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Identifying Social Impacts in Product Supply Chains: Overview and Application of the Social Hotspot Database

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Abstract: One emerging tool to measure the social-related impacts in supply chains is Social Life Cycle Assessment (S-LCA), a derivative of the well-established environmental LCA technique. LCA has recently started to gain popularity among large corporations and initiatives, such as The Sustainability Consortium or the Sustainable Apparel Coalition. Both have made the technique a cornerstone of their applied-research program. The Social Hotspots Database (SHDB) is an overarching, global database that eases the data collection burden in S-LCA studies. Proposed "hotspots" are production activities or unit processes (also defined as country-specific sectors) in the supply chain that may be at risk for social issues to be present. The SHDB enables efficient application of S-LCA by allowing users to prioritize production activities for which site-specific data collection is most desirable. Data for three criteria are used to inform prioritization: (1) labor intensity in worker hours per unit process and (2) risk for, or opportunity to affect, relevant social themes related to Human Rights, Labor Rights and Decent Work, Governance and Access to Community Services (3) gravity of a social issue. The Worker Hours Model was developed using a global input/output economic model and wage rate data. Nearly 200 reputable sources of statistical data have been used to develop 20 Social Theme Tables by country and sector. This paper presents an overview of the SHDB development and features, as well as results

from a pilot study conducted on strawberry yogurt. This study, one of seven Social Scoping Assessments mandated by The Sustainability Consortium, identifies the potential social hotspots existing in the supply chain of strawberry yogurt. With this knowledge, companies that manufacture or sell yogurt can refine their data collection efforts in order to put their social responsibility performance in perspective and effectively set up programs and initiatives to improve the social conditions of production along their product supply chain.

Keywords: Social Hotspot Database, Social Life Cycle Assessment, Social Impacts of Products, Supply Chain, Corporate Social Responsibility

1. Introduction

Consumers are more frequently questioning where, by whom, and under what conditions their products are being sourced and produced. Transparency, in economic theory, implies providing key information to help stakeholders make decisions, which in turn creates incentives for businesses to align their practices with the public's priorities [1]. With the complexity of globalized production and consumption, a great deal of transparency is lost, which can result in unintended and overlooked social and environmental impacts.

A socially responsible company considers the impacts of its products beyond its own sphere of local operation and within its true triple bottom line (including the externalities), with a life cycle perspective [2]. Referred to as "supply chain sustainability", the approach is defined as being the management of environmental, social and economic impacts, and the encouragement of good governance practices, throughout the lifecycles of goods and services [3]. Nevertheless, supply chains are extremely elaborate. Even though efficient and market responsive supply chains are becoming key to succeed in the globalized system of outsourced production and trade, for the most part, companies are still learning to manage extended supply chains. Stakeholders now demand accountability for behaviors that encompass several tiers of supply chain actors, over which the firm has varying degrees of control [4]. Simply paying close attention to the impacts caused by the first tier of suppliers is considered a good initial step to becoming more oriented towards life cycle thinking in business [5].

1.1. The development and operationalization of Social LCA

LCA is a technique, developed in the late sixties and first standardized in the nineties, that is used to quantify environmental impacts of a product or service over its lifetime, including raw material extraction, manufacture, distribution, use, and disposal. The methodology, standardized by ISO 14040 [6], aggregates inputs and outputs of resources and chemicals to air, water, and soil into several environmental impact categories, such as global warming, resource depletion, human health, and ecosystem services.

In 2009, after a five-year process with participation from over 70 international experts, the United Nations Environment Program (UNEP) and the Society of Environmental Toxicology and Chemistry (UNEP/SETAC) Life Cycle Initiative published the Guidelines for Social Life Cycle Assessment of

Products (The Guidelines). One of the objectives of the working group was to establish a consensus on how social impacts may be best captured and integrated into the life cycle assessment framework and move towards the development of Life Cycle Sustainability Assessment [7]. Hence, a study that combines S-LCA with LCA and Life Cycle Costing—a method that takes into account costs incurred over the entire supply chain, use phase, and end-of-life—a truly holistic representation of sustainability of products can be assessed [8-9].

A typical product system may include over a thousand unit processes. Therefore, there is an important need for prioritization of unit processes in conducting a S-LCA. Otherwise, it can rapidly become very costly and time consuming, and often not relevant, to collect data on-site at every organization involved in the production, use and disposal of a good or a service [7].

