Planet Tracker

Tracking Nature Impacts

A Nestlé Case Study

Supply chains in the spotlight

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CONTENTS

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Key Takeaways

- Management teams need to invest in sophisticated traceability systems to avoid exposure to logistical problems as well as regulatory and reputational scrutiny.
- There are numerous global laws where companies need to protect themselves and their investors from exposure to modern day slavery, money laundering and trading in illegal goods. Some of the more recent laws cover topics such as deforestation.
- However, it is management's decision what traceability data to reveal – i.e. provide transparency. Often executives worry that being transparent provides competitors with valuable data.
- This study demonstrates what is presently available to an outside observer and how by matching company data with geographical information systems (GIS), food supply chains can be mapped and the environmental footprint assessed, known as "***nature footprinting***".
- This study of Nestlé shows that:
  - Coffee and dairy exhibit some of the highest environmental impacts across most indicators, particularly deforestation and GhG emissions from farm management.
  - Coffee has the highest deforestation footprint in absolute terms but when normalised by volume, cocoa shows a higher deforestation intensity per tonne sourced.
  - Water usage is likely to pose increasing concerns across the coffee value chain over time, with some areas already under severe stress, as in the case of India. Coffee has the largest total water use both on an absolute and per tonne basis.
  - Dairy fresh milk production, notably in China, shows the highest GhG emissions from farm management. Additionally, dairy farming in India shows significant unsustainable water use due to its concentration in water-stressed regions.
- So, we are reaching a point where only limited supply chain data is needed by external observers to provide an estimate of the environmental impact of these food businesses and to identify potential risk hotspots and locations where they are at risk of not adhering to international regulations.

Executive Summary

Understanding a corporation's supply chain is a basic requirement for management teams. Not only do they need to understand the full logistical picture of their company, but also ensure they stay on the right side of the law on issues such as human trafficking and modern day slavery, trading in illegal or counterfeit goods, and avoiding money laundering. Newer regulation, notably in the European Union, requires that companies are diligent about identifying, preventing, and mitigating potential or actual adverse human rights and environmental impacts connected with their operations, including both upstream and downstream (Corporate Sustainability Due Diligence Directive - CSDDD). The recently approved European Union Deforestation Regulation (EUDR) aims to ensure that a set of key products traded and consumed in the EU and globally do not contribute to deforestation and forest degradation.

This is only achievable by creating a fully traceable supply chain. There is, of course, a difference between traceability and transparency; the former being an ability to monitor and collect relevant data, and the second being the sharing those details with others. With the development of evermore sophisticated tracking techniques, such as Geographic Information Systems (GIS) which can also be linked with AI, the transparency option may be revealed whether management teams desire it or not.

In this publication, Planet Tracker seeks to provide an example of what external organisations can determine about a corporation's supply chain solely by using publicly available sources. By partnering with Vizzuality and making use of its supply chain traceability tool LandGriffon, Planet Tracker analysed Nestlé's supply chain disclosures for the following key commodities:

Coffee

Cocoa

Fresh Milk

Palm Oil

Where precise procurement data was externally unavailable, the study sought to assess the environmental impact Nestlé exhibits with the above-mentioned commodities. The analysis focused on three main environmental indicators:

Deforestation footprint

GhGs emissions from farm management

Unsustainable water use

By using the breadth of sources that LandGriffon uses, Planet Tracker is able to reveal several insights, some of which are highlighted below:

- Fresh milk and coffee are generally associated with the highest absolute environmental footprints, particularly emissions (milk) and unsustainable water use (coffee)
- Cocoa displays the highest deforestation footprint per tonne sourced
- Palm oil disclosures seem to be of much higher quality than the rest of the group, providing the ability to geo-locate over 80% of Nestlé's suppliers.

We understand Nestlé has conducted similar environmental assessments across several of its value chains. As such, it is important to remark that the present study does not cover the actions Nestlé has taken over the years to reduce its nature footprint.

Ultimately, the analysis' precision is subject to the accuracy of disclosures. As such, Planet Tracker urges:

- Investors to demand more in-depth supply chain disclosures from its investees
- Corporates to engage with supply chain traceability tools, like LandGriffon
- Lenders to financially support companies in their traceability journey.

Transparency brings insight.
Insight brings action.
Action brings positive impact.

Making the case for Nature Footprinting

Ever since the European Commission first discussed the concept in their 2019 guidelines on non-financial reporting, the notion of ***double materiality*** has firmly remained in the limelight. Corporations have since been navigating through a plethora of sustainability standards to evaluate ways in which to efficiently report their impacts on the world and its natural resources. Such exercise requires deep knowledge of the company's operations and value chain linkages, with little valuable insight to gain when materials are not easily traceable.

It is now generally accepted that supply chain transparency is only achievable with full product traceability, as validated by the TNFD's LEAP approach.[1] Planet Tracker has shown support towards the implementation of traceability systems among value chains, via several pieces of research quantifying the financial value-add which comes from investments in traceable systems. Please see Planet Tracker's publications - Implementing Traceability (2022) and How to Trace $600 billion (2023) for more information on the economics of traceability.

Despite mounting evidence on the economics of traceability and the significant technological advancements in the space, fully traceable systems are still the exception rather than the rule. Yet, with a software such as Vizzuality's LandGriffon[2], it has become much easier. By connecting raw materials with their sourcing origins, corporations are closer than ever to quantifying their impacts on the natural world. We will call this ***nature footprinting***.

Accordingly, ***nature footprinting*** can be defined as the quantification of a company's impact (and/or dependence) on the natural world. In this instance we have examined the company's nature footprint in relation to its purchases of several commodities.

With the technological enhancements in geospatial analysis and the ever-growing catalogue of publicly available data, it is now possible to link a company's purchase of raw materials to several environmental impacts, including deforestation or water use. This can be performed by an external organisation, such as Planet Tracker, whether the corporate chooses to reveal this data or not.

To demonstrate how ***nature footprinting*** works, Planet Tracker has partnered with Vizzuality, which used their proprietary LandGriffon software to calculate the environmental impacts associated with Nestle's purchase of cocoa, coffee, fresh milk, and palm oil. The analysis is discussed in detail in the following sections.

LandGriffon: an overview

LandGriffon is a supply chain traceability software service developed by Vizzuality, designed to help companies assess environmental risk and impacts from agricultural production within their supply chains and analyse potential future scenarios. Inspired by the need to move beyond current approaches, LandGriffon was initially funded by the European Commission's Horizon 2020 research and innovation programme.

Using open-source data and company disclosures, LandGriffon aligns corporate data with guidelines from the Science Based Targets Network (SBTN) and the Taskforce on Nature-related Financial Disclosures (TNFD). This spatial traceability and impact accounting tool adheres to the following steps to produce its analysis:

1. **Data collection and preparation:** Companies provide detailed data on agricultural materials, including procurement volumes, supplier information, and sourcing locations by commodity.
2. **Data Integration:** LandGriffon combines procurement data with a variety of global datasets and other geospatial information to estimate a series of nature impacts, including a water and deforestation footprint.
3. **Impact Assessment:** A variety of nature footprints are produced, with the ability to further analyse commodities, suppliers or geographies of interest.
4. **Mitigation Pathways:** Users can explore impact mitigation through scenario planning, aligning with the LEAP approach from TNFD. This involves setting forecasted growth rates and adding interventions, such as changing materials, sourcing locations or improving production efficiencies.

The complete set of metrics produced by LandGriffon include:

1. Freshwater Quantity
   - Water Use (Mm^3/yr)
   - Unsustainable Water Use (Mm^3/yr).
2. Freshwater Quality
   - Nutrient Load (Mm^3/yr)
   - Excess Nutrient Load (Mm^3/yr).
3. Land Footprint (ha/yr)
4. Conversion of natural ecosystems
   - Deforestation (ha/yr)
   - Net Cropland Expansion (ha/yr).
5. Biodiversity loss from land use change
   - Forest Landscape Integrity Loss (Score)
   - Biodiversity Intactness Loss (Pct).
6. Greenhouse Gas (GhG) Emissions
   - GhGs at farm management (tCO_2e/yr)
   - GhGs linked to deforestation (tCO_2e/yr).

The results from this analysis are displayed in interactive maps, tables and charts in the LandGriffon tool, where more detailed information can be gathered at farm, county, or national level, according to the commodity chosen.

Nature Footprinting: Nestlé as case study

In collaboration with Vizzuality, Planet Tracker was able to use LandGriffon to produce a set of impact estimates, drawing from publicly available data. The subject of the case study is the Swiss-based drink and food processing conglomerate Nestlé, which has positioned itself at the forefront of supply chain traceability through a series of suppliers' disclosures for several of the commodities the company relies on.[3] Over the years, Nestlé has shown remarkable progress in its nature assessment journey, joining the Taskforce on Nature-related Financial Disclosures (TNFD) in 2021. Earlier this year, the company was also named across 17 businesses currently engaged in piloting the Science Based Targets for Nature (SBTN).

