OCCUPATIONAL HEALTH AND SAFETY

October 2022

True pricing method for agri-food products

Occupational Health and Safety

Impact-specific module for true price assessment

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This document provides the occupational health and safety impact-specific module for the assessment of the true price of an agricultural or horticultural product, within the PPS 'Echte en Eerlijke prijs' developed by True Price and Wageningen Economic Research. It provides information on quantification and monetisation of this impact and it is meant to be used in combination with the **True Pricing Assessment Method for Agri-food Products**. The **Valuation Framework for True Price Assessment of Agri-food Products** explains the underlying framework. Both these documents are developed within the same project.

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[3]For more information on the *PPS True and Fair Price for Sustainable Products*, please refer to https://www.wur.nl/nl/project/Echte-en-eerlijke-prijs-voor-duurzame-producten.htm

Relation to other components of the true price methodology for agri-food products

*This **Occupational Health and Safety – Impact-specific module for true price assessment** was developed by True Price and Wageningen Economic Research within the PPS True and Fair Price for Sustainable Products.*

This document contains the key methodological aspects to measure and value one social impact of the true price of agri-food products and value chains: "Negative effects on workers' health and safety", focusing on occupational injuries. Furthermore, it covers other health and safety aspects.

*This impact-specific module is complemented by four **Social and human capital modules** and five **Natural capital modules**. The other social capital modules, developed within this project, are: 1) Living income; 2) Animal welfare; 3) Consumer health; 4) Child labour. These impact-specific modules are preceded by the **Valuation framework for true pricing of agri-food products*** (Galgani et al., 2021a)*, which contains the theoretical framework, normative foundations and valuation guidelines, and the **Assessment Method for True Pricing of Agri-Food products**, which contains modelling guidance and requirements for scoping, data and reporting (Figure 1).*

Together, these documents present a method that can be used for true pricing of agri-food products, and potentially other products as well.

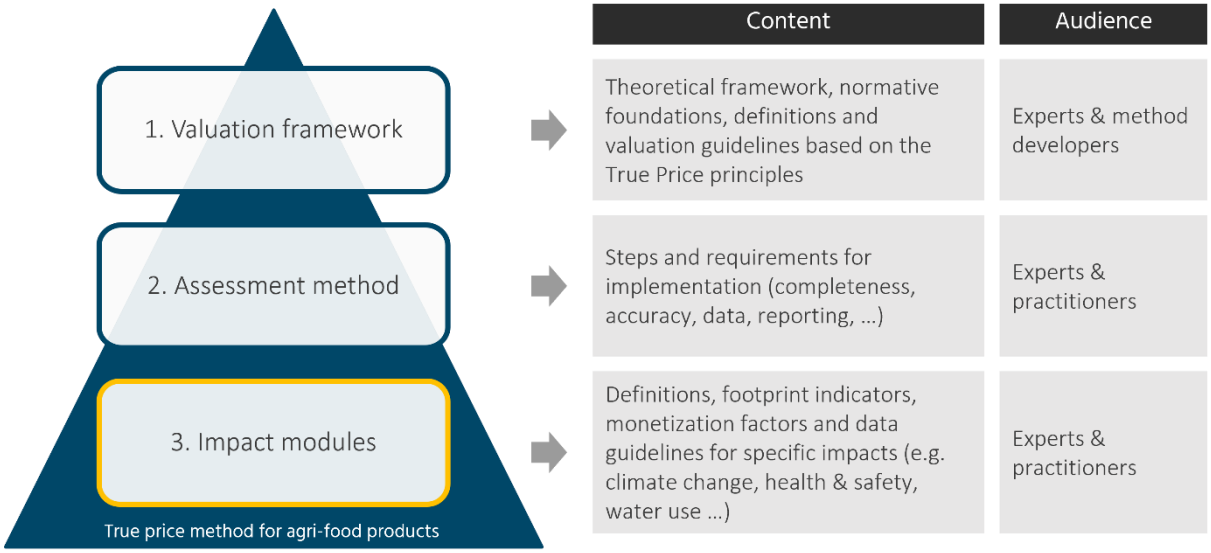

Figure 1: Components of the true price methodology for agri-food products. This document is one of the impact modules.

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1 Introduction

The true price is the market price of a product plus social and environmental costs, representing negative effect, or impacts, on society and the environment of the its production and consumption.. This document provides a method module for the assessment of the true price of an agricultural or horticultural product, within the public-private partnership 'Echte en Eerlijke Prijs'. It discusses the key aspects to one of the social impacts of agri-food products and their value chains: "**Negative effects on workers' health and safety**" and provides the key methodological aspects to measure and value one specific part of this impact: the negative effects of **fatal and non-fatal occupational injuries**. The inclusion in the true price of other negative effects on workers related to occupational health and safety is discussed in the annexes.

This module is meant to be used together with the **True Pricing Assessment Method for Agri-food Products** (Galgani et al., forthcoming)**,=** but it can be of interest to readers that want to learn more about measuring and valuing occupational health and safety impacts in agricultural value chains and in social LCA**.**

This module is organised as follows: Section 2 defines the impact Occupational Health and Safety. Section 3 discusses the scope of effects included. Section 4 includes the rationale for including this impact in a true price assessment. Section 5 shows which effects are captured and valued for this impact (the valuation model). Section 6 summarises the relevant footprint indicators, while Section 7 provides the monetisation approach. Lastly, Section 8 provides an overview of limitations and key items for further research. In addition, annexes with further information are provided at the end of the document.

2 Definitions

Occupational Health and Safety (H&S) within true pricing is covered by the impact called "***Negative effects on workers' health and safety***". The following relevant definitions are used in this module:

- ***Negative effects on workers' health and safety*** concerns the negative effects on workers' health and safety at work, specifically the extent to which working in the value chain negatively affects the safety and overall health status of the workers.
- **Health**, in relation to work, indicates not merely the incidence of occupational disease or infirmity, but also includes the physical and mental elements affecting health, which are directly related to safety and hygiene at work (Goedkoop et al., 2020; ISO, 2010).
- **Safety** is understood as the extent to which working can lead to fatal and non-fatal injuries, as well as the application of prevention measures and management practices to reduce their incidence.

- An **occupational H&S incident** is '*an occurrence, condition, or situation arising in the course of work **that resulted in or could have resulted** in injuries, illnesses, damage to health, or fatalities'* (CCOHS, 2019). This is a broader term that also covers accidents in the workplace. The term incident is preferred since accidents often imply that the event was related to fate or chance, yet in most cases when the root cause is determined, '*it is usually found that many events were predictable and could have been prevented if the right actions were taken'*, which removes the fate or chance aspect that defines an accident (CCOHS, 2019).
- **Workers** (as specified in the name of the impact) covers both **hired and other** labourers. Examples of workers that fall under the category hired labour that the method can be applied to are: permanent, seasonal, migrants, formal, informal and underage/child labourers. Other labourers that the method can be applied to are, for example, volunteers, smallholder farmers, family labour and self-employed people, as they are people working in the value chain of a product. On the other hand, the method

doesn't apply to subsistence farmers, as it focuses on the true price gap[4] of products that enter the market. In section 5.2, the difference of using the method for hired labour, as well as volunteers, and other labour is further explained (see explanation of compensation costs).

The above is a broad definition that covers and informs the reader on all types of hazards and effects related to occupational H&S in (agri-food) value chains. Section 3 specifies which of the negative effects on worker's health and safety are in scope of this module.

2.1 Solving the problem: remediation or internalisation

Another consideration for the development of the present method is the challenge of evaluating the extent to which these hazards can fully be eliminated (and the external costs thus internalised) by introducing preventative measures or risk control measures. Annex A provides a short discussion on acceptable risk in relation to occupational H&S. However, the true price assessment methodology focuses on providing transparency on the external costs related to the harm done and does this through an estimation of the costs to remediate the negative effects. The main body of the module provides a method to estimate the external costs of occupational injuries, in which every incident is considered as an external cost.

3 Scope

The following section first briefly examines the common negative effects on workers' H&S in agrifood value chains in order to illustrate the importance of developing a method to account for Occupational H&S. Then the methodological challenges of including certain effects, such as illness and chronic disease, are discussed and the negative effects that are in scope of this module are listed.