The UNEP SETAC Guidelines for S-LCA of products recommended the development of resources that prioritize the most important unit processes (i.e., hotspots) in supply chains to collect accurate data for. Hotspots are production activities in the product life cycle that provide a higher opportunity to address issues of concern (eg. human and worker rights, community well-being etc.), as well as highlight potential risks of violations, damage to reputation, or issues that need to be considered when doing business in a specific sector and country [7]. Social indicator data for country-specific-sectors (CSS) is extremely valuable, since unit processes are all associated with a particular industry in a country, that which may have specific social impacts to be aware of. Not only will this type of data identify the most important CSS to be aware of in a supply chain, it will also introduce an "activity variable" such as worker hours or value added that can be used to prioritize hotspots and assist in developing boundary conditions in the life cycle.

2. Methods

2.1. Global Data to Visualize Social Impacts in Supply Chains

A goal of this research was to develop the recommended inventory tool made up of country and sector-specific indicator tables to help identify hotspots, the countries and sectors of concern, in supply chains based on potential social impacts and the share of worker hours. The Social Hotspot Database (SHDB) project has led to the creation of 20 Subcategory Social Theme Tables for the database. The tables include indicator data and characterized risk or opportunity for social impacts such as forced labor, freedom of association, excessive working time, labor laws, and access to community services, to name a few (Table 1). Opportunities are defined as a chance for progress or advancement, in particular to establish initiatives or to create a market to improve the social conditions.

Regional specificity is a major consideration when collecting indicator data for the SHDB. The tables list quantitative data and qualitative characterization (level of risk or opportunity) for 191 countries and 57 sectors, when applicable. Ekvall [10] highlighted the relevance of national statistics to assess the potential social impacts of supply chains. Global indicator and qualitative data were collected for these tables from various international organizations with strong statistical agencies such as the World Health Organization, the International Labor Organization, the World Bank, and many others.

The second major component of the SHDB besides the subcategory Tables is the development of a Worker Hours Model that ranks unit processes (ie., CSS) within supply chains by labor intensity. Worker hours are a representation of where people are most active in supply chains. The SHDB team utilized an Input-Output economic model (derived from the Global Trade Analysis Project [GTAP]), supplemented with wage rate data (obtained primarily from the International Labor Organization [ILO]), to calculate worker hour estimates by country and sector involved in the supply chain of products. The activity variable not only provides the share of worker hours by CSS, but can also be used effectively for Life Cycle Attribute Assessment (LCAA) [11]. With LCAA, it is possible to calculate the share of a supply chain that may be affected by child labor, or perhaps the percentage of worker hours with site-specific data collected. The unit variable can also be applied to set cut-off boundaries of the product system under assessment.

Using both the Worker Hours Model and the SHDB Social Theme Tables, it is possible to guide the decision-making process to help determine if and where to conduct case-specific assessments. A Hotspot Index based on both social issues' risk and worker hours share is calculated to reduce the data down to a single value to help prioritize the CSS and identify the hotspots. This cost and time-efficient system including ranking by importance with an activity variable, hotspot assessment with the SHDB subcategory tables, and a limited number of site-specific visits represents a promising approach to S-LCA suggested by The Guidelines [7].

Table 1: Characterized Social Issues by Social Theme and Category

Category	Table Theme	Data Indicator	Characterized Issue
Labor Rights and Decent Work	**Labor Laws/ Conventions**	Number of Labor Laws	Potential of Country not passing Labor Laws
		Number of labor laws by sector	Potential of Country not passing Labor Laws by Sector
		Number of Labor Conventions ratified (out of 81 possible)	Potential of Country not adopting Labor Conventions
		Number of Labor conventions ratified by sector	Potential of Country not adopting Labor Conventions by Sector
		Year of last Minimum Wage Update	Potential of Minimum Wage not being updated
	Wage Assessment	Minimum Wages (USD)	Potential of Country Average wage being < Minimum Wage
		Average Unskilled Wages (USD) in country	
		Non-poverty Guideline (USD)	Potential of Country Average wage being < Non-poverty Guideline
		Average Unskilled Wages (USD) in country	
		Minimum Wages (USD)	Potential of Sector Average wage being < Minimum Wage
		Average Unskilled Wages (USD) by sector	
		Non-poverty Guideline (USD)	Potential of Sector Average wage being < Non-poverty Guideline
		Average Unskilled Wages (USD) by sector	
	Population living in Poverty	Percent of Population living on <$2/day	Risk of Population living on <$2/day
	Child Labor	Child Labor % in country	Risk of Child Labor in country
		Child Labor % by sector	Risk of Child Labor by Sector
	Forced Labor	Qualitative	Risk of Forced Labor in country
		Qualitative	Risk of Forced Labor by Sector

