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Supplementary Materials (Annex 1 and Annex 2)

on paper

Monetisation of external socio-economic costs of industrial production: A Social-LCA-based case of clothing production

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Annex 1. Additional Tables

	inside Europe	outside Europe (ILO-norms)	max hours Child Labour (agriculture, service and domestic work)
hours per day	8	8	2
days per week	5	6	6
hours per week	40	48	12
weeks per year	46	49	49
days per year	230	280	280
hours per year	1840	2240	560

Table A1.1 Norms for working hours

fabric: single jersey T-shirt knit produced via circular knitting				
density fabric	0.160	kg/m^2		
weight T-shirt	0.150	kg		
yarn count	200	dtex		
finished fabric needed for making up	0.158	kg	5%	making up waste*
finished fabric needed for cutting	0.165	kg	5%	cutting waste*
greige knitted fabric needed for finishing	0.174	kg	5%	finishing waste*
yarn needed	0.177	kg	2%	knitting waste*
raw cotton fibre needed	0.182	kg	2.50%	spinning waste*
seed cotton needed (machine picking)	0.309	kg	41%	picking waste**
seed cotton needed (hand picking)	0.213	kg	15%	picking waste**

**waste percentage verified by Han Hamers via personal communication d.d. 07-09-2015*

*** waste volumes for ginning - mainly plant residues - derived from: Ellebæk Larsen S, Hansen J et al (2007) EDIPTEX–Environmental assessment of textiles. Danish Ministry of the Environment, Environmental Protection Agency, p 220*

Table A1.2 Specifications of the T-shirt

fabric: woven fabric				
density fabric	333-500	kg/m^2		
weight fabric for Jeans	0.450	kg		
yarn count warp/weft	500	dtex		
finished fabric needed for making up	0.473	kg	5%	making up waste*
finished fabric needed for cutting	0.496	kg	5%	cutting waste*
greige woven fabric needed for finishing	0.521	kg	5%	finishing waste*
yarn needed	0.531	kg	2%	weaving waste*
raw cotton fibre needed	0.545	kg	2.50%	spinning waste*
seed cotton needed (machine picking)	0.926	kg	41%	picking waste*
seed cotton needed (hand picking)	0.640	kg	15%	picking waste*

**waste percentages assumed to be equal to the T-shirt*

Table A1.3 Specifications of the pair of Jeans

Specification	Reference + remarks
cotton picker picks 150 kg cotton per day	(Singh, 2000; Kelly, 2014) http://www.cottonginmuseum.org/museum.htm, accessed at 22-02-2016; https://www.youtube.com/watch?x-yt-cl=84411374&feature=player_embedded&v=YUmLBm5uoIU&x-yt-ts=1421828030, accessed at 22-01-2015
in a wet finishing factory a worker produces 2000 kg of fabric per 6 hours	personal communication with Han Hamers d.d. 07-09-2015 = 333 kg per hour = [fabric for] 2016 T-shirts or 672 Jeans per hour
dressmaker makes 20 T-shirts per hour	personal communication with Han Hamers d.d. 20-02-2015
dressmaker makes 2.25 Jeans per hour	personal communication with Erik Toenhake d.d. 20-02-2015
bio-cotton production, India	Reijn G (2015) Ontwikkelingshulp werkt toch. De Volkskrant, 2 September 2015, pp 31: Bio-cotton farmers achieve a 26% higher income than non-bio -; we assumed that this higher income is directly transferred to the workers

Table A1.4 Extra data used for the calculations of Table 3 and 4

Annex 2. The s-eco-costs as an indicator system for S-LCA

Section 2.1 of this Annex describes how the most relevant (sub)categories are selected from the comprehensive list of UNEP/SETAC (2009:49) in order to create a practical S-LCA tool for design and for sustainable supply chain management.

Section 2.2 describes how the PRPs are chosen, how the characterisation function is defined for each subcategory and how a subcategory-indicator is calculated, see also Fig. 1 in the main text.

Section 2.3 describes how the monetary end-scores for each subcategory can be calculated.

