 impact indicators covered are listed in the annex A. This LCA focuses on the stakeholders Workers and Society. It also addresses the stakeholders Local community and Value chain actors to avoid burden shifting among different categories.

## Functional unit

The functional unit chosen for this study is "1 organic cotton 2XL hooded sweater, with a weight of 750g, used for 1 year". It is assumed that the product is worn twice a week and that it is washed once a week. The sweater is therefore washed 52 times in 1 year.

## System boundary

The product is assessed in a cradle-to-grave system, from the extraction of raw materials to the disposal of the used product. The extraction of raw materials and pre-processing consists of the production of the cotton fabric, the zipper, and polyester resin. This life cycle stage, as well as the manufacturing stage, takes place in India. The product is then exported and retailed in Berlin where it is used and disposed of. The system boundary of the system as well of the foreground processes are illustrated Figure 2.

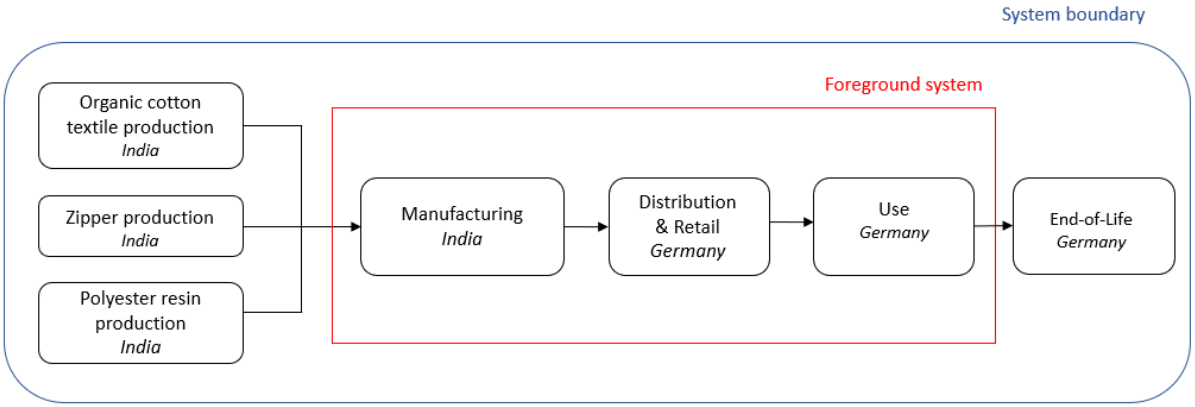



*Figure 2: System boundary of the system*

## Scenarios

Three scenarios are made for the Use phase, with a focus on the washing activity. The base case represents the users washing the product themselves. The direct social impacts regarding the stakeholder Workers are estimated to be inexistent. The second scenario "Laundry" represents the washing of clothes by a laundry service. Finally, the washing of clothes as a service at home is assessed, representing the activity of a housekeeper or a cleaner. This third scenario is referred as "Housekeeper" hereafter.

## Assumptions and limitations

The waste management services in India were approximated to transportation by truck. Indeed, the collection and transportation represent 90% of this activity (Sunil, et al., 2017). The market price of the intermediate product "Manufactured sweater" was estimated based on the values of several intermediate products from Almanza et al (2020) and the market price of the intermediate product "Distributed sweater". The values for child employment in India are rather old (2012). During the use phase, the clothes are assumed to be washed at 60°C and air dried. The washing machine is filled with 3.8 kg of clothes over the 6 kg capacity. The market price of a washing machine cycle is estimated from the prices of Laundromats in Berlin. The waste scenario is assumed to be incineration, which is the most representative treatment for German municipal waste (Ecoinvent 3.8). No recycling or reuse of the clothes was considered due to the complexity of the recycling processes and the lack of data. The market price for incineration was extrapolated from French average values for incineration of municipal waste (Les coûts de gestion des déchets ménagers explosent, 2012).

# II. Life cycle inventory

## a. Modelling the foreground system

This sub-section describes how to model a foreground system and link it with background data from the PSILCA database. This step allows (1) to create the structure of the life cycle stages and processes for the foreground system of the case study and (2) to link the inputs of foreground processes to background datasets from PSILCA.

### 1. Collecting inputs

**Methodology**

- *Finding data*. There are multiple ways to collect data for this step. Social and environmental studies found in the literature can provide life cycle inventories. E-LCA databases such as EcoInvent are also useful source of information for the background processes. The best case would be, of course, to have primary data for the foreground system.

- *Understanding the flow logic in s-LCA*. A significant difference with e-LCA is the nature of flows modelled as inputs or outputs. In social LCA, except the quantitative reference, the main output flows are the social indicators that characterize the process. Therefore, flows that are commonly modelled as outputs in e-LCA, such as waste flows, are often mapped to waste-related sectors from PSILCA and modelled as input services. However, waste can still be modelled as a "waste" flow, if the practitioner is able to model the associated waste treatment process, rather than taking a waste-related sector already available in PSILCA. Elementary flows can still be modelled as outputs or inputs but will have no influence on social LCA results. To track the mass balance or for documentation, it is possible to keep elementary flows in the social LCA model.

- *Adapting the distribution stage.* It can be difficult to assess the precise journey of a product, and which country bears the responsibility for it. Theoretically, the country responsible for the transport is the country that owns the means of transport. In practice the person carrying the study should try to find most representative journey based on the sectors and data available from PSILCA.

All the inputs for this case are taken from the E-LCA of this product realized previously (Loubert & Noi, 2022) The associated model graph from the previous environmental assessment is shown in Figure 3. All the waste flows from the former model are here considered as product flows in the inputs, modelled as waste management services. The modelling of transport was modified from the environmental model to fit the transport sectors available in the PSILCA database. The distribution from India to Berlin is therefore modelled as a road transport from the manufacturing site to Chennai, followed by the shipping from India to Germany, and finally the retailing of the sweater in Germany.

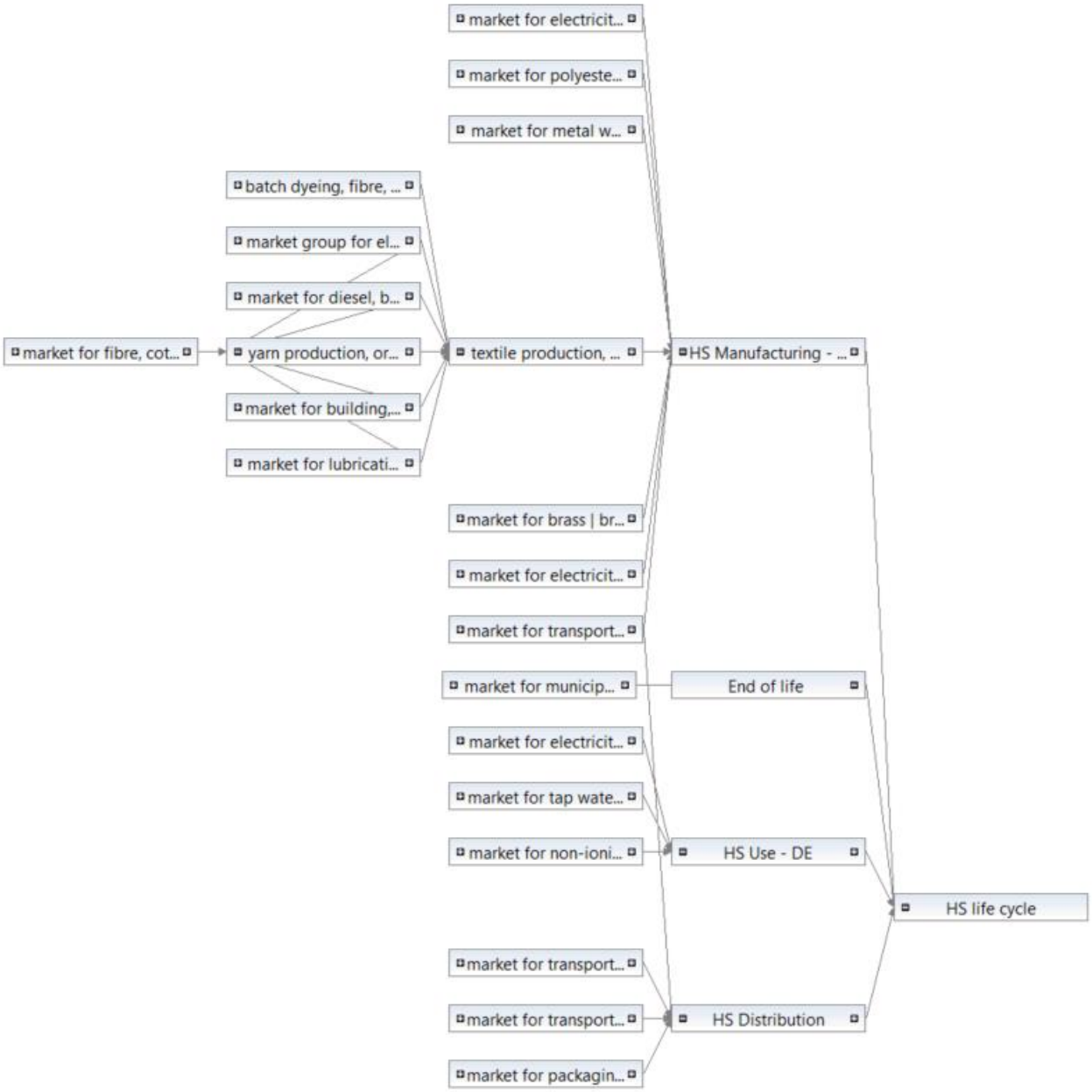



*Figure 3: Model graph of the life cycle of the hooded sweater*

## 2. Defining the PSILCA sector representing process inputs

Each item must be associated to a representative sector in order to link the model to the generic data available in PSILCA. The complete list of inputs for this product, along with associated PSILCA sectors, is given in the annex B.

Brass is approximated to be part of the sector Copper ore-IN, as copper is the main component of the zipper. The production of cotton fibre belongs to the sector Cotton- IN while the production of cotton thread and cotton knitted fabric belongs to Cotton textiles-IN.

The lack of information about the Indian waste management system, as well as its absence in the PSILCA database, required some adaptations for the model. Even though there are some waste management companies in India, waste collection is mostly driven by the informal sector, with thousands of waste pickers extracting value from household or industrial waste as their mains source of income (Sunil, et al., 2017). Since 90% of the costs of waste management come from the collection and transport of waste, this service was modelled as road transport, using the PSILCA sector "Other transport" in India. The health and social issues resulting from the lack of specific infrastructures are poorly accounted for by the proxy sector Other transport-IN, which is a limit to the modelling. However, since the health risks from collecting organic cotton waste fabric are low, as well as the economic value of the input in the model, the results are not expected to be significantly impacted.

The transportation from Odisha to Chennai is modelled with the sector Other transport- IN as no sector is available for road transport specifically.

- *Understanding the classification of sectors.* PSILCA follows the economic sectoral classification in place in each country. The most common statistical classifications of economic activities are given by NACE documentation for Europe, NAICS for North America, and ISIC for the world.
- *Choosing between the PSILCA sectors "Industries" or "Commodities".* Commodity represents the average for the provision of the good from different industries, similarly to the processes "market for…" in EcoInvent. It is preferable to take that option for product LCAs. Industry represents the whole industry sector, which can provide more than one commodity. For instance, the industry "Mining of metal ores" can produce metal ores, steam, and other by-products.
- *Modelling the End of life stage.* The waste sector is modelled in only a limited number of countries in PSILCA. There is no straightforward way to handle this limitation, however, several alternatives can be explored: finding a broader sector that includes waste management, using another sector as a proxy if relevant (e.g. the transport sector, in case collection of waste represents a large part of the activity), or using the waste management industry from a neighboring country.
- *Handling the absence of a sector in the database.* Similarly to the modelling of end of life, it is part of the researcher's choices and assumptions to choose a proxy which is the most representative as possible for the missing sector.

### 3. Quantifying process inputs with market prices

As this is a fictious case, no LCC or similar value-evaluating data were provided by the client. Market values were therefore assessed from retailing or services websites, completed by data found in the literature.