Nestlé was chosen because of the breadth of supplier information it discloses. As a market leader in the fast-moving consumer goods (FMCG) sector, Nestlé has recently published an update on its progress against a series of KPIs related to nature. Among these is the ambition to source 100% deforestation-free "primary supply chains" by 2022 for meat and palm oil (currently 98% complete), and by 2025 for coffee and cocoa (currently 93% complete). Plus, it has committed to be sourcing 50% of key ingredients from farmers adopting regenerative practices by 2030 (currently at 15%). Currently, no definition is provided by Nestlé for a ***primary supply chain***.[4]

The following analysis provides a greater insight into Nestlé's nature footprint and on what can be drawn from its supply chain disclosures. The analysis focuses on four key commodities: coffee, cocoa, fresh milk and palm oil.

Nestlé's Data

Sourcing Volumes

Just by looking at the number of commodities listed within its suppliers' disclosures, it is evident that Nestlé is a company highly dependent on nature for the products it markets. For more colour on the nature dependency please see Planet Tracker's publication NDE and Credit Ratings (2023).

Looking at fresh milk alone, in 2022 Nestlé sourced close to 5.5 million metric tonnes, a figure which would meet almost all dairy consumption in Australia in the same year.[5]

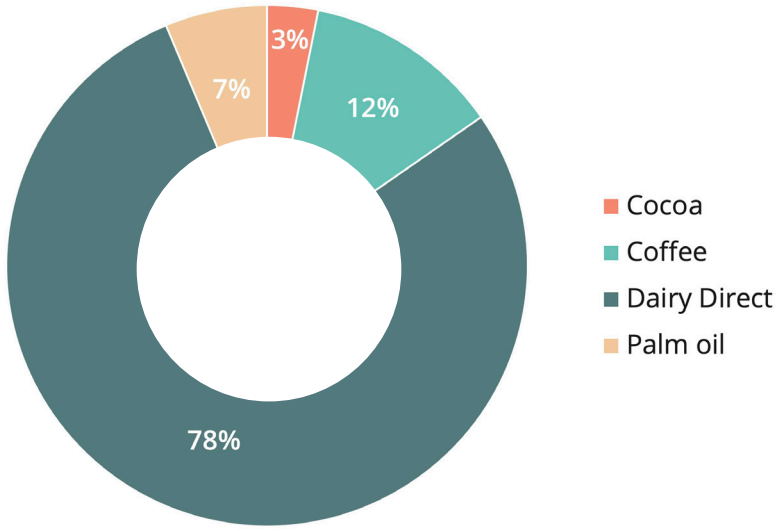


Figure 1: Nestlé sourcing volumes by tonnage for each commodity in 2022. Source: Planet Tracker, Nestlé.

The volume of cocoa, coffee and palm oil sourced are several orders of magnitude lower than dairy, but are still important in evaluating Nestlé's dependency on nature. Describing itself as t*he world's favourite coffee*,[6] Nestlé's Nescafe coffee brand required around 850,000 tonnes in 2022. This would equate to serving around 4 Nespresso capsules a day for the whole year to the entire population of France and Italy combined.[a]

Nestlé's palm oil consumption was in the region of 445,000 tonnes, and the 222,000 tonnes of cocoa sourced is equivalent to providing the US with enough chocolate to meet its easter eggs consumption for 12 years.[b]

The high volume of commodities sourced comes with a significant nature footprint. The impact can vary based on the origin of production so it is essential to understand where these commodities are sourced from.

a Assuming that each capsule contains around 5g of coffee.

b Business Insider (2022). Accessible here. The calculations assume 100g of cocoa in each easter egg.

Sourcing Regions

With the exception of dairy, whose production is very much spread across the globe, all the other commodities are sourced from within the tropics. Figure 2 shows Nestlé's purchases of cocoa in 2022.

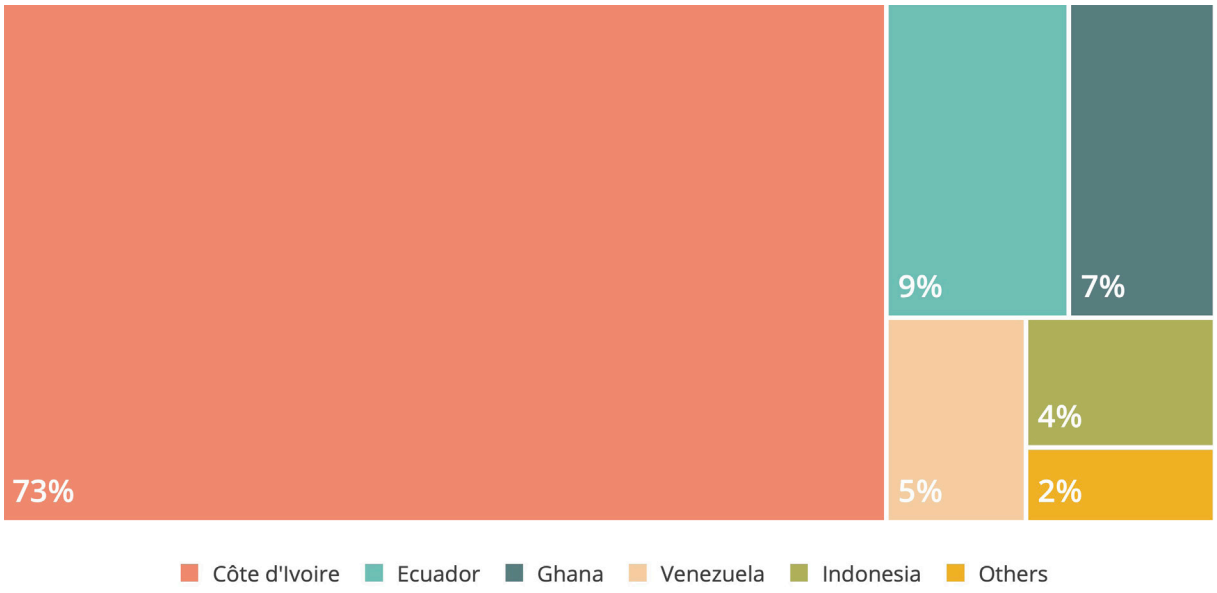


Figure 2: Nestlé's Cocoa origin regions by % of overall volumes sourced in 2022. Source: Planet Tracker, Nestlé

The case of cocoa is the most striking. According to Planet Tracker's estimates, in 2022 Nestlé sourced nearly three quarters of its cocoa supply from Cote d'Ivoire. Although Cote d'Ivoire retains the top spot for cocoa production according to the FAO (Food & Agriculture Organisation of the United Nations), with the country's production accounting for 38% of global production in 2022,[7] this over-reliance on Ivorian cocoa brings heightened idiosyncratic risk,[c] most notably in the form of political and climate physical risks.

The situation appears more balanced when analysing the other two commodities, where no country stands at over half of total supply. In the case of coffee, Planet Tracker estimated that in 2022 Nestlé sourced 38% of its coffee from Viet Nam, followed by Brazil at 25%. The two nations are the top two producing countries according to FAO estimates,[8] reaching nearly half of global volume produced when combined.

c Idiosyncratic risk, also known as unsystematic risk, is the series of risks and uncertainties linked to a specific asset or asset group, in this case cocoa from Cote d'Ivoire.

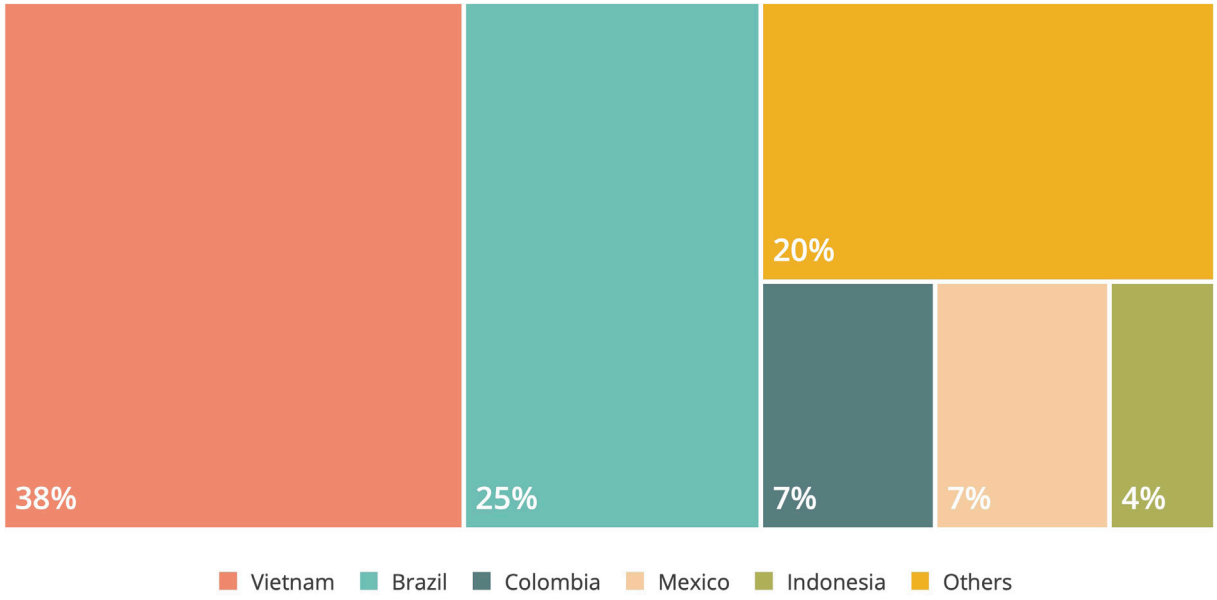


Figure 3: Nestlé's Coffee origin regions by % of overall volumes sourced in 2022. Source: Planet Tracker, Nestlé.