3.1 Negative effects on workers' Health and Safety

Negative effects on worker Health and Safety are an important problem in agriculture (Prüss-Ustün et al., 2011; WHO & ILO, 2021). Estimating the value of work-related incidents that result in an occupational injury, illness or disease is a challenging task. A first step to determine the external costs of occupational H&S incidents is understanding the hazards related to the field of work under study. According to ILO (2000), for agriculture, one of the most hazardous occupations worldwide, the most frequent hazards are related to:

- *'machinery such as tractors, trucks and harvesters, and cutting and piercing tools;*
- *hazardous chemicals: pesticides, fertilizers, antibiotics and other veterinarian products;*
- *toxic or allergenic agents: plants, flowers, dusts, animal waste, gloves (chrome), oils;*
- *carcinogenic substances or agents: certain pesticides such as arsenicals and phenoxy-acetic herbicides, UV radiations, parasitic diseases such as bilharziasis and facioliasis;*
- *transmissible animal diseases: brucellosis, bovine tuberculosis, hydatid disease, tularaemia, rabies, Lyme disease, tinea, listerioses;*
- *other infectious and parasitic diseases: leishmaniasis, bilharziasis, facioliasis, malaria, tetanus, mycosis;*
- *confined spaces such as silos, pits, cellars and tanks;*
- *noise and vibration;*
- *ergonomic hazards: use of inadequate equipment and tools, unnatural body position or prolonged static postures, carrying of heavy loads, repetitive work, excessive long hours;*
- *extreme temperatures due to weather conditions;*
- *contact with wild and poisonous animals: insects, spiders, scorpions, snakes, certain wild mammals'*.

[4] The true price gap of a product is the sum of all remediation costs of all unsustainable externalities caused by the production and consumption of that product (Galgani et al., 2021a)

Some of these hazards can result in **occupational injuries** while others are related to **occupational illness and chronic disease** (occupational disease).

The intensive use of machinery and of hazardous synthetic pesticides and other agrochemicals in arable farming has raised the risks. Use of machinery, such as tractors and harvesters, has the highest frequency and fatality rates of injury (ILO, 2000). Exposure to pesticides can result in acute pesticide poisoning, which is the medical term used to describe the health effect of people that showcase symptoms, such as headaches, nausea, vomiting or even organ failure, shortly after contact (Heinrich-Böll-Stiftung, BUND & PAN Germany, 2022). But contact with pesticides and other agrochemicals can also trigger chronic diseases. Scientific studies show a connection between pesticides and Parkinson's disease and childhood leukemia. In addition, pesticides are associated with an increased risk of liver and breast cancer, type II diabetes and asthma, allergies, obesity and endocrine disorders (Heinrich-Böll-Stiftung, BUND & PAN Germany, 2022).

3.2 Negative effects included in the method: occupational injuries

While all the hazards and their related negative effects listed above are known, official data on the incidence of occupational diseases are not well documented. The incidence of occupational injuries is more directly related to negative effects on workers and therefore, these effects are included in this module.

3.3 Negative effects not included the method: occupational diseases

This relation between hazards and incidence of health effects is less clear for occupational diseases. Moreover, chronic conditions due to exposure to pesticides, other chemicals and dust, noise or vibration are more difficult to evaluate due to their long-term effects and uncertain symptoms (ILO, 2000). Finally, as far as the authors are aware, too few scientific studies that quantify the relationship between exposure to hazardous chemicals, other toxic agents or transmittable/infectious diseases at work, and the resulting health damage or fatality are available to include these effects in the true price methodology in a valid manner. Therefore, the effects of hazards on illness, chronic disease, and other physical and mental health damages remain an item for further research. A possible approach to address these in a true price method is discussed in Annex B, but left out of scope for the main body of this module.

3.4 A note on data availability

The method described in the following sections allows practitioners to account for the negative effect of occupational injuries with use of collected primary data, or with relevant data gathered from secondary sources. However, the availability of data in the level of granularity described in the method is not always available by secondary sources. This limits the possibility of Occupational Health and Safety to be included in an assessment of a true price of a product, when primary data are not available. This is a limitation that can be encountered in most social impacts. Still, the method gives an insight on which type of data should be collected by actors/organisations related to the agri-food sector to meaningfully include this in true pricing, and other quantitative sustainability impact assessments.

4 Background and rationale for including as part of the true price method

This method takes a rights-based approach[5] to select the externalities to include in a true price assessment. Therefore, it is important to highlight the basic rights of individuals and groups that are impacted by the negative

[5] In this context, achieving a sustainable society means achieving a society in which everyone's rights are respected, including those of future generations. Therefore, a sustainable product is a product for which no rights are violated. In the context of true pricing it means that every right that is violated is regarded as contributing to an unsustainable impact. See also the documents *The Valuation Framework for True Price Assessment of Agri-food Products* (Galgani et al., forthcoming).

effects on Occupational H&S. Relevant rights are *the right to a decent standard of living* and *the right to the enjoyment of the highest attainable standard of physical and mental health*. These rights fall under at least three international conventions, namely the International Bill of Human Rights (Article 5) (UN General Assembly, 1948), the International Covenant of Economic and Social Council (Articles 7 and 12) (UN General Assembly, 1976) and the Sustainable Development Goals (Goal 3) (UNFCCC, 2015). From these rights, a responsibility for the value chain actors[6] to prevent negative effects on worker health and safety could be derived. This applies to occupational injuries and occupational diseases alike.

5 Model

Section 3 outlined the negative effects included in this module and section 4 specified how these effects relate to the rights-based approach. First, this section provides an overview of the valuation model used to determine the external costs of any negative effect on worker health and safety. Second, the cost types included in the model specifically for occupational injuries are described. Last, the costs that are not covered in this module or are covered by other impacts are listed.

5.1 Valuation of negative effects

The valuation of the negative effects of occupational H&S is based on the responsibility of businesses to provide remedy when violations of rights have led to adverse impacts (UN OHCHR, 2011). The valuation approach uses a remediation cost approach and follows the **Valuation Framework for True Price Assessment of Agri-food Products** (Galgani et al., 2021a).

The Valuation Framework is based on the UN Principles for Business and Human Rights definition of remediation. This states that "*where business enterprises identify that they have caused or contributed to adverse impacts, they should provide for or cooperate in their remediation through legitimate processes*. […] *Remedy may include apologies, restitution, rehabilitation, financial or non-financial compensation and punitive sanctions (whether criminal or administrative, such as fines), as well as the prevention of harm through, for example, injunctions or guarantees of non-repetition"* (UN OHCHR, 2011).

In this framework, severity and (ir)reversibility of the damage are the main factors that guide the principles of the remediation costs that are applied. According to the report "*What amounts to 'a serious violation of international human rights law'*?" by the Geneva Academy, violation of the right to health, as well as deplorable conditions of work, are considered as serious violations of human rights. Social impacts are deemed to lead to severe damage to people if they can be linked to serious violations of human rights of specific individuals (Geneva Academy, 2014).

The Valuation Framework principles that determine the remediation costs for the impact of Occupational H&S are the following:

- Severe damage to people or communities is restored if technically feasible
- Damage to people or communities is compensated if it is not restored
- Severe and irreversible damage to people or communities is prevented from re-occurring
- Damage that constitutes violations of legal or well-accepted obligations are retributed

[6] These are economic actors such as businesses, consumers, investors, government. The true price is based on the idea that the economic actors collectively have a responsibility to either produce and consume sustainable products, or to remediate all unsustainable negative impacts. However, the true price is agnostic to how the responsibility is shared among the economic actors (e.g., whether consumers would need to pay extra, or producers would need to pay for the remediation at the expense of their profit margins, or other) (Galgani et al., forthcoming).

When negative effects on worker's health and safety arise, this can lead to loss of health that can be reversible or irreversible. This, in turn, can lead to economic and non-economic damage for workers. This damage includes, for example, healthcare costs, lost income and well-being loss. The valuation of these effects consists of their remediation cost. The next section describes these remediation costs for Occupational H&S, under the context of this module which covers occupational injuries, as well as other types of costs that are not covered by this module but can be related to the impact of Occupational H&S.

5.2 Remediation costs for occupational injuries

For Occupational H&S, the remediation cost consists of three cost types:

- **Compensation** cost for (past and future) well-being loss and economic damage incurred by workers as a consequence of negative H&S effects.
    - **Well-being loss** is incurred by any worker in the value chain who suffers from an occupational injury.
    - **Economic damage** due to healthcare costs is incurred only by *hired labourers and volunteers who are not insured* for occupational H&S incidents by their employers. Employers have the responsibility to provide this insurance. When incidents are insured and paid by their employer, or the insurance company of the employer, these costs are internalised and are not part of the true price gap. On the other hand, workers that fall under the "other labour" category[7] bear the responsibility to cover the economic damage of such incidents themselves. In this sense, these costs are already internalised in the production cost of a product and they aren't part of the true price gap.
- **Retribution** cost for breaches of H&S regulations[8] that put workers health at risk. This is a type of justice cost, or moral cost that comes from not meeting obligations towards society and individuals. According to the valuation framework when violations of legal or well accepted obligations are present, this cost is added on top of the other costs. H&S regulations or standards in the workplace are well accepted obligations by the ILO (ILO, 1981). These standards are further described in section 6.3. True Price has proposed a method to quantify this cost based on legal penalties. The cost should only be included to the extent that no penalties have been already paid for these violations. This method is described in more detail in section 7.2.2.
- **Prevention of re-occurrence cost**, since some health effects will be irreversible and violations of the right to health is considered a severe form of damage. Following the valuation framework, prevention costs of re-occurrence are included for impacts that are irreversible and severe. This refers to the prevention of future situations to occur, rather than prevention of the impact that caused the damage under study. Prevention of re-occurrence costs are the costs that would allow to invest in measures that avoid, avert or prevent the social and environmental impacts of a product in the future.