### *Manufacturing*

Values representative of the market were mostly taken from Indiamart and Alibaba for the Indian inputs. The price of the manufactured sweater was estimated from the LCA of a cotton t-shirt (Almanza et al. 2020) weighted by the price of the retailed product. Weighting the market price with the relative weight of the sweater was not as relevant as the t-shirt does not include the same nature of cotton (organic or conventional) nor the same portions. The market price of "Manufactured sweater" was therefore weighted with the market prices of the retailed products, according to the formula below.

$$Price_{manufactured\_sweater} = Price_{manufactured\_Almanza} * Price_{distributed\_sweater} / Price_{distributed\_Amanza}$$

$$= 5.72\ USD2020 * 40\ USD2022 / 30\ USD2020$$

$$= 7.6267\ USD2022$$

### *Distribution and retail (D&R)*

The market price of the retailed sweater was estimated from a German garment retailer (Lotuscrafts, 2022), since this study does not evaluate the product of a specific retailer.

### *Use phase*

A price assumption of 4 euros for a cycle of a 6 kg is made based on the price of Laundromats in Berlin.

### *End of life*

No recycling is considered for this study due to the complexity of this path and the lack of data to model it. The whole sweater is assumed to be treated as municipal waste. French prices for the incineration of waste are used as a proxy.

The complete life cycle inventory can be found in the annex B. The exchange rates used at the time of the study are the following: 1 Indian rupee= 0.012 $2022; 1 €2022=0.96 $2022; 1 $2015= 1.25 $2022; 1 $2019= 1.16 $2022; 1 $2020= 1.14 $2022.

- *Finding the market price.* LCC may be provided by involved companies. Information can alternatively be found in the literature, on large retailers' website (e.g. Amazon), or prices found on the market for services. As prices can be found in a large range, it is recommended to use an average value of the market, validated by the commissioner of the study if feasible, and document the reference year and exchange rate.

- *Handling double counting.* It might be relevant in some cases to subtract the values of raw materials or intermediate product from downstream processes. This is specific to each study.

- *Converting to USD2015.* The economic flow properties are United States Dollars, which mean every input must be converted in this currency to be implemented in the model. As the reference year of PSILCA v.3 is 2015, it is also required to take into account the variation of currency since 2015.

- *Managing data.* The template below offers an example of how data can be collected. The market price of the quantitative reference is not required when entering it in the model, however it will be used to calculate the worker hours in the second part of the life cycle inventory.

| Process | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Input/Output** | **Item** | **Country** | **PSILCA sector** | **Amount** | **Unit** | **Market price** | **Unit** | **Source** | **Output price ($2022)** | **Output price ($2015)** |
| In | | | | | | | | | | |
| In | | | | | | | | | | |
| ... | | | | | | | | | | |
| Quantitative ref. | | | | | | | | | | |
| | | | | | | | | | | |
| **Social outputs** | **Item** | **Country** | **Data source** | **Raw value** | **Unit** | **Risk level** | **Unit labour cost** | **Mean hourly wage** | **Source (PSILCA sector)** | **Worker hours (h)** |
| | | | | | | | | | | |
| | | | | | | | | | | |

## b. Adding social indicators to the foreground system

The foreground system is here investigated to understand and evaluate site-specific social challenges. More precisely, relevant social indicators are selected, and their associated risk level are quantified for each process of the foreground system. The selection of social indicators is based on the goal and scope of the LCA. In this study a special attention is given to the indicators regarding workers and society. However, to identify social hotspots and avoid burden shifting, the indicators regarding local community and value chain actors are also covered. As shown in the LCI in the annex B, the social outputs collected fall into two groups: specific data when it could be found, completed with indicators from representative PSILCA sectors to fill data gaps.

### 1. Organizing the collection of raw values

This sub section focuses on the collection of raw values of social indicators. A screening of impacts in the life cycle can be useful to orient data collection. In this case study, a screening is first carried by looking at the most intensive activities in the supply chain (i.e. the PSILCA sectors that are inputs in the foreground model and that show higher market prices). These findings need to be combined to sector literature review. This allows to prioritize data collection.

The most intensive activities over the life cycle are the inputs from Cotton textile-IN and Shipping-DE. The indicators set to "High risk" and "Very high risk" are identified from the Social aspects tab of the relevant sectors in openLCA. For instance, based on the Figure 4, the indicators *Children in employment, male*, *Trade union density* and *Weekly hours per employees* can be spotted for the sector Cotton textiles-IN. The indicators *Social security expenditures, Extraction of biomass* and *Public sector corruption* are also spotted, as well as almost every indicator contributing to the categories *Safe and healthy living condition*, *Health and safety*, and *Contribution to economic development*.

| Name | Raw value | Risk level | Activity variable | Data quality |
|---|---|---|---|---|
| Workers | | | | |
| Discrimination | | | | |
| Fair Salary | | | | |
| Child labour | | | | |
| Children in employment, male | 82.6 [% of male children a... | Very high risk | 0.193436640511462 [h, wo... | (1;2;4;1;5) |
| Children in employment, female | 1.6 [% of female children ... | Very low risk | 0.193436640511462 [h, wo... | (1;1;4;1;5) |
| Children in employment, total | 1.7 [% of all children ages ... | Very low risk | 0.193436640511462 [h, wo... | (1;2;4;2;5) |
| Health and Safety | | | | |
| Freedom of association and collective bargaining | | | | |
| Trade union density | 19.57 [%] | Very high risk | 0.193436640511462 [h, wo... | (1;1;2;3;5) |
| Right of Association | 3 [4 point scale] | No risk | 0.193436640511462 [h, wo... | (1;1;3;1;5) |
| Right to Strike | 2 [4 point scale] | Low risk | 0.193436640511462 [h, wo... | (1;1;3;1;1) |
| Right of Collective bargaining | 3 [4 point scale] | No risk | 0.193436640511462 [h, wo... | (1;1;3;1;1) |
| Working time | | | | |
| Weekly hours of work per employee | 22.1 [h] | High risk | 0.193436640511462 [h, wo... | (1;2;1;3;3) |

*Figure 4: Social indicators extracted from the Social aspects tab of the PSILCA sector Cotton textiles-IN*

For the shipping sector in Germany, the following social indicators showed high potential risks: *Living wage, Gender wage gap, Presence of sufficient safety measures, Trade union density, Extraction of biomass, Level of industrial water (related to renewable resources), Certified environmental management systems, International migrant stock, Immigration rate,* and *Embodied CO2 footprint.*

Country-level raw values were retrieved from global databases such as The World Bank Data, the OECD database, the Global Peace Index, ILAB, the Global Slavery Index, and ILOSTAT. Sector-related data for manufacturing were collected from a Fair Wear Foundation (FWF) report (India Country Study, 2019), and an International Labour Organization (ILO) case study about the garment sector in India (Insights into working conditions in India's garment industry, 2015). Remaining data gaps were filled with data from proxy sectors, chosen accordingly to the NACE documentation: Cotton textiles-IN for Manufacturing, Wholesale trade-DE for D&R, Other services-DE for laundry services (Use Scenario 2), and Services for private households-DE for housekeeper services (Use Scenario 3).

No primary data was found for the End-of-Life stage. It was thus modelled with the input commodity Waste disposal and sewerage service-DE which contains generic indicators for this sector.

- *Prioritizing data collection.* As the inventory part can quickly become overwhelming, it is necessary to prioritize where to investigate. A first screening of the potential impacts can be made with a hotspot analysis of involved PSILCA sectors. Key social issues spotted in the literature, as well as the most active or intensive activities in term of activity variable, can also help to guide the research.

- *Finding data.* Site-specific data collection should be prioritized if possible. If not, or in order to cross check the primary data, open source database provided by the following organizations can be investigated: Fair Wage Database, OECD, ILO, and World Bank Group. Input-Output databases such as EORA and EXIOBASE can also contain data fitting to the scope of the study.

- *Limits of the activity variable modelling.* The activity variable logic not necessarily reflects the importance of the impact, as a small input can be part of a wider social issue. Moreover, qualitative data, or quantitative data that do not fit any of the existing indicators, cannot be implemented. This information should be stated in the report and used for the interpretation even though it is not included in the calculated impacts.

- *Dealing with unpaid services.* Such services are not included in the worker hours, albeit a potentially significant issue. This can for instance contribute to forced labor, as there can be constraints to work for free, using blackmail or other kind of pressure. Therefore, the integration of unpaid services is possible but very specific to each case.

## 2. Evaluating the risk of social indicators

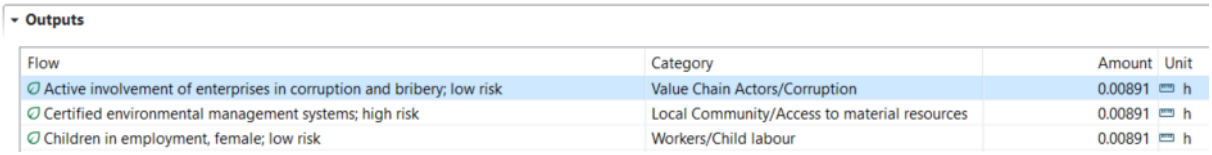
The raw value of each indicator found is attributed to a corresponding risk evaluation. For this study only already existing indicators from PSILCA were used. The risk levels are defined for the selected social indicators according to the descriptions of indicators provided in the PSILCA documentation (Maister, Noi, Ciroth, & Srocka, 2020). For instance, the FWF (2019) mentioned previously reports that the trade union density in the garment manufactures in India is inferior to 5%. According to the risk levels for this social indicator, illustrated in Figure 5, the indicator *Trade union density* is attributed to "Very high risk" for the process Manufacturing. Likewise, the raw values collected previously are attributed to a risk level and implemented in the social outputs of each process.

| *Indicator value y, %* | *Risk level* |
|---|---|
| $20 \geqslant y$ | *very high risk* |
| $20 < y \leqslant 40$ | *high risk* |
| $40 < y \leqslant 60$ | *medium risk* |
| $60 < y \leqslant 80$ | *low risk* |
| $80 < y$ | *very low risk* |

*Figure 5: Risk levels of the social indicator Trade union density, as defined in the PSILCA documentation*

The risk levels are already defined for proxy data from a representative sector. The social outputs are added to the process identically to the PSILCA sectors selected previously. Figure 6 illustrates some social outputs of the sector Wholesaletrade-DE, which is the proxy sector chosen for D&R.

As these social indicators are missing in the primary data collection they are added to the D&R process, with worker hours adapted to this case study (see 3. Defining the activity variable).



Outputs

| Flow | Category | Amount | Unit |
|---|---|---|---|
| Active involvement of enterprises in corruption and bribery; low risk | Value Chain Actors/Corruption | 0.00891 | h |
| Certified environmental management systems; high risk | Local Community/Access to material resources | 0.00891 | h |
| Children in employment, female; low risk | Workers/Child labour | 0.00891 | h |

*Figure 6: Partial list of outputs of the sector Wholesale trade-DE from the PSILCA database*

It is assumed that there is no risk for the users to wear or wash the sweater. Assuming that a hazardous chemical in the composition would have impacts on the consumer's health, a new indicator could be created in PSILCA as the current version does not include the stakeholder consumer. Moreover, as stated previously, the process End-of-Life does not have social outputs due to lack of data.

- *Understanding the risk levels of existing indicators.* Most of the indicators include a description and an evaluation schema. In case of doubt, or if some information is missing, the documentation of the PSILCA database gives a comprehensive description of every indicator along with an explanation of the risk scale associated.

- *Creating new indicators.* It can be relevant to create a new indicator specific to the study. The *Guidelines for Social Life Cycle Assessment of Products and Organizations* (Life Cycle Initiative, 2020) give recommendations for the creation of reference scales in the *Impact Assessment* section of the document.

## 3. Defining the activity variable

The activity variable used for this case is worker hours, defined by the following formula:

$$\textit{Worker hours} = \frac{\textit{Unit labour costs}}{\textit{Mean hourly labour cost (per employee)}} * \text{Price of product}$$

Worker hours per $ output

Workers hours are expressed in h, unit labour costs in USD/USD, mean hourly labour cost in USD/h and the price of the product in USD. More details can be found about the different terms of the formula in the PSILCA manual (Maister, Noi, Ciroth, & Srocka, 2020) and the S-LCA Guidelines (Life Cycle Initiative, 2020).

