BRI International Green Development Coalition
2020 Policy Study Series

Green Commodity Supply Chain Index: Contributing to Supply Chain Stability and Sustainability (Phase 1 Research)

December 2020

In April 2019, Chinese and international partners officially launched the BRI International Green Development Coalition (BRIGC) at the Second Belt and Road Forums for International Cooperation. BRIGC aims to establish a policy dialogue and communication platform, an environmental knowledge and information platform, and a green technology exchange and transfer platform, so as to advance global consensus, understanding, cooperation, and action of a green Belt and Road Initiative (BRI).

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Executive Summary

The greening of commodity supply chain ensures consistency with China's vision of building an Ecological Civilization and the concept of building a community with a shared future for mankind. Developing greener and more inclusive commodity supply chains is an effective means to assist Belt and Road Initiative (BRI) participating countries to address challenges and strengthen supply chain safety and security, and will be key to delivering a green Belt and Road.

The "Green Commodity Supply Chain Index" is a tool developed to help Chinese governments, companies, and financial institutions (including those involved in the Belt and Road Initiative or "BRI") assess the relative risk to the long-term security and stability of a soft commodity supply chain posed by major environmental and social factors. The Index indicates the degree of risk—categorized as either "high", "medium", or "low"—within a jurisdiction (a geographic or political boundary) that is the source of the commodity. It also indicates which environmental and social issue(s)—the components or "indicators" within the Index—might pose the biggest risk(s) to supply security or stability. The Index helps decision-makers know what level of further due diligence and due care they should take when investing in soft commodity projects or entering into sourcing contracts for soft commodities. Use of the Index has the potential to improve the stability and security of supply chains, reduce material risks to operations and contracts, and help improve overall supply chain sustainability.

This report is the output of Phase I research of the index, aiming at establishing the indicator system and the methodology for composing the index. The report is open for comments. For the next Phase of the work, the team will collect feedback and comments, further improve the methodology and pilot the index for selected areas, commodities and users.

Chapter 1. Content

1.1 Environmental and social factors can cause supply chain risk

Global commodity supply chains are essential to economic development. They are a pillar of ***trade***, bringing essential goods harvested, processed, and/or produced from places of comparative production advantage to consumers who want those goods. They are a pillar of ***investment***, serving as an attractive investment opportunity for development banks and commercial banks. And they are a pillar of ***business*** activity, with some of the world's largest and most profitable companies involved in one or more stages of commodity supply chains.

Long-term insecurity and instability in commodity supply chains—in the form of disruption in supply or volatility in prices—can be detrimental to economic development. Traditional analyses by ministries of commerce/trade and by financial institutions tend to focus on regulations, trade policies, or market factors as causes of these disruptions. But environmental and social factors also can cause disruptions in commodity supply chains. For instance, lack of available freshwater in a crop-growing region can curtail the production of agricultural commodities. Likewise, overuse of freshwater by the agricultural sector in that region can lead to social strife or regulatory action that impinges upon future production and export potential.

Because many commodities both *depend upon* and *impact* natural resources and ecosystems, unsustainable practices can lead to five types of material risk to those who export, import, and/or finance a particular commodity (Hanson, C. et al., 2012). These material risks include:

- *Operational risks* such as higher commodity costs, lower commodity output, or physical commodity supply disruptions.
- *Regulatory and legal risks* such as fines, regulations, or lawsuits.
- *Reputational risks* such as being targeted by non-governmental organization (NGO) or media campaigns for degrading pristine ecosystems or harming local people.
- *Market risks* such as failing to align with emerging consumer norms and new market demands.
- *Financing risks* such as banks implementing more rigorous lending requirements or lending restrictions due to recognition of their investment's exposure to any of the aforesaid risks and/or an increased focus on environment, social, and governance (ESG) concerns.

Any of these risks, in turn, can threaten the profitability and long-term security of a particular commodity supply chain and the companies and/or investors involved with it. And any of them can threaten the security and stability of a nation's ability to import those commodities.

1.2 Soft commodity supply chains are particularly risky

Today, risk in "soft commodities" (**Box 1**) is particularly high on political, business, and financier agendas (including those involved in the BRI) for several reasons：

A first reason concerns the environment. Soft commodities are major drivers of deforestation, climate change, and biodiversity loss. In particular, soybeans, palm oil, beef, and forest products (timber, pulp & paper) cause 40-50% (TFA 2020, 2018; Haupt et al., 2018) of the world's tropical deforestation. Tropical deforestation is a major contributor to climate change (UNFCCC, 2018) and a leading source of biodiversity loss, since tropical rainforests host the most terrestrial biodiversity of any biome on the planet (Millennium Ecosystem Assessment, 2005). Thus, as nations (and

companies) of the world set their climate and biodiversity agendas for the next decade, soft commodity trade is a growing focus

A second reason concerns legality. For example, the illegal timber trade is an estimated $50-152 billion globally per year (UNEP, 2017). More widely, a sizeable share of global soft commodity supply is associated with illegal land clearing, illegal logging, labor violations, tax evasion, and/or corrupt allocation of permits and licenses.

A third reason concerns social issues. For instance, farmer livelihoods are harmed when unsustainable commodity production degrades land, provides below-market wages, reduces crop yields, or limits access to water. Likewise, unsustainable soft commodity supply chains can impinge upon labor conditions, worker rights, and land rights of rural communities.

A fourth reason is that "business-as-usual" trade in soft commodities poses a threat to major international agreements. For instance, it undermines the rule of international law and the enforcement of national laws. It makes achieving numerous Sustainable Development Goals much more difficult. Moreover, continued tropical deforestation by these commodities will make it impossible to achieve the Paris Agreement on Climate Change and the globally agreed targets of the Convention on Biological Diversity (CBD).

A fifth reason concerns business profitability. Recent history includes high-profile cases—such as Lumber Liquidators, Gibson Guitar, United Cacao, ABC Indústria e Comércio SA, JJ Samar Agronegócios Eireli, and Uniggel Proteção de Plantas Ltda—where businesses suffered significant financial damage, reputational damage, and loss of access to markets and/or finance due to engaging in "business-as-usual" soft commodity sourcing practices (see CCICED, 2020).

Box 1 What are soft commodities?

"Soft commodities" consist of raw materials and derivatives produced by the agriculture and forestry sectors. Examples include food, fiber, feed, medicines, cosmetics, and fuels derived from plants and animals. Nations tend to rely on global supply chains to acquire the soft commodities they need. These commodities contrast with "hard commodities"—raw materials and derivatives extracted or mined, such as metals, oil, and natural gas.

Source: CCICED (2020)

1.3 "Greening" soft commodity supply chains can address these risks

An effective strategy for addressing these challenges is "greening" commodity supply chains (also called "value chains"). As described in the recent report *Global Green Value Chains* of The China Council for International Cooperation on Environment and Development (CCICED), a green supply chain" can strengthen the security of food supplies, rebuild trust in global commodity trade, and fill gaps in current global governance—harnessing the shared performance ambitions of commodity suppliers, traders, buyers, exporting countries, and importing countries" (CCICED, 2020).