Including retribution and prevention costs in the model of Occupational H&S, and other social impacts, is a methodological choice, derived from the definition of remediation from the UN Principles for Business and Human Rights, as described in section 5.1[9]. The use of sanctions and prevention of re-occurrence costs as a valuation method is an innovation and practitioners have the option to not include these costs in the final true price, however this choice should be clearly stated

[7] Workers that fall under the category "other labour" are listed in section 2. Volunteers are excluded in this case.

[8] The Global on Database Occupational Safety and Health Legislation (ILO, n.d.) offers an overview of regulations for individual countries.

[9] This methodological choice has been made by True Price and not Wageningen University & Research.

5.3 Costs covered by other modules and costs not included

Not all negative effects related to occupational H&S and their remediation costs are addressed in the present method, as mentioned previously. Moreover, certain costs linked to negative effects included in this module are covered in other impacts of the true price method. Costs that are not included in the current model are:

- **Hazards not related to injuries –** Remediation costs linked to hazards other than injuries. Examples of such costs are costs relating to exposure to use of agrochemicals, costs relating to mental health issues, costs relating to work-life balance (including burn -outs) or costs relating to unclear sources of infection – for example the external cost of contracting malaria from mosquito bites at work versus home. The difficulties of developing a concrete method to include other types of negative effects is illustrated by the example of (synthetic) pesticides in Annex B. A first approach to cover other negative health effects for workers, in case a model to quantify these affects is available, is provided in the same Annex.
- **Absence of work –** Economic costs linked to absence from work due to occupational incidents and diseases is not included under occupational H&S. Productivity loss is a cost borne within the value chain and therefore the cost to society is not an external cost. If this absence from work is uninsured, there is also a loss of income for the worker. This is an external cost, but it is part of a separate set of social costs of this method, under the impact **Underpayment and lack of social security**, including denied paid sick leave.
- **Health and safety of consumers, local communities and the public –** Remediation costs related to negative effects on the health and safety of non-workers, including the consumers of these products and the communities that might be affected by the environmental outputs of agricultural processes. These effects are not part of the present document, but are addressed in other impact-specific modules for true price assessment, such as Consumer Health (Manouchehrabadi et al., forthcoming) and Air, Soil and Water pollution (Galgani et al., 2021b)**.** Negative health effects for smallholder farmers are partly covered by the module Living Income Gap (Galgani, P. & van Veen, B., forthcoming) (see also section 6.2.1 of present module).

6 Quantification

6.1 Footprint indicators

The footprint indicators to quantify the selected effects of the impact "*negative effects on occupational health and safety"* are categorised following the three types of remediation costs mentioned in section 5.2:

- Occupational injuries that should be *compensated* with a distinction between fatalities and non-fatal injuries. The latter indicator is further separated into insured and uninsured injuries.
- Breaches of health and safety standards that should be *retributed*. These are divided into two types; work performed in violation of H&S standards, and breaches of health & safety standards resulting into occupational injuries[10].
- Labour force that should be audited for H&S to *prevent* re-occurrence of incidents.

Each of the three categories has a distinct set of footprint indicators (Table 1):

Table 1: Overview of footprint indicators for negative effects on occupational health and safety

Category	*Footprint indicator*	*Footprint sub-indicator*	*Unit*

[10] The difference between the two types related to exposing workers to violations of these standards and actual violations occurring.

Occupational injuries	Non-fatal occupational injuries	Insured	Injuries/unit output
		Uninsured	Injuries/unit output
	Fatal occupational injuries		Fatalities/unit output
Breach of health and safety standards	Work performed in violation of H&S standards		FTE/unit output
	Occupational injuries with breach of H&S standards		Injuries/unit output
Labour force to be audited for H&S	Labour force to be audited for H&S		FTE/unit output

An FTE is a Full Time Equivalent, representing the number of worker-hours in one year of full-time work for one person. The footprint indicators, alongside the formulas and data needs that are associated with them, are described in more detail in the following chapters.

6.2 Occupational injuries

Occupational injuries, fatal and non-fatal, often represent the most important part of the cost of negative effects on workers' H&S. The rest of this section explains how they are quantified.

6.2.1 Non-fatal occupational injuries

Non-fatal occupational injuries are further distinguished to insured and uninsured ones. This distinction allows the assessment of the impact of negative effects on occupational health and safety only for costs that have not already been internalised. Section 5.2 describes which costs are considered as internalised in the present method. Subsequently, monetisation factors between insured and uninsured injuries will be different. Two footprint sub-indicators emerge from this distinction**: Uninsured non-fatal occupational injuries** and **Insured non-fatal occupational injuries**.

Uninsured non-fatal occupational injuries refer to the number of injuries among workers (hired labour and volunteers) whose medical costs were covered by the affected worker rather than by the employer, their health insurance or social security schemes. In other cases, the injuries are considered to be uninsured. Other workers such as family labour is excluded from this indicator, as their healthcare costs are not considered an external effect and are part of the calculation of living income (Galgani, P. & van Veen, B., forthcoming).

The sub-indicator can be calculated as follows:

$$UNFI = f_{nfi} * EL * MC_{nc} \quad (1)$$

Where

$UNFI$ is the footprint sub-indicator *Uninsured non-fatal occupational injuries* (expressed in injuries per FTE)

f_{nfi} is the frequency of non-fatal injuries that occurred (expressed in injuries per FTE)

EL is the share of external labour[11] working in the value chain (expressed in %)

MC_{nc} is the share of medical costs that are not covered by the employer or work insurance (expressed in %)

Frequency of non-fatal occupational injuries is the ratio between non-fatal injuries that occurred in the considered time frame (normally, one year) and production unit (one farm, or one sector), and the total amount of labour (total workforce)[12] of that production unit in that time frame.

Subsequently, the following data are needed for the quantification of this sub-indicator:

- Total number of injuries that occurred
- Total amount of labour (FTEs) in the production unit when injuries occurred
- Share of external labour
- Share of medical costs that are not covered by insurance schemes and are paid by the workers that fall under external labour. If no medical costs are insured, this is equal to 100%.

Insured non-fatal occupational injuries refer to the total number of injuries among the total workforce whose medical costs are covered by occupational health insurance. This sub-indicator can be calculated as follows:

$$INFI = f_{nfi} * MC_c \quad (2)$$

Where

$INFI$ is the footprint sub-indicator *Insured non-fatal occupational injurie*s (expressed in injuries per FTE)

f_{nfi} is the frequency of non-fatal injuries that occurred (expressed in injuries per FTE)

MC_c is the share of medical costs that are covered by the employer or work insurance (expressed in %)

Subsequently, the following additional data are needed for the quantification of this sub-indicator:

- Share of medical costs that are covered by employer or work insurance (%). This can be determined taking into account the share of costs covered for each injury and/or the share of injuries (or workers) covered. It should be complementary to the 'share of medical costs that are *not* covered by employer or work insurance' mentioned above.

If more detailed information is available about the number of incidents that occurred *per type of injury*, then this distinction can be applied to quantify non-fatal injuries with a higher level of detail. For more information on this refer to Annex C.

Note: The above footprint sub-indicators should be normalised to the unit output of the product under study. This normalisation is specified in Section 6.5.

[11] Hired labour and volunteers

[12] Hired labour and other labour

6.2.2 Fatal occupational injuries

Fatal occupational injuries refer to the number of deaths as a result of work-related injuries within an organisation. The indicator can be calculated as follows:

$$FI = f_{fi} \quad (3)$$

Where

FI is the footprint sub-indicator *Fatal occupational injuries* (expressed in fatalities per FTE)
f_{fi} is the frequency of fatal injuries that occurred (expressed in fatalities per FTE)

Frequency of fatal occupational injuries is the ratio between fatal injuries that occurred in the considered time frame (normally, one year) and production unit (one farm, or one sector), and the total amount of labour (total workforce) of that production unit in that time frame.