Category	Table Theme	Data Indicator	Characterized Issue
	Excessive Working Time	Percent working >48 hours/week in country	Risk of Population working >48 hours/week in country
		Qualitative	Risk of Population working >48 hours/week by Sector
	Freedom of Association, Collective Bargaining, Right to Strike	Qualitative	Risk of not having Freedom of Association Rights
		Qualitative	Risk of not having Collective Bargaining Rights
		Qualitative	Risk of not having the Right to Strike
	Unemployment	Unemployment Average % from 2000-2009	Potential of High Unemployment in country
		Unemployment % by sector	Potential for High Unemployment by sector
Governance	**Legal System**	World Bank Worldwide Governance Indicator - Rule of Law	Overall weakness of Legal System
		Bertelsmann Transformational Index - Rule of Law, independent judiciary	
		CIRI Human Rights Index - Independent Judiciary	
		Global Integrity Index - Judicial Accountability	
		Global Integrity Index - Rule of Law	
		Global Integrity Index - Law Enforcement	
		World Justice Project Average	
Human Rights	**Indigenous Rights**	Presence of indigenous population, X	Not characterized
		Indigenous Population, %	Amount of indigenous population
		ILO Convention adopted for Indigenous, Y or N	Risk of country not adopting Indigenous ILO convention and UN Declaration
		UN Declaration for Indigenous, endorsed(Y), abstained(A), against(N)	
		Number of Laws enacted to protect indigenous	Risk of country not passing Laws to protect indigenous
		Qualitative	Potential for Indigenous Rights Infringements by Sector
	Gender Equity	Social Institutions and Gender Index	Overall weakness of Gender Equity
		Global Gender Gap	
		World Bank Gender Development Indicator	
		World Bank Gender Empowerment Index	
		CIRI Human Rights Index - Economic	
		CIRI Human Rights Index - Political	
		CIRI Human Rights Index - Social	
		Adolescent fertility rate (births per 1,000 women ages 15-19)	Not characterized
		Fertility rate, total (births per woman)	Not characterized
		Share of women employed in the nonagricultural sector (% of total nonagricultural employment)	Not characterized
		% Unemployment, (% of female labor force unemployed/% of male labor force unemployed)	Not characterized
		% of women workers vs. men by sector	Risk of Gender inequity by sector
	High Conflict Zones	Heidelberg Conflict Barometer - # of conflicts	Potential for High Conflict
		Heidelberg Conflict Barometer - maximum intensity of conflicts (1-5)	
		Heidelberg Conflict Barometer - change in conflicts (positive=worsening)	

Category	Table Theme	Data Indicator	Characterized Issue
		Number of Refugees - UN Refugee Agency (000's)	
		Center for Systemic Peace Indicator	
		Minority Rights Group Indicator	
		Top Risers from last year in Minority Rights Group Indicator, X	
		Qualitative	Potential for High Conflict specific to sectors
	Human Health - Communicable Diseases & Other Health Risks besides Disease	Life expectancy at birth (years) 2008	Risk of low life expectancy
		Mortality rates for injuries (per 100 000 population) 2004	Risk of high mortality rates due to injury
		Proportion of undernourished % of total population, (-) = <5% 2005-2007	Risk of high undernourishment
		Deaths due to indoor and outdoor air and water pollution, per million 2004	Risk of death due to air and water pollution
		Population affected by natural disasters, ave per year per million 2000-2009	Risk of death due to natural disasters
		Cases of HIV (per 1000 adults 15-49 years) 2010	Prevalence of HIV 2010
		Cases of Tuberculosis (per 100 000 population) 2008	Prevalence of Tuberculosis 2008
		Cases of Malaria (per 100 000 population) 2008	Prevalence of Malaria 2008
		Cases of Dengue Fever (per 100 000 population) 2005	Prevalence of Dengue Fever, 2005
		Cases of Cholera 2008	Prevalence of Cholera 2008
		Mortality rates from communicable diseases (per 100 000 population) 2004	Risk of mortality from communicable diseases
Community Infrastructure	**Children Out of School**	Children out of School – male	Risk of Children not attending School – male
		Children out of School – female	Risk of Children not attending School – female
		Children out of School – total	Risk of Children not attending School – total
	Access to Improved Drinking Water	Access to Improved Drinking Water, % - rural	Risk of not having access to Improved Drinking Water – rural
		Access to Improved Drinking Water, % - urban	Risk of not having access to Improved Drinking Water –urban
		Access to Improved Drinking Water, % - total	Risk of not having access to Improved Drinking Water – total
	Access to Improved Sanitation	Access to Improved Sanitation, % – rural	Risk of not having access to Improved Sanitation – rural
		Access to Improved Sanitation, % – urban	Risk of not having access to Improved Sanitation – urban
		Access to Improved Sanitation, % – total	Risk of not having access to Improved Sanitation – total
	Access to Hospital Beds	Access to Hospital Beds - # beds/1000 pop	Risk of not having Access to Hospital Beds