As no site-specific data were available for this case study, the worker hours were approximated with values from the literature. Regarding manufacturing, unit labour costs are estimated to be 3% of the intermediate product market price (Clean Clothes Campaign, 2022). The mean hourly labour cost was estimated from the average wage of workers in the garment sector in India (International Labour Organization, 2015). The worker hours of this process thus follow the formula:

$$\text{Worker hours}_{\text{Manufacturing}} = \text{Unit labour costs / Mean hourly labour cost} * \text{Price}$$
$$= \text{Unit labour costs} * (\text{Weekly hours} * \text{Number of weeks per month / Average wage of workers}) * \text{Price}$$
$$= 0.03 * (49.8\ \text{h} * 4.5 / 65.76\ \text{USD 2015}) * 6.1013\ \text{USD2015}$$
$$= 0.6238\ \text{h}$$

For the other processes, worker hours were calculated from the Worker hours per dollar of output of representative PSILCA sectors defined previously. For instance, the worker hours for Distribution and retail were calculated as described in the following formula:

$$\text{Worker hours}_{\text{D\&R}} = \text{Worker hours per \$ output}_{\text{Wholesaletrade-DE}} * \text{Market price}_{\text{Distributed\_HS}}$$
$$= 0.00891\ \text{h/USD 2015} * 30.72\ \text{USD 2015}$$
$$= 0.2737\ \text{h}$$

- *Defining the Unit labour costs and Meanly hour wage.* These values are generally given by the companies involved directly. If not, they have to be looked for in the literature.
- *Using Worker hours per dollar of output.* The PSILCA Database provides the worker hours associated to the activity of a given sector, in the *Amount* column of outputs. Processes are generally calibrated on one dollar of activity. The worker hours can be obtained by multiplying this result by the market price of the quantitative reference (in $2015).

# III. Life Cycle Impact assessment and Interpretation

The entire life cycle of the sweater is calculated in openLCA using the Social Impacts Weighting Method available in PSILCA.

## Hotspot analysis

*Table 1: Impact results for one cotton hooded sweater of 750g, for one year, in the case of an internal use*

| Name | Impact assessment result | Unit |
|---|---|---|
| Active involvement of enterprises in corruption and bribery | 7.31051 | AI med risk hours |
| Anti-competitive behaviour or violation of anti-trust and monopoly legislation | 29.71216 | AC med risk hours |
| Association and bargaining rights | 9.15707 | ACB med risk hours |
| Biomass consumption | 587.69117 | BM med risk hours |
| Certified environmental management system | 6.75771 | CMS med risk hours |
| Child Labour, female | 3.25884 | CL med risk hours |
| Child Labour, male | 463.59903 | CL med risk hours |
| Child Labour, total | 2.54899 | CL med risk hours |
| Contribution of the sector to economic development | 10.11386 | CE med risk hours |
| DALYs due to indoor and outdoor air and water pollution | 5.53732 | DALY med risk hours |
| Drinking water coverage | 525.47546 | DW med risk hours |
| Embodied agricultural area footprints | 0.50229 | EAF med risk hours |
| Embodied biodiversity footprints | 2.31943 | EBF med risk hours |
| Embodied forest area footprints | 0.2711 | EFA med risk hours |
| Embodied water footprints | 2.19908 | EWF med risk hours |
| Expenditures on education | 13.70427 | EE med risk hours |
| Fair Salary | 278.53791 | FS med risk hours |
| Fatal accidents | 0.49448 | FA med risk hours |
| Fossil fuel consumption | 0.09175 | FF med risk hours |
| Frequency of forced labour | 62.86115 | FL med risk hours |
| Gender wage gap | 66.72681 | GW med risk hours |
| GHG Footprints | 24.97052 | GHGF med risk hours |
| Goods produced by forced labour | 2.294 | GFL med risk hours |
| Health expenditure | 261.83303 | HE med risk hours |
| Illiteracy, female | 523.42325 | I med risk hours |
| Illiteracy, male | 522.4058 | I med risk hours |
| Illiteracy, total | 522.51906 | I med risk hours |
| Indigenous rights | 6.43059 | IR med risk hours |
| Industrial water depletion | 46.77229 | WU med risk hours |
| International migrant stock | 6.49353 | IMS med risk hours |
| International migrant workers (in the sector/ site) | 1.24952 | IMW med risk hours |
| Life expectancy at birth | 6.19282 | LE med risk hours |
| Men in the sectoral labour force | 0.081 | M med risk hours |
| Migration flows | 86.86577 | MF med risk hours |
| Minerals consumption | 3.09747 | MC med risk hours |
| Net migration | 0.10019 | NM med risk hours |
| Non-fatal accidents | 2.31341 | NFA med risk hours |
| Pollution | 61.30889 | P med risk hours |
| Promoting social responsibilty | 83.24297 | PSR med risk hours |
| Public sector corruption | 539.5785 | C med risk hours |
| Risk of conflicts | 56.16373 | ROC med risk hours |

| | | |
|---|---|---|
| Safety measures | 6.3122 | SM med risk hours |
| Sanitation coverage | 55.61668 | SC med risk hours |
| Social security expenditures | 524.56599 | SS med risk hours |
| Trade unionism | 572.03049 | TU med risk hours |
| Trafficking in persons | 15.80413 | TP med risk hours |
| Unemployment | 1.13392 | U med risk hours |
| Value added (total) | 329.90235 | VAT med risk hours |
| Violations of employment laws and regulations | 16.00174 | VL med risk hours |
| Weekly hours of work per employee | 109.25678 | WH med risk hours |
| Women in the sectoral labour force | 20.12978 | W med risk hours |
| Workers affected by natural disasters | 2.38181 | ND med risk hours |
| Youth illiteracy, female | 53.33254 | YI med risk hours |
| Youth illiteracy, male | 52.72115 | YI med risk hours |
| Youth illiteracy, total | 52.74783 | YI med risk hours |

Some additional information regarding the manufacturing stage could not be included in the quantitative assessment. For example, the loud ambient noise in the garment manufactures and the risks of building collapsing are not included in the model. At the scale of the worker, poor ergonomic conditions can result in musculoskeletal disorders (fibre2Fabric). Moreover, pressure to do overtime, bad treatments such as beating and harassment including sexual harassment towards women were declared by workers in surveys carried by ILO (International Labour Organization, 2015). These additional risks could potentially increase the impact in categories such as Violations of employment laws and regulations, Frequency of force labour (considering that overtime is done under pressure and/or blackmail from the manager), DALYs due to indoor and outdoor air, Non-fatal accidents, or Safety measures.

Figure 4 illustrates the contribution of life cycle stages to the overall results. The impacts are mainly divided between Manufacturing, D&R and the use phase. The end of life has few inputs, which is the reason why it contributes so little to the impacts. The impacts from Manufacturing predominate for most categories regarding the stakeholder Society. It can be explained by high illiteracy rates in India as well as low public expenditures on education and health. Likewise, the position in India in the Global Peace Index (Institute for Economics and Peace, 2022) results in this stage representing more than 90% of the category *Risk of conflicts*. Manufacturing also weighs a lot in the impact categories regarding the stakeholder Workers. Indeed, the social expenditures of the Indian government are very low and forced labour has been reported in the India garment sector, backed up by the list of goods produced by child of forced labour (ILAB, 2022). The high share in the indicator *Weekly hours of work* is due to systematic overtime in the cotton textile factories. The most contributing process of Manufacturing is Cotton textiles-IN. A large part of the impacts of this sector comes from the sector Manufacture of leather and leather products-IN, one of the most important inputs of Cotton textile-IN in terms of amounts. The direct impacts of Manufacturing share a significant part of the burdens as well.

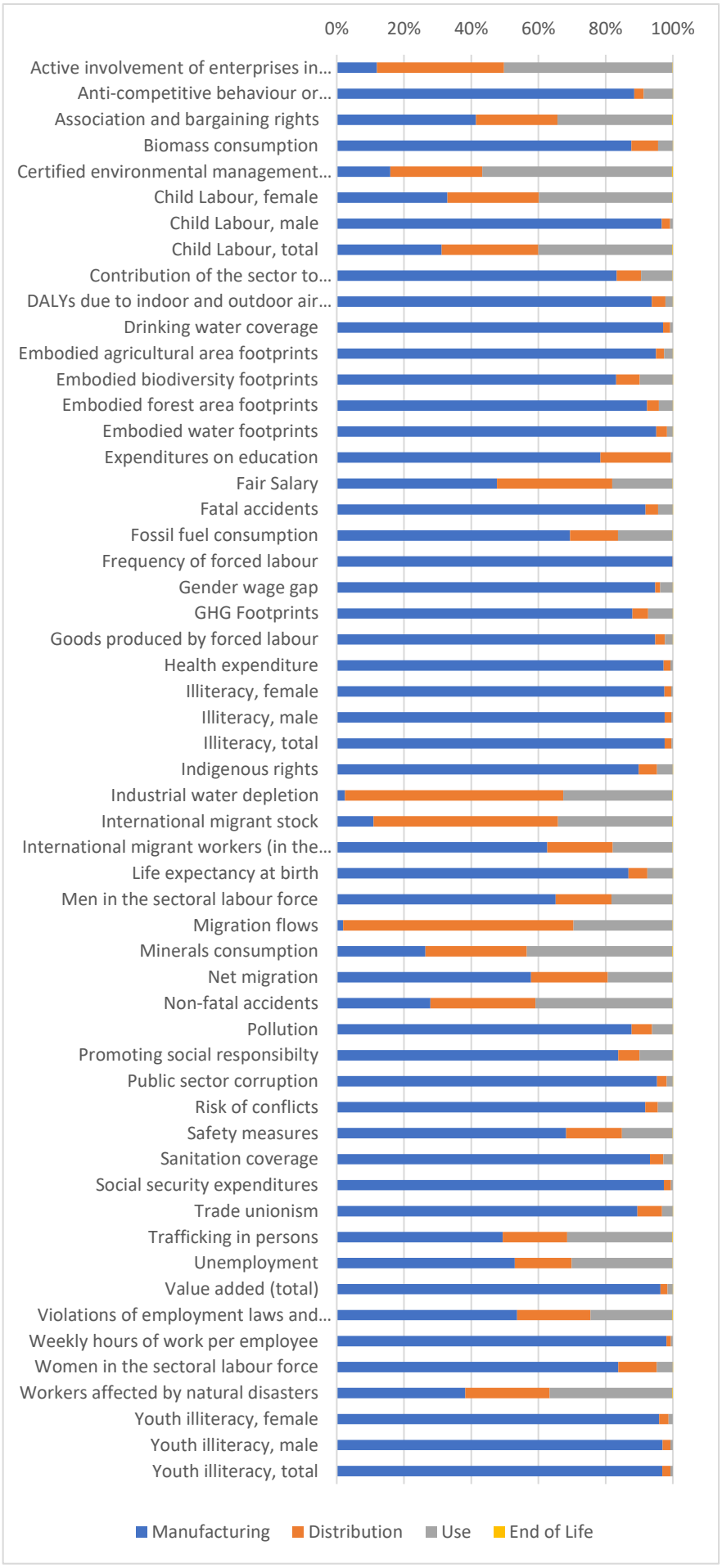



*Figure 7: Contribution of life cycle stages over the whole life cycle of the sweater*

Finally, the input "Copper ore" punctually shares a significant part of the impacts, for the categories *Violation of employment laws and regulations* and *Goods produced by forced labour* for instance.

D&R contributes to the total impacts as well. The direct impacts of this process influence the category *Expenditures on education* due to the low budget for education in Germany (4.9 % of GDP in 2018 according to the World Bank database). They also contribute significantly to the impact categories *Fair Salary, Industrial water depletion, International Migrant Stock* and *Migration flows*. Apart from these categories, most of the impacts of this stage do not come from the direct impacts but from the input "Shipping".

The contribution of the use stage to the impacts are only due to the supply chain, as the base case does not include any social outputs. The sector Electricity and district heat-DE is responsible for most of the impacts of this stage, due to the electricity consumption of the washing machine. Manufacture of chemical products-DE is the second most contributing input, due to the use of non-ionic surfactant.

A more detailed analysis and interpretation is given to the impact categories *Fair salary, Gender wage gap, Trade unionism* and *Value-added* hereafter. These categories were selected based on the primary data available and the potential risks screened in the literature. Although all life cycle stages are considered, End of life does not appear in the process contribution graphs due to rounding, as its contribution does not exceed 0.2% of the total impacts.

