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Social-LCA results (system boundaries and functional unit)

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Deliverable 7.4

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Authors:	**Sophie Sfez, Léo Staccioli, Benjamine Belloncle, Rocío Barros**
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Publishable Executive Summary

The GREENER project aims at developing green, sustainable, efficient, and low-cost solutions for soil/sediment and water bioremediation that will effectively accelerate the remediation time of a range of organic and inorganic pollutants of high concern. WP7 aims at assessing the sustainability of the developed technologies, as well as conducting a Regulatory, Legal and Risk Assessment of the demonstration sites. This deliverable is the preliminary version of D7.4 – Social-Life Cycle Assessment (SLCA) results (system boundaries and functional unit).

More specifically, this document is the introductory report to Social Life Cycle Assessment applied to the GREENER technologies. It presents the method of SLCA as defined in the UNEP-SETAC guidelines (UNEP/SETAC 2009 and 2020). Then, it looks upon the previous applications of this method found in the literature, to identify the potential approaches which could be followed in GREENER.

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1. Objectives

This deliverable aims to:

- Introduce the method of Social Life Cycle Assessment
- Present relevant approaches found in the literature
- Propose first methodological approaches which will be followed in GREENER

2. Introduction to Social Life Cycle Assessment

The methodological approach considered for this study follows the UNEP guidelines as integrated in the methodology presented in the following studies:

- Simões, M., Carvalho, A., Lucas de Freitas, C., Barbosa-Póvoa, A.P. (2014) "Social Life Cycle Assessment-Standardisation of Mid-Point impact categories" - 4th LCA business Conference.
- Simões, M., Carvalho, A., Lucas de Freitas, C., Barbósa-Póvoa, A.P. (2014) "How to assess social aspects in supply chains?", Computer Aided Chemical Engineering. (Simões et al., 2014)
- Silva, P., Lucas de Freitas, C, Carvalho, A. (2015) Social sustainability in supply chains, Master Thesis.
- Popovic, T., Carvalho, A., Kraslawski, A., Barbosa Póvoa, A. (2016) "Framework for assessing social sustainability in supply chains", Computer Aided Chemical Engineering. (Popovic et al., 2016)
- Popovic, T., Kraslawski, A., Barbosa Póvoa, A., Carvalho, A. (2017) Quantitative indicators for social sustainability assessment of society and product responsibility aspects in supply chains, Journal of International Studies. (Popovic et al., 2017).

The four steps of Social LCA are described below, following the UNEP-SETAC guidelines (UNEP/SETAC 2009 and 2020).

2.1 Goal and scope definition

While in environmental LCA the functional unit is defined with regard to a reference flow, it is not always possible or wanted in SLCA, especially if the social impacts of the plant or organization where the technology is set up are evaluated. Indeed, these social impacts, such as the compliance to standards or job creation, cannot always be allocated to the product itself. Moreover, one user of the SLCA results might be interested in knowing if the production of a given product impacts a specific social issue along the supply chain (e.g. if the use of plastic packaging creates a risk of child labour elsewhere in the world, as for example in the production country of the raw material), while another user might prefer knowing the social impacts of the plant producing the packaging itself (e.g. benefits from the jobs creation at a local scale). Two levels can therefore be defined when conducting a SLCA (Figure 1):

- Level 1 accounts for the impacts and benefits from the supply chain related to the process/plant/organization under study.
- Level 2 accounts for the impacts and benefits from the process/plant/organization where the process under study is implemented.

Depending on the analyzed technology sector, one can choose to focus on one or both of these levels.