2.2. An Index to Identify Hotspots

Even by prioritizing the CSS in a supply chain by worker hours, with over 50 characterized social issues for 20 Social Themes, the amount of data is difficult to assess for decision-making. In order to better understand the vast amount of social impact information for each CSS, a Social Hotspot Index was calculated. The Index was determined by weighing the level of risk or opportunity identified for

each Social Issue, dividing by the highest potential score (ie, if all Social Issues had the highest possible risk), and multiplying by a factor of 100. A zero was assigned to social issues with low risk, a 1 was assigned to those that are medium, a 2 to those with high risk, and a 3 for those with very high risk. Summing across all social issues resulted in a total number of weighted hotspot issues to be aware of when working in that country and sector.

The index then incorporated the share of worker hours for each CSS in the Worker Hours ranking. For those with greater than or equal to 1% of the total worker hours per million dollars of product, the weighted sum of social issues was increased by 30%; those with greater than or equal to 0.2% of the total worker hours per million dollars were increased by 20%; and those with greater than or equal to 0.1% of the total worker hours per million dollars were increased by 10%.

Next, the final sum was divided by the highest possible score for that CSS, which discounts for the issues that have no data (n.d.) or are not applicable (n.a.). The maximum Index a CSS could achieve is 100 because in some cases, where the weighted sum of social issues was greater than the total possible score (due to the increases added for CSS with the highest share of worker hours), the calculated value for the Index could be greater than 100.

The Social Hotspot Index was then used to prioritize the CSS in the supply chain with the greatest risk of social issues or opportunity to make positive social change. Two lists of CSS were tested within the SHDB model, one based on the share of worker hours and another based on an external review of other important countries and sectors in the supply chain. Results from testing the two CSS lists with tables, as well as the worker hour rankings were then used to calculate the Hotspot Index.

3. Results and Discussion

To test the proficiency of the SHDB, seven Social Scoping Assessments (SSA's) were performed on various product categories for The Sustainability Consortium. These pilot tests included orange juice, strawberry yogurt, wheat cereal, shampoo, laundry detergent, hard surface cleaner, and laptop. For this paper, the SSA for strawberry yogurt is highlighted. The SSA is an extensive report that investigates the history, production methods, ingredient formulas, and market for strawberry yogurt produced in the U.S. A modeling assessment, which includes an analysis of the supply chain worker hours, is performed with the SHDB to determine the major social issues and hotspots in the supply chain. In order to verify that assessment, a literature review investigates relevant social issues for the primary ingredients in strawberry yogurt. In addition, a list of the main media campaigns, initiatives, and certifications that raise awareness to social issues in the sectors related to this product are highlighted. This section provides a summarized overview of the full report.

Strawberry Yogurt is an agricultural product manufactured in large volumes in the U.S. Yogurt production in 2010 was 4.2 billion pounds at 116 processing plants [12]. The industry relies on two primary sectors: fruits and vegetables and dairy products in the U.S. However, the results of this study indicate that many more sectors and countries are at play in the supply chain, or cradle-to-gate life cycle, of fruit yogurt.