2.1 Selection of the most relevant categories and subcategories

2.1.1 Aim of the s-eco-costs method, and the selection of the category Worker

The aim of the s-eco-costs method as presented in this paper is:

1. to focus on the unsustainable and appalling working conditions in the supply chain (suitable for cradle-to-cradle analyses as well)
2. to quantify product related social topics (child labour, extreme low wages, unsafe work places, et cetera)
3. to quantify results of S-LCA in a way that the unsustainability of products are comparable and can be communicated to designers, business managers and the public
4. to provide transparency in the calculations of the (sub)category indicators, based on general statistical data (World Bank, ILO, Eurostat, etc.) and/or specific data which can easily be measured at the production sites
5. to be complementary to and combinable with the eco-costs system for (E)-LCA, which means that the s-eco-costs have to result in monetised indicators

The above list must be placed in the context of improvement of the supply chain of production systems (in the case of this paper the production chain of clothing). This can be done by means of sustainable supply chain management of the company which distributes the end-products in consumer markets, and implies that chosen categories of S-LCA are within the sphere of the responsibility and direct influence of the management of the production facilities. This has three consequences:

- (Sub)categories based on general indexes on a country level (e.g. HDI, Gini coefficient) are not suitable, because they can hardly be influenced by the management of a production facility. Parent et al. (2013) states that boycotting an enterprise on the basis of such general indexes would neither lead to changes of practices in this enterprise, neither of other enterprises in the country. In other words: such indicators might be suitable for government politics but not for supply chain management

- SMEs are often too small to bear the costs of medical care and general education in countries where these social services are not available, so it is not fair to SMEs to include such issues in the list of criteria.
- We consider priority setting as an important issue in management of improvements: major things must be tackled first, and should not be blurred by issues of secondary importance. In supply chains with appalling conditions (like our case of clothing) issues like 'permanent education', 'work-life balance' and 'job satisfaction' (Fontes, 2016) are of secondary importance and therefore left out for this moment (s-eco-costs for these subcategories are to be developed when supply chains in service industries are analysed).

Given this aim of improving sustainable production and consumption by means of better supply chain management (Vermeulen, 2010)(Parent et al. 2013), we argue that for S-LCA it does make sense to focus on the stakeholder category Worker at first, and not on the other stakeholder categories (Local community, Society, Consumers, and Value chain actors; UNEP/SETAC, 2009). Herewith we would like to emphasise that E-LCA already focusses on Consumers, Local Community and Society (their health and their natural environment), so these groups are not totally excluded when S-LCA is combined with E-LCA.

2.1.2 Selection of the most relevant subcategories

In line with the list of the five issues of Section 2.1.1 (the aim of the method), we formulated five requirements for subcategory-indicators:

a. the indicator must be specific, relevant and easy to understand
b. data for calculations must be relatively easy to measure at the level of specific manufacturing plants
c. data for calculations must be available at the level of countries as well (to have an average practice to compare with within a country, and to be able to benchmark between countries)
d. the indicator must be applicable to products, so data must be available "per unit of input" (e.g. per hour) as well as "per unit of output" (e.g. per T-shirt), because it must be possible to communicate results to designers, business managers and consumers
e. it must be possible to translate a 'subcategory-indicator' (a specific indicator for a specific 'subcategory') to an 'end-score' (a single indicator for the stakeholder category Worker).

All eight subcategories of the category Worker (Freedom of Association and Collective Bargaining, Child Labour, Fair Salary, Working Hours, Forced Labour, Equal opportunities/Discrimination, Health and Safety,

Social Benefits/Social Security; UNEP/SETAC, 2009) have been analysed with regard to the five aforementioned requirements a. to e. This analysis resulted in the following five subcategories for s-eco-costs:

1. Minimum Acceptable Wage (a specific aspect of Fair Salary)
2. Child Labour
3. Extreme Poverty (as a specific aspect of Forced Labour, and defined as labour that must be done despite of the fact that the salary is too low to feed the family; the extreme is slavery)
4. Excessive Working Hours, involuntary (forced labour in excess of 48 hours per week)
5. Occupational Safety and Health (OSH)

The following subcategories cannot be applied in the s-eco-costs since these do not meet the above five requirements:

- Equal Opportunities/Discrimination (since it is hard to measure and quantify)
- Freedom of Association and Collective Bargaining (since it is a complex issue in many developing countries, and hard to establish and hard to quantify)
- Social Benefits/Social Security (since it is hardly implemented in developing countries; when it is present at a specific factory, it should be counted as part of the salary as far as that it can be monetised)

2.1.3. The choice on Minimum Acceptable Wage (a specific aspect of subcategory Fair Salary)

The issue of Fair Salary covers may aspects, and is complex. The Fair Wage Network (http://fair-wage.com/, accessed November 2016) provides 2 definitions and 12 dimensions: (1) regular payments, (2) minimum living standards, (3) minimum wage regulations, (4) equality in same sectors, (5) no excessive working hours, (6) no disciplinary wage sanctions, (7) information in advance, (8) no discrimination, (9) indexed with price index, (10) in line with enterprise performance growth, (11) no drastic reduction in wages or employment, (12) progress of wage in line with intensity and complexity of work and required skills.