For palm oil, Nestlé's sourcing regions are mostly in line with current production hotspots, with a slight overweight on Malaysian palm as compared with FAO's figures. Currently, Indonesia supplies around 60% of the world's palm oil, followed by Malaysia at 22%.[9] In comparison, according to Planet Tracker estimates, Nestlé secured 46% of its palm oil in Indonesia, followed by Malaysia at 33%.

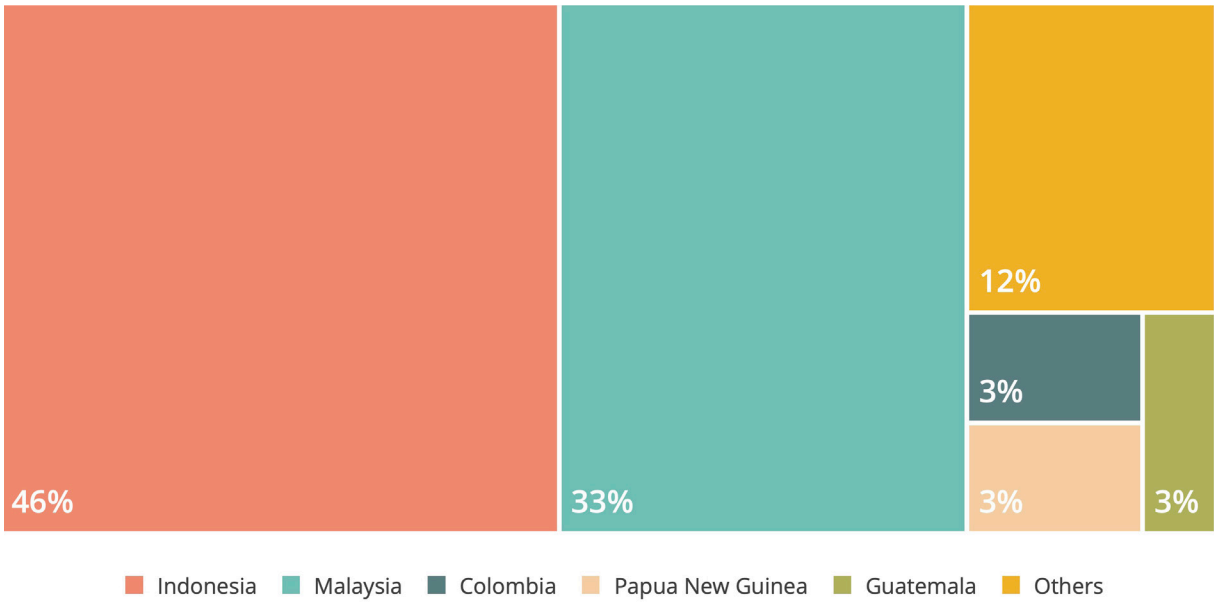


Figure 4: Nestlé's Palm Oil origin regions by % of overall volumes sourced in 2022. Source: Planet Tracker, Nestlé

Nestlé's Environmental Footprint Analysis

Analysis Overview

Before delving into the analysis, it is important to note that, given the absence of complete procurement data, the below study is to be taken as a statistical exercise and therefore not representative of the farms that Nestlé are physically sourcing from.

That said, Planet Tracker has concentrated on the following three metrics, out of the eleven[d] that Vizzuality's LandGriffon provides:

- **Deforestation footprint (sLUC)**, the annual average area of deforestation attributable to the quantity of raw material sourced. It uses a statistical land use change (sLUC) accounting method, which allocates responsibility for deforestation based on land use (Gassert et al 2023).
- **GhGs from farm management**, the amount of greenhouse gas (GhG) emissions, including CO_2, N_2O and CH_4, that result from farm-management practices involved in producing the quantity of raw material sourced (Halpern et al 2022).
- **Unsustainable water use**, the volume by which the water consumption associated with the production of the raw material (Water Footprint Network) must be decreased to reduce pressure on nature according to SBTN Guidance (Science Based Target Network (2023) Technical guidance: Step 3 - Freshwater v1.). This relates to the volume of water being withdrawn from local watersheds, above and beyond their natural replenishment levels.

Choosing the above three indicators provides an insight into Nestlé's impact in terms of conversion of natural ecosystems, greenhouse gas emissions and water stress. Impact values were normalised by the quantity purchased for each commodity, in order to provide a fair comparison. Given the uncertainty surrounding the volumes associated with each supplier, and the limitations in identifying all production locations, the impacts should be treated with some caution. Please see Appendix A for more colour on the limitations surrounding the analysis. For a comprehensive explanation of the LandGriffon methodology and assumptions used to determine the most likely sourcing region, see Appendix B. Nonetheless, the results showcase the potential to achieve a more accurate and detailed impact assessment when a complete set of information is available. This would be a scenario in which all suppliers have been geographically located, and their procurement volumes accurately traced.

That said, the Figure 5 depicts the absolute and normalised environmental impacts by commodity, taking into account the estimated tonnages sourced for each one.

d The 11 metrics are:

Water Use (Mm^3/yr), Unsustainable Water Use (Mm3/yr), Nutrient Load (Mm^3/yr), Excess Nutrient Load (Mm^3/yr), Land Footprint (ha/yr), Deforestation (ha/yr), Net Cropland Expansion (ha/yr), Forest Landscape Integrity Loss (Score), Biodiversity Intactness Loss (Pct), GhGs at farm management (tCO_2e/yr), GhGs linked to deforestation (tCO_2e/yr)