3.1. Worker Hours Ranking for the Dairy and Fruit and Vegetable Sectors in the U.S.

According to the results of the worker hours assessment based on a functional unit of US$1M of strawberry yogurt in the U.S., 95% of the worker hours are within the top 488 ranked CSS for the dairy product sector and the top 292 for the vegetable and fruits sector[1]. The worker hours are therefore, more distributed across sectors for the dairy products sector compared to the vegetables and fruits sector. Ultimately, it is desirable to narrow down the top-ranked CSS to report only 10-20 that may be potential hotspots. In order to determine the most important CSS that may be social hotspots in the supply chain, the top 200 from the dairy products and the top 50 from the fruits and vegetable sector are evaluated with the SHDB. The results are discussed in Section 3.2.

The top CSS with the greatest share of worker hours in the total labor force for US$1M of dairy products produced in the U.S. is the dairy products sector in the U.S.[2]. The milk product sector is responsible for nearly 20% of the total and unskilled worker hours, and only 9% of the skilled labor. The India oil seed sector is the only CSS from another country to appear on the top ten CSS with the most worker hours. This sector is most likely used in producing feed for dairy cows. The important U.S. sectors with regards to worker hours for dairy products include business services and retail operations, raw milk production, financial intermediation, construction, and transport. The top ten CSS represent 61% of the total worker hours in the dairy product supply chain.

The top CSS with the greatest share of worker hours in the total labor force for production of US$1M of vegetables and fruits in the U.S. is vegetables and fruits in the U.S., which is responsible for 34% of the total worker hours, 38% of the unskilled worker hours, and 8% of the skilled labor in the supply chain. The important sectors in the U.S. with regards to worker hours for vegetables and fruits include business services and retail operations, financial intermediation, paper products and publishing, construction, and transport. U.S. lumber is important, most likely for pallets to ship fruits and vegetables, as well as the chemical industry, for its fertilizers and pesticides and plastic packaging. The top ten CSS represent 69% of the worker hours in the fruit and vegetable supply chain.

3.2. Social Hotspot Database Modeling of the Strawberry Yogurt Supply Chain

The two primary CSS of interest, the dairy products and fruit and vegetables sectors in the U.S., may generate moderate social impacts in the supply chain. Prior to SHDB modeling, these two CSS were viewed with the SHDB web instance, www.socialhotspot.org, to better understand the social issues at the top of the supply chain. The issues with very high risk in the U.S. are: (1) the country's refusal to ratify international labor conventions and (2) its deficiencies in collective bargaining rights for workers. Freedom of Association and the Right to Strike are also not well recognized. At the sector-specific level for the growing of vegetables and fruits in the U.S., wages might not be adequate in keeping unskilled workers above the non-poverty guideline set by the International Labor Rights Forum [13]. There is also the limited risk of forced labor within this particular sector. Specifically for dairy production in the U.S., for all the characterized SHDB issues, this sector has only low or medium risk.

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[1] The number of CSS in the top 95% of the cumulative worker hours is out of a total matrix of 6,441 CSS used in the Worker Hours Model developed from the GTAP database.

[2] This is not always the case, for skilled labor the most worker hour intense CSS is business services in the U.S.

The supply chain, or cradle-to-gate life cycle, of strawberry yogurt was more thoroughly examined by modeling two separate CSS lists within the SHDB, one from the Worker Hours Assessment and another from an external review of the supply chain. From the Worker Hours Assessment, the top 200 CSS were analyzed from the dairy product sector analysis (89% of total worker hours) and the top 50 CSS were tested from the vegetable and fruit product analysis (83% of total worker hours). The results of the SHDB modeling of these CSS indicate that, specifically for the top ten CSS, the Hotspot Index (HI) is the highest for oil seeds from India (HI=87), and ranges from approximately 38-45 for the U.S. sectors. The dairy industry has a lowest Hotspot Index and the highest is for corn and other grains used to feed the cows. Raw Milk falls in the middle with a Hotspot Index of 42. Since production activities for U.S.-made strawberry yogurt rank highest in the worker hours assessment occur primarily within the U.S., they are important to assess for social issues, even if sectors within the U.S. have a lower Social Hotspot Index compared to other countries.