Subsequently, the following data are needed for the quantification of this indicator:

- Total number of fatal injuries that occurred
- Total amount of labour (FTEs) in the production unit when injuries occurred

The above formula is used **when no compensation was paid to the family of the deceased**. However, it needs to be corrected in case compensation was received. This requires an additional data point, namely the *Share of loss not compensated by payment from employer (%)*.

When compensation was paid to the family of the deceased, the indicator can then be calculated as follows:

$$FI_c = f_{fi} * L_{nc} \quad (4)$$

Where

FI_c is the adjusted footprint indicator *Fatal occupational injuries corrected for compensation received* (expressed in fatalities per FTE)
f_{fi} is the frequency of fatal injuries that occurred (expressed in fatalities per FTE)
L_{nc} is the share of loss not compensated by payment from employer (expressed in %).

L_{nc} can in turn be calculated as follows:

$$L_{nc} = 1 - \frac{C}{VSL} \quad (5)$$

Where

C is the compensation received by the family of the victim that is paid by the employer (expressed in EUR per incident of fatality)
VSL is the Value of Statistical Life (expressed in EUR per incident of fatality)

Subsequently, the following additional data are needed for the quantification of the indicator when compensation has been paid to the family of the victim:

- The amount of compensation received by the family of the deceased
- The Value of Statistical Life. This is taken from OECD (2012) and is further described in section 7.2.1.3.

Note: The above footprint indicator should be normalised to the unit output of the product under study. This normalisation is specified in Section 6.5

6.3 Breach of Health and Safety Standards

Specific standards are defined within production sectors to safeguard the health and safety of all workers. The violation of these requirements, and the presence of occupational injuries due to lack of these standards, are accounted for with the footprint indicators **Work performed in violation of H&S standards** and **Occupational injuries with breach of H&S standards**.

H&S standards have several dimensions (ILO, 1981):

I. Safe and healthy work environment
   (a) Workplaces, machinery, equipment and processes under their control are safe and without risk to health, so far as is reasonably practicable[13].
   (b) Chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken, so far as is reasonably practicable.
   (c) Provisions, where necessary, of measures to deal with emergencies and accidents, including adequate first-aid arrangements
II. Necessary, adequate protective clothing and protective equipment to prevent risk of accidents or of adverse effects on health
III. Workers and their representatives in the undertaking are given appropriate training in occupational safety and health

These dimensions are summarised in three types of breaches that can be quantified in FTE:

- *Workers without H&S training*: representing workers that did not receive the required H&S training,
- *Work performed without Personal Protective Equipment* (PPE)
- *Work performed in unsafe or unhealthy environment*

Training and use of Personal Protective Equipment (PPE) are basic H&S requirements that should always be followed. Work in unsafe or unhealthy environment is an umbrella category to include all other H&S breaches that depend on the employer. The specifics of what this means are sector dependent.

To quantify **Work performed in violation of H&S standards,** the average of these three types of breaches is calculated as follows:

$$W_{VHS} = \frac{W_{WT} + W_{WPPE} + W_{UE}}{3} \quad (6)$$

Where

W_{VHS} is the footprint indicator *Work performed in violation of H&S standards* (expressed in FTE in violation per total FTE)

W_{WT} is work done by workers without H&S training (expressed in FTE of all workers without training per total FTE)

W_{WPPE} is work done by workers without PPE (expressed in FTE of all workers without PPE per total FTE)

[13] See Annex A for a discussion of acceptable risks.

W_{UE} is work performed in unsafe or unhealthy environment (expressed in FTE of all workers performing work in an unsafe or unhealthy environment per total FTE)

W_{UE} can be calculated as follows:

$$W_{UE} = \frac{H_{UE}}{TH} \quad (7)$$

Where

H_{UE} are the total amount of hours of work carried out in unsafe or unhealthy environment
TH is the total amount of hours of worked carried out

More often, W_{UE} is calculated as:

$$W_{UE} = \frac{WE_{UE}}{TL} \quad (8)$$

Where

WE_{UE} are the workers exposed to unsafe or unhealthy environment (expressed in FTE)
TL is the amount of labour in the production unit (expressed in FTE)

The two ways to calculate W_{UE} yield the same result, because the ratio between H_{UE} and WE_{UE} is the size of an FTE in yearly hours, and equivalent to the ratio between TH and TL.What constitutes an unsafe or unhealthy environment needs to be further specified based on the H&S requirements employers should meet in the considered country or sector, beyond training and PPE. For example a requirement can be to not enter a field for a certain amount of time after pesticides are sprayed.

Subsequently, the following additional data are needed for the quantification of the indicator:

- FTEs of all workers in the production unit
- FTEs of workers without H&S training in the production unit
- FTEs of workers without PPE in the production unit
- FTEs of workers exposed to unsafe or unhealthy environment in the production unit

Finally, breaches that are linked to incidents leading to occupational injuries are quantified separately, looking at the indicator **Occupational injuries with breach of H&S standards.** This can be estimated as follows:

$$I_{BHS} = (f_{nfi} + f_{fi}) \times W_{VHS} \quad (9)$$

Where

I_{BHS} is the footprint indicator *Occupational injuries with breach of H&S standards* (expressed in injuries per FTE)

The variables of the formula and the data needed to quantify these factors have been described in the previous sections.

Note: The above footprint indicators should be normalised to the unit output of the product under study. This normalisation is specified in Section 6.5

6.4 Labour force to be audited for Health and Safety

The last indicator is a metric to capture the total workforce, since the cost to implement measures to prevent future severe and non-reversible impacts (such as incidents leading to severe injuries) is dependent on the size of the workforce at risk. **It is included in a true price assessment only if data shows the presence of breaches of H&S standards**. Types of breaches that are material for labour force to be audited for H&S are the same as section 6.3. Prevention costs considered are the costs to introduce a third party monitoring for health and safety.

This indicator can be calculated as follows:

$$LF_{AHS} = 1 - LF_m \quad (10)$$

Where

LF_{AHS} is the footprint indicator *Labour force to be audited for Health and Safety* (expressed in FTE of labour not being audited per total FTE)

LF_m is the share of labour force with third party monitoring for health and safety (expressed in FTE of labour being audited per total FTE)

Subsequently, the share of labour force that is monitored by a third party for health and safety is needed.

Note: The above footprint indicator should be normalised to the unit output of the product under study. This normalisation is specified in Section 6.5

6.5 Expressing footprint indicators per unit output using labour intensity

Normalisation is required to scale the results of an assessment from worker level to the level of one product. All footprint indicators in Table 1 are expressed per unit output (for example, injuries/unit output for the indicator *Non-fatal occupational injuries*). The equations provided in the sections above give results per FTE, not per unit output. To convert the footprint indicators in unit output they need to be multiplied with the labour intensity of the considered process in the life cycle (e.g. farming, or food processing).

- A **unit output** is the unit of product output of the single process in the life cycle, or single value chain step studied. The unit output can differ for each life cycle process under study (for example, a kg of cacao beans, a kg of cocoa butter, a bar of chocolate after manufacturing) [14].
- An **FTE** is a Full Time Equivalent, representing the number of worker-hours in one year of full-time work for one person. The final step is to assess footprint indicators per unit output.
- **Labour intensity** is the amount of work needed to produce a certain amount of product, expressed in FTE per unit of output. It is determined by dividing the total amount of work[15] (expressed in FTE) with the total production of the examined production unit(s), be it farms, production facilities, or other.

If footprint indicators expressed in FTE and labour intensity data are available for individual production units in the considered value chain (e.g. multiple farms, multiple processing facilities), then the footprint indicators per unit output can be calculated for each production unit. In order to aggregate the data of multiple production units, it is recommended to carry out a weighted average by output, so that facilities that produce most weigh the most, and vice versa.

[14] To aggregate results for *several* process in the life cycle, one more calculation step is required, namely conversion to the so-called *functional unit* of the study. This step is described in the True Price Assessment Method (Galgani et al., forthcoming)

[15] Hired and other labour.

6.6 Potential sources of data

The quantification of the indicators listed above involve a substantial number of data to use. Primary data collection usually offers the best data quality. If collecting primary data is not possible, then an approximation can be made by using secondary data on frequency of fatal and non-fatal injuries, coverage by health insurance of employees and use of personal protective equipment. Sector level databases for number of injuries and fatalities can be found in ILOSTAT (ILOSTAT, 2022), Eurostat (Eurostat, 2022) or in U.S. Bureau of Labor Statistics (U.S. Bureau of Labor Statistics, n.d.). These data points are often collected and published at sector level. Product data on health insurance and compliance with legislation could also be found in product level reports.

