

**Table S1.** The full list of indicators, characterized issues, resolution of data, rules of characterization, and sources for the SLCA. The general descriptive data were adapted from the SHDB and the specific descriptive data were designed in this study.

Stakeholders	Impact Categories	Social Themes	Characterized Issue	Data Indicators	Types of Data (Quantitative, qualitative)	Resolution of Data	Rules for Characterization	Original Sources
Workers	Labor rights and decent work	Child labor	Risk of child labor in country	Percent total child labor in country	Quan	Country	<4% = low, 4–10% = med, 10–20% = high, >20% = very high	ILO, US Department of Labor, UNICEF
		Forced labor	Characterization of ILO's forced labor regional estimates	Prevalence of forced labor by region	Quan	Region to country	<3 = low, 3–3.5 = medium, 3.5–4 = high, >4 = very high	ILO
		Excessive working time Freedom of association, collective bargaining, and right to strike	Risk of excessive working time by sector	Percent of population working > 60 hours	Quan, Qual	Sector	<10% = low, 10–25% = medium, 25–50% = high, >50% = very high	US Department of State
			Risk of a country lacks or does not enforce freedom of association	Freedom of association rights	Qual	Country	Low = rights recognized, medium = allowed with minor restrictions, high = recognized but very limited, very high = no laws or laws against	ITUC
			Risk of a country lacks or does not enforce collective bargaining rights	Collective bargaining rights	Qual	Country	Same as freedom of association rights.	ITUC
			Risk of a country lacks or does not enforce right to strike	Right to strike	Qual	Country	Same as freedom of association rights.	ITUC
	Health and safety	Occupational injuries and deaths	Risk of fatal injuries by sector	Fatal injury rate by sector, per 100,000 workers	Quan	Country to sector	Low = <5, medium = 5–15, high = 15–20, very high = >20	Hamalainen et al. 2009
			Risk of non-fatal injuries by sector	Non-fatal injury rate by sector, per 100,000 workers	Quan	Country to sector	Low = <5000, medium = 5000–15,000, high = 1500–25,000, very high = >25000	Hamalainen et al. 2009
		Occupational toxics and hazards	Risk of death by exposure to carcinogens	Overall occupational cancer risk, deaths	Quan	Region to country	Based on the average of lung cancer, Leukemia, and Mesothelioma	Driscoll et al. 2005
			Risk of loss of life years by exposure to carcinogens	Overall occupational cancer risk, loss of life years	Quan	Region to country	Same as risk of death by exposure to carcinogens	Driscoll et al. 2005

			Risk of workplace noise exposure	Overall occupational noise exposure	Quan	Region	Low = <14, medium = 14–22, high = 22–22.5, very high = >22.5	WHO
	Human rights	Gender equality	Risk of gender inequality in country	Overall gender inequity in country	Quan	Country	Based on the average of SIGI, Global Gender Gap Index, and GII	UNDP, SIGI, CIRI, World Bank
Local community	Health and safety	Exposure to NORMs	Risk of exposure to U-238	U-238 series in P ore	Quan	Country	Low = <500, medium = 500–1000, high = 1000–2000, very high = >2000	NIRS
			Risk of exposure to radioactive Th-232	Th-232 series in P ore	Quan	Country	Low = <500, medium = 500–1000, high = 1000–2000, very high = >2000	NIRS
			Risk of exposure to radioactive K-40	K-40 series in P ore	Quan	Country	Low = <2500, medium = 2500-5000, high = 5000-7500, very high = >7500	NIRS
	Human rights	Indigenous rights	Risk of indigenous people are negatively impact at sectoral level	Indigenous sector issues identified	Qual	Country	Subjective judgement based on reported evidences	UNDESA
			Risk of indigenous people are negatively impact at P activity	Indigenous P issues identified	Qual	Country	Subjective judgement based on reported evidences	Cordell et al. 2015
		High conflict zones	Risk of high conflict	Overall risk of high conflict	Qual	Country	Based on the average of Heidelberg Conflict Barometer, State Fragility Index, UN Refugee Agency Global Trends Reports, and the Conflict without Borders assessment	Heidelberg Institute, UN Refugee Agency, Conflict without borders
	Governance	Corruption	Risk of corruption	Overall risk of corruption	Qual	Country	Based on the average of Worldwide Governance Indicators, World Economic Forum, and Transparency International	Transparency International, World Economic Forum
Farmer	Livelihood	Income	Risk of unaffordable of P fertilizers	Ratio of income spending on P fertilizer	Quan	Country	Expert judgement	Japan Agricultural Statistics
			Risk of overpriced of P fertilizers	Farm gate price of P fertilizers relative to international market price			Expert judgement	IFA
Society	P Security	P import dependency	Dependency of foreign P	Ratio of import P and total P consumption	Quan	Country	Expert judgement	Japan Agricultural Statistics

Commitment to Sustainability issues	Mineral P depletion	Risk of over consumption of P fertilizer	Mineral P consumption relative to global consumption, in per ha input	Quan	Country	Expert judgement	Japan Agricultural Statistics
	Education and responsibility	Risk of hindering the promotion of circular society	Effort in promoting recycling	Qual	Country	Expert judgement	Interview

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\* ILO: International Labour Organization, UNICEF: The United Nations Children's Fund, ITUC: International Trade Union Confederation, UNDP: United Nations Development Programme, WHO: World Health Organization, SIGI: Social Institutions and Gender Index, CIRI: The CIRI Human Rights Data Project, NIRS: National Institute of Radiological Sciences, Japan, UNDESA: The United Nations Department of Economic and Social Affairs, IFA: International Fertilizer Industry Associatio.