A number of major players in the global economy are already taking steps to "green" their commodity supply chains. Via its Green Deal, the European Union intends to ensure imported commodities are environmentally and socially sustainable. The United Kingdom is following suit. Major agricultural companies such as Cargill, Mars, Nestlé, Olam, and Wilmar are implementing strategies to make their supply chains green or sustainable. Likewise, consumers in a number of

markets, including China, are signaling an interest in having the commodities they buy be sustainable (CCICED, 2020).

1.4 Using an "index" can help

One component of a strategy to "green" commodity supply chains is to use a risk "index" to screen and inform sourcing, investment, and related decisions. Government agencies, financial institutions, and companies could use an index to assess the relative performance and/or degree of risk facing a company, investment, and/or a sourcing jurisdiction (i.e., a specific geography or political region). Such an assessment would be valuable for evaluations of the sustainability of and risks to BRI investments and projects. The risk assessment is based on a suite of parameters or "indicators" deemed as important components or drivers of performance and risk. The index and its constituent indicators compare performance against an absolute quantitative standard and/or compare between actors.

A number of sustainability indices that touch upon commodity supply chains exist. These include FECO's Green Supply Chain Index for Industrial Sector, the Food Sustainability Index, CDP's index on corporate sustainability, and others. However, none to date focus upon the sustainability of soft commodity supply chains.

Chapter 2. Green Commodity Supply Chain Index

2.1 Proposal and purpose

The "Green Commodity Supply Chain Index" is designed to fill this gap. It is a tool developed to help Chinese government agencies, companies, and financial institutions assess the relative risk to the long-term security and stability of any particular commodity supply chain posed by major environmental and social factors. The Index indicates the *degree* of risk—categorized as either "high", "medium", or "low"—within a jurisdiction that is the source of the commodity. It also indicates *which* environmental and social issue(s)—the components or "indicators" within the Index—might pose the biggest risk(s) to supply security or stability.

The Index focuses on jurisdictions—the geographic or political areas where relevant decisions are made—that are the ultimate source of commodities. There are a number of reasons for this focus (**Box 2**). At a *de minimus*, the jurisdiction should be an entire country. For medium-sized and large-sized countries (in terms of area), the jurisdiction should be states or provinces. If data is available for the indicators and for the origin of the commodity, then the jurisdiction could be sub-provincial (e.g., municipalities in Brazil, districts in Indonesia). Future evolution of the Index could expand to cover individual companies.

The Index generates a color-coded assessment of jurisdictions—overall and per environmental and social component of the Index. The color coding implies level of risk and recommended actions by Index users, namely:

- **Green** = *low risk*. This jurisdiction should be eligible for normal or "fast track" approval for investment, contracts, and other forms of sourcing commerce.
- **Yellow** = *medium risk*. The jurisdiction should undergo some level of scrutiny and review—particularly on those issues or indicators that cause the index to be "yellow"—prior to investment, contracts, or other forms of sourcing commerce. This scrutiny should assess the nature and causes of the risk, and what the jurisdiction or company sourcing from that jurisdiction is going to do to reduce that risk.
- **Red** = *high risk*. The jurisdiction should undergo thorough scrutiny and review prior to investment, contracts, or other forms of sourcing commerce. This scrutiny should include direct one-on-one engagement with the jurisdiction or company sourcing from that jurisdiction, preparation of a plan for how to reduce the risk, and follow-up performance monitoring. An investor or buyer should *not* immediately avoid commercial interaction with that jurisdiction or company sourcing from that jurisdiction. Immediately avoiding that jurisdiction might result in the unintended consequence of that jurisdiction (or suppliers in that jurisdiction) merely switching to customers or investors that do not care about environmental and/or social performance. Such a response would not solve the underlying sustainability problems. Rather, the purpose of the Index is to spur improvement within jurisdictions. Thus, an investor or buyer should start by directly engaging the jurisdictional government, suppliers from that jurisdiction, and/or companies sourcing from that jurisdiction. If over time the jurisdiction's performance does not improve, then the investor or buyer should consider ceasing business engagement.

This "Green Commodity Supply Chain Index" can support decisions of Chinese government agencies (e.g., to inform trade arrangements), Belt and Road Initiative (BRI) investors, and individual companies involved in commodity supply chains. While the Index has been developed

initially for application to soft commodities (e.g., agricultural and forestry products), it later can be expanded to hard commodities (e.g., commodities not derived from recently living material).

Box 2 Why focus on the jurisdiction of the first stage of the supply chain?

The Index focuses on the jurisdiction—the geographic or political area—that is the ultimate source of the commodity (i.e., the first stage of the supply chain). Although fully greening soft commodity supply chains involves improvements along each stage of a supply chain, what happens during the production stage *has the most impact* on climate change, biodiversity, and local people. This is because growing or extracting commodities directly causes the loss or degradation of natural ecosystems such as forests and wetlands. This loss and degradation are a major contributor of global greenhouse gas emissions and the leading driver of biodiversity loss (Millennium Ecosystem Assessment, 2005; Alkama and Cescatti, 2016). In fact, for many major soft commodities of importance to China, the conversion of land is the commodity's major contribution to greenhouse gas emissions.

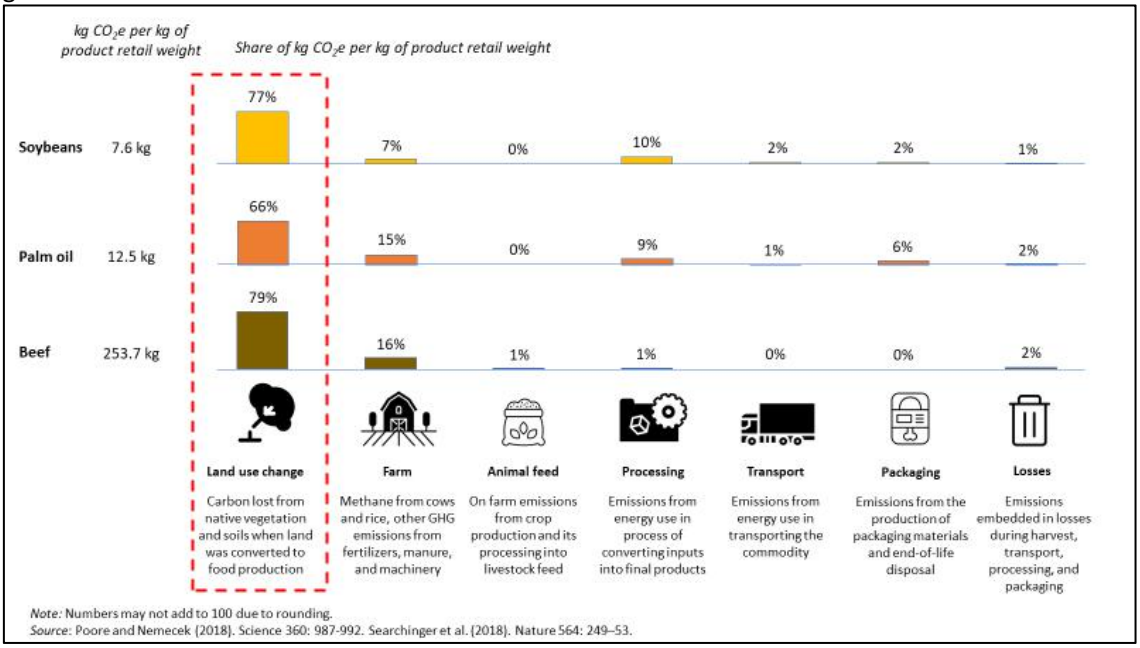


Figure 1 Share of greenhouse gas emissions per stage in the value chain for selected soft commodities

Source: Quoted and adapted from CCICED (2020).