However, this system does not provide quantitative guidance in terms of absolute wage levels, neither at company level, nor at country level. ILO does not provide any monetary values for fair salaries either. Croes and Vermeulen, (2016a) propose a restricted level of inequality of salaries in a company, e.g. less than a factor 23.8 for the highest and lowest salary. However, no clear answer can be found to the question: “What is a fair wage in the absolute sense?”. Of the above list of 12 dimensions, there are two dimensions that can lead to absolute wage

levels, namely dimension 2 (minimum living standards) and 3 (minimum wage regulations).

There are a few sources on absolute global minimum living standards:

- The World Bank (2005) introduced the concept of the 1,25 Int $ PPP per day poverty line, as an *absolute minimum* wage per day, updated in 2015 to $ 1.90 Int $ PPP per day (price level 2011)
- Croes and Vermeulen (2016b) made a calculation based on World Bank data, 2.00 Int $ PPP per hour, and derived an *absolute minimum* wage of 0.83 Int $ PPP per hour
- Anker (2006a, 2006b, 2011), senior economist of the ILO, defined an average minimum living wage of 1.70 Int $ PPP per hour
- Section 2.2.4 shows our own calculation on Extreme Poverty, based on World Bank data and developments in food prices, resulting in an *absolute minimum* wage per day of 0.935 Int $ PPP (price level 2014)

To our opinion, however, such an absolute minimum wage at the poverty line cannot be regarded as a "fair wage". Fair wage should have a relation to minimum wage regulations (point 3 of the 12 dimensions), since these regulations are the result of political discussions on the fairness of wages in a country. But the question remains whether or not it would it be fair to determine for employees in poor countries a minimum wage that is a realistic percentage of the minimum wage of workers in rich countries. What percentage is acceptable for both the workers in the rich countries as well as the poor countries?

This dilemma is the core of the trade-off decision in the triple P of Elkington (1997). It is the prosperity in the rich countries versus the people in the poor countries.

In terms of sustainability this trade-off is related to the issue of economic migrants. The current situation is far from sustainable: regions (the EU) and countries (e.g. USA and Botswana) are building fences to stop the migration flow, and many economic migrants drown in the Mediterranean (near Italy) and in the waters around Australia. Refugees from war zones are suffering lengthy procedures, because they must be separated from economic migrants.

The sustainable solution is not more and higher fences, but a smaller gap between wages. When wages in home countries are high enough, economic migration will be considerably lower. The sustainable difference of wages is the level at which the employees in the poor countries accept it, so that they tend to stay home, and at which the workers in the rich world are happy that their jobs are not taken away by cheap labour and foreigners overflowing their country.

The phenomenon of economic migration has been studied by many scholars in the EU, especially in the UK (e.g. by OECD, 2012; Dustmann et al., 2003 and Holland et al., 2011). The situation within the western part of Europe is rather unique since the region is stable, and at certain moments in time the internal borders were opened for free flow of workers (i.e. the transition from strict control of working permits to no working permits at all). At these moments of transition, monitoring took place of what happened with the flow of economic migrants. These statistical data are used to calculate the PRP of the Minimum Acceptable Wage for the s-eco-costs in Section 2.2.2.

Unfortunately, we could not find a similar situation outside Europe where pure economic migration has been monitored with sufficient statistical data (the situations USA-Mexico, Zimbabwe-Bostswana, and the poor countries around Australia are different because in those regions strict border control is hindering economic migration). The free flow of economic migrants *within* the USA (the states have different minimum wages) and *within* China might be comparable, but also on that we could not found any statistics.

The authors would like to stress that it is not the intention of Fig. A2.1 to predict the size of migration (which is not the subject of this paper), since migration in general is affected by many other factors as well, such as well-being (with the many aspects as described in (OECD, 2011; Helliwell et al., 2013) and in the Inequality-adjusted Human Development Index); barriers for migration (physical and legal); cultural differences and extreme local conditions (e.g. wars, starvation). The subject of this paper is what is being described as ‘economic migration’ in relation with the role of production companies in this respect.

2.2 The subcategory-indicators

2.2.1 General

The s-eco-costs of a product are based on the salaries per working hour of shop floor employees, the working conditions, and the required time to make a product. These data must be measured at the factory and based on the actual situation.

To benchmark unsustainable situations on the level of a country, statistical data have to be used.