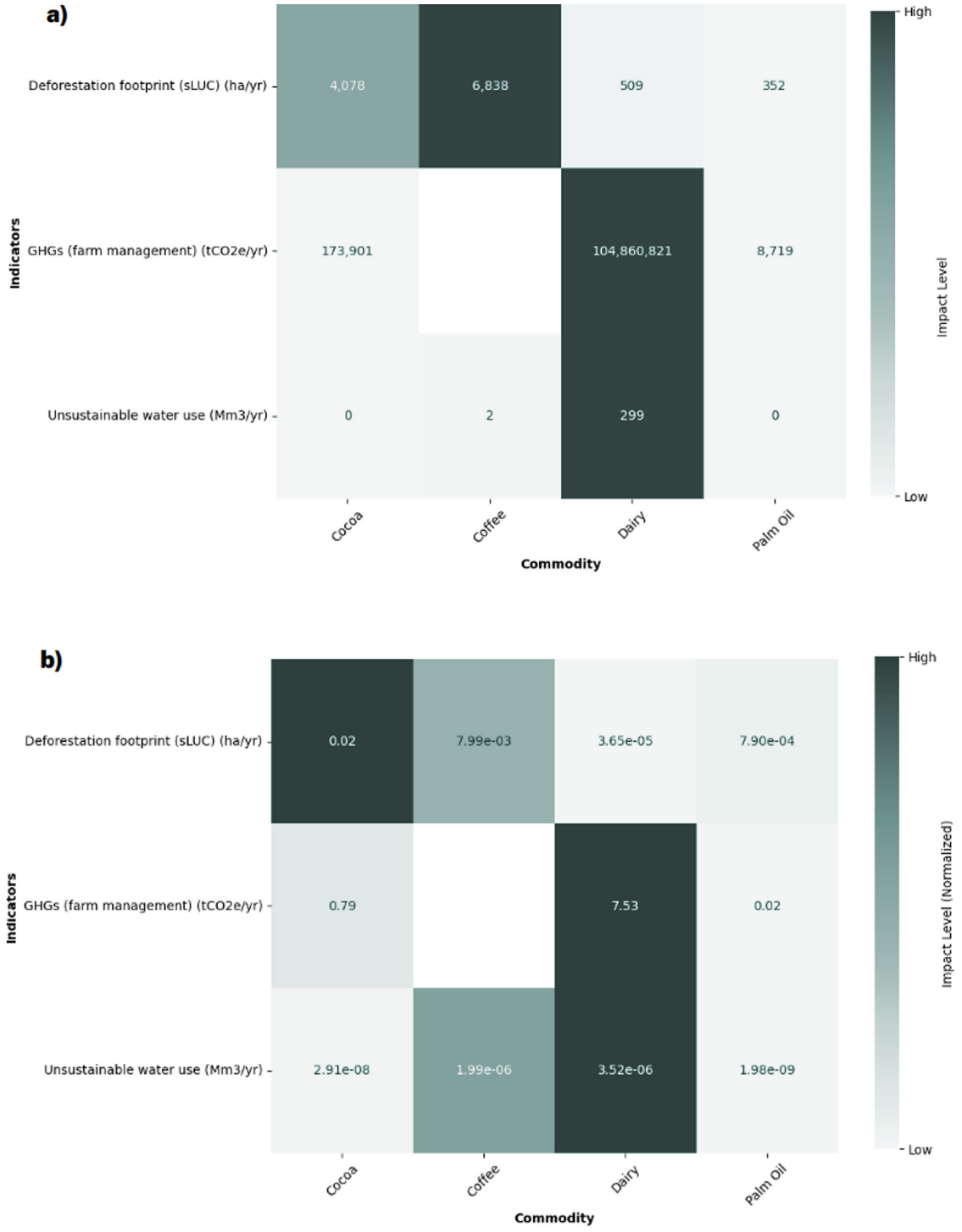


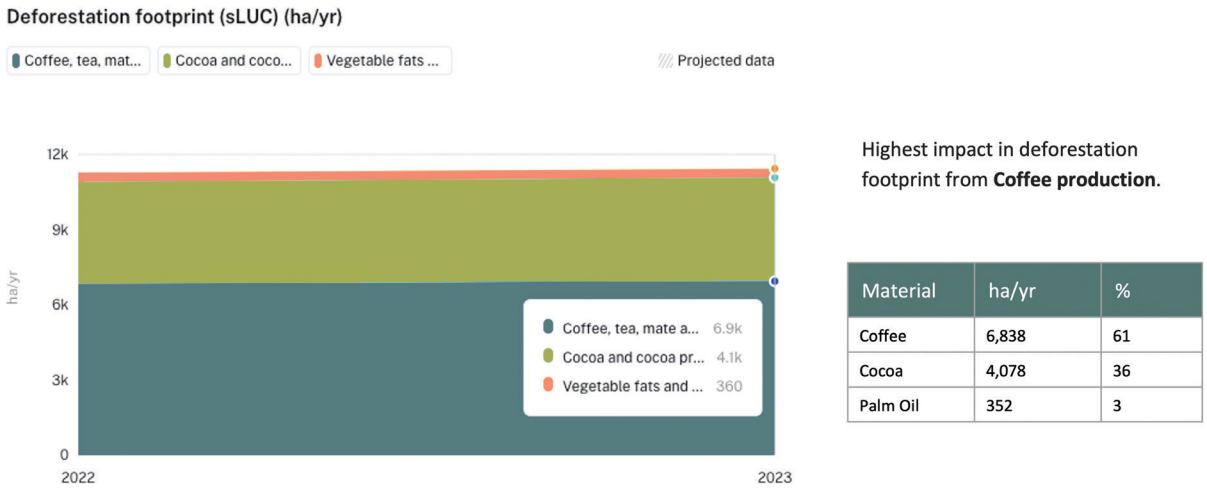
Figure 5: Nestlé's environmental footprint in 2022 by commodity, a) in absolute values and b) normalised by sourced volumes. Source: Vizzuality.

The analysis reveals a detailed impact assessment across various commodities, highlighting significant environmental factors such as the deforestation footprint, GhG emissions from farm management and the unsustainable water use.

In absolute terms, for Nestlé, coffee and dairy exhibit the highest environmental impact across most indicators (Figure 5a), particularly in deforestation and GhG emissions from deforestation, while palm oil shows the lowest impacts in most categories. Coffee has the highest deforestation footprint, but when normalised by volume (Figure 5b), cocoa has a higher impact per tonne produced, indicating that cocoa production is more deforestation intensive. Dairy production, including the impacts of required feed components, contribute significantly to environmental impacts, particularly in terms of GhG emissions from farm management. In line with existing evidence (Halpern et al, 2022),[10] this analysis suggests the impacts of fresh milk production greatly overshadows all other commodities within the study. The total dairy impact encompasses both the direct production processes and the associated feed requirements, illustrating its broader environmental footprint. Given the significant complexities and uncertainties involved in modelling fresh milk production due to the highly dynamic nature of the livestock value chain, the following section solely concentrates on coffee, cocoa and palm oil.

Main findings from Total Impact analysis

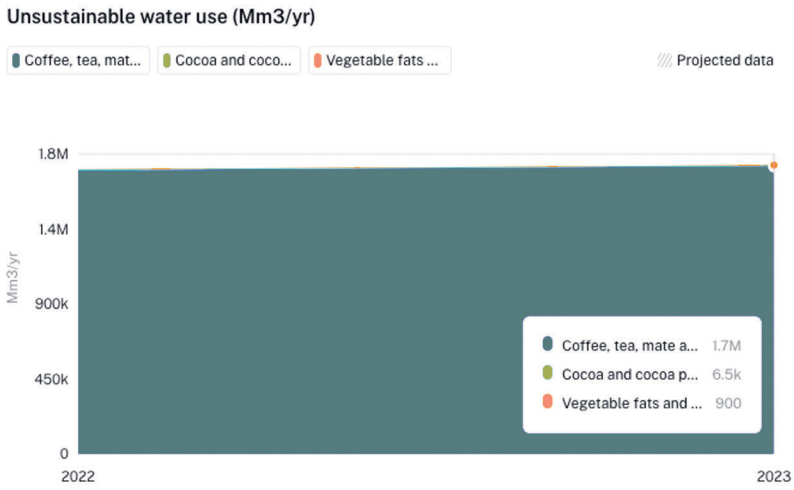
Concentrating on absolute numbers and excluding dairy as previously mentioned, we find coffee to be the commodity with the bulk of the deforestation footprint, with palm oil at the other end of the spectrum contributing to 3% of the total deforestation for Nestle's coffee, cocoa and palm oil supply chain.



Material	ha/yr	%
Coffee	6,838	61
Cocoa	4,078	36
Palm Oil	352	3

Figure 6: Nestlé's deforestation footprint in 2022 concerning coffee, cocoa and palm oil production. Source: Vizzuality, LandGriffon.

In addition to wider land use, coffee is a crop that requires substantial irrigation (Luong and Tauer, 2006),[11] with water from rainfall only covering a quarter of water needs (Amarasinghe et al, 2015).[12] As such, coffee retains the prime spot for unsustainable water use too. The disproportionate water impact of coffee can be attributed to several factors. Coffee is often grown in regions with high water stress, where irrigation is necessary to achieve optimal yields. For instance, India, which accounts for the largest share of unsustainable water use related to coffee production, is characterised by significant regional water scarcity, needing heavy reliance on irrigation. In contrast, cocoa and palm oil are predominantly grown in regions with abundant rainfall, reducing the need for supplementary irrigation.



Highest impact in land footprint from **Coffee production**.

Material	Mm3/yr	%
Coffee	1,700,053	99.6
Cocoa	6,446	0.35
Palm Oil	883	0.05

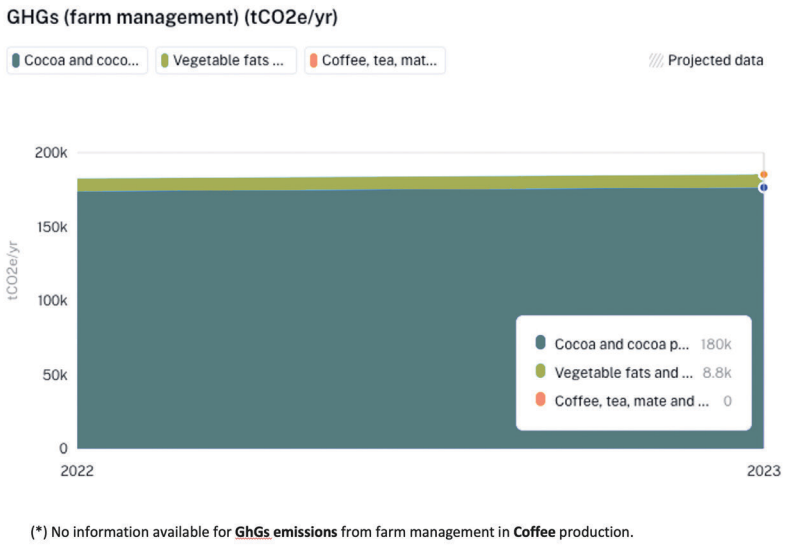
Figure 7: Nestlé's unsustainable water use in 2022 concerning coffee, cocoa and palm oil production. Source: Vizzuality, LandGriffon.

Lastly, the LandGriffon tool currently lacks specific data on GhG emissions from farm management for coffee production. This limitation arises because the data sources used are primarily focused on food products that directly contribute to human nutrition, thereby excluding non-nutritional agricultural items like coffee. Consequently, while the tool can analyse GhG emissions for the other commodities, the absence of data for coffee means its potential emissions are not explicitly accounted for in this instance.