2.2 Users and application

The Green Commodity Supply Chain Index can be used by a variety of entities to improve the stability and security of their supply chains, reduce material risks to their operations and investments, and help improve overall supply chain sustainability. The Index essentially identifies the relative degree of risk and the source of risk in jurisdictions which generate commodities. In so doing, it enables improved decisions and creates incentive signals. Index applications include but not limited to:

- **Government agencies** *(including those involved with BRI activities)*

- Targeting incentives to reward jurisdictions for reducing sources of environmental and social risk, thereby helping to improve performance, dissuade poor performance, and/or prioritize interventions.
- Facilitating a jurisdiction achieving some form of "favored trade" status.
- Using a "green" index score as a market-positioning tool to attract buyers and investors to its region.

- **Commodity buyer companies**
  - Prioritizing jurisdictions or companies from which to source commodities.
  - Prioritizing jurisdictions or companies to most actively engage in performance improvement or integrate performance improvement requirements into contracts.
- **Commodity producer companies**
  - Monitoring performance of its operations, business units, subsidiaries, etc.
  - Identifying those business units that need more active or more frequent monitoring, performance improvement, and investment (based on in which jurisdiction they operate).
  - Focusing attention on those jurisdictions and/or business units to start traceability programs.
  - Demonstrating to buyers and investors that they are worthy of reduced paperwork, oversight, etc.
  - Using a "green" index score as a market-positioning tool, aiming to attract buyers and investors that are risk-averse.
- **Investors** *(e.g., BRI investors, banks, commercial investors, development assistance agencies)*
  - Prioritizing jurisdictions and/or companies in which to increase investment or provide more favorable lending terms.
  - Prioritizing which clients to most actively engage in performance improvement and integrate performance improvement requirements into investment agreements.
- **Certification programs**
  - Reducing auditing costs by using the Index to create differentiated auditing rules based on the jurisdiction's Index performance (e.g., "green" jurisdictions "earn" lower auditing burdens).

2.3 Design principles

The Green Supply Chain Index is designed with several user-friendly principles in mind. It should be:

- **Simple**. The Index should be easy to tabulate, understand, and apply.
- **Focused**. The Index should focus on just a small set of issues or "indicators" in order to concentrate attention on the highest priority environmental and social issues of the day. Moreover, having just a few indicators ensures that each indicator has an impact on the overall index. When indexes have a lot of indicators, the final index scores across entities tend to be very similar between entities, making it difficult to discern distinctions. Over time, as use of the

Index becomes more mainstream and as priority issues start to be successfully addressed, additional issues or indicators could be added to the Index.

- **Applicable today.** The Index should be capable of being generated and used *now* and not have to wait for better information. This means that the Index needs to use currently available data. Of course, as improved data emerges, that data can replace current data and thereby strengthen the Index.
- **Differentiating.** The Index should generate results that provide sufficient distinctions between assessed entities. Not every assessed entity should receive roughly the same "score", otherwise the utility of the Index is nil. Likewise, the constituent indicators should be sufficiently independent of each other to avoid close correlation of two indicators leading to an "over-weighting" of one set of conditions on the Index.
- **Outcomes-based.** What ultimate matters in terms of risk mitigation and sustainability is on-the-ground performance. Thus, where possible, the Index should be based on objective on-the-ground performance or results, not on practices or policies an entity implements (which may or may not lead to on-the-ground change and risk mitigation).
- **Good enough.** The Index should not seek to address everything or necessarily have perfect measurements. It just needs to be "good enough" to send the right behavior signals to government, business, and financial actors.

Chapter 3. The Index: Indicators and Metrics

The Green Supply Chain Index consists of five indicators, each of which covers an important environmental or social source of possible supply chain risk. The following profiles each of these indicators in terms of why it is important, what metric to use, how that metric can be measured, and how the metric can be scaled as "green", "yellow", or "red". The current focus of the Index is soft commodities.

3.1 Indicator: forest loss

Forest loss refers to the loss of forest area due to clearing forestland and converting it into agricultural land (to grow soft commodities) or due to cutting natural forests to generate timber, wood, and paper pulp.

- ***Why important.*** Halting conversion of natural forests is important for political, business, environmental, and social reasons:
  - *Political: Reducing forest conversion and degradation is a high priority of the UNFCCC Paris Agreement on climate change. Nearly every climate model indicates that the world will not meet the Paris Agreement to limit global warming to 2.0/1.5ºC unless deforestation and forest degradation is halted. Likewise, because natural habitat loss is the world's most significant cause of biodiversity loss (Millennium Ecosystem Assessment, 2005), halting deforestation is a priority of the Convention on Biological Diversity (to be hosted by China in 2021).*
  - *Business: Multinational companies including Mars, Unilever, Nestlé, Wilmar, and other members of the Tropical Forest Alliance have made ambitious commitments to eliminate deforestation from their soft commodity supply chains. Thus, the issue of deforestation is rising on private sector agendas.*
  - *Environmental: Since the dawn of the first agricultural revolution 8,000 to 10,000 years ago, growing crops and raising livestock have been the primary causes of loss and degradation of natural ecosystems (Millennium Ecosystem Assessment, 2005). Today, the majority of current land-use change in the world is forests, wetlands, and grasslands being converted into farms and grazing pastures. For instance, agriculture was responsible for roughly 80 percent of tropical deforestation between 2000 and 2010 (Kissinger et al., 2012). Land-use change (particularly deforestation) causes at least 10 percent of net global annual greenhouse gas emissions, and causes an even larger share of gross annual emissions. Land-use change can be a proxy for biodiversity loss, as well, since habitat loss is the world's most significant cause of biodiversity loss (Millennium Ecosystem Assessment, 2005).*
  - *Social: Millions of people, many of whom are Indigenous, live in and rely upon natural forests. Deforestation undermines these peoples' sources of food, water, shelter, income, cultural identity, and more.*
- ***What metric:*** Different metrics are proposed for jurisdictions falling within tropical ecozones versus those in temperate and boreal ecozones. This is due to differences in forest conversion dynamics and data availability between these zones. Deforestation is not currently possible to measure directly at a global scale. Furthermore, while deforestation is rampant in the tropics, it is less common in temperate and boreal forest ecozones. In these regions, the sustainability of

forest management practices in the context of logging of natural forests, especially large tracts of intact forests, is a greater ecological concern.