### Fair salary

This impact category takes into account the subindicators *Living wage, per month*, *Minimum wage, per month* and *Sector average wage, per month*. In the PSILCA documentation (2020), fair salary corresponds to "a wage fairly and reasonably commensurate with the value of a particular service or class of service rendered, and, in establishing a minimum fair wage for such service or class of service".

The contribution of processes to this category is illustrated Figure 5. Almost half of the impacts comes from the garment manufactures. This is due to the low wages reported in this sector, notably as they are lower than the living wage. Some regions in India have a legal minimum wage, such as Maharashtra, which is lower than the living wage lower bond reported by FWF. Moreover, some regions do not have a legal minimum wage, such as Odisha which is one of the regions producing a large part of Indian cotton garments. The direct impacts of the D&R stage represent a significant part of the total impacts as well, despite reasonably high salaries when comparing to the living wage. The risk comes from the living wage in itself which is rather high. It is also the case of the sector of electricity in the use stage, which shares the same social aspects as it is based in Germany.

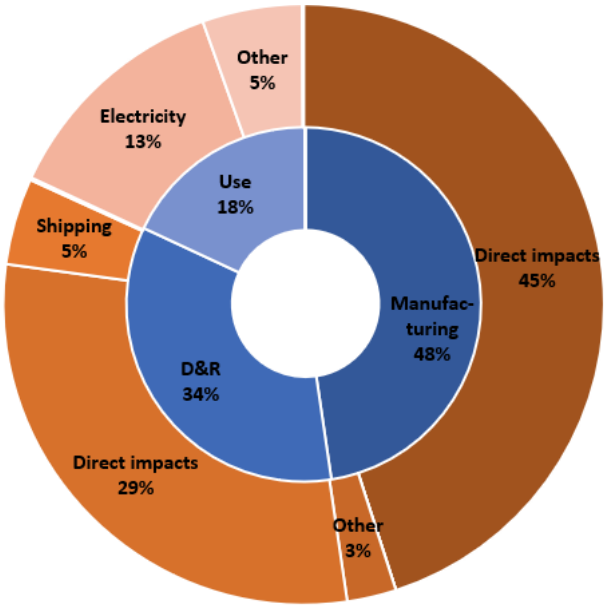



*Figure 8: Process contribution to the impact category Fair salary*

## Gender wage gap

This impact category follows the definition of gender wage gap as the "difference between median earnings of men and women relative to median earnings of men, referring to full-time employees" (2020).

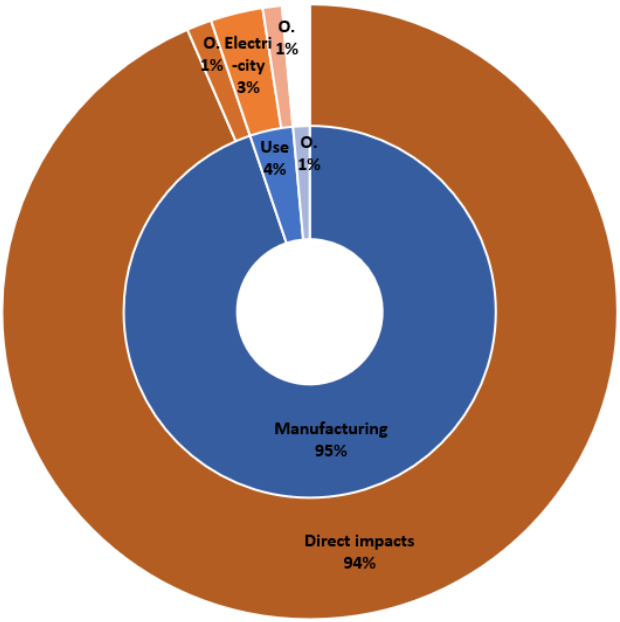



*Figure 9: Process contribution to the impact category Gender wage gap. O.=Other*

The contribution of processes to this category is illustrated Figure 6. Almost all impacts come from the garment manufacturing site. Indeed, FWF reports a very high gender gap (39%). Inequalities in the access to education and the workplace results in the segregation of women to unskilled activities such as basic agriculture, elementary services and handicraft

manufacturing according to the same report. Moreover, managerial positions are predominantly given to men, which explains the high gender wage gap in the garment sector.

### Trade unionism

This impact category represents the indicator *Trade union density*. The latter assesses how liberal and vivid trade union culture is, and to what degree the right to organize freely is assured in different sectors (2020).

The contribution of processes to this category is illustrated Figure 7. There is a very low trade union density in Indian garment manufactures (less than 5%) which explains its high contribution to the issue. This density is higher for Cotton textiles-IN and Manufacturing of metal products-IN (19.57% for both), as well as for D&R in Germany (19.3%), compared to garment manufactures. All these sectors are evaluated as "Very high risk" as their raw value is below 20% (see Figure 5). Therefore, their characterisation factor only depends on the working hours associated, which explain the predominance of Cotton textiles-IN over Manufacturing of metal products-IN and the direct impact of Manufacturing. More than half of the impacts of Cotton textiles-IN comes from sector of leather products, which is a significant input in terms of value, followed by the direct impacts of the sector itself.

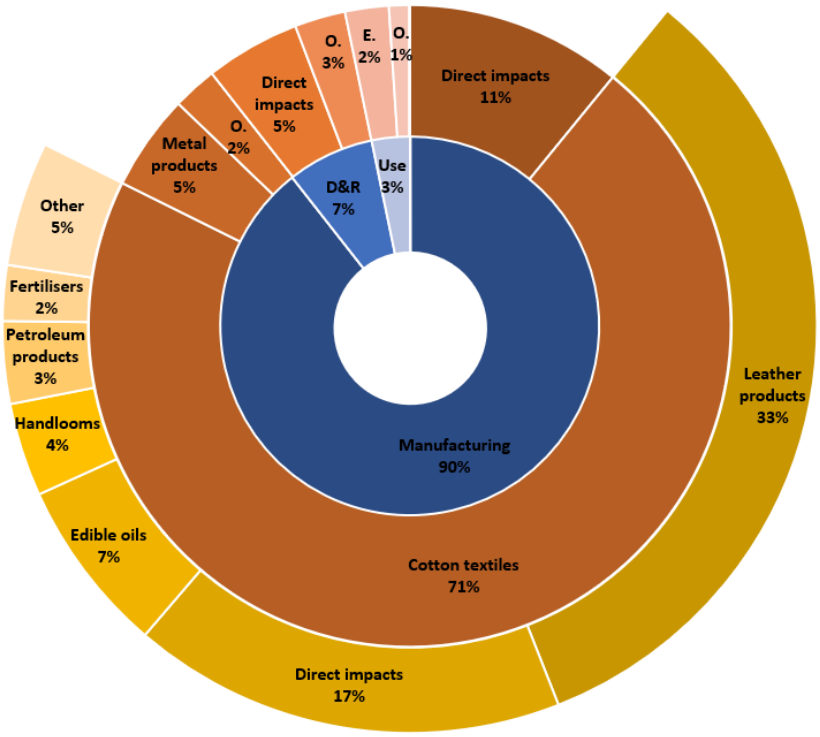



*Figure 10: Process contribution to the impact category Trade unionism. O.=Other, E.=Electricity*

## Value added

This impact category represents the indicator *Embodied value-added total*. It reflects the average value of the difference between the sale price and the production cost in relation to 1 dollar of the output product within various sectors.

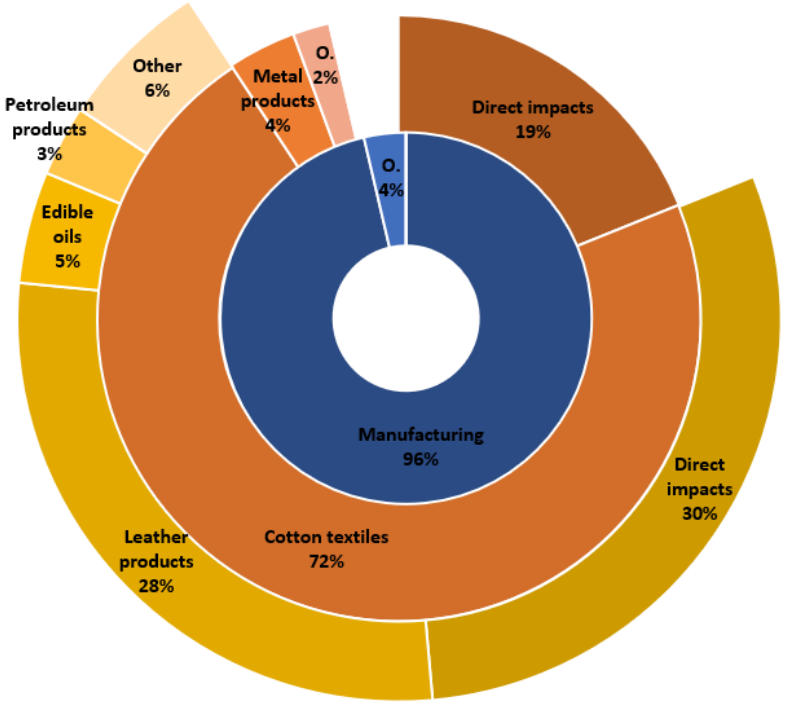



*Figure 11: Process contribution to the impact category Value added. O.=Other*

The contribution of processes to this category is illustrated in the Figure 11. The value added is very low in India in the sectors of production of cotton, cotton textiles and cotton garments. It notably explains the attractive price for European retailers. This low added value is partly made possible by the low labour costs, that reflect on the low wage of the workers.

## Scenarios of use

Two scenarios were assessed regarding the use of the sweater: the washing by a laundry as a service, and the washing at home by a housekeeper. The results are reported Table 2. The detailed relative results are reported in the annex C.

*Table 2:* Impact results of the life cycle of the hooded sweater for three scenarios of use: internal, laundry and housekeeper

| Name | Internal | Laundry | Housekeeper | Unit |
|---|---|---|---|---|
| Active involvement of enterprises in... | 7.31051 | 8.42558 | 7.33993 | AI med risk hours |
| Anti-competitive behaviour or violation of... | 29.71216 | 30.65464 | 30.00635 | AC med risk hours |
| Association and bargaining rights | 9.15707 | 9.66468 | 9.15707 | ACB med risk hours |
| Biomass consumption | 587.6912 | 728.1069 | 882.17765 | BM med risk hours |
| Certified environmental management system | 6.75771 | 21.16409 | 36.17693 | CMS med risk hours |
| Child Labour, female | 3.25884 | 3.68725 | 3.55304 | CL med risk hours |