Data scarcity is a known challenge for quantifying social impacts like occupational H&S, when compared to environmental impacts. The present module also serves as a guide on the relevant data points that should be collected by relevant stakeholders and organisations involved in agri-food value chains, in order to initiate a systematic approach to estimate this impact.

7 Monetisation

7.1 Monetisation Factors

Each of the footprint indicators presented in chapter 6 are associated with a monetisation factor. Together, the summation of all indicators and monetisation factors represents the remediation cost of *Negative effects on occupational health and safety*. Table 2 gives an overview of the resulting monetisation factors at 2021 price levels. Monetisation factors are rounded to three significant figures since they don't represent actual costs but an estimation of those based on available sources.

Table 2: Monetisation factors (2021 price levels)

Footprint indicator	*Footprint sub-indicator*	*Unit*	*Value - Global*	*Value -NL*	*Source*
Occupational injuries					
Non-fatal occupational injuries	Insured	EUR/injury	3,620	3,620	(OECD, 2012)
	Uninsured	EUR/injury	3,740	4,020	(OECD, 2012; RIVM, 2022; Stam, C. & Blatter, B., 2020; WHO, 2021)
Fatal occupational injuries		EUR/fatality	3,070,000	3,070,000	(OECD, 2012)
Breach of health and safety standards					
Work performed in violation of H&S standards		EUR/FTE	1,860	1,860	True Price Penalty Database (see 6.2.2)
Occupational injuries with breach of H&S standards		EUR/injury	4,130	4,130	True Price Penalty Database (see 6.2.2)
Labour force to be audited for H&S					
Labour force to be audited for H&S		EUR/FTE	8.55	8.55	(SAAS, 2013)

A breakdown of the different types of costs comprising these, as well as an overview of the valuation approach, are presented in the following sections.

7.2 Valuation approach

The monetisation factors are selected based on the **Valuation Framework for True Pricing Agri-Food Products** (Galgani et al., 2021a). They represent the cost to *remediate* negative impacts. The principles used to select remediation costs for each impact and the costs included in the impact of Occupational H&S have been briefly described in section 5.1 of this document. More information on remediation costs and how these are selected

according to a set of principles which consider the degree of reversibility, severity and illegality of an impact can be found in the Valuation Framework for True Pricing Agri-Food Products (Galgani et al., 2021a, Section 4).

There are three type of costs used to derive monetisation factors for H&S, as mentioned in section 5 (Valuation model). Injuries are valued using compensation cost, which includes the value of health loss, compensation for healthcare costs and the value of fatalities. Breaches of H&S standards are valued using retribution cost, which is based on a database of penalties created by True Price. Labour force to be audited is linked to audit costs to quantify prevention cost. Figure 2 summarises the valuation approach used for each indicator.

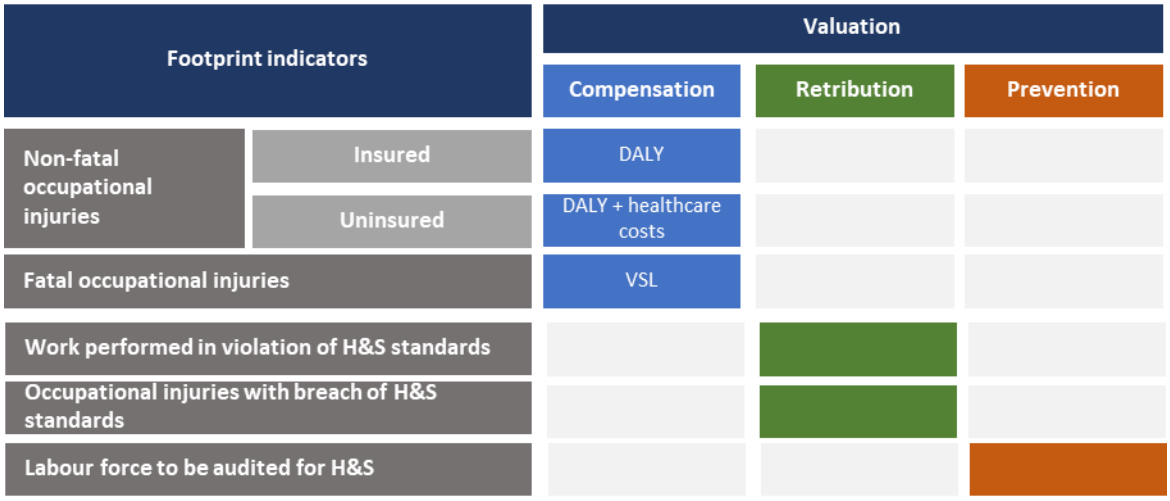

Figure 2: Valuation approach used for each indicator. DALY stands for Disability-Adjusted Life Year, while VSL stands for Value of Statistical Life.

The three different types of remediation costs utilised in the Occupational H&S valuation model, together with the sources used to derive them, are further described in the following sections: compensation cost (section 7.2.1), retribution cost (section 7.2.2) and prevention cost (section 7.2.3).

7.2.1 Compensation cost

Compensation costs apply to non-fatal and fatal injuries.

There are three types of compensation costs that are accounted for:

- Compensation for the value of health lost due to non-fatal injuries (well-being loss) measured in **DALY** (Disability-adjusted life year)
- Compensation for direct **healthcare costs** (medical costs) of non-fatal injuries
- Compensation for fatal injuries, estimated through the **Value of a Statistical Life** (VSL).

These costs are applied in the different (sub-)indicators as seen below.

Footprint indicators		Valuation		
		Compensation	Retribution	Prevention
Non-fatal occupational injuries	Insured	DALY		
	Uninsured	DALY + healthcare costs		
Fatal occupational injuries		VSL		
Work performed in violation of H&S standards				

7.2.1.1 DALY valuation

The well-being loss cost of *Non-fatal occupational injuries* is quantified and valued using DALY from WHO statistics on the impact of occupational accidents. The DALY indicator measures the loss in worker well-being and, in some cases, future earning reduction.

The amount of DALYs lost due to an adverse health event is estimated as the sum of Year of Life Lost (YLL) and Years of Life lived with Disability (YLD)[16] (WHO, 2020). YLL in this case can be left out as it only applies to fatal accidents. The average YLD of injuries is estimated based on the global YLD due to injuries (both occupational and non). It is based on the ratio between global burden of injuries and global incidence of injuries in the Global Burden of Disease study from 2013. The total burden of injuries globally is 32,900,000 YLD[17], while the amount of incidents corresponding to this value is equal to 940,463,000 (Haagsma et al., 2016). This is equivalent to an average of 0.035 DALY per incident.

It is possible to derive a more specific value of DALY loss due to occupational injuries, if information is available about the frequency of different types of injuries in the considered value chain. Annex C contains different YLD equivalents for different types of injuries.

To convert DALY loss to a monetary value, a meta-analysis of 92 willingness-to-pay studies carried out by the OECD in 2012 is used[18]. OECD published average values for the Value of a Statistical Life (VSL). The average VSL for health is 2,574,140 US$ (OECD, 2012, Table 1, p.12 2005 price level). An average valuation of one Year of Life Lost (YLL, assumed to be valued the same as a DALY) of 86,750 US$ can be derived by dividing this VSL by the average life expectancy of the respective respondents of the studies included in the meta-analysis (equal to 29.67 years, determined as the difference between the average life expectancy and the average age of respondents of each study[19]). This is equivalent to EUR/DALY 103,461 (2021 price level).[20]

[16] DALYs for a disease or health condition are the sum of years of life lost due to premature mortality (YLLs) and years of healthy life lost due to disability (YLDs) due to prevalent cases of the disease or health condition in a population.

[17] Injuries attributed to War and disaster are excluded from this value.

[18] For further justification on the choice of DALY value refer to the Impact-specific module for true price assessment: Air, Soil and Water Pollution (Galgani, P. et al., 2021b, chapter 7.3.1).

[19] The dataset with average age of respondents in each study is available in (OECD, 2012).

[20] This is based on the original value of $US\$_{2005}$ of 86,744, which is equal to EUR_{2016} 98,347 based on an inflation rate of 1.255 for the US and the World bank exchange rate to euro of 0.9034. The accumulated inflation to 2021 (1.0521) gives the final value of EUR 103,461.