- *Within tropical forest ecozones, jurisdictions should be assessed by the average annual rate of loss in natural forests and primary forests over the past five years (hectares of loss divided by total natural forest area and primary forest area as of 2001). "Primary forests" are a subset of natural forests and are considered particularly important due to their outsized levels of carbon storage and biodiversity.*
- *Within temperate and boreal forest ecozones, jurisdictions should be assessed by the total hectares of forest loss related to forestry activities occurring in the past five years within Intact Forest Landscapes (IFLs). IFLs are defined as unbroken expanses of natural forest ecosystems showing no significant human activity and large enough that all native biodiversity, including viable populations of wide-ranging species, could be maintained. The expansion of logging operations into IFLs is an indication of unsustainable forest management systems.*

- ***How measured:*** Global tree cover extent in 2001 has been mapped at 30x30 meter (0.09 hectare) resolution using satellite imagery by the University of Maryland (Hansen et al., 2013). To arrive at natural forest extent, known tree plantations (as mapped within the Spatial Database of Planted Trees (Harris et al., 2019)) are eliminated from the map of global tree cover extent. Primary forests (Turubanova et al., 2018) and Intact Forest Landscapes (Potapov et al., 2017) are subsets of natural forests, which have been further delineated using satellite imagery analysis. Hansen et al. (2013) have also mapped global tree cover loss annually at 30x30 meter resolution from 2001 through to the present. This tree cover loss data is overlaid with maps of natural forests, primary forests, and Intact Forest Landscapes to quantify the amount of loss within each category. All of this data is freely and publicly available on Global Forest Watch (www.globalforestwatch.org).
- ***How scaled:***
  - **Green**
    - **Tropics**: Less than 0.2% annual 5-year average natural forest loss AND less than 0.1% annual 5-year average primary forest loss
    - **Temperate/boreal**: Less than 10 hectares of loss related to forestry in IFL in the past five years
  - **Yellow**
    - **Tropics**: Less than 0.5% annual 5-year average natural forest loss AND less than 0.25% annual 5-year average primary forest loss
    - **Temperate/boreal**: Less than 1,000 hectares of forestry loss in IFL in the past five years
  - **Red**:
    - **Tropics**: More than 0.5% annual 5-year average natural forest loss OR more than 0.25% annual 5-year average primary forest loss
    - **Temperate/boreal**: More than 1,000 hectares of forestry loss in IFL in the past five years

Figure 2 provides a draft map of this indicator at the state and provincial jurisdiction scale.

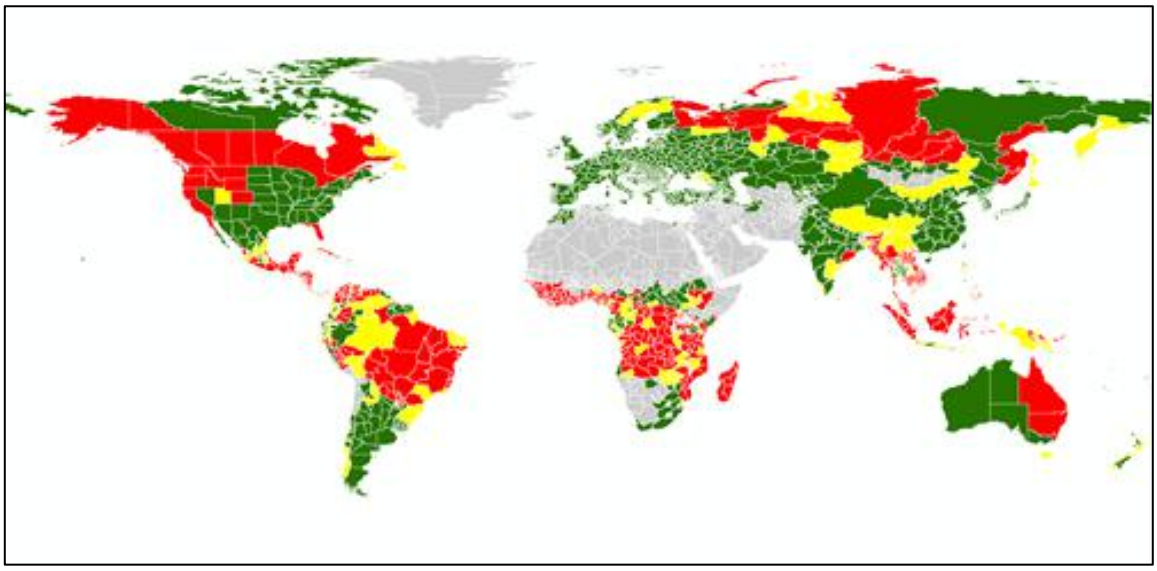


Figure 2 Map of forest conversion indicator per state/province

- ***Future considerations:*** As remote-sensing systems emerge that monitor all forms of land and ecosystem change at high resolution, this indicator should be expanded beyond forest conversion to include conversion of other types of natural ecosystems (e.g., grasslands, wetlands). This is important given the climate, biodiversity, and local community impacts of that conversion.

3.2 Indicator: water stress

"Water stress" refers to the level of freshwater withdrawals relative to the level of freshwater availability in a jurisdiction. "Low water stress" means that freshwater availability vastly outpaces the level of freshwater demand in the jurisdiction. "High water stress" means that freshwater withdrawals approach the amount of freshwater availability, increasing the possibility that there will not be enough water to meet all agricultural, urban, industrial, and natural ecosystem needs.

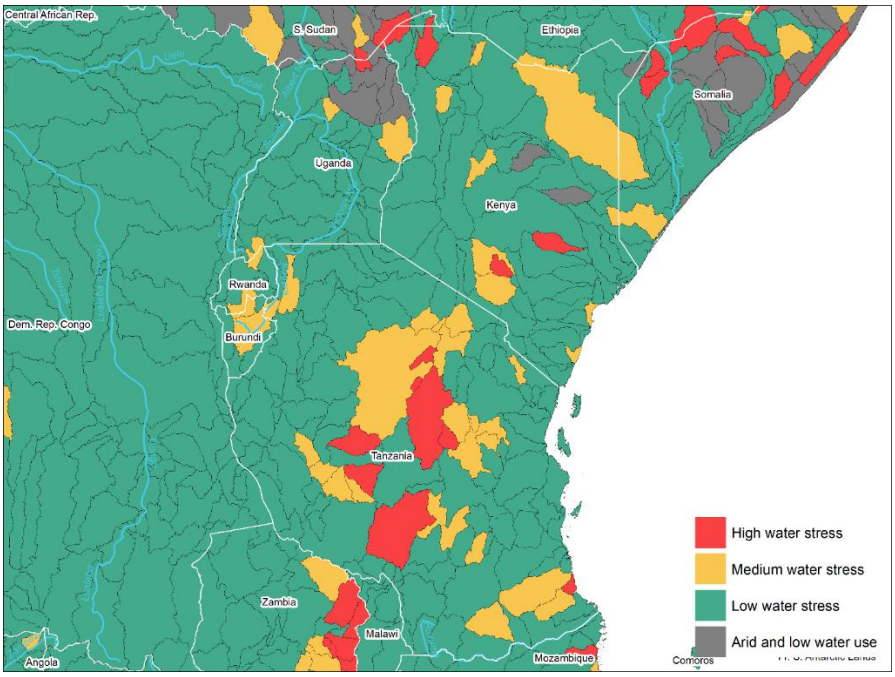
- ***Why important:*** Ensuring that freshwater withdrawals in a jurisdiction are not too high relative to available freshwater supply is important for political, business, environmental, and social reasons:
  - *Political:* Given water's fundamental importance to citizen and economic well-being, high levels of water stress can trigger domestic, and even transnational, strife and conflict.
  - *Business:* Businesses recognize the risk to their ability to produce and manufacture commodities caused by water stress. For instance, in the World Economic Forum's annual survey of business perceptions of risk, "water" has consistently ranked in the "top 5 concerns" over recent years. Likewise, 175 business executives from leading companies have signed the UN Global Compact's CEO Water Mandate, a CEO-led industry-driven initiative committed to reducing water stress by 2050.
  - *Environmental:* Using too much available water in a jurisdiction for agriculture, industry, and urban demands can jeopardize that jurisdiction's (and downstream jurisdictions') freshwater ecosystems and the many ecosystem services they provide humankind.
  - *Social:* Adequate supplies of clean fresh water are critical for the people's health and hygiene.