The second list was based on a literature review of the life cycle's main production activities and their potential locations, resulting in 159 CSS to be tested in the model. The results show that other countries and sectors are also of interest in the U.S. strawberry yogurt supply chain. Strawberries may very well be imported from Mexico when California strawberries are out of season. Added ingredients such as gelatin from India or China, or starches from China, can be at risk of social impacts. Sugar, in particular from India, also bares significant risk. Chemical products, including plastic containers and fertilizers/pesticides, also represent important risk when originating in countries like China, Venezuela, India, and Indonesia. Fossil fuel extraction and mining sectors represent a large share of the worker hours and are extremely susceptible to social issues and, particularly for society and local communities, but also for workers. The Hotspot Indexes, as well as the worker hour rankings, are shown for several CSS from this second modeling experiment (Table 2).

Table 2. Top Country-specific Sectors (CSS) most at risk for social issues to be present based on a literature review of the most important CSS in the supply chain of strawberry yogurt.

Country	Sector Description	Hotspot Index (0-100)	Worker Hours Rank in dairy sector
Angola	Oil extraction	100.00	48
China	Chemical products, plastics	75.11	15
India	Live animal products, gelatin	73.33	92
Indonesia	Chemical products, plastics	72.15	96
India	Sugarcane, beet sugar	66.67	135
India	Mining of metal ores	66.67	166
China	Coal mining, refining	63.87	61
Venezuela	Oil extraction	63.73	17
China	Other food products, starches	62.33	99
China	Vegetables & Fruits	61.51	50
India	Chemical products, plastics	60.42	215
Turkmenistan	Gas extraction	58.59	203
China	Petroleum products - fertilzers, pesticides	57.78	367

Country	Sector Description	Hotspot Index (0-100)	Worker Hours Rank in dairy sector
China	Live animals, gelatin	55.91	183
Philippines	Vegetables & Fruits	54.55	356
Venezuela	Chemical products, plastics	53.85	63
Mexico	Vegetables & Fruits	45.56	56

3.3. Supporting Literature including Initiatives, Certifications and Campaigns

Information obtained in a literature review of reports and documents offering information on the main social issues found in the strawberry yogurt life cycle is presented along with the SHDB results of CSS most at risk for Social Hotspots. The literature review validated the modeling results and provided additional information to make expert judgments on the most pertinent social issues, and where they might occur, in the production of strawberry yogurt from cradle-to-gate. The social issues distinguished in the countries and sectors of interest include:

- Worker rights such as inadequate housing and transport, lack of transparency from labor contractors, exclusion from unemployment insurance and prevention of collective bargaining may be an issue for some hired dairy workers [14].
- Local food production, maintaining a community's agriculture heritage, recreational access, charitable activities (donation of time and money), as well as farm "nuisances" like flies and odor are among the most important community social issues for the dairy sector [15].
- Large amounts of pesticide and insecticide are being applied to strawberries that can affect the health and safety of workers and neighboring communities [16].
- Occupational safety and heat stress protections, denial of rest and meal periods, unpaid overtime and minimum wages, retaliation and wrongful termination as well as sexual harassment are violations most commonly reported for California Specialty crops farming operations [14].

A high number of the media campaigns compiled reflects that several issues pertaining to dairy farms and strawberries were brought to the attention of the public in recent years. It supports the social issues literature review and the social hotspots assessment of working conditions in the specialty crops and dairy sector especially regarding freedom of association and collective bargaining rights, infringement of workers rights and health and safety risk related to pesticide and insecticide use. A limited number of certifications are available for strawberries, sugar and dairies. Ingredients often need to be organic in order to obtain a "fair" certification. One of the most important initiatives related to strawberry yogurt is the U.S. Stewardship Index for Specialty Crops.

3.4. Identification of Hotspots in the Strawberry Yogurt Life Cycle

Results of the SHDB assessments, in combination with the literature review of social issues and media campaigns, indicate what production activities and countries may be hotspots in the strawberry yogurt life cycle and what social issues are the most important to look for. Dairy and strawberry

production are both responsible for a very large amount of the worker hours in the strawberry yogurt supply chain. They are important to assess for social issues using the SHDB, even if sectors within the U.S. have a lower probability for social impacts compared to other countries. Issues occurring in countries like China, India, Venezuela, Indonesia and Mexico are more probable. Table 3 offers a selection of the countries and sectors to be aware of in the supply chain based on the results of the SHDB assessments and literature review.

The CSS were selected as hotspots if:

- They are responsible for a large share of the worker hours
- They are at high risk for social issues based on the Hotspot Index
- They were identified by multiple sources including media campaigns

Table 3: Sectors & countries most at risk to be hotspots in the supply chain for Strawberry Yogurt produced in the U.S.