In this paper we apply the following general conversion factors to define the calculation system of the s-eco-costs (based on price level 2014):

- Calculations on the Minimum Acceptable Wage are done on the basis of Purchasing Power Parity (because the normal exchange rates of currencies would give the wrong picture). For data see the website of the OECD (OECD, 2015a). The conversion factor in the s-eco-costs metrics is: 1 Int $ PPP = 0.83 euro.
- To calculate the salaries per working hour in a country outside the European Union, the general norm of the ILO, 49 weeks of 48 hours, is applied, minus 14 public holidays. This results in 2240 hours per year, 280 days of 8 hours per year, 6 days of 8 hours per week, for 46.7 weeks (note that work in overtime is calculated separately).
- To calculate the salaries per working hour within the European Union (and in the s-eco-costs system to be used as the global benchmark of a fair minimum wage per hour), the following norms have been used: 1840 hours per year, 230 days of 8 hours per day, 5 days of 8 hours per week for 46 weeks (see Table 6 in Annex A for an overview of the norms for working hours). Applying the aforementioned ILO standard would not result in a fair benchmark per hour, because the working hours in the EU are less than the ILO standard, so applying the ILO standard for the minimum fair wage would lead to a hourly wage that would be too low.

In the following Sections 2.2.2 through 2.2.6, the five subcategory-indicators are defined for each subcategory. Per subcategory of the s-eco-costs, the choices which have been made are described step by step:

- first, the issue of the subcategory (i.e. a description of the unsustainable problem)
- then, the PRP (the minimum target level) is proposed for the subcategory, to enable the distance-to-target calculation
- finally, the characterisation function (equivalent to the characterisation factors in E-LCA) is determined, which is the key to the distance-to-target subcategory-indicator score (Int $ PPP/hour, or DALY/year) for the specific working condition in a production facility

The factors that are required to create the end-score (euro/hour) are proposed in Section 2.3.

2.2.2 Minimum Acceptable Wage subcategory-indicator

The issue. The difference of wages between the rich countries and in the developing countries is not only unfair, but is unsustainable as well. It is causing an increasing pressure of migration of shop floor workers to the rich countries, as confirmed by Dustmann et al. (2003). There is no other solution for this problem than to bring all

wages to a fair level.

The PRP. The performance reference point in the s-eco-costs system is the point where the issue is solved (this is similar to the approach of marginal prevention costs in the eco-costs system). To find the PRP, we analysed the migration within Europe, which has been studied extensively (e.g. by OECD, 2012; Dustmann et al., 2003 and Holland et al., 2011). Dustmann et al. suggest that there is virtually no migration when the income per capita in the poor country is higher than 2/3 of that of the rich country, and that migration starts below 1/2. This assumption is more or less confirmed by the data of Holland et al. (2011). Since the s-eco-costs system requires a PRP on shop floor wages, we calculated the relationship between migration and the ratio of the minimum wages in the poor and the rich countries (the 'relative minimum wage') within the European Union. See Fig. A2.1. This figure shows that migration increases with low wages, and that migration stops at a ratio of approximately 50%. The dotted curve in Fig. A2.1 is a curve-fit ($y = 0.1\ x^{-0.396}$, $R^2 = 0.7593$), which crosses the 50% line at 0.037% emigration per year, which might be regarded as a sustainable migration flow. Note that the data in Fig. A2.1 are after the accession of the countries, so migration between countries without physical and legal boundaries.

The minimum wage in the rich countries of the EU member states is around 1775 Int $ PPP per month, plus or minus 15%, year 2014 (Wageindicator Foundation 2015; OECD 2015), so the PRP for Fair Wage is 0.50 x 1775 = 888 Int $ PPP per month (888 x 12 / 1840 = 5.79 Int $ PPP per hour).

The characterisation function. The characterisation function of the Minimum Acceptable Wage Deficit is determined by the marginal prevention costs, which is in this case distance to the target (the PRP), see Fig. A2.1. In formula:

(1) $I_{MAW} = PRP_{MAW} - S_{hour}$ if $PRP_{MAW} > S_{hour}$

(2) $I_{MAW} = 0$ if $PRP_{MAW} \leq S_{hour}$

where:

I_{MAW} = Minimum Acceptable Wage Deficit indicator (Int $ PPP/hr)

PRP_{MAW} = 5.79 (Int $ PPP/hr)

S_{hour} = actual salary per hour (Int $ PPP/hr)

Example: when a worker has an actual salary of 2.50 Int $ PPP/hr, the Minimum Acceptable Wage Deficit indicator is 5.79-2.50 = 3.29 Int $ PPP/hr

When the actual production site is not yet known, the minimum wage for countries might be taken, which can be found at (Trading Economics, 2015), and (Wageindicator Foundation, 2015).