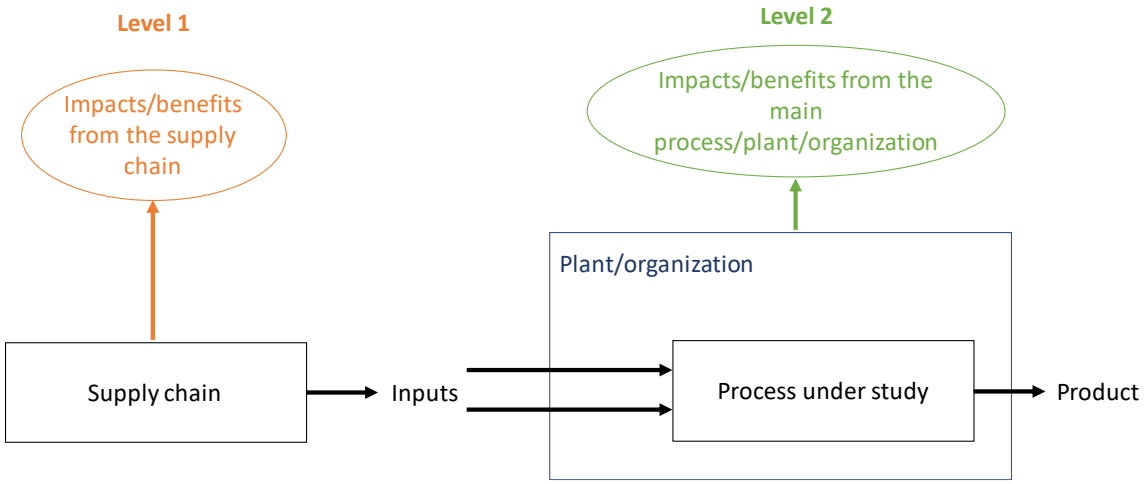

Figure 1: The two possible levels of assessment in Social LCA.

2.2 Inventory Analysis

This step consists in collecting data on social impacts along the supply chain and/or at a specific production site/organization.

First, the social issues and stakeholders impacted by the product's production need to be defined to make a relevant data collection The UNEP-SETAC guideline defined five stakeholders' categories: workers, consumers, local community, society and value chain actors. For each of these groups, the guideline provides impact categories to be evaluated. In the 2020 edition, "children" has been added as stakeholder category and new impact categories have been included: employment relationship, sexual harassment, smallholders including farmers, wealth distribution, ethical treatment of animals, poverty alleviation, education provided in the local community, health issues for children as consumers, children concerns regarding marketing practices). These are summarized in **¡Error! No se encuentra el origen de la referencia.**.

Each of these impact categories gathers indicators. For examples, the impact category "Social security/social benefits" gathers indicators as the percentages of employees covered by health insurance, retirement insurance, paid maternity and paternity leaves, legal contracts, etc, … and the impact category "corruption" involves bribery, embezzlement, theft and fraud, extortion, abuse of discretion, favoritism, nepotism and clientelism, conduct creating or exploiting interests, and improper political contributions, etc, … (UNEP/SETAC 2013) which are concepts that are difficult to quantify, as corruption is de facto illegal.

Literature review and field surveys allow selecting the more relevant stakeholders' categories and, if needed, narrowing down the impact categories to the few ones to be analyzed. Data collection can then begin..

Foreground activities – When analyzing the social impacts of the production plant or the organization managing the production, specific data can be collected based on field surveys, company visits or analysis of companies reports.

Background activities – When analyzing a full product's supply chain, collecting specific data for all steps of the supply chain is not feasible. Therefore, as for environmental LCA, databases reporting country and sector specific risks of social impacts can be used. They do not represent actual impacts but the risks of an impact to occur when consuming inputs for the production of the studied product, based on generic information found in literature for a specific sector and country (e.g. from UNICEF, World Bank or country specific reports on social themes).

Table 1: Stakeholder's groups and impact categories for Social LCA (UNEP/SETAC 2009, update of 2020 edition in green)

Stakeholder categories	Description	Impact categories
Worker	People that have a direct or indirect work relation with the production plants	• Freedom of association and Collective bargaining • Child Labor • Fair Salary • Working Hours • Forced Labor • Equal opportunities/Discrimination • Health and Safety • Social benefits/Social security • Employment relationship • Sexual harassment • Smallholders including farmers
Consumer	The users of the final products and outcomes of the project able to reach the market	• Health & Safety • Feedback mechanism • Consumer privacy • Transparency • End of life responsibility
Local community	Population living in the areas surrounding the production plants	• Access to material resources • Access to immaterial resources • Delocalization and migration • Cultural heritage • Safe & healthy living conditions • Respect of indigenous rights • Community engagement • Local employment • Secure living conditions
Society	Group of individuals involved in persistent social interaction, sharing the same geographical or social territory typically subject to the same political authorities	• Public commitments to sustainability issues • Contribution to economic development • Prevention and mitigation of armed conflicts • Technology development • Corruption • Ethical treatment of animals • Poverty alleviation
Value chain actors (not including consumers)	Group of stakeholders that contribute to create and add value to the considered process, production chain and service supply. Typical value actors include: authorities, organizations (public and private), companies (e.g. suppliers), communities and end use customers.	• Fair competition • Supplier relationships • Respect of intellectual property rights • Promoting social responsibility • Wealth distribution
Children		• Education provided in the local community • Health issues for children as consumers • Children concerns regarding marketing practices