| | | | | |
|---|---|---|---|---|
| Child Labour, male | 463.599 | 465.579 | 466.541 | CL med risk hours |
| Child Labour, total | 2.54899 | 2.91439 | 2.84318 | CL med risk hours |
| Contribution of the sector to... | 10.11386 | 23.76494 | 39.53309 | CE med risk hours |
| DALYs due to indoor and outdoor air... | 5.53732 | 5.57558 | 5.56674 | DALY med risk hours |
| Drinking water coverage | 525.4755 | 526.2501 | 525.5049 | DW med risk hours |
| Embodied agricultural area footprints | 0.50229 | 0.50475 | 0.50229 | EAF med risk hours |
| Embodied biodiversity footprints | 2.31943 | 2.38766 | 2.34884 | EBF med risk hours |
| Embodied forest area footprints | 0.2711 | 0.27343 | 0.2711 | EFA med risk hours |
| Embodied water footprints | 2.19908 | 2.21914 | 2.49327 | EWF med risk hours |
| Expenditures on education | 13.70427 | 27.1697 | 43.1235 | EE med risk hours |
| Fair Salary | 278.5379 | 695.8627 | 1455.336 | FS med risk hours |
| Fatal accidents | 0.49448 | 0.51382 | 0.5239 | FA med risk hours |
| Fossil fuel consumption | 0.09175 | 0.10838 | 0.12117 | FF med risk hours |
| Frequency of forced labour | 62.86115 | 62.87688 | 62.89057 | FL med risk hours |
| Gender wage gap | 66.72681 | 80.82953 | 96.14604 | GW med risk hours |
| GHG Footprints | 24.97052 | 28.12671 | 30.85437 | GHGF med risk hours |
| Goods produced by forced labour | 2.294 | 2.43899 | 2.58819 | GFL med risk hours |
| Health expenditure | 261.833 | 262.5769 | 262.745 | HE med risk hours |
| Illiteracy, female | 523.4233 | 523.8 | 523.4527 | I med risk hours |
| Illiteracy, male | 522.4058 | 522.7093 | 522.4352 | I med risk hours |
| Illiteracy, total | 522.5191 | 522.83 | 522.5485 | I med risk hours |
| Indigenous rights | 6.43059 | 6.62132 | 6.72478 | IR med risk hours |
| Industrial water depletion | 46.77229 | 185.2308 | 341.2588 | WU med risk hours |
| International migrant stock | 6.49353 | 20.46438 | 35.91276 | IMS med risk hours |
| International migrant workers | 1.24952 | 1.42937 | 1.54371 | IMW med risk hours |
| Life expectancy at birth | 6.19282 | 6.30917 | 6.19282 | LE med risk hours |
| Men in the sectoral labour force | 0.081 | 1.42941 | 3.02292 | M med risk hours |
| Migration flows | 86.86577 | 376.3023 | 704.6696 | MF med risk hours |
| Minerals consumption | 3.09747 | 3.51155 | 3.42108 | MC med risk hours |
| Net migration | 0.10019 | 0.11726 | 0.1296 | NM med risk hours |
| Non-fatal accidents | 2.31341 | 2.39138 | 2.34283 | NFA med risk hours |
| Pollution | 61.30889 | 62.14218 | 61.60308 | P med risk hours |
| Promoting social responsibilty | 83.24297 | 86.36269 | 112.6622 | PSR med risk hours |
| Public sector corruption | 539.5785 | 541.5949 | 539.8727 | C med risk hours |
| Risk of conflicts | 56.16373 | 56.77482 | 56.19315 | ROC med risk hours |
| Safety measures | 6.3122 | 6.51678 | 6.6064 | SM med risk hours |
| Sanitation coverage | 55.61668 | 56.06475 | 55.91087 | SC med risk hours |
| Social security expenditures | 524.566 | 525.1148 | 524.8602 | SS med risk hours |
| Trade unionism | 572.0305 | 710.8979 | 866.2228 | TU med risk hours |
| Trafficking in persons | 15.80413 | 16.98285 | 16.09832 | TP med risk hours |
| Unemployment | 1.13392 | 1.35789 | 1.42811 | U med risk hours |
| Value added (total) | 329.9024 | 330.928 | 329.9318 | VAT med risk hours |
| Violations of employment laws... | 16.00174 | 30.28419 | 19.23786 | VL med risk hours |
| Weekly hours of work per employee | 109.2568 | 110.7212 | 112.1987 | WH med risk hours |
| Women in the sectoral labour force | 20.12978 | 20.35731 | 20.1592 | W med risk hours |
| Workers affected by natural disasters | 2.38181 | 2.57998 | 2.41123 | ND med risk hours |
| Youth illiteracy, female | 53.33254 | 53.49169 | 53.36195 | YI med risk hours |
| Youth illiteracy, male | 52.72115 | 52.79636 | 52.75057 | YI med risk hours |
| Youth illiteracy, total | 52.74783 | 52.824 | 52.77725 | YI med risk hours |

The two alternative scenarios show higher impacts than the original one in all impact categories, since they include additional social outputs in the use stage. The impacts are particularly higher in categories for which the use stage was already contributing significantly in the base case, such as *Fair Salary*, *Industrial water depletion*, *International migrant stock, Migration flows* and *Minerals consumption*. Between the two scenarios, Housekeeper performs worse than Laundry for these categories. Indeed, the worker hours of Housekeeper are over twice as much as for the Laundry scenario, which results in a higher characterisation factor, and therefore higher impact results. The base case is the scenario with the lowest social impacts overall.

# IV. Conclusions and recommendations

Most impacts of the sweater come from the manufacturing stage, although the distribution and the use stage share a significant portion of the burdens for some impact categories. The end of life has negligible impacts on the whole life of the sweater. Within Manufacturing, the social potential impacts mostly come from the cotton textiles sector and from the direct impacts of garment manufactures. Both sectors show hotspots regarding wage, trade union culture, and value added. The gender gap is particularly significant in Indian garment manufactures. For distribution and retailing, most of the impacts are direct ones, notably due to the high living wage in Germany. For the use stage, most of the impacts come from the electricity consumption of the washing machine.

The Use stage alternative scenarios perform worse for all impact categories. The housekeeper scenario shows the most significant increase of impacts.

New indicators could be developed to include sector-specific issues in a more comprehensive manner. Moreover, additional research could be done to evaluate the impacts of the product during the use phase. Despite these limitations, this study provides good insights about the social hotspots of the life cycle of the hooded sweater.

The main recommendations for the German retailers are to choose a manufacturer which performs socially responsibly in terms of working conditions, particularly regarding weekly hours, overtime hours, trade union density, and sector wage. The main recommendation for the user is to wash the sweater himself or herself.

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# Annex A: Impact categories of the Social Impacts Weighting Method

*Table 3: Name and unit of the impact categories covered by the Social impacts weighting method*

| Name | Reference unit |
|---|---|
| Active involvement of enterprises in corruption and bribery | AI med risk hours |
| Anti-competitive behaviour or violation of anti-trust and monopoly legislation | AC med risk hours |
| Association and bargaining rights | ACB med risk hours |
| Biomass consumption | BM med risk hours |
| Certified environmental management system | CMS med risk hours |
| Child Labour, female | CL med risk hours |
| Child Labour, male | CL med risk hours |
| Child Labour, total | CL med risk hours |
| Contribution of the sector to economic development | CE med risk hours |
| DALYs due to indoor and outdoor air and water pollution | DALY med risk hours |
| Drinking water coverage | DW med risk hours |
| Embodied agricultural area footprints | EAF med risk hours |
| Embodied biodiversity footprints | EBF med risk hours |
| Embodied forest area footprints | EFA med risk hours |
| Embodied water footprints | EWF med risk hours |
| Expenditures on education | EE med risk hours |
| Fair Salary | FS med risk hours |
| Fatal accidents | FA med risk hours |
| Fossil fuel consumption | FF med risk hours |
| Frequency of forced labour | FL med risk hours |
| Gender wage gap | GW med risk hours |
| GHG Footprints | GHGF med risk hours |
| Goods produced by forced labour | GFL med risk hours |
| Health expenditure | HE med risk hours |
| Illiteracy, female | I med risk hours |
| Illiteracy, male | I med risk hours |
| Illiteracy, total | I med risk hours |
| Indigenous rights | IR med risk hours |
| Industrial water depletion | WU med risk hours |
| International migrant stock | IMS med risk hours |
| International migrant workers (in the sector/ site) | IMW med risk hours |
| Life expectancy at birth | LE med risk hours |
| Men in the sectoral labour force | M med risk hours |
| Migration flows | MF med risk hours |
| Minerals consumption | MC med risk hours |
| Net migration | NM med risk hours |
| Non-fatal accidents | NFA med risk hours |
| Pollution | P med risk hours |
| Promoting social responsibilty | PSR med risk hours |
| Public sector corruption | C med risk hours |
| Risk of conflicts | ROC med risk hours |

| | |
|---|---|
| Safety measures | SM med risk hours |
| Sanitation coverage | SC med risk hours |
| Social security expenditures | SS med risk hours |
| Trade unionism | TU med risk hours |
| Trafficking in persons | TP med risk hours |
| Unemployment | U med risk hours |
| Value added (total) | VAT med risk hours |
| Violations of employment laws and regulations | VL med risk hours |
| Weekly hours of work per employee | WH med risk hours |
| Women in the sectoral labour force | W med risk hours |
| Workers affected by natural disasters | ND med risk hours |
| Youth illiteracy, female | YI med risk hours |
| Youth illiteracy, male | YI med risk hours |
| Youth illiteracy, total | YI med risk hours |

# Annex B: Life cycle Inventory

*Table 4: LCI of the manufacturing stage (inputs)*

| Item | Country | PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (USD 2022) | Output price (USD 2015) |
|---|---|---|---|---|---|---|---|---|---|
| Brass | India | Copper ore | 0.02 | kg | 580 | Rs/kg | https://dir.indiamart.com/impcat/brass-alloy.html | 0.1392 | 0.1114 |
| Metal working | India | Manufacture of metal products n.e.c. and n.s. | 1 | item | 60 | Rs/zipper | https://dir.indiamart.com/search.mp?ss=brass+zippers&stype=attr=1 | 0.7200 | 0.5760 |
| Polyester resin | India | Manufacture of plastic products | 0.02 | kg | 120 | Rs/kg | https://dir.indiamart.com/search.mp?ss=polyester+resin&mcatid=5369&catid=111&prdsrc=1&src=as-popular%3Akwd%3Dpolyester%3Apos%3D6%3Acat%3D-2%3Amcat%3D-2 | 0.0288 | 0.0230 |
| Transport, lorry | India | Other transport | 0.04 | t.km | 3.6 | Rs/tkm | https://www.statista.com/statistics/1248959/india-per-metric-ton-kilometer-cost-of-different-modes-of-logistics/ | 0.0017 | 0.0014 |
| Textile, knit cotton | India | Cotton textiles | 0.79 | kg | 670 | Rs/kg | https://dir.indiamart.com | 6.3516 | 5.0813 |
| Electricity | India | Electricity | 0.686667 | kWh | 6.15 | Rs/kWh | https://www.statista.com/statistics/808201/india-cost-of-state-electricity-supply/ | 0.0507 | 0.0405 |
| Waste textile | India | Other transport | 0.08 | kg | 1000 | Rs/t | https://royalsocietypublishing.org/doi/10.1098/rsos.160764 | 0.0010 | 0.0008 |
| Manufactured HS | India | | 1 | item | 7.626667 | USD/item | Almanza et al. 2020 | 7.6267 | 6.101333333 |

*Table 5: LCI of manufacturing (output: collected data)*

| Item | Country | Data source | Raw value | Unit | Risk level | Labour cost | Mean hourly wage | Worker hours (h) |
|---|---|---|---|---|---|---|---|---|
| Gender wage gap | India | Fair wair foundation 2019 | 39 | % | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Minimum wage per month | India | Simpliance 2022 | 84.7488 | USD | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Living wage upper bound | India | Fair wair foundation 2019 | 311.808 | USD | Very low | 0.03 | 0.293440428 | 0.623772263 |
| Living wage average | India | Fair wair foundation 2019 | 252.88 | USD | Medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Living wage lower bound | India | Fair wair foundation 2019 | 193.952 | USD | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Sector average wage | India | ILO 2015 | 65.76 | USD | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Children in employment, male | India | World Bank 2012 | 1.9 | % | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Children in employment, female | India | World Bank 2012 | 1.6 | % | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Children inemployment, total | India | World Bank 2012 | 1.7 | % | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Trade union density | India | Fair wair foundation 2019 | <5 | % | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Weekly hours of work per employee | India | ILO 2019 | 49.8 | h | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Weekly hours of work with overtime | India | Fair wair foundation 2019 | 70-100 | h | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Frequency of forced labour | India | Global Slavery Index 2018 | 6.1 | 1/1000 | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Embodied value added total | India | World Bank 2018 | 0.09 | $/$ | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Health expenditure, public | India | World Bank 2019 | 32.79 | % of tot expenditure | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Health expenditure, external | India | World Bank 2019 | 0.83 | % of tot expenditure | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Domestic (private) health expenditure | India | World Bank 2019 | 66.38 | % of tot expenditure | Sub indicator | 0.03 | 0.293440428 | 0.623772263 |
| Health expenditure, out-of-pocket | India | World Bank 2019 | 54.78 | % of tot expenditure | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Health expenditure, total | India | World Bank 2019 | 3.01 | % of GDP | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Life expectancy at birth | India | World Bank 2020 | 70 | years | medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Global peace index | India | Global peace index 2022 | 2.578 | ratio | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Goods produced by forced labour | India | ILAB 2022 | 5-6 | # | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Public expenditure to education | India | World Bank 2020 | 3.36 | % of GDP | High risk | 0.03 | 0.293440428 | 0.623772263 |