Sectors to be aware of:	Countries to be aware of within sector:
Raw Milk, Dairy Products, Business Services	USA
Vegetables and Fruits - strawberries	USA, Mexico, China
Corn and other cereal grains	USA
Animal products - gelatin	India, China
Other foods - starches	China
Sugarcane, beet sugar, oil seeds	India
Chemical products – containers	China, Venezuela, Indonesia
Petroleum products - fertilizers	China

Figure 1 offers a visual representation of several CSS recommended as hotspots in the strawberry yogurt supply chain. The risk or opportunity levels for the most relevant social issues are indicated, but many more were measured using the SHDB.[3] The legend shows a selection of CSS chosen as hotspots for strawberry yogurt.[4] The scale is defined as: 0=no data or no evidence, 1=low, 2=medium, 3=high, and 4=very high risk or opportunity.

[3] All 20 Social Themes were assessed with results for over 50 indicators. See Table 1 (or 2) for the complete list of characterized issues.

[4] To view the graph properly, only a selection of CSS and a selection of social issues are shown.

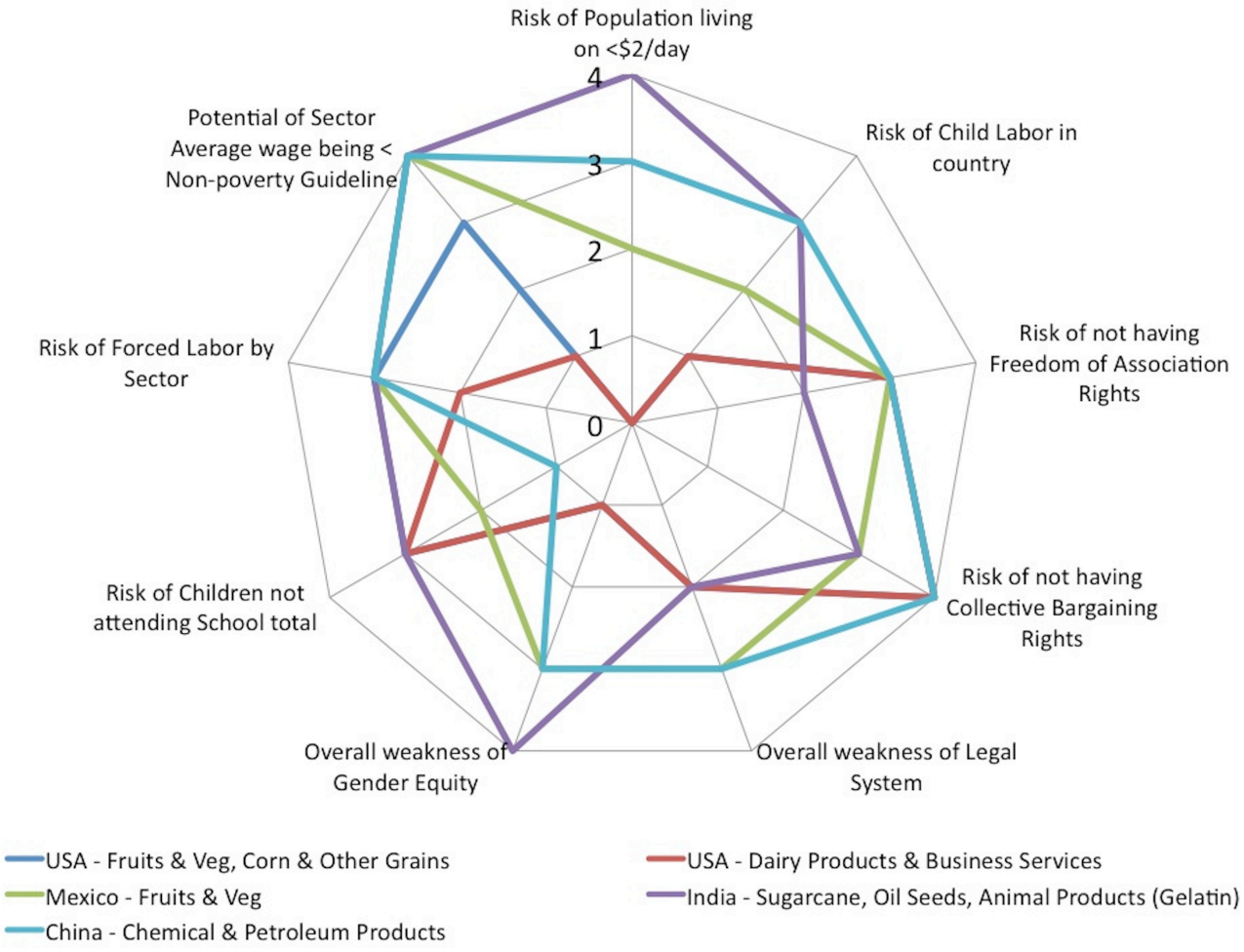

Figure 1: Plot of the prominent social issues present in particular countries and sectors involved in the supply chain of Strawberry Yogurt

The results of the SSA indicate that social issues do occur in the strawberry yogurt supply chain, and that companies producing and marketing yogurt should be aware of particular countries and sectors where the opportunity for social improvements exists. Because the worker hours are concentrated mostly in the U.S., which has a fairly low level of social issues compared to other less developed economies, U.S. strawberry yogurt production can show rapid improvement if it addresses the social issues within the country, primarily in the arena of labor rights. Children not attending school is also a problem in the U.S., however, child labor is less of an issue.

Those countries and sectors with a significant share of the labor time for strawberry yogurt produced in the U.S., like fruits and vegetables in Mexico and China and chemical products from China and Venezuela, as well as those CSS slightly further down in the worker hours ranking with high Hotspot Indexes, such as sugar from India and starches from China, do require major improvements in the social sphere. Gender equity in these countries, as well as low wages and lack of worker's rights, are prominent issues. Child and forced labor is certainly prevalent. And the countries' legal systems are most likely inadequate in protecting the workers or the local communities.

4. Conclusions

S-LCA is a technique developed to enable the assessment of potential and real social impacts within product life cycles. Ultimately, it aims to inform the improvement of the social conditions of production. As businesses are increasingly encouraged, and in some instances required, to show progress regarding their product supply chains sustainability impacts, S-LCA is considered to be one of the most relevant methods available.