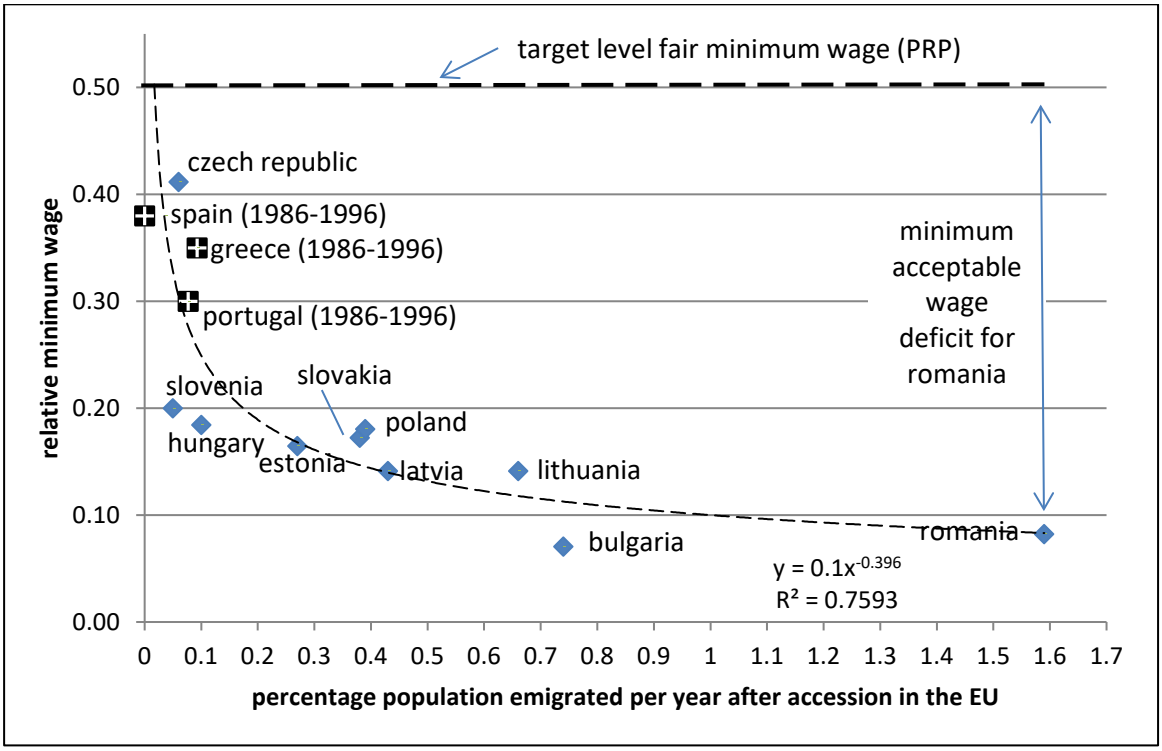

Fig. A2.1 Percentage of population migrated after the accession in the EU as a function of relative minimum wage

2.2.3 Child Labour subcategory-indicator

The issue. The definition of child labour is rather complex, but it is related to the fact that children are deprived of the opportunity to attend school (ILO, 2015). The age is not part of the definition, since it depends on culture and situation. The ILO convention on child labour takes 15 years as a basis. Worldwide, 58.6% of the child labour is in agriculture, 7.2% in industry, 25.4% in services (e.g. hotels, restaurants, retail, social personal services), and 6.9% domestic work (ILO, 2013). Child labour is in a way related to the issue of Extreme Poverty (the parents are forced to ask their children to work), but it should be eradicated anyway where it obstructs education, since education is the way out of poverty.

In the s-eco-costs system, Child Labour is not dealt with in terms of prevention costs, since the prevention measure would be more wage for the parents, which is already covered in the Minimum Acceptable Wage indicator. Child Labour is regarded as causing misery that takes place (next to unfair payment), and must as least be compensated elsewhere in the society with relief of misery. We choose to compare it to relief of misery of ill people, and apply the prevention costs for it.

The PRP. The performance reference point (the target) in the s-eco-costs system for the industry is set to zero hours/year, as a consequence of the fact that it should be eradicated. The fact that these children cannot attend school, and appalling circumstances of their lives, makes that 1 year of Child Labour is set equal to 1 'lost life year'. To quantify such a lost life year we have chosen to apply the DALY (disability-adjusted life year), which has been developed by the WHO to classify the burden of a disease from mortality and morbidity. It is also used in the ReCiPe indicator system for E-LCA. In the s-eco-costs system 2240 hours/year of child labour equals to 1 DALY as a default value.