- ***What metric:*** An appropriate metric for "water stress" is the ratio of total freshwater withdrawals to available renewable surface and groundwater supplies within the selected jurisdiction. This metric has several advantages. First, it is comparable across hydrological basins and administrative jurisdictions. Second, it is quantitative and highly granular, calculated for more than 16,000 hydrological sub-basins worldwide (using the "HydroBASINS Level 6" sub-basins from Lehner and Grill 2013). Third, it is an established method of measuring water quantity-related risk, used by many universities, research institutions, multinational corporations, financial institutions, and governments. Users include S&P, BlackRock, McKinsey, Cargill, Microsoft, the World Bank, the Asian Development Bank, the OECD, the United Nations, China's Ministry of Ecology and Environment, the U.S. Department of Defense, Tongji University, and Yale University. The model (PCR-GLOBWB 2) used to calculate water stress has been published and is widely referenced in peer review journals.
- ***How measured:*** Water stress is the ratio of total water withdrawals to available renewable surface and groundwater supplies. Per sub-basin, water withdrawal is calculated for four sectors: domestic, industrial, irrigation, and livestock.
    - Irrigation water withdrawal is determined using monthly irrigated areas per grid cell, crop phenology, and crop factors, which are based on FAOSTAT, MIRCA 2000, and the Global Crop Water Model, respectively ("FAOSTAT", 2012; Portmann et al., 2010; Siebert and Döll, 2010). The irrigation water requirements are derived from FAO guidelines (Allen et al., 1998; Doorenbos and Pruitt, 1977). Paddy and non-paddy crops are calculated separately and are both fully coupled with changes in surface and groundwater balance. Evapotranspiration is dynamically modeled using soil, vegetation, climate, and crop states.
    - Industrial withdrawal captures water demand for manufacturing, power generation, and other industrial processes. Water use intensities are used to derive time series (1960–2014) from a reference dataset (Wada et al., 2011), and are then combined with a reference industrial water withdrawal data. Country-level results are spatially disaggregated using nighttime lights.
    - Daily livestock withdrawal is determined by multiplying the total number of livestock per grid cell by a corresponding daily drinking water requirement depending on temperature. Gridded livestock density for 1960–2014 is obtained by combining the gridded livestock densities of 2000 with historical livestock growth (Wada et al., 2011).
    - Domestic withdrawal includes water demand from households in both urban and rural areas. Domestic water demand per country 1960–2014 is calculated by combining the total country population 1960–2014 with the average per capita water use of a reference year. Annual country withdrawal data are then further processed using gridded population and gridded air temperature (Wada et al., 2011).

  For water supply, the model uses daily time series of precipitation, temperature, and evaporation. Available renewable water supplies factors in the impacts of upstream consumptive water uses and large dams on downstream water availability.

  The unit of measure is cubic meters for both withdrawals and supply. Higher ratios of water stress indicate more competition among users. Water stress indicators are publicly available via the Aqueduct Water Risk maps, available at https://www.wri.org/aqueduct. Water stress can be aggregated to country, provincial, and/or sub-provincial jurisdictional units (see **Figure 3** for an example from East Africa).
- ***How scaled:***

- **Green** = a ratio of withdrawals to supply of 0.20 or less [on the Aqueduct scale, this corresponds to "low" (<0.10) or "low to medium" (0.10-0.20) water stress]
- **Yellow** = a ratio of withdrawals to supply of 0.20 to 0.40 [on the Aqueduct scale, this corresponds to "medium to high" (0.20-0.40) water stress]
- **Red** = a ratio of withdrawals to supply of 0.40 or higher [on the Aqueduct scale, this corresponds to "high" (0.40-0.80) or "extremely high" (>0.80) water stress]



Source: (WRI, 2020)

Figure 3 Water stress indicators for East Africa

3.3 Indicator: yield growth

Yield growth refers to the rate of increased crop, livestock, and/or forest product production per hectare of crop, pasture, and/or timber land.

- ***Why important***. Ensuring that the yields of the major crops, livestock, and timber that form the basis of soft commodities continue to increase over time in a jurisdiction is important for political, business, environmental, and social reasons:
  - *Political:* Many domestic industries and citizen livelihoods are linked to soft commodity production. Yield growth implies improved efficiency of production, which in turn can benefit industry sector growth and profitability and the ability of the jurisdiction and/or country to compete in global markets.
  - *Business:* Continuously increasing yields can translate into improved margins for companies involved in commodity supply chains.
  - *Environmental:* Boosting yields on existing agricultural (e.g., crop, livestock, timber) land is a critical strategy in global efforts to combat climate change and save biodiversity. The projected global demand growth for food, timber, and other soft commodities will result in the conversion of hundreds of millions of hectares of forests and other natural

ecosystems unless yield growth equals or exceeds that demand growth—as noted by the World Resources Institute, the World Bank, United Nations Development Programme, and United Nations Environment Programme (Searchinger et al., 2019).

- *Social:* Yield growth can improve farmer margins and the amount of product a given farmer (for a given amount of land) can deliver to market. These improvements, in turn, can help farmers be more resilient to shocks (e.g., market, climate), bringing more rural social stability.

- ***What metric:*** An appropriate metric for "yield growth" is the rolling 5-year average production (in metric tons) of a commodity per hectare within the jurisdiction. The metric should be "per commodity", thus there will be a metric for soybeans, another for palm oil, another for pulp & paper, and so forth. The metric should aspire to be "per jurisdiction" (e.g., district or state level), but in many cases the highest resolution of data publicly available might be just at the country level. In addition, the commodity yield growth should be compared against the projected annual growth in demand by 2050 for that commodity. This is important because the climate and biodiversity benefits, for instance, of yield growth come when yield growth meets or exceeds demand growth (thereby reducing pressure to convert natural ecosystems into crops, livestock, or timber land.
- ***How measured:*** Data on yield growth rates and projected growth in demand are publicly available from the Food and Agriculture Organization of the United Nations (FAO).
- ***How scaled:*** Per commodity:
  - **Green** = 5-year average annual yield growth is greater than projected annual growth in demand
  - **Yellow** = 5-year average annual yield growth approximates projected annual growth in demand
  - **Red** = 5-year average annual yield growth is less than projected annual growth in demand

3.4 Indicator: risk of Illegality

Risk of illegality refers to the degree to which a soft commodity supply chain might suffer from illegal activities (e.g., illegal land clearing, slave labor, bribery).