With no information available for GhGs emissions from farm management in coffee production, cocoa production displays the highest emissions intensity. Considering the regions where coffee is predominantly sourced – such as Vietnam, Mexico, Brazil, Colombia, Indonesia, India and Ethiopia - it is likely that GhG emissions from farm management in coffee production could be significant, particularly in areas with intensive agricultural practices. This is particularly pertinent in high-input systems.

For comparison, the highest GhG emissions from cocoa farm management are observed in Venezuela, Indonesia and Ecuador, resulting in GhG intensities ranging from 12.01tCO_2e per tonne in Venezuela to 1.09 tCO_2e per tonne in Ecuador. Palm oil production, while often associated with higher GhG emissions due to deforestation, shows substantial farm management emissions in regions like Malaysia and Indonesia.

Given these factors, it is reasonable to estimate that coffee could exhibit farm management GhG intensities comparable to or possibly exceeding those of cocoa, particularly in high-input systems such as those found in Vietnam and Brazil. The lack of specific GhG data for coffee production represents a key limitation in the LandGriffon methodology (see Appendix A for further details).



Highest impact in GHG emissions from farm management from **Cocoa production.**

Material	tCO2e/yr	%
Cocoa	173,901	95
Palm Oil	8,719	5

(*) No information available for **GhGs emissions** from farm management in **Coffee** production.

Figure 8: Nestlé's emissions from farm management in 2022 concerning cocoa and palm oil production. Source: Vizzuality, LandGriffon.

As previously mentioned, the impact of commodity production can vary based on the specific location it's grown in. The following sections provide more details on the specific geographic areas with the highest nature footprint.

In depth findings: Cocoa

As previously mentioned, Nestlé sourced most of its cocoa from Côte d'Ivoire in 2022. Figure 9 illustrates Nestlé estimated cocoa-related deforestation footprint with historical global cocoa production hotspots in 2010.

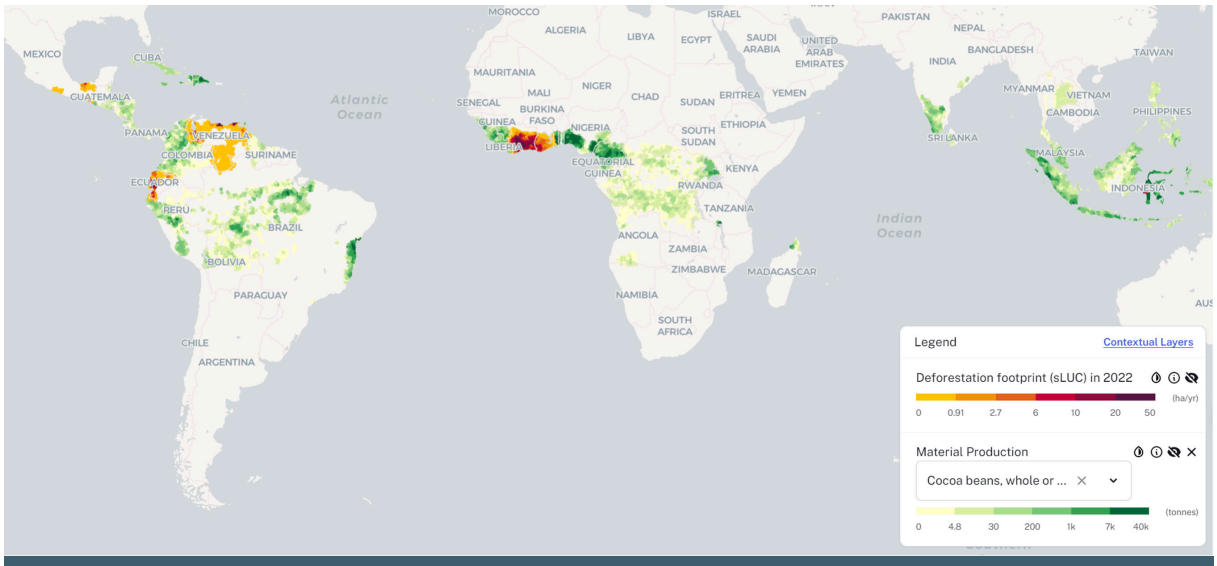


Figure 9: Nestlé's estimated cocoa-related deforestation footprint in 2022 compared to cocoa producing regions and volumes in 2010. Source: Vizzuality, LandGriffon, MapSPAM (IIASA), Gassert et al, 2023.

By assigning production quantities to specific suppliers, LandGriffon allows an estimation of the environmental impacts directly linked with such production. Whilst in cocoa's case suppliers' exact locations are not known, LandGriffon projects that, with the estimated tonnages sourced by Nestlé in 2022, a forest area equivalent to 2,000 hectares would have been lost in Côte d'Ivoire due to cocoa production. In this estimation, LandGriffon combines direct land-use change (dLUC) accounting methodology and statistical land-use change (sLUC) metrics. sLUC metrics are particularly valuable for estimating land use impacts where exact sourcing locations are unknown, as they more accurately capture deforestation rates across a landscape, recognising that deforestation typically occurs outside existing cropland. sLUC also serves as a proxy for dLUC in situations where there is no information on the previous state of the land (GhG Protocol, 2022). For a detailed discussion on the differences between these metrics and their implications, please see Appendix A.

Côte d'Ivoire, the world's largest cocoa producer, has seen extensive deforestation driven by the expansion of cocoa farming into protected areas (Kalischek, N., et al., 2023).[13] Similar patterns are observed in Venezuela and Indonesia. This approach highlights LandGriffon's ability to provide critical insights into the environmental footprint of supply chains, even with limited data.

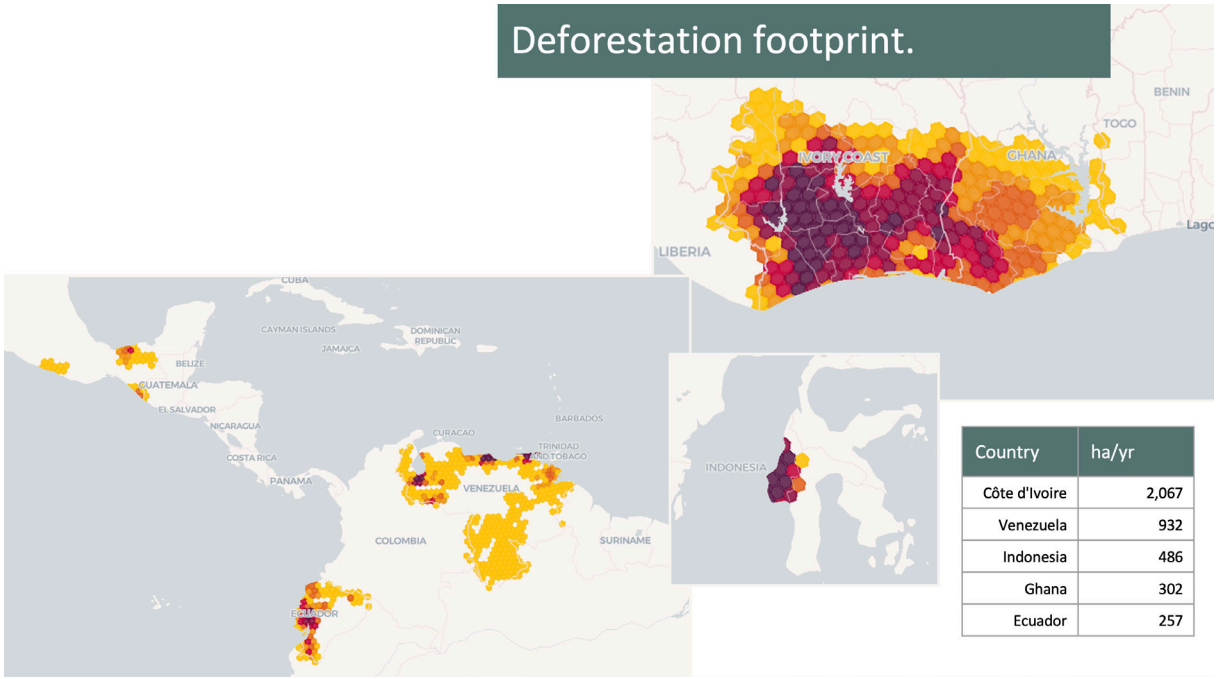


Figure 10: Nestlé's estimated cocoa-related deforestation footprint in 2022. Source: Vizzuality, LandGriffon, Gassert et al, 2023.

The numbers portray a different story when normalising for estimated tonnages, with Venezuela and Indonesia displaying the highest deforestation footprint per ton of cocoa produced in 2022. The exact reasoning as to why these countries show a heightened footprint is not known at this stage. Presumably, lower yields per hectare are likely to be contributing to the need for enlarged cropland.