It is obvious that there are many forms of child labour, from severe forms of slavery related to hazardous work to less severe forms of helping parents at home. It is also obvious that the age of the child plays a role as well. However, we could not find any quantified classification system, since it is still to be developed (ILO, 2015). *The consequence for S-LCA is that the default value of 1 year child labour is 1 DALY cannot be differentiated yet: the S-LCA practitioner has to decide whether or not to set this default value higher (when children are traumatised) or lower than 1 (in case of no injuries and no mental traumas).* WHO (2004) may give some guidance for comparison (a year of blindness is 0.6 DALY, a year with Dengue haemorrhagic fever is 0.55 DALY), from which it may be concluded that the choice of 1 DALY for 1 year Child Labour includes some form of subsequent damage (e.g. trauma's later in their life), since 1 DALY is more than just 1 year of misery. The reason that we propose 1 DALY as default value for 1 year of child labour, is that child labour should be eradicated anyway, so any default value is better than skipping the subject "because there is no scientific measure to differentiate".

The PRP for agriculture, services and domestic work is a bit more complicated, since many cultures stimulate children to do some work after school. Therefore the PRP for these sectors is set to 2 hours per day (2240/8 x 2 = 560 hours per year) as an absolute maximum. Above this 2 hours education is likely to suffer, which we regard as not acceptable (see Table 6 in Annex 1 for an overview of the norms for working hours).

The characterisation function. The characterisation function of child labour is:

(3) $I_{CLindustry} = H_{CL}/C_{CL}$

(4) $I_{CLagriculture} = (H_{CL} - 560)/C_{CL}$ for $H_{CL} > 560$ hours per year

(5) $I_{CLagriculture} = 0$ for $H_{CL} \leq 560$ hours per year

where:

$I_{CLindustry}$ = Child Labour indicator in industry (DALY/year)

$I_{CLagriculture}$ = Child Labour indicator in agriculture, services and domestic (DALY/year)

H_{CL} = working hours per child per year (hr/year)

C_{CL} = DALY conversion factor = 2240 (hr/DALY)

Example: when a child works 1000 hr/year in a factory, the Child Labour indicator is 1000/2240 = 0.45 DALY/year

2.2.4 Extreme Poverty and slavery subcategory-indicator

The issue. Extreme poverty in the s-eco-costs system is defined by the fact that the wage is not enough to buy enough food in the family, under the assumption that a standard family is man, wife plus 2 children (World Bank, 2005), and that either the man or the wife is employed for 2240 hours per year. Croes and Vermeulen (2016b) give an excellent overview of all variations on this assumption in literature.

Extreme poverty leads to a form of 'modern slavery', which can be considered as extreme exploitation of workers: when the wage is near to zero, the worker is caught in a poverty trap (not able to escape the terrible situation, and forced to ask his/her children to work for their own food). When the wage is zero, it is slavery.

The PRP. For a wage of zero (slavery) the indicator is proposed as 1 DALY/year. The reason for this default value, and the deliberations why, is similar to that of child labour (see Section 2.2.3). The PRP, however, is the level where this specific problem is over: the point where there is enough wage for food and other essential things for living. The calculation of the PRP is based on the assumptions of the World Bank: the 1.25 Int $ PPP (2005) absolute poverty line (the absolute minimum needs for living per person per day), and the assumption that aforementioned standard family is 2.7 people equivalent: the man is 1, the woman is 0.7, and a child is 0.5 person equivalent (World Bank, 2005). Applying the food price index of the FAO for the period 2005 – 2014 (food became factor 1.7 more expensive), we assume 1 worker per family (2240 hours, 280 days per year), which results in the PRP of the Extreme Poverty:

1.25 x 2.7 x 1.7 x 365/280 = 7,48 Int $ PPP per day, 2094 Int $ PPP per year, 0,935 Int $ PPP per hour.

This PRP is the target in the s-eco-costs system for the Extreme Poverty indicator.

The characterisation function. The characterisation function of Extreme Poverty is:

(6) $I_{EP} = (PRP_{EP} - W_{year})/C_{EP}$ if $PRP_{EP} > W_{year}$

(7) $I_{EP} = 0$ if $PRP_{EP} \leq W_{year}$

where:

I_{EP} = Extreme Poverty indicator (DALY/year)

PRP_{EP} = 2094 (Int $ PPP/year)

W_{year} = actual wage per year (Int $ PPP/year)

C_{EP} = DALY conversion factor = 2094 (Int $ PPP/DALY)

Example: when the salary of a worker is 1000 Int $ PPP/year, the Extreme Poverty indicator is (2094 –1000)/ 2094 = 0.49 DALY/year

Note. Double counting with the Minimum Acceptable Wage Deficit indicator is avoided in the system, as explained in Fig. A2.2, Section 2.3.