- ***Why important***. Ensuring that a soft commodity supply chain has a low risk of illegal activities—particularly at the source location—is important for political, business, environmental, and social reasons:
  - *Political:* Illegal activities rob governments of tax revenues, undermine the rule of domestic laws, and can contravene international laws and norms.
  - *Business:* Companies that participate, even unknowingly, in a commodity supply chain that suffers from illegalities can face legal, reputational, operational, market, and financing risks.
  - *Environmental:* Illegality is often an indicator of poor environmental governance and unsustainable use of and impacts on natural resources.
  - *Social:* Illegal activities often negatively impact the well-being, safety, and livelihoods of local communities.
- ***What metric:*** While there may not yet be a "perfect", publicly available indicator for the risk of illegality in soft commodity supply chains, the "Control of Corruption" indicator from the World

Bank's Worldwide Governance Indicators (WGI) can be used as a proxy for the relative risk of corruption—and links to illegality—in a commodity sourcing country. The indicator "reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests" (Kaufmann, D., et al., 2010). The degree of control of corruption is reported in percentile rank terms, ranging from 0 (lowest control of corruption) to 100 (highest control of corruption) among all countries worldwide.

- ***How measured:*** The Control of Corruption indicator is provided by the World Governance Indicators (https://info.worldbank.org/governance/wgi/), which are tabulated by the World Bank. The World Governance Indicators assess six dimensions of governance, including (1) Voice and Accountability, (2) Political Stability and Absence of Violence/Terrorism, (3) Government Effectiveness, (4) Regulatory Quality, (5) Rule of Law, and (6) Control of Corruption. The WGI covers more than 200 countries and territories annually, from 1996 onward. The WGI draws from more than 30 data sources and collects views of public, private, and non-governmental sector experts worldwide.
- ***How scaled:***
  - **Green** = 67-100 in percentile rank of the "Control of Corruption" indicator
  - **Yellow** = 34-66 in percentile rank of the "Control of Corruption" indicator
  - **Red** = 0-33 in percentile rank of the "Control of Corruption" indicator

3.5 Indicator: human development

Human development refers to the income and well-being of people living in regions that produce soft commodities. It serves as a proxy measure for the livelihood of those who cultivate, grow, and harvest crops, livestock, trees, and other sources of soft commodities.

- ***Why important***. Ensuring that livelihoods in a jurisdiction are good is important for political, business, environmental, and social reasons:
  - *Political:* The risk of political instability is higher if rural livelihoods are not good or not improving.
  - *Business:* Business supply chains are more stable and productive when farmer livelihoods are stable or improving.
  - *Environmental:* Some studies have found that, at the regional level, poverty reduction can reduce environmental impacts, for example, reducing deforestation pressure.[i]
  - *Social:* Increased income, education, and health in a commodity producing region have clear benefits for the region's inhabitants.
- ***What metric:*** Ideally, the Green Supply Chain index should use an indicator focused on farmer (or rural) livelihoods (e.g., income, health, education) given that the rural sector drives production of soft commodities. However, there is a lack of available granular datasets on farmer livelihoods. Instead, a subnational variation of the "Human Development Index" can serve as a proxy indicator.

  Created by the United Nations Development Program (UNDP), the national-level Human Development Index (HDI) consists of three dimensions of development: (1) long and healthy life, (2) knowledge, and (3) decent standard of living. Within these dimensions, it has four indicators: (1) life expectancy at birth, (2) expected years of schooling, (3) mean years of schooling, and (4)

GNI per capita (**Figure 4**). The HDI currently serves international development institutions and national governments as an accepted measure of human development. Radbound University in The Netherlands compiles and publishes the HDI at the subnational (i.e., province, state) level.

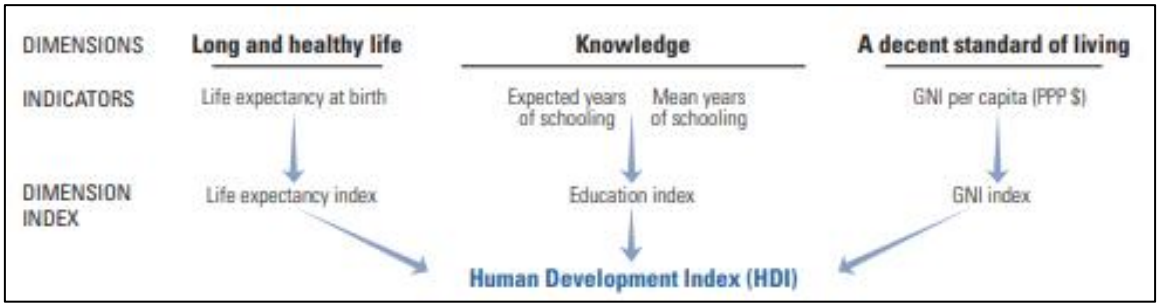


Figure 4 Components of the Human Development Index

Source: UNDP (2019)

- ***How measured:*** Compare the 3-year average *Subnational* Human Development Index for a jurisdiction against the 3-year average of the associated *National* Human Development Index to determine if the jurisdiction is improving faster or slower than the national average. The better the jurisdiction is performing relative to the national average, the more likely farmers and others in the producing soft commodity economy are satisfied and thus the less risk of socio-economic disruptions. Using 3-year averages counters short-term volatilities (e.g., economic recession, impact of a pandemic). If the HDI in a commodity producing region inside a country is growing slower than the national average, it could mean that people in this region are being "left behind" and are not realizing the benefits of economic activity. This in turn could present a risk for the region's long term stability and viability of production due to social tension, lack of human capital, and even rural exodus.
- ***How scaled:***
  - **Green** = Subnational HDI grows faster than national average HDI (>0.1%)
  - **Yellow** = Subnational HDI varies in accordance with national average HDI (between 0% and 0.1%)
  - **Red** = Subnational HDI variation is outperformed by national average HDI (<0%)

  Table 1 gives an example of this scaling.

Table 1 Subnational HDI indicator for selected soft commodity producing jurisdictions

Country	Subnational jurisdiction	ΔSHDI vs ΔHDI
Argentina	Cordoba	*0.00%*
Argentina	Santa Fe	*-0.24%*
Brazil	Mato Grosso	*0.00%*
Brazil	Para	*0.03%*
Brazil	Parana	*-0.01%*
Colombia	Antioquia	*0.13%*
Indonesia	Jambi	*0.01%*
Indonesia	West Kalimantan	*0.18%*
Malaysia	Sabah	*0.05%*
Malaysia	Terengganu	*0.01%*
Paraguay	Caaguazú	*0.02%*
Paraguay	Concepción	*0.03%*

3.6 Combining indicators

To arrive at a single index, the component indicators are integrated by weighting and aggregating them. **Box 3** summarizes standard options for weighting and aggregating indicators for any index. For the Green Supply Chain Index, we recommend "equal weighting" and "arithmetic average" aggregation.

To conduct calculations, one converts the "green, yellow, red" scale for each indicator into numerical values: "green = 1", "yellow = 2", and "red = 3". One then conducts an aggregation calculation: (forest loss indicator + water stress indicator + yield growth indicator + risk of illegality indicator + farmer livelihood indicator) divided by 5 The resulting number from this calculation becomes the singular index value. That value is then aligned with an overall "color" per the following scale:

- **Green** = 1.0 – 1.5
- **Yellow** = 1.6 – 2.2
- **Red** = 2.3 – 3.0

However, if any constituent indicator is "red", then the best the index can be is "yellow". A red indicator signifies that the jurisdiction or company needs to conduct some due diligence, thus warranting at least a "yellow". **Table 2** provides illustrative example calculations.