*Table 6: LCI of manufacturing (output: proxy from PSILCA sector Cotton Textiles- IN)*

| Item | Country | Raw value | Unit | Risk level | Labour cost | Mean hourly wage | Worker hours (h) |
|---|---|---|---|---|---|---|---|
| Illiteracy rate, female | India | 36.78 | % | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Illiteracy rate, male | India | 20.08 | % | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Illiteracy rate total | India | 28.23 | % tot pop | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Youth illiteracy, female | India | 0.17 | % | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Youth illiteracy, male | India | 9.3 | % | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Youth illiteracy rate, total | India | 11.39 | % of pop aged 15-24 | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Women in the sectoral labour force | India | 1.12 | ratio | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Men in the sectoral labour force | India | 0.96 | ratio | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| DALYs due to indoor and outdoor air and water pollution | India | 23.2 | DALY rate | Medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Violations of mandatory health and safety standards | India | 5.40E-07 | ratio | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Workers affected by natural disasters | India | 2.02 | % | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Right of Association | India | 3 | 4 point scale | No risk | 0.03 | 0.293440428 | 0.623772263 |
| Right of Collective bargaining | India | 3 | 4 point scale | No risk | 0.03 | 0.293440428 | 0.623772263 |
| Right to Strike | India | 2 | 4 point scale | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Trafficking in persons | India | 2 | Tier | Medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Evidence of violations of laws and employment regulations | India | 2.28 | Cases per 10000 employees | Medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Social security expenditures | India | 1.2 | % of GDP | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Certified environmental management systems | India | 0.14 | # | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Extraction of biomass (related to area) | India | 852.23 | annual t/km2 | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Extraction of biomass (related to population) | India | 2.06 | annual t/cap | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Extraction of fossil fuels | India | 0.57 | annual t/cap | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Extraction of industrial and construction minerals | India | 2.29 | annual t/cap | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Extraction of ores | India | 0.14 | annual t/cap | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Level of industrial water use (related to renewable water resources) | India | 0.52 | % of total actual renewable water | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Level of industrial water use (related to total withdrawal) | India | 2.23 | % of total water withdrawal | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Drinking water coverage | India | 49.4 | % | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Sanitation coverage | India | 35.9 | % | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Pollution level of the country | India | 75.81 | Pollution index | High risk | 0.03 | 0.293440428 | 0.623772263 |
| Embodied water footprint | India | 3.79E-07 | Mm3/$ | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Presence of indigenous population | India | 1 | Y/N | Medium risk | 0.03 | 0.293440428 | 0.623772263 |
| Indigenous People Rights Protection Index | India | 4 | 6 point scale | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| International Migrant Stock | India | 0.39 | % | Very low risk | 0.03 | 0.293440428 | 0.623772263 |
| Public sector corruption | India | 60 | Index score | Very high risk | 0.03 | 0.293440428 | 0.623772263 |
| Presence of anti-competitive behaviour or violation of anti-trust and monopoly legislation | India | 0.07 | Cases per 10000 employees | Low risk | 0.03 | 0.293440428 | 0.623772263 |
| Contribution of the sector to the economy | India | 16.24 | % | Medium opportunity | 0.03 | 0.293440428 | 0.623772263 |

*Table 7: LCI of the distribution and retail stage (inputs)*

| Item | Country | PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (USD 2022) | Output price (USD) |
|---|---|---|---|---|---|---|---|---|---|
| Packaging | India | Manufacture of plastic products | 0.1 | kg | 140 | IR/kg | https://dir.indiamart.com/search.mp?ss=plastic+packaging+materials&stype=attr=1 | 0.1680 | 0.1344 |
| Road transport Odisha-Chennai | India | Other transport | 1.216 | tkm | 3.6 | IR/tkm | https://www.statista.com/statistics/1248959/india-per-metric-ton-kilometer-cost-of-different-modes-of-logistics/ | 0.0525 | 0.0420 |
| Parcel India-Germany | Germany | Shipping | 0.76 | kg | 336 | IR/kg | https://www.activexinternationalcourier.com/courier-charges/chennai-to-germany.html | 3.0643 | 2.4515 |
| Plastic waste | Germany | Waste disposal and sewerage services | 0.1 | kg | 94 | EUR/ton | https://www.actu-environnement.com/ae/news/couts-gestion-dechets-menagers-fnade-amorce-16953.php4#:~:text=Par%20type%20de%20traitement%2C%20les,%C3%A0%20251%20%E2%82%AC%2Ft | 0.0090 | 0.0113 |
| Ditributed HS | Germany | | 1 | item | 40 | EUR/item | https://www.lotuscrafts.eu/products/organic-mens-hooded-sweatshirt?variant=39437175750754?variant=39437175750754&trc_gcmp_id=17538712939&trc_gag_id=&trc_gad_id=&utm_source=google&utm_medium=paid&utm_campaign=17538712939&utm_content=&utm_term=&gadid=&gclid=EAIaIQobChMItbG6t4y6-gIVWEaRBR34wwJ_EAQYASABEgI2NfD_BwE | 38.4 | 30.72 |
| | | | | | | | | | |

*Table 8: LCI of distribution and retail (output: collected data)*

| Item | Country | Data source | Raw value | Unit | Risk level | Worker hours (h) |
|---|---|---|---|---|---|---|
| Health expenditure, public | Germany | World Bank 2019 | 77.73 | % of tot exp | Low risk | 0.2737152 |
| Health expenditure, external | Germany | World Bank 2019 | 0 | % of tot exp | Very low risk | 0.2737152 |
| Domestic (private) health expenditure | Germany | World Bank 2019 | 22.27 | % of tot exp | Sub indicator | 0.2737152 |
| Health expenditure, out-of-pocket | Germany | World Bank 2019 | 12.82 | % tot exp | Low risk | 0.2737152 |
| Health expenditure, total | Germany | World Bank 2019 | 11.7 | % of GDP | Low risk | 0.2737152 |
| Life expectancy at birth | Germany | World Bank 2020 | 81 | years | no risk | 0.2737152 |
| Global peace index | Germany | Global peace index 2022 | 1.462 | ratio | Very low risk | 0.2737152 |
| Public expenditure to education | Germany | World Bank 2020 | 4.7 | % of GDP | High risk | 0.2737152 |
| Gender wage gap | Germany | ILO 2020 | 20% | | Medium risk | 0.2737152 |
| Sector average wage | Germany | ILO 2020 | 4241.712 | USD | Very low risk | 0.2737152 |
| Trade union density | Germany | OECD 2019 | 19.3 | % | Very high risk | 0.2737152 |

*Table 9: LCI of distribution and retail (output: proxy from PSILCA sector Wholesale trade-DE)*

| Item | Country | Raw value | Unit | Risk level | Worker hours (h) |
|---|---|---|---|---|---|
| Living wage per month | Germany | 2018.18 | USD | Very high risk | 0.2737152 |
| Weekly hours per employee | Germany | 36.64 | h | Medium risk | 0.2737152 |
| Minimum wage per month | Germany | 1799.55 | USD | Very low risk | 0.2737152 |
| Illiteracy rate, female | Germany | 0.86 | % | Very low risk | 0.2737152 |
| Illiteracy rate, male | Germany | 0.54 | % | Very low risk | 0.2737152 |
| Illiteracy rate total | Germany | 0.7 | % | Very low risk | 0.2737152 |
| Youth illiteracy, female | Germany | 0.17 | % | Very low risk | 0.2737152 |
| Youth illiteracy, male | Germany | 0.26 | % | Very low risk | 0.2737152 |
| Youth illiteracy rate, total | Germany | 0.25 | % | Very low risk | 0.2737152 |
| Women in the sectoral labour force | Germany | 1.09 | ratio | Very low risk | 0.2737152 |
| Men in the sectoral labour force | Germany | 0.91 | ratio | Very low risk | 0.2737152 |
| DALYs due to indoor and outdoor air and water pollution | Germany | 0.76 | DALY rate | Very low risk | 0.2737152 |
| Presence of sufficient safety measures | Germany | 0.0221 | Cases per | High risk | 0.2737152 |
| Rate of fatal accidents at workplace | Germany | 0.63 | # /yr | Very low risk | 0.2737152 |
| Rate of non-fatal accidents at workplace | Germany | 1814.8 | # /yr | Medium risk | 0.2737152 |
| Violations of mandatory health and safety standards | Germany | 7.60E-07 | ratio | Low risk | 0.2737152 |

| | | | | | |
|---|---|---|---|---|---|
| Workers affected by natural disasters | Germany | 0.0079 | % | Very low risk | 0.273715 |
| Right of Association | Germany | 3 | 4 point scale | No risk | 0.273715 |
| Right of Collective bargaining | Germany | 3 | 4 point scale | No risk | 0.273715 |
| Right to Strike | Germany | 3 | 4 point scale | No risk | 0.273715 |
| Trafficking in persons | Germany | 1 | Tier | Low risk | 0.273715 |
| Frequency of forced labour | Germany | 2 | %o | Very low risk | 0.273715 |
| Evidence of violations of laws and employment | Germany | 1.71 | Cases per 10000 employees | Medium risk | 0.273715 |
| Social security expenditures | Germany | 18.57 | % of GDP | Low risk | 0.273715 |
| Certified environmental management systems | Germany | 0.00140749 | # | High risk | 0.273715 |
| Extraction of biomass (related to area) | Germany | 646.75 | annual t/km2 | Very high risk | 0.273715 |
| Extraction of biomass (related to population) | Germany | 2.85 | annual t/cap | Low risk | 0.273715 |
| Extraction of fossil fuels | Germany | 2.43 | annual t/cap | Very low risk | 0.273715 |
| Extraction of industrial and construction minerals | Germany | 6.62 | annual t/cap | Low risk | 0.273715 |
| Extraction of ores | Germany | 0.01 | annual t/cap | Very low risk | 0.273715 |
| Level of industrial water use (related to renewable water resources) | Germany | 17.55 | % of total actual renewable water | Very high risk | 0.273715 |
| Level of industrial water use (related to total | Germany | 19.94 | % of total water withdrawal | Low risk | 0.273715 |
| Drinking water coverage | Germany | 99.2 | % | Very low risk | 0.273715 |
| Sanitation coverage | Germany | 95.4 | % | Low risk | 0.273715 |
| Embodied water footprint | Germany | 6.60E-08 | Mm3/$ | Very low risk | 0.273715 |
| International Migrant Stock | Germany | 14.87 | % | High risk | 0.273715 |
| Public sector corruption | Germany | 19 | Index score | Low risk | 0.273715 |
| Contribution of the sector to the economy | Germany | 11.34 | % | Medium opportunity | 0.273715 |
| Net migration rate | Germany | 1.5 | %o | Very low risk | 0.273715 |
| Emigration rate | Germany | 0.01 | ratio | Very high risk | 0.273715 |
| Number of asylum seekers | Germany | 0.0024 | ratio | Very high risk | 0.273715 |
| Immigration rate | Germany | 0.02 | ratio | High risk | 0.273715 |
| Unemployment rate in the country | Germany | 3.8 | % | Low risk | 0.273715 |
| Number of threatened species | Germany | 2.80E-07 | # | Very low risk | 0.273715 |
| Embodied value added total | Germany | 0.59079 | $/$ | Low risk | 0.273715 |
| Active involvement of entreprises in corruption | Germany | 4 | % | Low risk | 0.273715 |

*Table 10: LCI of the use stage, Scenario 1 Internal use (inputs)*

| Item | Country | PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (EUR) | Output price (USD) |
|---|---|---|---|---|---|---|---|---|---|
| Electricity | Germany | Electricity and district heat | 0.32 | kWh | 0.47 | Eur/kWh | https://www.statista.com/statistics/1267541/germany-monthly-wholesale-electricity-price/ | 0.1504 | 0.1155 |
| Non ionic surfactant | Germany | Manufacture of chemical products | 0.01 | kg | 2.62 | eur/kg | REWE | 0.0262 | 0.0201 |
| Tap water | Germany | Water supply | 13 | kg | 1.81258 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0236 | 0.0181 |
| Wastewater | Germany | Waste disposal and sewerage services | 13 | L | 2.21 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0287 | 0.0221 |
| Washed clothes | Germany | | 1 | kg | 4 | EUR/Cycle of 6 kg | Lavomatic Berlin | 0.666666667 | 0.5120 |