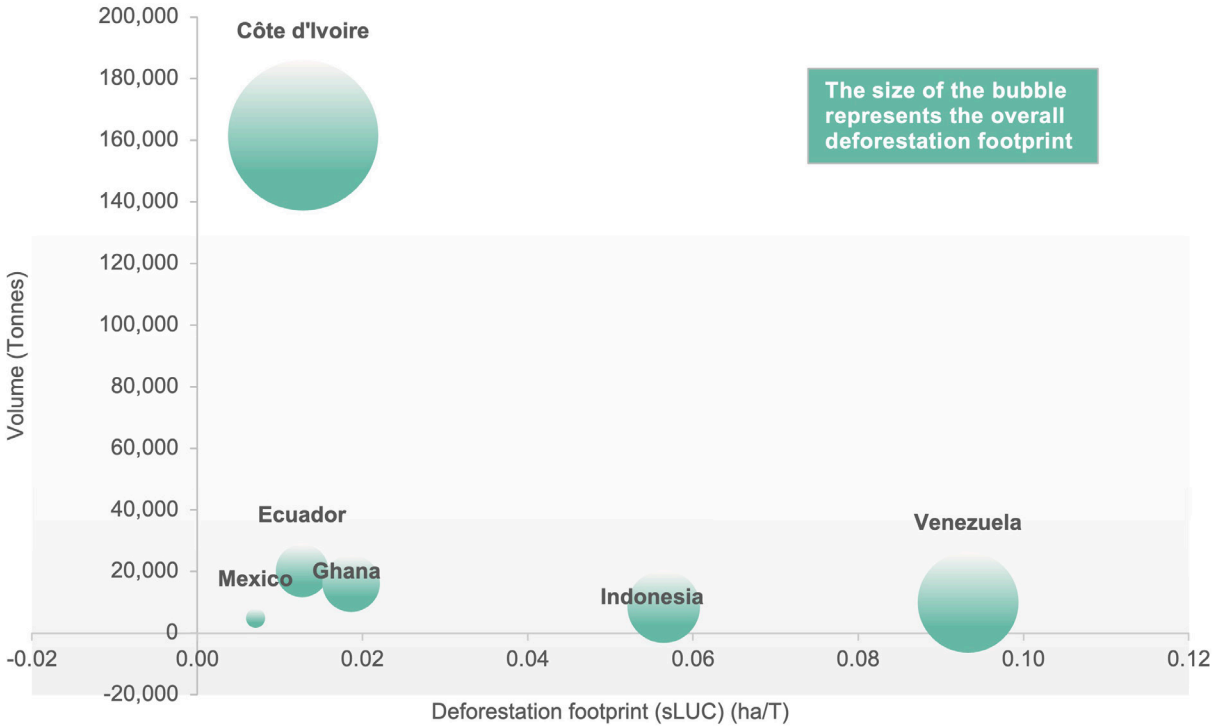


Figure 11: Nestlé's estimated cocoa-related deforestation footprint in 2022, normalised by sourced volumes. Source: Planet Tracker, Vizzuality.

Nonetheless, by minimising the amount of cocoa sourced from the likes of Venezuela and Indonesia Nestlé seems to be effectively lowering its environmental impact on forests, doing so more efficiently than if it targeted its suppliers in Ghana and Ecuador, two countries where it sources similar quantities of cocoa. With that, Nestlé would also be lowering its overall emissions intensity as Côte d'Ivoire produces lower GhG emissions per tonne of cocoa produced than Venezuela and Indonesia.Figure 12: Nestlé's estimated cocoa-related GhG emissions from farm management in 2022 (Sources: Vizzuality, LandGriffon, Halpern et al 2021)

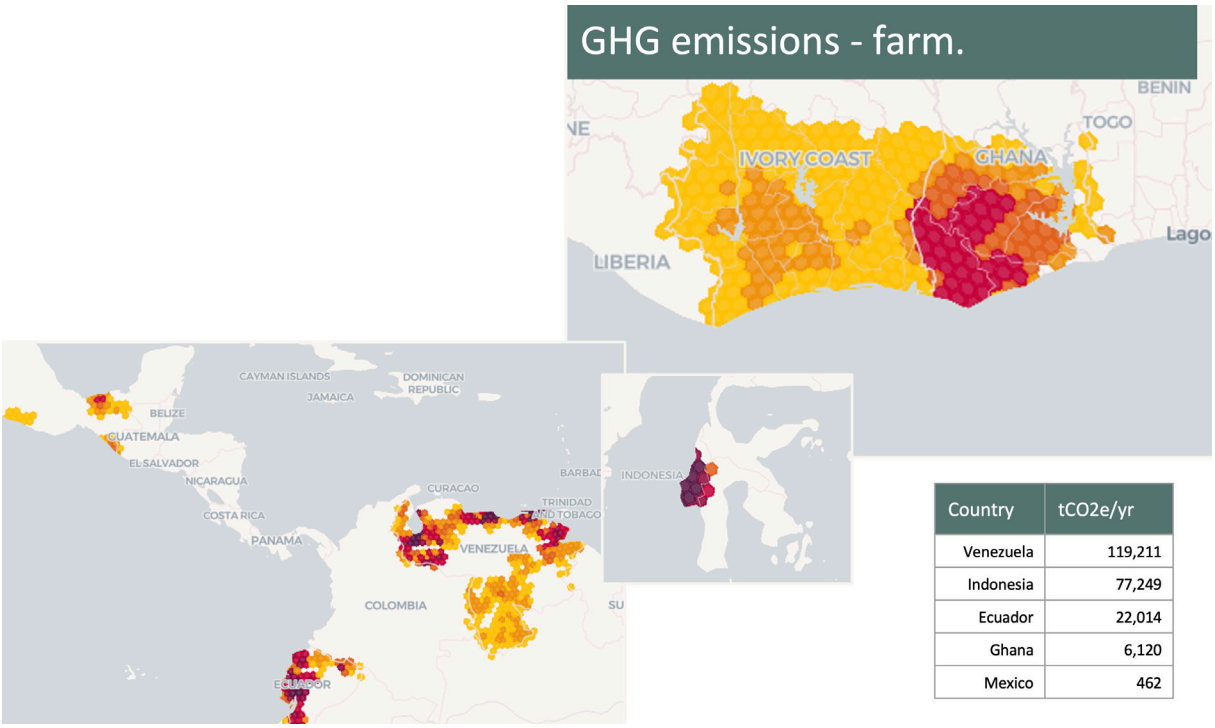


Figure 12: Nestlé's estimated cocoa-related GhG emissions from farm management in 2022. Source: Vizzuality, LandGriffon, Halpern et al 2021.

In its latest Cocoa Plan Progress Report, Nestlé reported sourcing 86% of its cocoa in 2023 through its Cocoa Plan, tracing 70% of it from African regions, 27% from Latin America and the rest from Asia. The company also quotes the ambition to go fully traceable by 2025.[14] While this progress is certainly welcome, the methodology centres around the use of mass balancing, a sourcing method that allows for certified and non-certified ingredients to become mixed during the shipping and manufacturing processes. This could lead to an increased risk of non-certified raw materials, from potentially deforested areas, ultimately mixing with certified ones.

As such, while it is true that mass balancing reduces operating costs, some will argue for full segregation, where Nestlé would ideally be bearing the financial burden needed to upgrade its suppliers' compliance systems, while ensuring full traceability.

It is important to note that traceability also affects how deforestation and related GhG emissions impacts are reported. With full traceability, a company may report a zero-deforestation footprint by focusing on direct land use change (dLUC) metrics. However, this doesn't account for the broader landscape impacts, such as those captured by statistical land use change (sLUC) metrics. For more detail on the differences between the dLUC and sLUC metrics and how traceability might affect them, please see Appendix A.

In depth findings: Coffee

By looking at Nestlé's 2023 Nescafé Progress report, it is impossible not to notice the high emphasis placed on ***regenerative agriculture***. The word regenerative is itself mentioned 59 times (as compared to 47 times in the 2022 equivalent report[15]) and retains a focal place within the company's goals.

Nestlé' is committed to have 100% responsibly sourced coffee by 2025, with 20% coming from regenerative agriculture methods. By 2030 the percentage coming from regenerative agriculture methods is poised to increase to 50%, alongside a 50% greenhouse gas emissions reduction.[16]

Surprisingly, no target is associated with water consumption related to coffee production. While coffee trees have traditionally been rainfed, surging global demand is leading to higher use of freshwater. As such, Sporchia et al (2023) argue that irrigation for coffee may increase competition for water in areas that are already water scarce.[17]

While the company acknowledges the importance of efficient water management within its sustainability efforts, the lack of a hard KPI makes progress difficult to track. Such progress is especially needed in areas like South Asia and Central America, as shown by the figure below.