Table 2 Illustrative calculations converting indicators into an index

Indicator	Jurisdiction 1	Jurisdiction 2	Jurisdiction 3	Jurisdiction 4
Deforestation	1	2	2	1
Water stress	2	1	2	1
Yield growth	1	2	2	1
Illegality	1	2	3	1
Farmer income	2	3	3	3
Total index	**1.4**	**2.0**	**2.4**	**1.4**

Box 3 Options for weighting and aggregating indicators to create an index

Weighting

- ***Equal weighting:*** This approach gives all components equal significance in the index.
- ***Adjusted weights based on statistical correlation:*** This approach uses a correlation coefficient to test components to either (1) choose only components that have a low degree of correlation and assign equal weights, or (2) adjust the weights of components according to their degree of correlation (e.g., give less weight to correlated indicators). This approach avoids double counting or biasing the index in favor of statistically similar components.

Differential weighting based on expert judgment: This approach involves convening a group of experts to assign weights to components based on their judgment of which components are more or less important in reflecting policy priorities or other objectives of the index.

Aggregating

- ***Arithmetic average:*** This linear approach sums all components and divides them according to the size of the collection. This approach values each component in equal proportion. The result is that a high score for one component can compensate for a proportionally lower score for another component.
- ***Geometric average:*** This nonlinear approach uses the product of the components to the n^{th} root (where n is the size of the collection). This approach rewards a component's high score and penalizes a low score more than a linear aggregation approach. Thus it is much more difficult for a high score in one component to offset or compensate for a low score in another component.

Assigning a "knock-out" threshold: In this approach, a minimum threshold value is set that components must meet to be included in the aggregation. Failure of one component to meet its threshold prevents the aggregation from occurring.

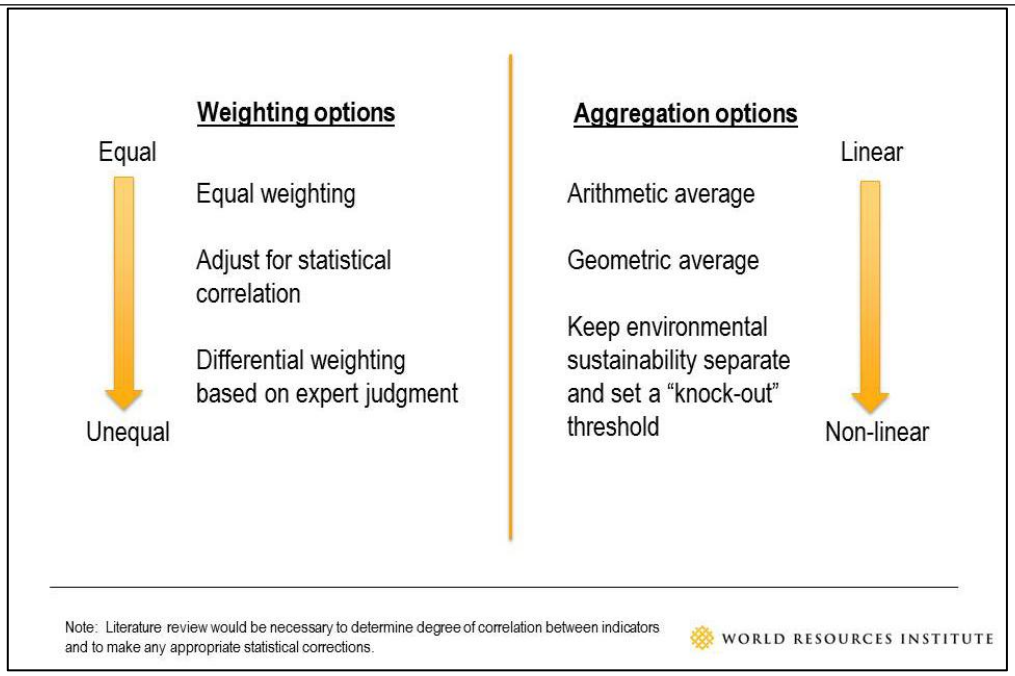


Figure 5 Approaches for integrating indicators

When integrating indicators into an overall index, it is important to keep five points in mind. First, no single integration approach for designing an index is considered statistically or scientifically superior to another: all represent value judgments.[ii] Second, the approach selected depends largely on the index's intended purpose.[iii] Third, avoid using constituent indicators that overlap or cover the same issue; they will "double count" in the aggregate index. Fourth, avoid constituent indicators that are the opposite of each other; they will zero each other out in the aggregate index. Fifth, recognize that an aggregate index may be too broad for some audiences to derive a clear message regarding the meaning and implications of the index. Too much information may be integrated, making the result unclear or even misleading. Therefore, stakeholders considering combining indicators into one index should proceed with caution.

Source: Adapted from Hanson and Henninger (2014).

The proposed Green Commodity Supply Chain Index described in previous sections is a draft from Phase 1. To convert it into a final proposed index, we plan the following next steps in Phase 2:

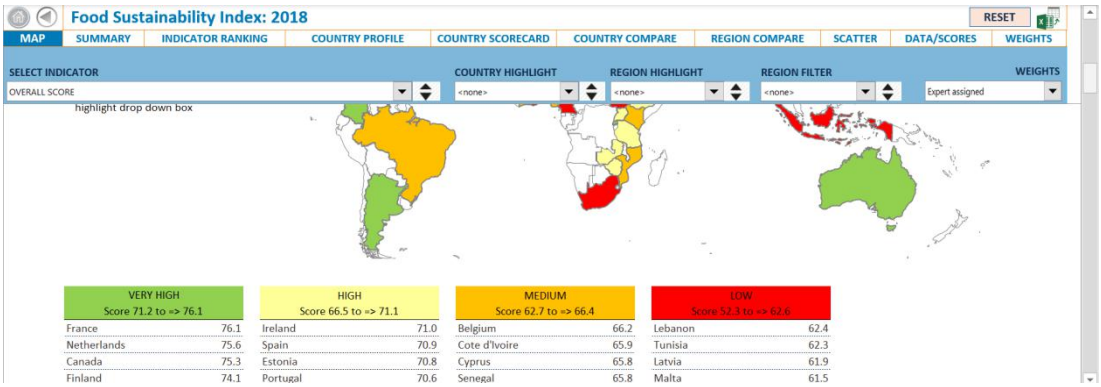
- Refine indicators and index (and text).
- Conduct a global pilot application of the indicators and index (for "yield growth" we will select a set of commodities).
- Receive additional input and feedback.
- Support decision making of departments related to environment, business, financial institutions and enterprises.
- Apply the index and publish result periodically.

Annex 1. Selected Existing Supply Chain-Related Indices

Several existing indices touch upon commodities and commodity supply chains. An assessment of them provides a flavor of what is already available and hints at some shortcomings that the Green Supply Chain Index seeks to overcome. The following is not an exhaustive list or assessment.