*Table 11: LCI of the use stage, Scenario 2 Laundry (inputs)*

| Item | Country | PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (EUR) | Output price (USD) |
|---|---|---|---|---|---|---|---|---|---|
| Electricity | Germany | Electricity and district heat | 0.79 | kWh | 0.2664 | Eur/kWh | https://www.statista.com/statistics/1050448/industrial-electricity-prices-including-tax-germany/#:~:text=Industrial%20electricity%20prices%20including%20tax%20in%20Germany%201998%2D2022&text=Industrial%20electricity%20prices%20including%20electricity,cents%20was%20reached%20since%201998 | 0.2105 | 0.1616 |
| Non ionic surfactant | Germany | Manufacture of chemical products | 0.016667 | L | 1.18 | EURO/L | https://www.metro.de/marktplatz/product/0ded1c0d-3b42-452e-8bd3-57b1b0f62160?mfeed_oid=c9db3947-2d08-4465-95d6-67ee8579ebbe&gclid=EAIaIQobChMI58Cy7OHp-gIVU49oCR3UbwynEAQYBiABEgKB-fD_BwE&itm_pm=cookie_consent_accept_button | 0.0197 | 0.0151 |
| Tap water | Germany | Water supply | 13 | kg | 1.81258 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0236 | 0.0181 |
| Wastewater | Germany | Waste disposal and sewerage services | 13 | L | 2.21 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0287 | 0.0221 |
| Washed clothes | Germany | | 1 | kg | 6 | EUR/sweater | https://hublo.eu/prix-tarif-pressing/#:~:text=De%203%2C5%E2%82%AC%20%C3%A0,un%20pull%20ou%20un%20pantalonhttps://hublo.eu/prix-tarif-pressing/#:~:text=De%203%2C5%E2%82%AC%20%C3%A0,un%20pull%20ou%20un%20pantalon | 8 | 6.144 |

*Table 12: LCI of the use stage, Scenario 2 Laundry (outputs: collected data)*

| Item | Country | Data source | Raw value | Unit | Risk level | Worker hours (h) |
|---|---|---|---|---|---|---|
| Health expenditure, public | Germany | World Bank 2019 | 77.73 | % of tot exp | Low risk | 0.021842104 |
| Health expenditure, external | Germany | World Bank 2019 | 0 | % of tot exp | Very low risk | 0.021842104 |
| Health expenditure, out-of-pocket | Germany | World Bank 2019 | 12.82 | % tot exp | Low risk | 0.021842104 |
| Health expenditure, total | Germany | World Bank 2019 | 11.7 | % of GDP | Low risk | 0.021842104 |
| Life expectancy at birth | Germany | World Bank 2020 | 81 | years | no risk | 0.021842104 |
| Global peace index | Germany | Global peace index 2022 | 1.462 | ratio | Very low risk | 0.021842104 |
| Public expenditure to education | Germany | World Bank 2020 | 4.7 | % of GDP | High risk | 0.021842104 |
| Trade union density | Germany | OECD 2019 | 19.3 | % | Very high risk | 0.021842104 |
| Average wage of the sector | Germany | https://www.erieri.com/salary/job/dry-cleaner/germany/berlin | 2473.92768 | USD | Medium risk | 0.021842104 |

*Table 13: LCI of the use stage, Scenario 2 Laundry (outputs: proxy from PSILCA sector Other service activities- DE)*

| **Item** | **Country** | **Raw value** | **Unit** | **Risk level** | **Worker hours (h)** |
|---|---|---|---|---|---|
| Weekly hours per week | Germany | 53.2 | h | Medium risk | 0.021842104 |
| Living wage per month | Germany | 2018.18 | USD | Very high risk | 0.021842104 |
| Minimum wage per month | Germany | 1799.55 | USD | Very low risk | 0.021842104 |
| Illiteracy rate, female | Germany | 0.86 | % | Very low risk | 0.021842104 |
| Illiteracy rate, male | Germany | 0.54 | % | Very low risk | 0.021842104 |
| Illiteracy rate total | Germany | 0.7 | % | Very low risk | 0.021842104 |
| Youth illiteracy, female | Germany | 0.17 | % | Very low risk | 0.021842104 |
| Youth illiteracy, male | Germany | 0.26 | % | Very low risk | 0.021842104 |
| Youth illiteracy rate, total | Germany | 0.25 | % | Very low risk | 0.021842104 |
| Women in the sectoral labour force | Germany | 1.49 | ratio | Very low risk | 0.021842104 |
| Gender gape wage | Germany | 20.87 | % | High risk | 0.021842104 |
| Men in the sectoral labour force | Germany | 0.57 | ratio | Medium risk | 0.021842104 |
| DALYs due to indoor and outdoor air and water pollution | Germany | 0.76 | DALY rate | Very low risk | 0.021842104 |
| Presence of sufficient safety measures | Germany | 0.0019 | Cases per 10000 employees | Very low risk | 0.021842104 |
| Rate of fatal accidents at workplace | Germany | 2.53 | # /yr | Very low risk | 0.021842104 |
| Rate of non-fatal accidents at workplace | Germany | 588.66 | # /yr | Very low risk | 0.021842104 |
| Violations of mandatory health and safety standards | Germany | 7.60E-07 | ratio | Low risk | 0.021842104 |

| | | | | | |
|---|---|---|---|---|---|
| Workers affected by natural disasters | Germany | 0.0079 | % | Very low risk | 0.021842 |
| Right of Association | Germany | 3 | 4 point scale | No risk | 0.021842 |
| Right of Collective bargaining | Germany | 3 | 4 point scale | No risk | 0.021842 |
| Right to Strike | Germany | 3 | 4 point scale | No risk | 0.021842 |
| Trafficking in persons | Germany | 1 | Tier | Low risk | 0.021842 |
| Frequency of forced labour | Germany | 2 | %o | Very low risk | 0.021842 |
| Evidence of violations of laws and employment regulations | Germany | 20.91 | Cases per 10000 employees | High risk | 0.021842 |
| Social security expenditures | Germany | 18.57 | % of GDP | Low risk | 0.021842 |
| Certified environmental management systems | Germany | 0.001407 | # | High risk | 0.021842 |
| Extraction of biomass (related to area) | Germany | 646.75 | annual t/km2 | Very high risk | 0.021842 |
| Extraction of biomass (related to population) | Germany | 2.85 | annual t/cap | Low risk | 0.021842 |
| Extraction of fossil fuels | Germany | 2.43 | annual t/cap | Very low risk | 0.021842 |
| Extraction of industrial and construction minerals | Germany | 6.62 | annual t/cap | Low risk | 0.021842 |
| Extraction of ores | Germany | 0.01 | annual t/cap | Very low risk | 0.021842 |
| Level of industrial water use (related to renewable water resources) | Germany | 17.55 | % of total actual renewable water | Very high risk | 0.021842 |
| Level of industrial water use (related to total withdrawal) | Germany | 19.94 | % of total water withdrawal | Low risk | 0.021842 |
| Drinking water coverage | Germany | 99.2 | % | Very low risk | 0.021842 |
| Sanitation coverage | Germany | 95.4 | % | Low risk | 0.021842 |
| Embodied water footprint | Germany | 6.60E-08 | Mm3/$ | Very low risk | 0.021842 |
| International Migrant Stock | Germany | 14.87 | % | High risk | 0.021842 |
| Public sector corruption | Germany | 19 | Index score | Low risk | 0.021842 |
| Contribution of the sector to the economy | Germany | 48.29 | % | High opportunity | 0.021842 |
| Net migration rate | Germany | 1.5 | %o | Very low risk | 0.021842 |
| Emigration rate | Germany | 0.01 | ratio | Very high risk | 0.021842 |
| Number of asylum seekers | Germany | 0.0024 | ratio | Very high risk | 0.021842 |
| Immigration rate | Germany | 0.02 | ratio | High risk | 0.021842 |
| Unemployment rate in the country | Germany | 3.8 | % | Low risk | 0.021842 |
| Number of threatened species | Germany | 2.80E-07 | # | Very low risk | 0.021842 |
| Embodied value added total | Germany | 0.703 | $/$ | Very low risk | 0.021842 |
| Active involvement of entreprises in corruption | Germany | 1 | % | Very low risk | 0.021842 |
| Membership in an initiative that promotes SCR | Germany | 10 | Number of companies | Medium risk | 0.021842 |

*Table 14: Table 6: LCI of the use stage, Scenario 3 Housekeeper (inputs)*

| Item | Country | PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (EUR) | Output price (USD) |
|---|---|---|---|---|---|---|---|---|---|
| Electricity | Germany | Electricity and district heat | 0.32 | kWh | 0.47 | Eur/kWh | https://www.statista.com/statistics/1267541/germany-monthly-wholesale-electricity-price/ | 0.1504 | 0.1155 |
| Non ionic surfactant | Germany | Manufacture of chemical products | 0.01 | kg | 2.62 | eur/kg | REWE | 0.0262 | 0.0201 |
| Tap water | Germany | Water supply | 13 | kg | 1.81258 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0236 | 0.0181 |
| Wastewater | Germany | Waste disposal and sewerage services | 13 | L | 2.21 | EUR/m3 | https://www.bwb.de/content/en/html/1720.php | 0.0287 | 0.0221 |
| Washed clothes | Germany | | 1 | kg | 10.65 | EUR/h worked | https://www.payscale.com/research/DE/Job=Cleaner/Hourly_Rate | 2.441666667 | 1.8752 |

*Table 15: LCI of the use stage, Scenario 3 Housekeeper (outputs: collected data)*

| Item | Country | Data source | Raw value | Unit | Risk level | Worker hours (h) |
|---|---|---|---|---|---|---|
| Health expenditure, public | Germany | World Bank 2019 | 77.73 | % of tot exp | Low risk | 0.047774816 |
| Health expenditure, external | Germany | World Bank 2019 | 0 | % of tot exp | Very low risk | 0.047774816 |
| Health expenditure, out-of-pocket | Germany | World Bank 2019 | 12.82 | % tot exp | Low risk | 0.047774816 |
| Health expenditure, total | Germany | World Bank 2019 | 11.7 | % of GDP | Low risk | 0.047774816 |
| Life expectancy at birth | Germany | World Bank 2020 | 81 | years | no risk | 0.047774816 |
| Global peace index | Germany | Global peace index 2022 | 1.462 | ratio | Very low risk | 0.047774816 |
| Public expenditure to education | Germany | World Bank 2020 | 4.7 | % of GDP | High risk | 0.047774816 |
| Trade union density | Germany | OECD 2019 | 19.3 | % | Very high risk | 0.047774816 |
| Average wage of the sector | Germany | https://www.glassdoor.de/Salaries/germany-housekeeper-salary-SRCH_IL.0,7_IN96_KO8,19.htm?countryRedirect=true#:~:text=The%20estimated%20total%20pay%20for,of%20%E2%82%AC1%2C806%20per%20month | 1774.862069 | USD | Very high risk | 0.047774816 |