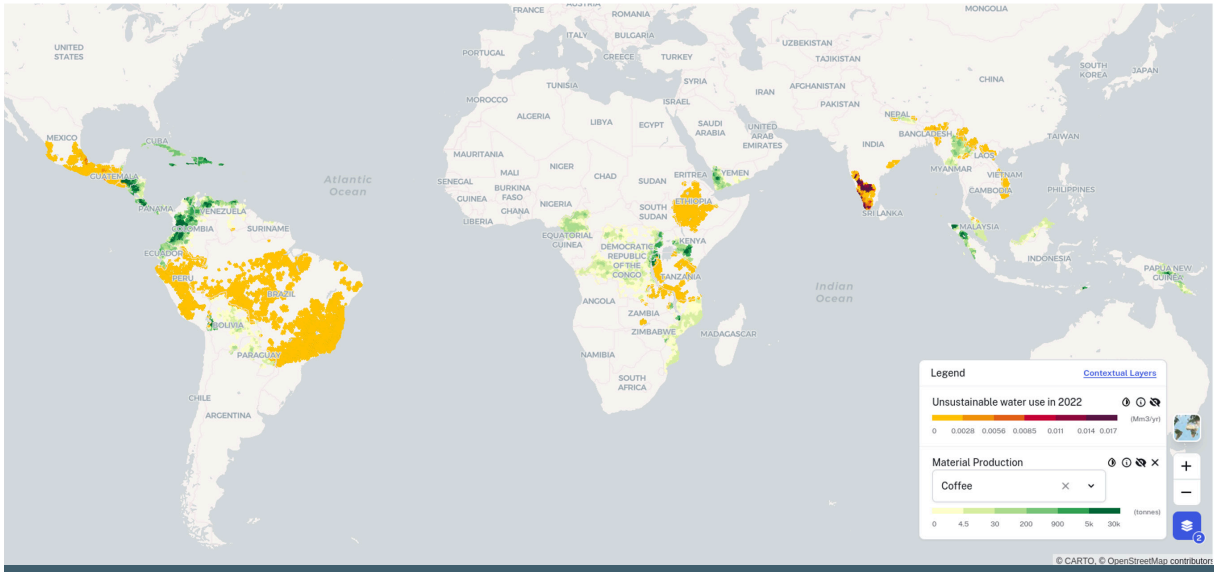


Figure 13: Nestlé's estimated coffee-related unsustainable water in 2022 compared to arabica coffee producing regions and volumes in 2010. Source: Vizzuality, LandGriffon, Aqueduct 4.0 2019, Mekonnen 2011,Mekonnen 2012.

However, with the bulk of its coffee coming from Vietnam and Brazil, Nestlé is currently sourcing from regions where water use is less associated with unsustainable practices. On an absolute basis, the highest unsustainable water use is indeed observed in India followed by Mexico. These impacts highlight the critical water scarcity challenge faced by these regions, especially in areas where coffee production is intensive and local water resources are already under significant pressure. When normalising for tonnages sourced, India leads the pack again, underscoring the extreme pressure on water resources per tonne of coffee produced. Albeit to a lesser extent, El Salvador and Tanzania show high normalised impacts too, further indicating that coffee production in these regions is particularly water-intense relative to the amount of coffee produced.

This data further underscores the importance of considering the water footprint of coffee production in the context of regions where water scarcity is already a critical issue.

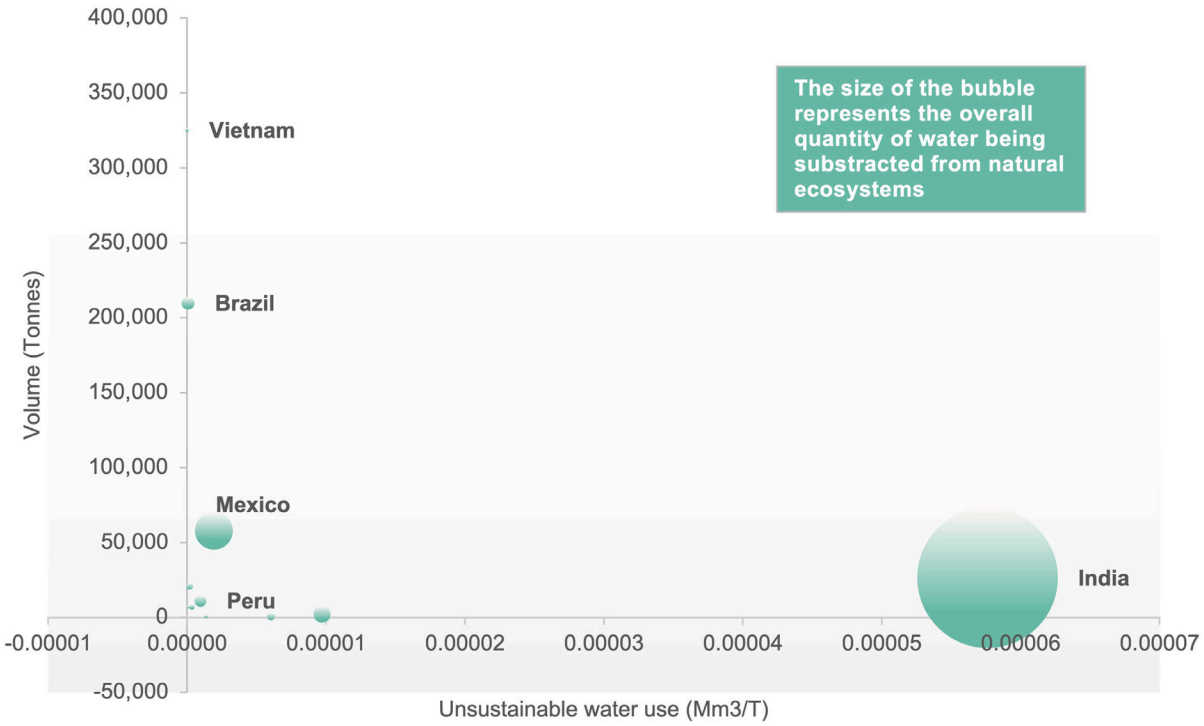


Figure 14: Nestlé's estimated coffee-related unsustainable water use in 2022, normalised by sourced volumes. Source: Planet Tracker, Vizzuality.

Turning to the other indicators, while no information is available for GhGs at farm level, as previously mentioned, it is likely that these emissions could be significant, particularly in regions with intensive agricultural practices such as Vietnam, Brazil and Indonesia. Nestlé's efforts in promoting regenerative agriculture can indeed contribute to lower GhG emissions in coffee production. However, it is important to consider these practices within the broader context of GhG emissions from deforestation, particularly in regions where coffee sourcing may contribute to significant land use change. While regenerative agriculture has benefits, its potential to mitigate climate change may be limited when compared to the substantial GhG emissions linked to deforestation (Ranganathan et al., 2020). This consideration is crucial in ensuring that the company's sustainability efforts are aligned with the most impactful strategies for reducing overall GhG emissions. That said, deforestation seems to have a lower footprint per tonne produced when compared to cocoa production.

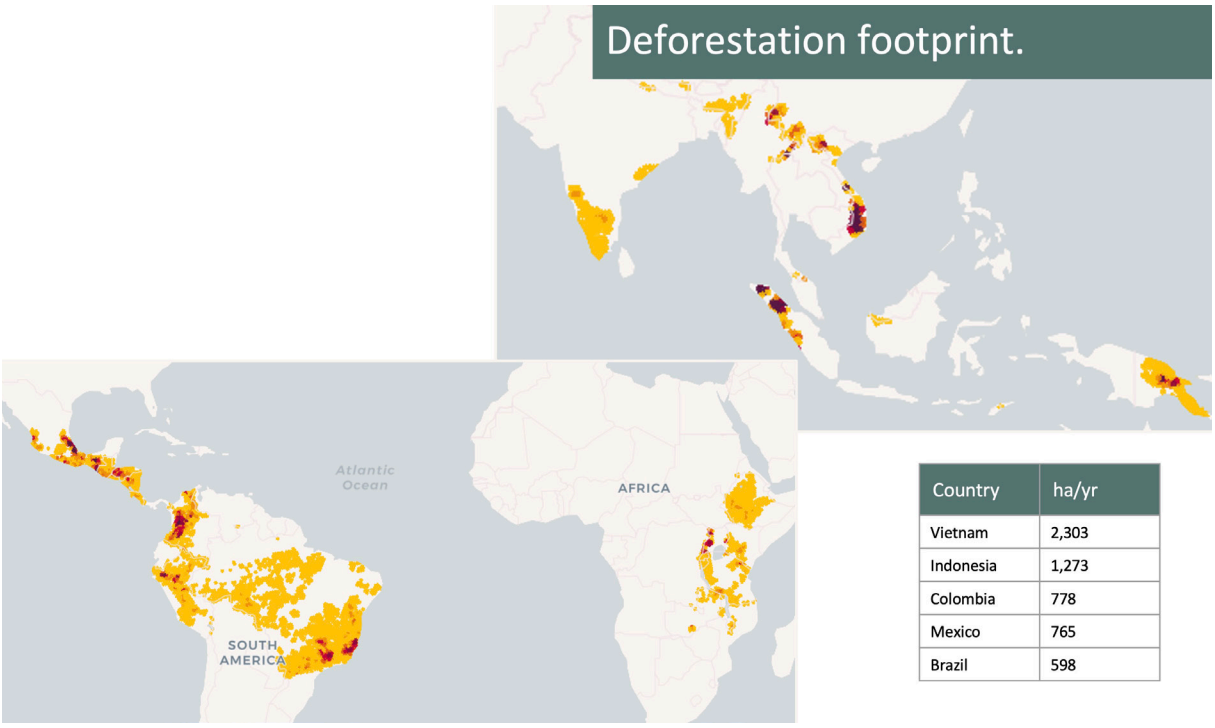


Figure 15: Nestlé's estimated coffee-related deforestation absolute footprint in 2022. Source: Vizzuality, Gassert et al, 2023.