2.3 Impact assessment

At the end of the data inventory, the indicators for each flow/activity will have been estimated. The principle of impact assessment in SLCA is to aggregate these indicators into a score per impact category or stakeholder category. As SLCA is at a very early stage of development, there is little consensus on how to aggregate the indicators into social impacts for each impact category. If the supply chain is not considered in the assessment or if very few indicators are of interest, it could be relevant to stay at the indicators level. However, when the supply chain is included in the assessment and a consequent number of indicators have been selected in the previous step, aggregation is necessary to support interpretation. One approach proposed in the Social Hotspots Database and the PSILCA database (Benoît Norris et al. 2015; Eisfeldt 2017) consists in converting each indicator into a level of risk and multiplying the level of risk by "worker hours", which are related to the efforts put to produce a specific flow in a specific country. For example, if the risk level for having access to health insurance for a worker in the steel sector in China is set to 2 and the production of 1 kg of steel requires 0.2 man hours, the value of this indicator for the production of 1 kg of steel is 0.4. All indicators are therefore characterized in terms of "work hours" and their relative importance can be assessed.

2.4 Interpretation

As for environmental and economic life cycle assessment (respectively LCA and LCC), the interpretation step consists in identifying the hotspots. Results can be analyzed based on their level of certainty as some social indicators are subject to a very high level of uncertainty or even impossible to quantify in some countries. The interpretation of the results allows drawing recommendations on actions to take at the production site or regarding the supply chain, e.g., highlighting specific flows for which responsible sourcing is especially important.

3. Approach proposed for GREENER

3.1 Relevant studies

A screening of the literature was conducted to identify the main approaches and points of attention when assessing the social impacts of remediation activities. SLCA applied in this field is rather scarce and the search was also extended to wastewater treatment technologies. Two studies are particularly relevant for the GREENER SLCA: The report "A framework for assessing the sustainability of soil and groundwater remediation" (SuRF 2010) proposes a set of six categories of indicators (called "headline indicators") to assess the social impacts of remediation technologies. The approach does not follow the SLCA approach as framed by UNEP-SETAC, but some of the proposed categories are similar:

- *Impacts on human health and safety:* this category includes risks from remediation activities to site workers, site neighbours and the public,. The activities/outputs from remediation technologies to be considered in this category are chemical exposure hazards, vehicle movement and excavation/drilling. This category is more generally assessed at a generically-based scale.
- *Ethical and equity considerations:* this category is rather theoretical and aims at covering the questions related to whether or not the "polluter pays principle" is respected, if there is intergenerational equity (e.g. by avoiding that pollution emitted now is transferred to the next generation), or if the technology is more favorable to a particular group of people than to another. This category does not analyze site-specific set ups but rather focuses on the technology development level.
- *Impacts on neighborhood and regions:* this category includes impacts on local community, including dust, light, noise, odour and vibrations. This category is assessed at a specific site level.
- *Community involvement and satisfaction:* this category includes impacts of works on public access to services, the transparency and involvement of local community in the decision process. This category assesses site-specific set ups and is assessed after technology implementation.
- *Compliance with policy objectives and strategies:* this category includes the compliance of the works with policies, regulatory standards and good practice as defined nationally, by local authority, at the request of community and/or in line with industry working practices and expectations. This assessment has to be conducted based on the location where the technology has been implemented.
- *Uncertainty and evidence:* this category evaluates the quality of the sustainability assessment and the potential variation of results depending on the conditions of technology implementation.

Some of these categories are rather theoretical and what they encompass is not always easy to understand. A DEFRA research project aimed at selecting and applying this framework to remediation technologies (Defra 2010). The selected categories were *Impacts on human health and safety* and *Impacts on neighborhood and regions*. The indicators have been assessed in a qualitative manner. Table 2 shows an example of the social impacts assessment for *In Situ Enhanced Bioremediation (redox amendments)* and *Ex Situ Biological Treatment (Biopiles, Windrows, Landfarming),* made on a generic consideration of the technology.

The approach followed in this report is qualitative but allows screening the potential social impacts of the remediation technologies before their implementation.

Table 2: Examples of qualitative social impact assessment of two soil remediation technologies

Category	Indicator	Impacts (pros/cons)	
		In Situ Enhanced Bioremediation	*Ex Situ Biological Treatment*
Safety	Chemical exposure hazards	Con: Oxidants and/or reductants may pose safety hazard.	Pro: none
	Vehicle movements	Pro: Low due to being an in-situ process.	Con: Moderate – High. Due to being an ex-situ process, many on-site vehicle movements are likely.
	Excavation and drilling	Con: Moderate – Low. May require moderate treatment/monitoring borehole network to be drilled.	Con: High due to excavation requirement of ex situ process. Dependant on volume of excavation.
Neighborhood and regions	Noise	Pro: Minimal (low)	Pro: Minimal (low)
	Aesthetic impacts	Pro: Minimal headworks & visual impact.	Pro: Minimal headworks (excluding stockpiles) & visual impact. Cons: - May require extensive use of space and involve stockpiles. – Dust generation – Odour generation