2.2.5 Excessive Working Hours (forced labour) subcategory-indicator

The issue. This issue is related to the fact that at some production sites workers are forced to work more than 48 hours per week, leading to exhaustion. When this is involuntary, it is to be regarded as a form of modern slavery. It is reported frequently in the Chinese production facilities for electronic equipment (CLW, 2012).

To quantify the Excessive Working Hours we propose the DALY as indicator (as we did in Section 2.2.3 for Child Labour and in Section 2.2.4 for Extreme Poverty), proportional to the number of Excessive Working Hours.

The PRP. The performance reference point (the target) in the s-eco-costs system for extreme working hours is set to zero (as far as the working hours are involuntary).

The characterisation function. The characterisation function of Excessive Working Hours is:

(8) $I_{EWH} = (H_{EWH} - 2240)/C_{EWH}$ only for $H_{EWH} > 2240$

where:

I_{EWH} = Excessive Working Hours indicator (DALY/year)

H_{EWH} = working hours per year (hr/year)

C_{EWH} = DALY conversion factor = 2240 (hr/DALY)

Note. In case of very irregular working times, it is advised to do the calculation on a weekly basis.

Example: when a worker has to work 2500 hr/year, the Excessive Working Hours indicator is (2500-2240)/2240 = 0.12 DALY/year

2.2.6 Occupational Safety and Health (OSH) subcategory-indicator

The issue. Legislation in the field of Health and Safety is different from country to country, and the way specific production sites adhere (or not) to the legislation is a matter of local culture, norms and values of the

management. So although the indictor is important, the problems are the way the data can be gathered in manufacturing plants and non-disclosure of this data of a company. It is relatively easy to interview workers on their wage and working hours (via asking them when they are not at work), but data on sick leave and injuries they might have had in the past can only be gathered via the management (because they probably do not remember the exact data of sick leaves or injuries of themselves nor of their colleagues). In the textile producing countries it is not so easy to collect this kind of data because the (sometimes corrupt) executives in this sector are often not too open about these issues. To obtain the right LCI data it could help to exert pressure from the downstream companies via purchasing and expediting procedures.

The PRP. The performance reference point (the target) in the s-eco-costs system for work related injuries, illness, and mortality is zero.

On the level of countries, worldwide, data were gathered more than 10 years ago (ILO 2003), and there are many examples - as described by e.g. Berik and Rodgers (2010) and Mariani (2013) - that the situation in general has not been improved in the textile producing countries since then.

For the OSH indicator we analysed 'work related illness and accidents causing at least 4 days absence' and 'work related mortality' (ILO 2003).

The characterisation function. The characterisation function of OSH is:

(9) $I_{OSH} = (C_A \times P_A) + (C_M \times P_M)$

where:

I_{OSH} = OSH Indicator (DALY/yr)

P_A = number of accidents and work related illness causing over 4 days' absence per year/number of workers

P_M = number of work related death per year/number of workers

C_A = average lost life year per case (DALY)

C_M = average lost life year per calamity (DALY) = average life expectancy in a country - age of the worker

Note 1. C_A is rather small: estimate from US data (BLS, 2013) is less than 1/12 = 0,08 DALY

Note 2. Characterisation factors for countries can be found at www.ecocostsvalue.com tap data

2.3 The monetary end-scores

The goal of the s-eco-costs method is to benchmark products (from cradle-to-gate, from cradle-to-grave, or from cradle-to-cradle). The end-scores must therefore be given 'per hour of processing', and must be monetised, to fulfil requirement number 3 of Section 2.1.1.

So the last step in the s-eco-costs system is to monetise the DALY. In the medical science, the DALY is used to make comparisons in terms of prevention costs. It was developed by the WHO to access the costs efficacy of medical cure in the developing countries (where financial resources are scarce). Because of the progress in medical science, efficacy of medical care in the rich countries becomes an issue as well ("we cannot give more medical treatment than our society can afford"). For pharmaceutical products a maximum price of 40.000 to 50.000 euro per DALY is accepted in Europe, however, higher prices are suggested for medical cure in hospitals. In the USA the price of kidney dialysis ("the dialysis standard") is proposed as the maximum price for 1 DALY (Grosse, 2008) (King et al. 2005), being 82.000 US $ in 2009 (NIH, 2012). Although the DALY cannot be used as tool for medical decision making on the level of the individual patient (Cleemput et al., 2011), it is often used for general guidance for higher level policy decisions. RVZ (2006) proposes 80.000 euro per DALY in Europe. One of the basic principles for the eco-costs, as well as for the s-eco-costs, is that a life in a poor country has the same value as a life in a developed country, so we apply 80.000 euro per DALY.