7.2.1.2 Healthcare costs

Direct healthcare costs are quantified as treatment cost per injury, relevant only for costs borne by hired labour[21] that are not covered by the employer (uninsured injuries). For other labour healthcare costs are not taken into account (see section 5.2 for further explanation)

The treatment cost per injury is calculated for an average injury based on Dutch data[22] and adapted to other countries using WHO estimates on Health service delivery costs at a country level. To adapt the Dutch value to a different country we multiply by the ratio between costs in The Netherlands and costs in the target country [23]. Health service delivery costs represent the estimated cost per hospital bed-day. These estimates represent the "hotel" component of hospital costs, i.e., excluding the cost of drugs and diagnostic tests but including costs such as personnel, capital and food costs (WHO, 2021). For the Netherlands this value is equal to 397 EUR per injury in 2021 prices, while the global average is calculated as 123 EUR per incident.

7.2.1.3 Value of Statistical Life

Compensation for fatal injuries is estimated through the Value of Statistical Life (VSL). The VSL is considered to also include future income loss for the family of the victim. It should be noted that for fatal injuries where workers are not insured, it is possible that the family has incurred medical costs. However, economic compensation for healthcare costs are not quantified separately for *Fatal occupational injuries*, as the VSL is high enough that it can be assumed that these would be negligible.

The monetary value of VSL is based on the same OECD meta-analysis of 92 willingness-to-pay studies (OECD, 2012). The average VSL for health is 2,574,140 US$ (OECD, 2012, Table 1, p.12 2005 price level). This is equivalent to EUR 3,070,192 (2021 price level), which is rounded to EUR 3,070,000 (Table 2: Monetisation factors (2021).

7.2.1.4 No regional adjustment of VSL and DALY valuation

An important consideration is whether a regional adjustment of the value of DALY and VSL should be applied, to reflect differences in willingness-to-pay by people in countries with different income, living costs and life expectancy. While both options can be defended, it is decided for the time being not to apply a regional adjustment to the VSL and DALY values used. The reason for this is to consider the health of workers equally, independently of the income level and the price level of the country where they live. Since this is a normative choice, we suggest that this choice is further discussed with experts and stakeholders in the field. The original value from OECD includes values from different locations and years, and for comparability purposes it is already expressed in the original source in 2005 US dollars using Purchasing Power Parity (PPP) adjustment.

7.2.1.5 Build-up of monetisation factors for injuries

For *Insured non-fatal occupational injuries* the monetisation factor is estimated based on Compensation for Health loss (derived from the amount of DALYs lost and the monetary value of a DALY presented in section 7.2.1.1). For *Uninsured non-fatal occupational injuries* the monetisation factor consists of two costs:

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[21] And volunteers.

[22] $Cost\ of\ an\ injury\ NL = \frac{Total\ cost\ of\ injuries\ in\ the\ Netherlands\ in\ 2019}{Amount\ of\ medically\ treated\ injuries\ in\ the\ Netherlands\ in\ 2019}$. Total cost of injuries in the Netherlands in 2019 is equal to 1,966,200,000 EUR (RIVM, 2022), while the Amount of medically treated injuries in the Netherlands in 2019 is equal to 5,050,000 (Stam & Blatter, 2020)

[23] The country-specific WHO estimates are represented by the mean value of health services estimated from a sample of 30 countries (Stenberg et al., 2018). For example, in the case of the Netherlands this is equal to 722 $PPP in 2010, while for the case of Philippines it's 42 $PPP in 2010, resulting in a WHO estimate ratio equal to 0.06 for the Philippines and a Healthcare cost equal to 39 EUR in 2021 (WHO, 2021). **This method is applied to all countries with WHO estimates and an average of all mean values of health services is taken for the global value**.

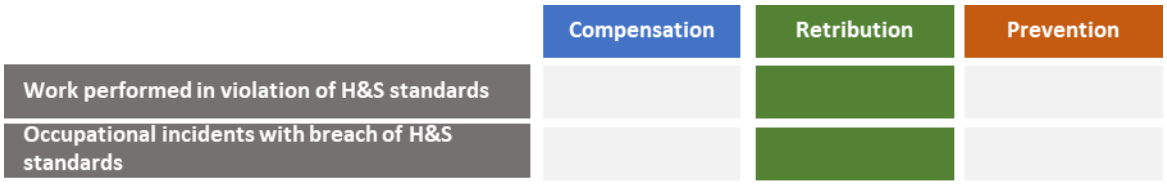
Compensation for Health loss (same as above) and Compensation for Healthcare costs (explained in 7.2.1.2). Table 3 gives an overview of this build up.

Table 3: Build-up of the 2021 monetisation factor for Non-fatal occupational injuries.

Component		Unit	Value (NL)	Value (Global)
Average DALY loss non-fatal injuries	*A*	*DALY/injury*	*0.035*	*0.035*
DALY value	*B*	*EUR 2021/DALY*	*103,461*	*103,461*
Monetisation factor Insured non-fatal occupational injuries	C=A*B C (rounded)	EUR 2021/injury	3,621 **3,620**	3,621 **3,620**
Average healthcare costs for an occupational injury	*D*	*EUR 2021/injury*	*397*	*123*
Monetisation factor Uninsured occupational non-fatal injuries	E=C+D E (rounded)	EUR 2021/injury	4,017 **4,020**	3,743 **3,740**

For *Fatal occupational injuries*, the monetisation factor is directly based on the VSL as explained in 7.2.1.3

7.2.2 Retribution cost for breaches of H&S standards



Retribution costs represent a component of social costs of labour and Human rights impacts that is not part of conventional approaches to value non-economic goods. This component is a sort of justice cost, or moral cost that comes from not meeting obligations towards society and individuals.

7.2.2.1 The penalties method for retribution costs

True Price has proposed a method to **quantify this cost based on legal penalties**. Penalties are mentioned explicitly as part of remediation in the UN Principles for Business and Human Rights (See also section 5). With this method, **retribution costs represent an international population-weighted average of legal sanctions for legal violations** related to the considered impact.

True Price has collected a database[24] with a list of fines for Human and labour rights violations in different countries. For each violation that can be measured as part of a true price assessment, a corresponding set of fines in various countries is used to estimate a weighted global average. The key elements of the method to derive retribution costs that can be applied to footprint indicators are presented below:

[24] The penalties database is not a published source but it was created by True Price based on publicly available laws that for the impact *Occupational Health and Safety* are listed in this section.

- It is assumed that the penalty for a violation defined in the law is applicable for violations as measured in the true price methodology, which is measured in units like EUR, number of FTEs exposed, or injuries in the case of occupational H&S.
- Different countries can specify penalties for specific legal violations in multiple ways, such as a fixed fine, a maximum fine, a minimum fine, a number of years of imprisonment, or a combination. If this is the case, the method needs a system to translate these to comparable fines.
- For each violation, a set of countries is selected based on accessibility of information, language, population size and representation of different geographies and legal systems. As this True Price method uses international rights to define what constitutes a violation of business responsibility, only countries where a penalty for the considered legal violation exists are taken into account.
- Penalties are converted to the same currency-year for comparability. Conversion to International $ uses the World Bank's PPP rates and inflation to 2021 price levels uses inflation from the year where the studied regulation has been published.
- Countries are assigned weights based on the square root of population size[25], following the methodology used to allocate seats to countries in the UN General Assembly.

7.2.2.2 The penalties method applied to Occupational H&S

There are two types of violations that are identified, in relation to H&S in value chains in this module.

- Work exposed to H&S breaches
- Injuries with H&S breaches

The country sample for both *Work performed in violation of H&S standards* and *Occupational injuries with breach of H&S standards* consists of the Netherlands, India, USA and Brazil, based on the criteria described in section 7.2.2.1.

In the Netherlands, a fine of 4500 Euros (price level 2019) is enforced for the absence of a Risk Inventory and Evaluation, that investigates whether the work can pose a danger or cause damage to the health of the workers (Arboned, 2020). This is multiplied by a factor 3.5 for incidents[26] leading to permanent health consequences.

In the USA, a violation of the 29 U.S. Code 654, that defines the duties of employers and workers concerning occupational safety and health standards, is assessed a civil penalty of up to $7,000 (price level 2011) (LII, n.d.). Countries also define higher fines for violations that lead to permanent, severe or fatal incidents, equal to $10,000.

In Brazil there is a section of laws, known as CLT (Consolidação das Leis do Trabalho), that establish rules for the collective and common labour relations. If an employer does not obey or does not act in accordance with this rules they can be charged with penalties by the Ministry of work. Breaking the security in the work place rules, can lead to a fine between 670.89 to 6,708.59 BRL, in 2013 prices (Duran, 2013). These two ends of the range are taken for the two types of H&S violations under study.

India's Bill No.93 of 2014, defines a minimum penalty of 5,000 rupees in case of an accident causing serious bodily injury, while for accidents causing death the minimum fine is equal to 25,000 rupees, in 2014 prices (Ministry of Labour and Employment, 2014). These are minimum fines for exposure of workers to a serious

[25] Countries are weighted with sqrt(population size)/1000.