- Cadena et al. (2019) conducted the comparative Social LCA of an innovative technology based on wastewater phytoremediation developed during the H2020 AquaNES project, and implemented at a wastewater treatment plant in France. The Performance Reference Points (PRP) method was usedfor which the performance of the studied plant is compared with basic requirement for the selected indicators.It helps to identify risks and consistent, proactive and engaged behaviours. In this method, the PRPs of each subcategory is to be determined by the lowest national or international standards. The organizational and departmental PRPs were defined based on average data, or the behaviour of three neighbouring sites treating wastewater. For sectorial information, the PRPs were defined as the average of the values observed for the three main water operators in France (SAUR, Veolia and Suez).

  The analysis concludes on two levels of social impacts:

  - the impacts which do not depend on the implementation of the innovative technology at the studied wastewater treatment plant (e.g., Fair competition subcategory)
  - the impacts scores are impacted by the implementation of the innovative technology (e.g., indicators Involvement in the technology transfer and Cost of the system for users).

  The study concludes that the second set of impacts is mainly better than PRPs, due to the involvement of the wastewater treatment plant in the development of the innovative technology. The study also provided some recommendations related to the social performance of the wastewater treatment plant in general, which could beneficiate from the deployment of the innovative technologyas, for example the collaboration of the site with social institutions and the frequency of interactions with local organizations.

Table 3: Indicators selected in the social impact assessment of phytoremediation of wastewater in Cadena et al. (2019)

Stakeholder group	Subcategory	Description of indicator	Unit
Local Community	Community engagement	Number of meetings with community stakeholders per year	Number of meetings and visits per year
		Information of local stakeholders on water treatment and management	Number of channels used
		Public Trust of Politicians	Compliance of the site measured by the public administration
	Local Employment	People hired from the local community (at significant location of operation)	Percentage of the total workforce
		Employability improvement	Number of training hours per employee per year
	Safe, healthy and secure living conditions	Impact on bathing water	Semiquantitative 1-5 scale
		Percentage of households connected to collective wastewater treatment	%
Value Chain Actors	Fair Competition	Employee awareness of the importance of compliance with competition legislation and fair competition.	Number of tools made available to employees to ensure fair competition.
		Local actions pending or completed during the reporting period regarding anticompetitive behaviour and violations of antitrust and monopoly legislation in which the reporting organization has been identified as a participant	Number of actions related to anticompetitive behaviour or violation of antitrust and monopoly
	Promoting Social Responsibility	Existence of a social or CSR auditing policy for suppliers in the company.	Yes or No, transferred into semi-quantitative value (Yes= 1; No= 0)
		Membership in at least one initiative that promotes social responsibility along the supply chain.	Yes or No, transferred into semi-quantitative value (Yes= 1; No= 0)
		Integration of ethical, social, environmental and regarding gender equality criterions in purchasing policy, distribution policy and contract signatures.	%

Stakeholder group	Subcategory	Description of indicator	Unit
Workers	Health and Safety	Level of knowledge of the site's technology and asset management	Score from 0 to 120
		Frequency of injuries or fatal accidents inside the company.	Frequency of accidents registered
		Presence of a formal policy concerning health and safety, materialized by OHSAS 18001 certification	Yes or No, transferred into semi-quantitative value (Yes= 1; No= 0)
Society	Public commitment to Sustainability Issues	Presence of publicly available documents as promises or agreements on sustainable issues	Yes or No, transferred into semi-quantitative value (Yes= 1; No= 0)
		Awareness of water technology implication	%
		Acceptance to reuse treated wastewater	Number of people that agree with the idea of having cNES in their region/neighbourhood
	Contribution to economic development	Cost of the system for the users	€/m^3 of treated water
		Contribution to solidarity actions	€/m^3 of treated water
	Technology Development	Involvement in technology transfer program or projects	Number of project/programs involved
		Investments in technology development/ technology transfer	Low, medium, high

3.2 SLCA in GREENER

SLCA in GREENER is divided into three stages:

1. Functional unit and system boundaries definition (this report),
2. Screening test and first recommendations (M38),
3. Final assessment (M50).

3.2.1 Preliminary SLCA - Screening test and first recommendations

The SLCA of technologies developed at laboratory scale is not relevant as social impacts highly depend on local and real conditions of implementation. Therefore, the SLCA will be conducted at the scale of the demonstration sites. However, in the first stage of SLCA (screening test and first recommendations), a first selection of indicators based on the power-interest grid approach as well as literature (e.g. indicators proposed by Cadena et al. (2019) and Defra (2010)) will be made.