Food Sustainability Index

- *Description*: The Food Sustainability Index (FSI) is a global study on nutrition, sustainable agriculture and food waste which collects data from 67 countries across the world to highlight best practices and key areas for improvement in relation to the food paradoxes and the main Sustainable Development Goals. The overall score is calculated based on a weighted average of 37 indicators which are divided into the three category scores: Food Loss and Waste (which is further divided into two categories-food loss and end user food waste), Sustainable Agriculture (which includes three categories- water resources, land (land use, biodiversity, human capital), air (GHG emissions)) and Nutritional Challenges (life quality, life expectancy and dietary change) (The Economist, 2020). A higher score means that a country is on the right path towards a sustainable food and nutrition system.
- *Developed by*: Barilla Foundation and Economist Intelligence Unit



Green Supply Chain Index

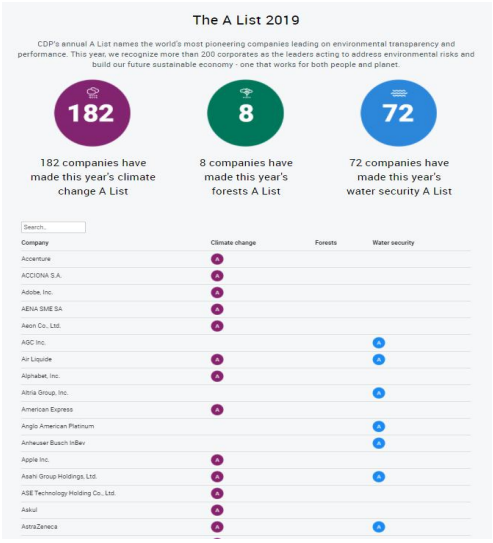
- *Description*: This index evaluates companies on three type criteria (i.e., design and procurement, production and logistic, green sales and recycling) from 34 KPIs covering environment performance (mainly pollutants), energy performance, and low-carbon development. Companies are invited to conduct external evaluations, and results are rated from 1 star to 5 stars. Currently, the index has been piloted for the furniture, textile, shoemaking, electronics, manufacturing sectors and for retailers. Results are published every one or two years (not fixed).
- *Developed by*: Foreign Environment Cooperation Center of the Ministry of Ecology and Environment

Results of FECO's Index

	Score	Rating
1	200-400	1 star
2	400-600	2 stars
3	600-700	3 stars
4	700-800	4 stars
5	800-1000	5 stars

CDP

- *Description*: CDP has a series of methodologies to help investors, companies, cities, and regions to manage their environmental impact (including deforestation, water, climate change) along the supply chains and puts the results into certain scores. CDP publishes results annually. Based on the answers to the questionnaires (deforestation, water, and climate change), the score of each area is calculated in four dimensions: disclosure, awareness, management, and leadership. There are a few open questions, and majority of the questions can be answered through selecting one of the options that CDP provides. The scores are rated A, B, C, and D, with A as the best rate. Thus, when a company reports on all three questionnaires, the best rate they can get is AAA. However, there is a minimum requirement on the score for level C and D before companies can go for level A and B. Weighting of the criteria is different across industries.



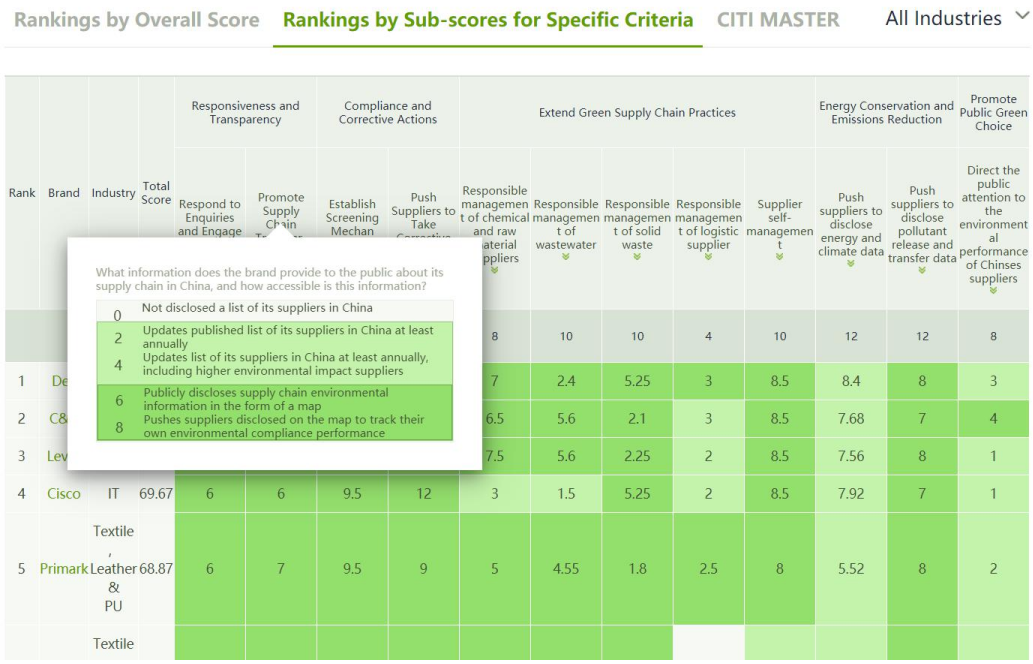
- *Developed by*: CDP

CITI Index

- *Description*: The *CITI Index* assesses brands on the environmental management of their supply chains in China. The Index has five categories of indicators: Responsiveness and

Transparency, Compliance and Corrective Actions, Extended Green Supply Chain Practices, Energy Conservation and Emissions Reduction, and Promote Public Green Choice. The evaluation uses government supervision data and public information published by the brand to assess overall supply chain environmental management. The Index is scored based on public information of a company's environmental performance in China. This includes pollution (e.g., water pollutions, chemicals, solid waste), and whether their environmental issues are reported publicly (from public website or local MEE website), and whether buyers have engaged with their suppliers to take corrective actions. The CITI report, an annual analysis of brand action, has been published annually since 2014.

- *Developed by*: Institute of Public & Environmental Affairs (IPE)



Rankings by Overall Score | Rankings by Sub-scores for Specific Criteria | CITI MASTER | All Industries

Rank	Brand	Industry	Total Score	Responsiveness and Transparency		Compliance and Corrective Actions		Extend Green Supply Chain Practices					Energy Conservation and Emissions Reduction		Promote Public Green Choice
				Respond to Enquiries and Engage	Promote Supply Chain	Establish Screening Mechan	Push Suppliers to Take	Responsible management of chemical and raw aterial ppliers	Responsible management of wastewater	Responsible management of solid waste	Responsible management of logistic supplier	Supplier self-management	Push suppliers to disclose energy and climate data	Push suppliers to disclose pollutant release and transfer data	Direct the public attention to the environmental performance of Chinses suppliers
								8	10	10	4	10	12	12	8
1	De							7	2.4	5.25	3	8.5	8.4	8	3
2	C&							6.5	5.6	2.1	3	8.5	7.68	7	4
3	Lev							7.5	5.6	2.25	2	8.5	7.56	8	1
4	Cisco	IT	69.67	6	6	9.5	12	3	1.5	5.25	2	8.5	7.92	7	1
5	Primark	Textile, Leather & PU	68.87	6	7	9.5	9	5	4.55	1.8	2.5	8	5.52	8	2
		Textile													

What information does the brand provide to the public about its supply chain in China, and how accessible is this information?

0	Not disclosed a list of its suppliers in China
2	Updates published list of its suppliers in China at least annually
4	Updates list of its suppliers in China at least annually, including higher environmental impact suppliers
6	Publicly discloses supply chain environmental information in the form of a map
8	Pushes suppliers disclosed on the map to track their own environmental compliance performance

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