[26] According to Article 1 of the Policy Rule on the imposition of fines Working Conditions Legislation (Artikel 1 van de Beleidsregel boeteoplegging Arbeidsomstandighedenwetgeving), in the event of an industrial accident that leads to permanent injury, the standard fines for the underlying violations are multiplied by 3.5 for moderate permanent injuries (Overheid, 2020).

bodily injury, poisoning or disease or death due to a manufacturing process or operation carried on in a factory. The research did not identify fines for a H&S breach that does not lead to accidents. The above mentioned minimum fines are taken for the two types of occupational H&S violations in India.

The resulting retribution costs are equivalent to 1,863 EUR per FTE exposed and 4,133 EUR per injury in 2021 prices for Work performed in violation of H&S standards and Occupational incidents with breach of H&S standards respectively. These values are rounded to 1,860 EUR per FTE and 4,130 EUR per incident, respectively (Table 2: Monetisation factors 2021). Annex D provides the overview of the values used.

7.2.3 Prevention cost for labour force to be audited

The prevention of re-occurrence cost represents the one-off costs to be incurred by the value chain actors to put systems in place that can prevent the severe and irreversible impacts to re-occur in the future. Following the valuation framework, prevention costs of re-occurrence are included for impacts that are irreversible and severe. Violation of the right to health is considered a severe form of damage.

The value is the average cost to set up an auditable certification standard on socially acceptable practices in the workplace, expressed per worker. This should represent a one-off cost, meaning that it needs to be paid once. For this reason, only the initial accreditation costs are included to value occupational audit systems. The cost of the SA8000 Social Accountability Accreditation is used as a proxy. The average cost per worker for an organisation is taken. This prevention cost estimate is used for all Human and Social Capital impacts of this methodology[27], since this value represents the cost of setting up an audit system that covers all social responsibility practices in the workplace. Because of this, to estimate the prevention cost of occupational H&S this value is divided among the nine impact groups, or themes, related to workers' rights[28] in the true price methodology. This assumes that accreditation for a single theme would be proportionally cheaper, for simplicity.

The prevention costs represent application and assessment fees[29], and come up to an average $37,700 (2021 price level) (SAAS, 2013) per accredited company. These initial accreditation costs are then converted to a weighted average value per worker, based on the number and distribution of workers employed by SA8000 certified facilities, resulting in an average of 77.0 EUR per worker, in 2021 price levels. Annex E provides a more detailed overview on the way this value is derived.

Assuming 1 FTE equivalent to 1 worker, the resulting accreditation cost for each social impact in the True Price method is EUR 8.55 per FTE (2021 price level) (Table 2: Monetisation factors (2021).

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[27] True price includes 9 social impacts in total in each methodology, where penalties are included: Child labour, Forced Labour, Discrimination, Underpayment in the value chain, Lack of social security, Excessive and underpaid overtime, Occurrence of harassment, Lack of freedom of association and Negative effects on employee health and safety.

[28] H&S, harassment, child labour, forced labour, underpayment, social security, overtime, freedom of association, discrimination.

[29] Assessment fees include document review, office audit, witness audit, report writing and travel expenses.

8 Limitations and items for further research

8.1 Limitations

1. The guidelines provided to quantify and monetise occupational non-fatal injuries are based on an average global DALY load of an injury. This is a reasonable simplification assuming that over a large volume of incidents the distribution of more and less severe injuries will always be similar. However, it is also possible to look at specific types of injuries more in detail (Annex C). The current approach could lead to an underestimation of incidents, for example if simple injuries are not reported.
2. Market prices may already incorporate penalties paid and environmental taxes that are used to restore damage caused by violation of international rights. These taxes and penalties are already included in the market prices and counting them in the true price gap should be avoided. This problem is at this moment not addressed by the framework.
3. The current method is not worked out for occupational diseases, while these are important health and safety issues, especially in the agri-food sector, and in particular on how to measure health loss from acute and chronic exposure to pesticides. Good sources of data to quantify the risk of occupational diseases, which can be linked to measurable company indicators or practices are limited. A problem with including this kind of impacts is that in many cases there is no clear relationship between certain working conditions and the onset of certain diseases.
4. Lack of available secondary data can limit the possibility of capturing the impact at a product level. Secondary databases exists at sector level, or data can be found. While primary data can be collected, this requires a large effort. Secondary data values can be used, but this will reduce the accuracy and applicability of the calculated values. The decision to collect primary data or not should be in line with the goal of the study and the materiality of this impact in the overall study. More information on data quality, goal of the study and materiality can be found in the *True Price Assessment Method* (Galgani et al., forthcoming).
5. Level of acceptable risk is not included, making every incident an external cost even if measures have been taken.

8.2 Items for further development

1. Further develop methodology to include occupational diseases as part of negative effects on workers' health and safety. Since the use of pesticides is considered as a great risk for the H&S of workers in the agricultural and food sector, the level of occupational exposure and its association with short- and long-term health effects should be estimated in a product level. Other occupational diseases are also material. Quantification and monetisation approaches to capture the impact of this should be developed.
2. Expert review of penalty database approach
3. Compare true price methodology on Occupational Health and Safety with Social LCA methods
4. The degree to which the estimated costs are already internalized (i.e. already part of the production cost of the considered product) is difficult to determine. This can lead to overcounting.
5. Discuss with experts and stakeholders the normative choice of no regional adjustment of human health valuation

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Annex A: Acceptable risks for occupational H&S incidents

An occupational H&S risk can be defined as the combination of the **likelihood of occurrence** of a work-related hazardous situation or exposure, and the **severity** of injury or ill health that can be caused by the situation or exposure (GRI, 2018). Reducing such risks has a cost in itself, and risk assessments are utilised by businesses to estimate which measures can be implemented, in a manner that is feasible and cost-effective. Ultimately, it is commonly accepted that risks can be managed and mitigated, but not entirely removed. Therefore, a remaining level of risk will always exist and can hardly be eliminated. Under this context, businesses need to address the specific question "*What is the minimum risk level that 'can' (or is allowed to) remain*?" or "*How safe is safe-enough*?" (Marhavilas & Koulouriotis, 2021). Establishing this level of acceptable risk goes beyond the scope of this method module, and therefore currently every incident is considered as an external cost.

There is a variety of risk assessment methodologies and risk assessment criteria in relation to occupational H&S, but generally risks with low probability of a hazardous situation occurring and with low severity are classified as acceptable risks (Rodrigues et al., 2015). While a risk assessment can reduce the frequency and severity of occupational H&S incidents, if these occur they need to be investigated to identify their causes and required risk control measures to prevent their recurrence. The ILO Investigation of Occupational Accidents and Diseases guide for labour inspectors provides the hierarchy of risk control measures that should be followed to prevent future fatal and non-fatal incidents. Elimination of the risks that lead to hazards lays on the top of the hierarchy, followed by substitution (eg of machinery), engineering controls, administrative controls and personal protective equipment (ILO, 2015) .

Annex B: Occupational illness and other negative effects on worker health and safety – a high level approach

Occupational injuries do not tell the whole story about negative effects on worker health and safety for the agri-food sector. This Annex describes the relevance of occupational diseases for agri-food products, and proposes a high level approach to include this in a true price assessment.

The relevance of occupational illness for agri-food: the case of pesticides

Modern agriculture involves a massive utilisation of pesticides and fertilisers to increase crop protection and production. Occupational exposure to pesticides in agriculture concerns a variety of worker types, like product distributors, mixers and loaders, applicators, bystanders, and rural workers re-entering the fields shortly after treatment (Maroni et al., 2006; Yan et al., 2016). However, assessing the exposure to pesticides is challenging due to the wide range of pesticide products registered over time and selective use by farmers. Semi-quantitative methods have been developed to estimate the cumulative exposure to pesticides by workers based on variables such as pesticide exposure intensity, pesticide exposure (personal) protection, and pesticide exposure duration (Negatu et al., 2016).

A further complication on estimating how the use of pesticides affects the health of workers, is the association and effect of low exposure in the development of disease and illness. While the link between pesticide exposure and emergence of health problems is supported with a lot of evidence, demonstrating cause and effect with chronic issues and calculating this *per unit of product* is difficult to do. Identifying the active ingredients that are the source of such health problems is challenging as well. In general '*the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of coming into contact'* (van der Maden et al., 2014). Meta-analyses on how exposure to pesticide ingredients affects the risk of developing diseases, such as Parkinson's or Alzheimer's disease, show positive associations (Tangamornsuksan et al., 2019; Yan et al., 2016). However, the studies included in the meta-analyses might concern mixed populations of occupational and environmental exposures, and an appropriate subgroup analysis is difficult to do in a systematic way. Moreover, attributing cases of illness and disease to a specific cause when there is more than one route of exposure or transmission is fraught with difficulties.