The power-interest grid approach aims at selecting the stakeholders of interest for the GREENER technologies among the ones listed in **¡Error! No se encuentra el origen de la referencia.**. The evaluation of the stakeholders that need to be taken into consideration to perform the SLCA will be based on four steps, defined in the methodology from (E. Cadena et al. 2019):

1. Identification of the main actors belonging to the stakeholders' categories and their connection with the project;
2. Analysis of the project's impacts on the stakeholders;
3. Classification of the stakeholders by means of the power-interest grid (Figure 2);
4. Validation of the stakeholders' analysis by means of semi-structured interviews within the consortium (if necessary).

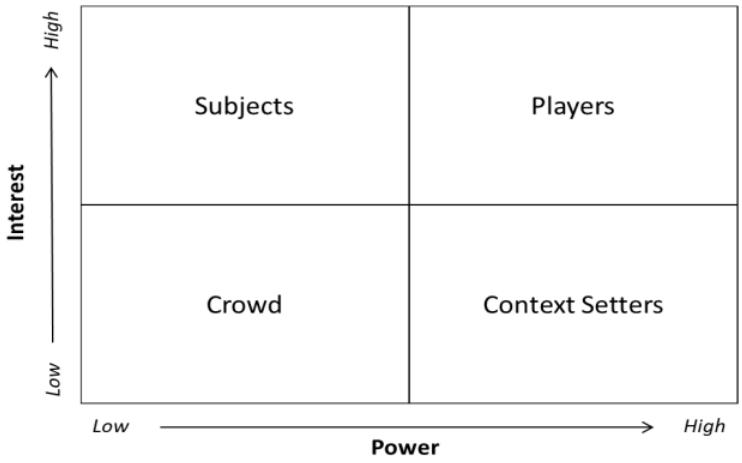

Figure 2: Power-interest grid

The most relevant stakeholders to analyze will be selected based on the results of the power-interest grid. The closest to the up-right corner the stakeholders will be positioned, the more relevant they are to analysed. Then, the indicators of these two or three appropriate stakeholders will be selected based on data availability and relevance. The choice of these indicators needs to be precise and relevant for each type of demonstration site (groundwater or soil) to ease the comparison of the sites between them. For example, if corruption is highlighted as relevant for society, the information from the Transparency International organisation, the global coalition against corruption, will be helpful to compare EU and China sites as the rank of China in their 2020 report is 78/158, behind all the European countries (Spain (32), UK (11), Italy (52), Ireland (20), Slovenia (35), Czech republic (49), Belgium (15), Germany (9), France (23)). A preliminary qualitative assessment of the impacts, will be done as in Defra (2010). This screening will be based on interviews conducted with technology developers to qualitatively identify the pros and cons of their technology regarding the selected indicators.

3.2.2 Final assessment

The final SLCA will assess the social impacts of the demonstration sites. The most relevant social impacts of remediation technologies occur at the level of the foreground system, i.e., the social impacts of the upstream supply chain do not appear to have a significant relevance to assess the social impacts of remediation. Therefore, **the social impact assessment of the demonstration sites will be conducted for the foreground systems only**.

The **functional unit is defined at the level of the demonstration sites**. Some indicators, which can be quantitatively assessed (e.g., number of jobs created), can be expressed per m^3 of treated groundwater or ton of treated soil to allow a fair comparison between the compared systems.

The SLCA will be conducted with the aim to compare the performance of the demonstration sites with other systems. For each demonstration site, a comparative system will be defined. To identify the benefits of implementing the GREENER technologies at the demonstration sites, the priority will be to **compare the performance of the site with no action**. If this is not feasible because of a lack of data, or not adapted to the demonstration site, the approach followed by Cadena et al. (2019), which compares the social impacts of demonstration sites with plants located nearby or with sectorial data, will be followed.

4. Conclusions

This deliverable presents the SLCA methodology as framed by the UNEP-SETAC guidelines which is for the moment an international consensus as SLCA is a quite young subject. Moreover, it presents two relevant studies which can be used as a basis for the SLCA conducted in GREENER. The report from SuRF (SuRF 2010) can be used as a basis for the preliminary assessment of the technologies. The method it presents allows a first qualitative screening of the potential social impacts of remediation technologies. This screening will be made for the indicators selected using the power-interest grid approach. Therefore, the next step of the study is to receive the feedback of the project partners on the power-interest grid, asking them to locate the different stakeholders on the grid.

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