This results in the following conversion factors in the s-eco-costs method:

- Minimum Acceptable Wage Deficit 1 I_{MAW} (Int $ PPP/hr) = 0.83 (euro/hr)
- Child Labour 1 I_{CL} (DALY/year) = 80.000/2240= 35.71 (euro/hr)
- Extreme Poverty 1 I_{EP} (DALY/year) = 80.000/2240= 35.71 (euro/hr)
- Excessive Working Hours 1 I_{EWH} (DALY/year) = 80.000/2240= 35.71(euro/hr)
- OSH 1 I_{OSH} (DALY/year) = 80.000/2240= 35.71 (euro/hr)

Fig. A2.2 shows the characterisation lines for extreme poverty and fair wage deficit. This figure demonstrates that - to avoid double counting - the fair wage deficit should not be accounted for when the wage is lower than 0.823 Int $ PPP per hour. In that case only the s-eco-costs of extreme poverty should be taken into account (and the s-eco-costs of fair wage must be left out).

The total s-eco-costs can be calculated as following:

(10) Total s-eco-costs = $0.83 \times I_{MAW} + (I_{CL} + I_{EWH} + I_{OSH}) \times 80000/2240$ euro for $S_{hour} > 0.823$

(11) Total s-eco-costs = $(I_{CL} + I_{EP} + I_{EWH} + I_{OSH}) \times 80000/2240$ euro for $S_{hour} < 0.823$

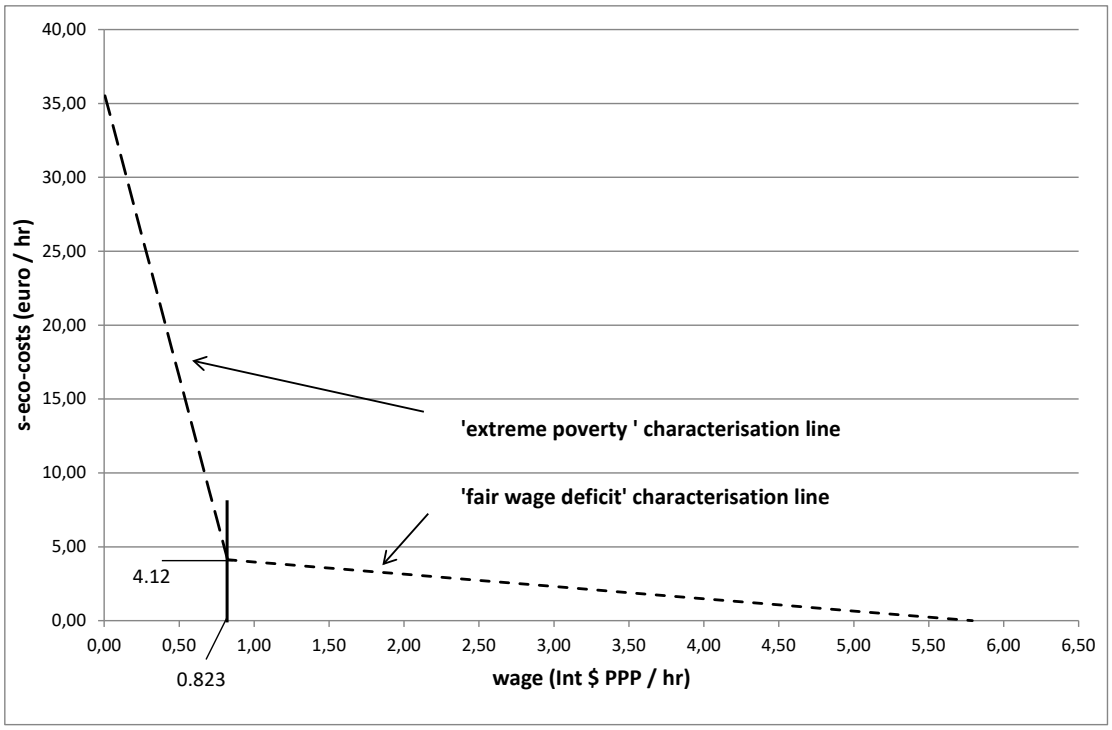

Fig. A2.2 The s-eco-costs as a function of the wage

This s-eco-costs method has been made operational in the Simapro LCA software. A Simapro CSV import file can be found at the homepage of www.ecocostsvalue.com

References

See main text