Research on high exposure to pesticides that leads to occupational unintentional[30] acute poisoning and the effect on human health is also developing. *'Acute poisoning implies the occurring of adverse effects immediately or within 24 hours after exposure to the pesticide'* (van der Maden et al., 2014). A global study on the prevalence of unintentional acute pesticide poisoning (UAPP) concluded that 44% of farmers are poisoned by pesticides every year (Boedeker et al., 2020). The study also provides a global distribution of fatal and non-fatal UAPP incidents with a better coverage of countries and data sources compared to earlier studies. Country specific studies have been conducted to estimate the health burden of such incidents at a national or regional level (Buendía et al., 2019; Ko et al., 2018), however a global study is not yet available.

From the above it can be understood that research on establishing impact pathways between pesticides and related short and long term affects in human health is developing. However the damage attributed to occupational exposure is harder to estimate and the lack of global evidence on the health burden of such incidents hinder the development of a true price method in a systematic way at the moment.

[30] Separate from self-induced poisoning.

A high level approach

In this section a potential approach to account for occupational illness and chronic diseases, including chronic negative effects of unintentional acute pesticide poisoning, and long-term exposure to pesticides is provided. To cover these aspects, a footprint indicator **Other negative health effects for workers** can be defined.

To quantify this, a model is necessary that estimates the health loss from these effects measured in DALY (Disability Adjusted Life Year), in a way that can be attributed to production in a given year and therefore to an individual product. As discussed, such a model can be complex and its development currently out of scope for this module, and a clear priority item for further research. If such models are available, however, this impact can easily be integrated in the True Price method, by quantifying and monetising this footprint indicator. The suggested footprint indicator and the corresponding monetisation factor are defined in Table 4 and Table 5 respectively.

Table 4: Footprint indicator for Other negative effects for workers

Component	*Footprint indicator*	*Unit*
Other negative health effects for workers	Other negative health effects for workers	DALY /unit output

Table 5: Monetisation factor for Other negative effects for workers (EUR 2021)

Footprint indicator	*Unit*	*Value - Global*	*Value -NL*	*Source*
Other negative health effects for workers	EUR/DALY	103,461	103,461	OECD, 2012

Annex C: DALY loss per type of injuries

It is possible that data is available on the frequency of incidents for different types of injury. These can be combined with injury-specific YLD factors, to derive a more accurate estimate of YLD (equivalent to DALY) loss due to occupational injuries. This in turn can be monetized using the monetary value of DALY presented in section 7.2.1.1. By doing so, a more accurate estimate of the cost of *Non-fatal occupational injuries* can be calculated.

Table 6 provides an overview of YLD values (health loss values) per incident linked to different types of injuries. If a similar dataset is available which is more sector-specific, this should be preferred.

Table 6: Years Lost due to Disability per incident per type of injury

Type of injury	*YLD loss per incident*	*Source*
Pinching / bumping / cutting	0,009	Calculation based on Haagsma et al. (2016)
Fall / trip	0,083	Calculation based on Haagsma et al. (2016)
Traffic	0,090	Calculation based on Haagsma et al. (2016)
Toxic substances etc.	0,022	Calculation based on Haagsma et al. (2016)
Animals	0,006	Calculation based on Haagsma et al. (2016)
Aggression (people) mental / physical	0,027	Calculation based on Haagsma et al. (2016)
Fire	0,036	Calculation based on Haagsma et al. (2016)
Other	0.027	Calculation based on Haagsma et al. (2016)

Annex D: Supplementary information retribution cost

This annex provides an overview of the country specific fines, presented in section 7.2.2 utilised to quantify international penalties for breaches in H&S standards.

Fines in original currency year are converted to Int.$ 2021 using World Bank PPP rates and inflation rates. The population weights are used for calculating a weighted average and they represent the square root of the population divided by 1,000.

Two types of violations are defined:

1. Work performed in violation of H&S standards (FTE). The resulting penalty for this indicator is equal to 1,863 EUR 2021, which is rounded to 1,860 (Table 2: Monetisation factors (2021).

Table 7: Country-specific fines used to estimate an international penalty for Work performed in violation of H&S standards.

Country	Fine in original currency-year	Original currency year	Fine in Int.$ 2021	Population weight
Netherlands	4,500	EUR 2019	5,964	4.12
USA	7,000	USD 2011	8,308	18.00
India	5,000	INR 2014	349	36.42
Brazil	670.89	BRL 2013	455	14.48

2. Occupational injuries with breach of H&S standards (incident). The resulting penalty for this indicator is equal to 4,133 EUR 2021, which is rounded to 4,130 (Table 2: Monetisation factors (2021).

Table 8: Country-specific fines used to estimate an international penalty for Occupational injuries with breach of H&S standards.

Country	Fine in original currency-year	Original currency year	Fine in Int.$ 2021	Population weight
Netherlands	15,750[31]	EUR 2019	20,873	4.12
USA	10,000	USD 2011	11,869	18.00
India	25,000	INR 2014	1,747	36.42
Brazil	6,708.59	BRL 2013	4,549	14.48

[31] For the Netherlands the fine attributed to Work performed in violation of H&S standards is multiplied with 3.5. According to Article 1 of the Policy Rule on the imposition of fines Working Conditions Legislation (Artikel 1 van de Beleidsregel boeteoplegging Arbeidsomstandighedenwetgeving), in the event of an industrial accident that leads to permanent injury, the standard fines for the underlying violations are multiplied by 3.5 for moderate permanent injuries (Overheid, 2020)

Annex E: Supplementary information prevention cost

This annex explains how the cost of an initial accreditation for an SA8000 Certification is calculated, as a basis for developing a prevention cost monetisation factor.

The application fee itself is equal to $7,500 (SAAS, 2013). Additionally, assessment fees for Accreditation Audits are included, covering document review, office audit, witness audit and report writing. These are calculated $1,400 per auditor per day, plus $650 per day for travel (SAAS, 2013). The number of Auditor days depends on several factors, including: the number of documents received in the document review, the size of the organization being audited (in an office audit), where the Certification Body is in the audit cycle, the audit plan (for a witness audit), and the number of travel days required to get to the audit (SAI, n.d.). Average audit days are listed in Table 9. To convert these assessment fees into initial accreditation costs, the maximum number of auditors and days are used. For example, the initial accreditation cost related to an office audit is calculated as $1,400 per auditor per day times 6 (2 auditors times 3 days). This is equal to 8,400 $. For travel expenses it is assumed that 2 auditors need to travel for 6 days in total to realise the assessment.

This results in a total of 37,700$ per accredited facility (Table 10: Initial SA8000 accreditation costs breakdown).

Table 9: Average audit days (SAI, n.d.)

Audit item	**Average number of Auditor days**
Document review	1-2 days
Office Audit	1-2 auditors for 2-3 days
Witness Audit	2 auditors for 2-3 days
Report Writing	1-2 days

Table 10: Initial SA8000 accreditation costs breakdown

Initial SA8000 accreditation step	**Initial SA8000 accreditation cost ($)**
Initial Accreditation- Application Fee	7,500
Initial Accreditation- Document Review	2,800
Initial Accreditation- Office Audit	8,400
Initial Accreditation- Witness Audit	8,400
Initial Accreditation- Report writing	2,800
Travel expenses	7,800
Total	37,700

The initial accreditation cost is converted to a weighted average value per worker, based on the number and distribution of workers employed by SA8000 certified facilities. These values can be seen in Table 11. The total number of people working in the certified facilities listed in Table 11 amounts to 2,103,596 and the total number of facilities is 4,760 (SAI, 2022). Therefore, there are 442 workers on average in a facility. Dividing the accreditation cost of 37,700$ by this number, a resulting average cost of 85.2 $/worker is calculated, or 77,0 EUR/worker.

Table 11: SA8000 certified facilities (by size) (Source: SAAS, 2022)

Workers employed	**Number of facilities**	**% total**
1 - 25	900	18.9%
26 - 100	1477	31.0%
101 - 250	972	20.4%
251 - 500	607	12.8%

501 - 800	254	5.3%
801 - 1200	194	4.1%
1201 - 2000	136	2.9%
2001 - 3000	94	2.0%
3001 - 6000	78	1.6%
6001 - 10,000	34	0.7%
10,001 - 15,000	8	0.2%
15,001+	6	0.1%