*Table 16: LCI of the use stage, Scenario 2 Laundry (outputs: proxy from PSILCA sector Services for private households-DE)*

| Item | Country | Raw value | Unit | Risk level | Worker hours (h) |
|---|---|---|---|---|---|
| Weekly hours per week | Germany | 53.2 | h | Medium risk | 0.047774816 |
| Living wage per month | Germany | 2018.18 | USD | Very high risk | 0.047774816 |
| Minimum wage per month | Germany | 1799.55 | USD | Very low risk | 0.047774816 |
| Illiteracy rate, female | Germany | 0.86 | % | Very low risk | 0.047774816 |
| Illiteracy rate, male | Germany | 0.54 | % | Very low risk | 0.047774816 |
| Illiteracy rate total | Germany | 0.7 | % | Very low risk | 0.047774816 |
| Youth illiteracy, female | Germany | 0.17 | % | Very low risk | 0.047774816 |
| Youth illiteracy, male | Germany | 0.26 | % | Very low risk | 0.047774816 |
| Youth illiteracy rate, total | Germany | 0.25 | % | Very low risk | 0.047774816 |
| Women in the sectoral labour force | Germany | 1.49 | ratio | Very low risk | 0.047774816 |
| Gender gape wage | Germany | 20.87 | % | High risk | 0.047774816 |
| Men in the sectoral labour force | Germany | 0.57 | ratio | Medium risk | 0.047774816 |
| DALYs due to indoor and outdoor air and water pollution | Germany | 0.76 | DALY rate | Very low risk | 0.047774816 |
| Presence of sufficient safety measures | Germany | 0.0019 | Cases per 10000 employees | Very low risk | 0.047774816 |
| Rate of fatal accidents at workplace | Germany | 2.53 | # /yr | Very low risk | 0.047774816 |
| Rate of non-fatal accidents at workplace | Germany | 588.66 | # /yr | Very low risk | 0.047774816 |
| Violations of mandatory health and safety standards | Germany | 7.60E-07 | ratio | Low risk | 0.047774816 |
| Workers affected by natural disasters | Germany | 0.0079 | % | Very low risk | 0.047774816 |

| | | | | | |
|---|---|---|---|---|---|
| Workers affected by natural disasters | Germany | 0.0079 | % | Very low risk | 0.047775 |
| Right of Association | Germany | 3 | 4 point scale | No risk | 0.047775 |
| Right of Collective bargaining | Germany | 3 | 4 point scale | No risk | 0.047775 |
| Right to Strike | Germany | 3 | 4 point scale | No risk | 0.047775 |
| Trafficking in persons | Germany | 1 | Tier | Low risk | 0.047775 |
| Frequency of forced labour | Germany | 2 | %o | Very low risk | 0.047775 |
| Evidence of violations of laws and employment regulations | Germany | 4.24 | Cases per 10000 employees | Medium risk | 0.047775 |
| Social security expenditures | Germany | 18.57 | % of GDP | Low risk | 0.047775 |
| Certified environmental management systems | Germany | 0.00395756 | # | High risk | 0.047775 |
| Extraction of biomass (related to area) | Germany | 646.75 | annual t/km2 | Very high risk | 0.047775 |
| Extraction of biomass (related to population) | Germany | 2.85 | annual t/cap | Low risk | 0.047775 |
| Extraction of fossil fuels | Germany | 2.43 | annual t/cap | Very low risk | 0.047775 |
| Extraction of industrial and construction minerals | Germany | 6.62 | annual t/cap | Low risk | 0.047775 |
| Extraction of ores | Germany | 0.01 | annual t/cap | Very low risk | 0.047775 |
| Level of industrial water use (related to renewable water resources) | Germany | 17.55 | % of total actual renewable water | Very high risk | 0.047775 |
| Level of industrial water use (related to total withdrawal) | Germany | 19.94 | % of total water withdrawal | Low risk | 0.047775 |
| Drinking water coverage | Germany | 99.2 | % | Very low risk | 0.047775 |
| Sanitation coverage | Germany | 95.4 | % | Low risk | 0.047775 |
| Embodied water footprint | Germany | 1.83E-06 | Mm3/$ | Low risk | 0.047775 |
| International Migrant Stock | Germany | 14.87 | % | High risk | 0.047775 |
| Public sector corruption | Germany | 19 | Index score | Low risk | 0.047775 |
| Contribution of the sector to the economy | Germany | 48.29 | % | High opportunity | 0.047775 |
| Net migration rate | Germany | 1.5 | %o | Very low risk | 0.047775 |
| Emigration rate | Germany | 0.01 | ratio | Very high risk | 0.047775 |
| Number of asylum seekers | Germany | 0.0024 | ratio | Very high risk | 0.047775 |
| Immigration rate | Germany | 0.02 | ratio | High risk | 0.047775 |
| Unemployment rate in the country | Germany | 3.8 | % | Low risk | 0.047775 |
| Number of threatened species | Germany | 2.80E-07 | # | Very low risk | 0.047775 |
| Embodied value added total | Germany | 0.9974 | $/$ | Very low risk | 0.047775 |
| Membership in an initiative that promotes SCR | Germany | 2 | Number of companies | High risk | 0.047775 |
| Active involvement of entreprises in corruption | Germany | 1 | % | Very low risk | 0.047775 |

*Table 17: LCI of End of life stage (inputs)*

| Input/Output | Item | Country | Corresponding PSILCA sector | Amount | Unit | Market price | Unit | Source | Output price (USD) | Output price (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| Input | Municipal waste | Germany | Waste disposal and sewerage services | 0.75 | kg | 94 | EUR/ton | https://www.actu-environnement.com/ae/news/couts-gestion-dechets-menagers-fnade-amorce-16953.php4#:~:text=Par%20type%20de%20traitement%2C%20les,%C3%A0%20251%20%E2%82%AC%2Ft | 0.06768 | 0.054144 |
| Quantitative ref. | Disposed HS | Germany | | 1 | item | | | | | |

*Table 18: LCI Life cycle*

| Input/Output | Item | Amount | Unit |
|---|---|---|---|
| Input | Disposed sweater | 1 | item |
| Input | Distributed sweater | 1 | item |
| Input | Manufactured sweater | 1 | item |
| Input | Used sweater | 0.75*laundry*52*6/3.8 | kg |
| Input | Used sweater | 0.75*housekeeper*52*6/3.8 | kg |
| Input | Used sweater | 0.75*internal*52*6/3.8 | kg |
| Quantitative ref. | Entire cycle sweater | 1 | item |

## Annex C: Relative results

| Name | Internal | Laundry | Housekeeper | Unit | Internal | Laundry | Housekeeper |
|---|---|---|---|---|---|---|---|
| Active involvement of enterprises in corruption and bribery | 7.31051 | 8.42558 | 7.33993 | AI med risk hours | 100% | 115% | 100% |
| Anti-competitive behaviour or violation of anti-trust and monopoly legislation | 29.71216 | 30.65464 | 30.00635 | AC med risk hours | 100% | 103% | 101% |
| Association and bargaining rights | 9.15707 | 9.66468 | 9.15707 | ACB med risk hours | 100% | 106% | 100% |
| Biomass consumption | 587.6912 | 728.1069 | 882.17765 | BM med risk hours | 100% | 124% | 150% |
| Certified environmental management system | 6.75771 | 21.16409 | 36.17693 | CMS med risk hours | 100% | 313% | 535% |
| Child Labour, female | 3.25884 | 3.68725 | 3.55304 | CL med risk hours | 100% | 113% | 109% |
| Child Labour, male | 463.599 | 465.579 | 466.54095 | CL med risk hours | 100% | 100% | 101% |
| Child Labour, total | 2.54899 | 2.91439 | 2.84318 | CL med risk hours | 100% | 114% | 112% |
| Contribution of the sector to economic development | 10.11386 | 23.76494 | 39.53309 | CE med risk hours | 100% | 235% | 391% |
| DALYs due to indoor and outdoor air and water pollution | 5.53732 | 5.57558 | 5.56674 | DALY med risk hours | 100% | 101% | 101% |
| Drinking water coverage | 525.4755 | 526.2501 | 525.50488 | DW med risk hours | 100% | 100% | 100% |
| Embodied agricultural area footprints | 0.50229 | 0.50475 | 0.50229 | EAF med risk hours | 100% | 100% | 100% |
| Embodied biodiversity footprints | 2.31943 | 2.38766 | 2.34884 | EBF med risk hours | 100% | 103% | 101% |
| Embodied forest area footprints | 0.2711 | 0.27343 | 0.2711 | EFA med risk hours | 100% | 101% | 100% |
| Embodied water footprints | 2.19908 | 2.21914 | 2.49327 | EWF med risk hours | 100% | 101% | 113% |
| Expenditures on education | 13.70427 | 27.1697 | 43.1235 | EE med risk hours | 100% | 198% | 315% |
| Fair Salary | 278.5379 | 695.8627 | 1455.33649 | FS med risk hours | 100% | 250% | 522% |
| Fatal accidents | 0.49448 | 0.51382 | 0.5239 | FA med risk hours | 100% | 104% | 106% |
| Fossil fuel consumption | 0.09175 | 0.10838 | 0.12117 | FF med risk hours | 100% | 118% | 132% |
| Frequency of forced labour | 62.86115 | 62.87688 | 62.89057 | FL med risk hours | 100% | 100% | 100% |
| Gender wage gap | 66.72681 | 80.82953 | 96.14604 | GW med risk hours | 100% | 121% | 144% |
| GHG Footprints | 24.97052 | 28.12671 | 30.85437 | GHGF med risk hours | 100% | 113% | 124% |
| Goods produced by forced labour | 2.294 | 2.43899 | 2.58819 | GFL med risk hours | 100% | 106% | 113% |
| Health expenditure | 261.833 | 262.5769 | 262.74502 | HE med risk hours | 100% | 100% | 100% |
| Illiteracy, female | 523.4233 | 523.8 | 523.45267 | I med risk hours | 100% | 100% | 100% |
| Illiteracy, male | 522.4058 | 522.7093 | 522.43522 | I med risk hours | 100% | 100% | 100% |
| Illiteracy, total | 522.5191 | 522.83 | 522.54848 | I med risk hours | 100% | 100% | 100% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Indigenous rights | 6.43059 | 6.62132 | 6.72478 | IR med risk hours | 100% | 103% | 105% |
| Industrial water depletion | 46.77229 | 185.23083 | 341.25877 | WU med risk hours | 100% | 396% | 730% |
| International migrant stock | 6.49353 | 20.46438 | 35.91276 | IMS med risk hours | 100% | 315% | 553% |
| International migrant workers (in the sector/ site) | 1.24952 | 1.42937 | 1.54371 | IMW med risk hours | 100% | 114% | 124% |
| Life expectancy at birth | 6.19282 | 6.30917 | 6.19282 | LE med risk hours | 100% | 102% | 100% |
| Men in the sectoral labour force | 0.081 | 1.42941 | 3.02292 | M med risk hours | 100% | 1765% | 3732% |
| Migration flows | 86.86577 | 376.30232 | 704.66957 | MF med risk hours | 100% | 433% | 811% |
| Minerals consumption | 3.09747 | 3.51155 | 3.42108 | MC med risk hours | 100% | 113% | 110% |
| Net migration | 0.10019 | 0.11726 | 0.1296 | NM med risk hours | 100% | 117% | 129% |
| Non-fatal accidents | 2.31341 | 2.39138 | 2.34283 | NFA med risk hours | 100% | 103% | 101% |
| Pollution | 61.30889 | 62.14218 | 61.60308 | P med risk hours | 100% | 101% | 100% |
| Promoting social responsibilty | 83.24297 | 86.36269 | 112.6622 | PSR med risk hours | 100% | 104% | 135% |
| Public sector corruption | 539.5785 | 541.59491 | 539.87269 | C med risk hours | 100% | 100% | 100% |
| Risk of conflicts | 56.16373 | 56.77482 | 56.19315 | ROC med risk hours | 100% | 101% | 100% |
| Safety measures | 6.3122 | 6.51678 | 6.6064 | SM med risk hours | 100% | 103% | 105% |
| Sanitation coverage | 55.61668 | 56.06475 | 55.91087 | SC med risk hours | 100% | 101% | 101% |
| Social security expenditures | 524.56599 | 525.11476 | 524.86019 | SS med risk hours | 100% | 100% | 100% |
| Trade unionism | 572.03049 | 710.89792 | 866.22277 | TU med risk hours | 100% | 124% | 151% |
| Trafficking in persons | 15.80413 | 16.98285 | 16.09832 | TP med risk hours | 100% | 107% | 102% |
| Unemployment | 1.13392 | 1.35789 | 1.42811 | U med risk hours | 100% | 120% | 126% |
| Value added (total) | 329.90235 | 330.92804 | 329.93177 | VAT med risk hours | 100% | 100% | 100% |
| Violations of employment laws and regulations | 16.00174 | 30.28419 | 19.23786 | VL med risk hours | 100% | 189% | 120% |
| Weekly hours of work per employee | 109.25678 | 110.72115 | 112.19871 | WH med risk hours | 100% | 101% | 103% |
| Women in the sectoral labour force | 20.12978 | 20.35731 | 20.1592 | W med risk hours | 100% | 101% | 100% |
| Workers affected by natural disasters | 2.38181 | 2.57998 | 2.41123 | ND med risk hours | 100% | 108% | 101% |
| Youth illiteracy, female | 53.33254 | 53.49169 | 53.36195 | YI med risk hours | 100% | 100% | 100% |
| Youth illiteracy, male | 52.72115 | 52.79636 | 52.75057 | YI med risk hours | 100% | 100% | 100% |
| Youth illiteracy, total | 52.74783 | 52.824 | 52.77725 | YI med risk hours | 100% | 100% | 100% |