The SHDB represents an actionable system to assess the social hotspots of product life cycles. It was developed over a period of 3 years as a follow-up project to the UNEP SETAC Guidelines for S-LCA. A first version of all tables was created over this time and the content is expanding. It is composed of a global worker hour assessment model and 20 social subcategory risk and opportunity tables. It offers characterized indicator data on 191 countries and multiple sectors where applicable and modeling capabilities for 113 countries and regions and 57 sectors. In the future, the information available will be more granular. The data was collected from nearly 200 data sources including mostly international organizations' secondary databases. The SHDB risk and opportunity tables' references and characterization methods are fully transparent and can be accessed on the project website (www.socialhotspot.org).

The SHDB is a system that can be used to prioritize site-specific data collection activities and to put site-specific results in perspective. However, it is not a system to be used to make sourcing decisions. Because every country and sector has potential impacts, shifting production from a country to another on this basis would be counterproductive. Site-specific data are required to inform decision-making and even in this case, it is worth pursuing active engagement in improving the existing conditions.

Because a very large amount of information is provided by a social hotspot assessment, there was a need to further refine the hotspots assessment to prioritize only a smaller subset of CSS. In order to achieve the required level of refinement, a Hotspot Index was developed valuing the number and the level of risk and opportunity as well as the labor intensity of each CSS.

The SHDB system was piloted for 7 product categories in a project mandated by The Sustainability Consortium (www.sustainabilityconsortium.org). One of the product categories that were assessed was strawberry yogurt, produced and sold in the U.S. For each of the product categories, a social scoping assessment report was developed. The reports included findings generated from modeling and literature reviews.

The results of the SSA indicate that social issues do occur in the strawberry yogurt supply chain, and that companies producing and marketing yogurt should be aware of particular countries and sectors where the opportunity for social improvements exists. The assessment enabled prioritization of a small number of CSS and highlighted specific social issues to be aware of in those CSS as a first step to further research activities.

The availability, quality and sources of information on social impacts of product supply chains is currently very limited and in many cases inexistent. The SHDB is an innovative system to offer the first top down visualization of a product supply chain's potential social impacts.

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Conflict of Interest

The authors declare no conflict of interest.

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