As the above figure shows, it is Vietnam that registers the highest absolute deforestation footprint. However, on a normalised basis, it is Indonesia that takes the prime spot across the globe's top producers, with its footprint three and five times higher than that of Colombia and Vietnam, respectively. This disparity can be attributed to lower average coffee yields in Indonesia, meaning that more land is required to produce the same amount of coffee, intensifying deforestation impact relative to other major coffee-producing regions.

In depth findings: Palm Oil

We were able to geolocate 84% of Nestle's palm oil suppliers. Despite not knowing the tonnage sourced by each supplier, the ability to locate farms on the ground enhances accuracy in the results generated by LandGriffon.

Turning to the figures, palm oil has a lower deforestation footprint compared to coffee and cocoa, with the highest absolute impact in the top producing countries, Indonesia and Malaysia. Normalising for sourced volumes, it is however Nigerian palm oil that comes with a higher deforestation intensity, as per below chart.

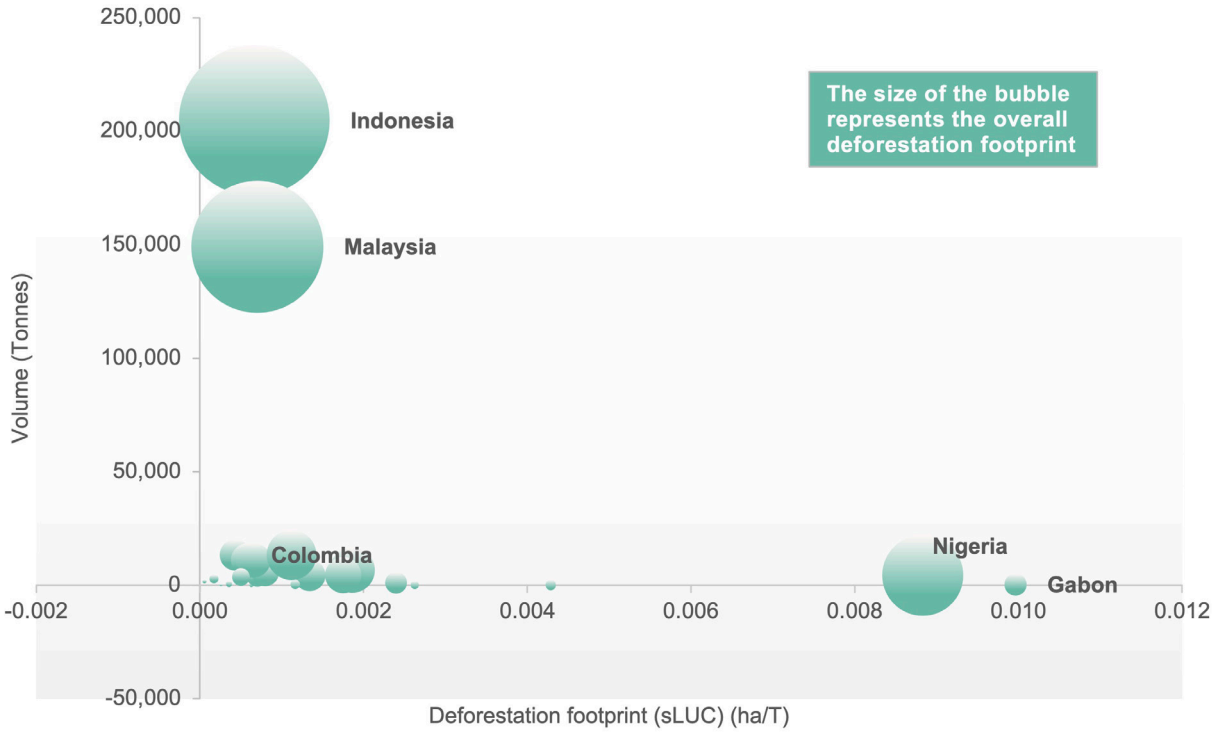
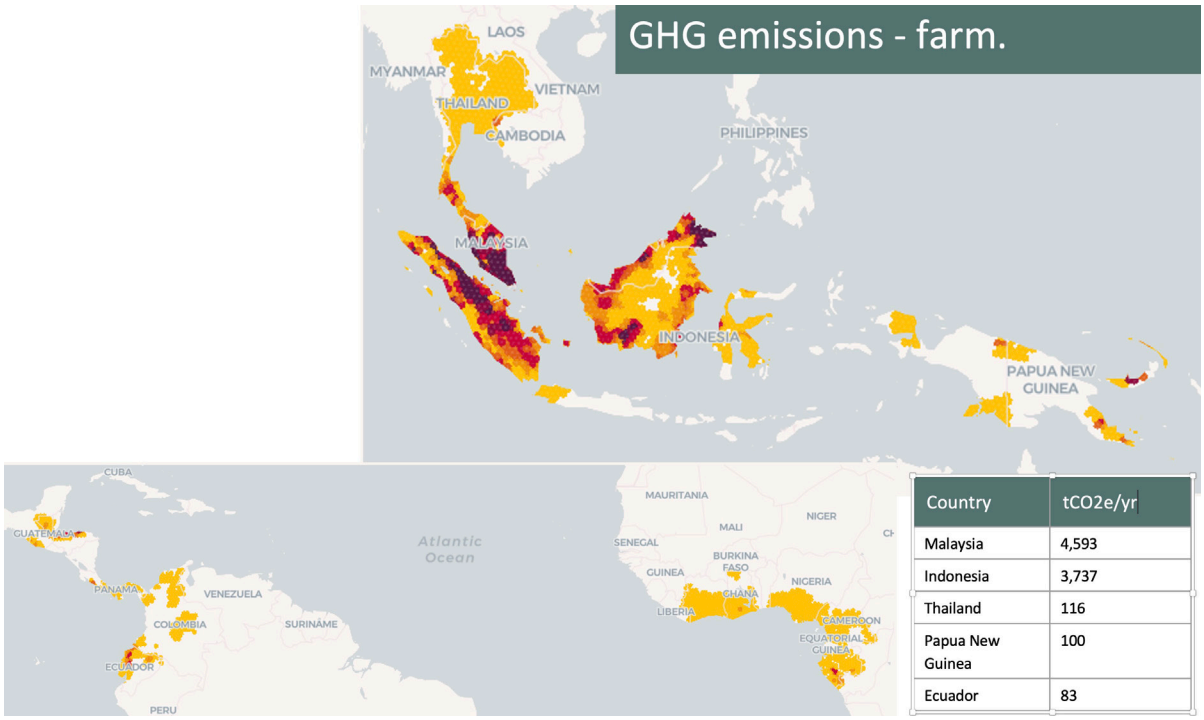


Figure 16: Nestlé's estimated palm oil-related deforestation footprint in 2022, normalised by sourced volumes. Source: Planet Tracker, Vizzuality.

With Nestlé committing to have all its palm oil deforestation-free by 2022, the company is currently marginally behind targets, sitting at around 98% in 2023.[18]

Palm oil also has much less of an impact when considering farm level GhG emissions and unsustainable water use.

Emissions-wise, the results point to the slight comparative advantage that Indonesian palm oil has over the Malaysian counterpart, where seemingly less efficient farm management practices raise emission figures on absolute as well as normalised levels.



Country	tCO2e/yr
Malaysia	4,593
Indonesia	3,737
Thailand	116
Papua New Guinea	100
Ecuador	83

Figure 17: Nestlé's estimated palm oil-related GhG emissions from farm management in 2022. Source: Vizzuality, Halpern et al 2021.

In depth findings: Fresh Milk

While the three agricultural commodities already analysed all show relatively comparable impact numbers, fresh milk comes as a stark contrast to what already shown.

Fresh milk has the highest absolute impact across most indicators, particularly in deforestation footprint and GhG emissions. This is also true when data is normalised by sourced volumes.

There is an important caveat here in that, different from the other commodities involved in the study, Nestlé does not provide a list of suppliers, but rather a list of regions where it sources its fresh milk. Assuming milk production to be mostly localised to preserve freshness, Planet Tracker estimates that the United States and China are prime sourcing regions globally.

Turning to impacts, and following what seen for the other commodities, countries in the tropical belt display the highest impact from deforestation when normalising for sourced volumes, with Indonesia coming out on top per unit of milk produced.

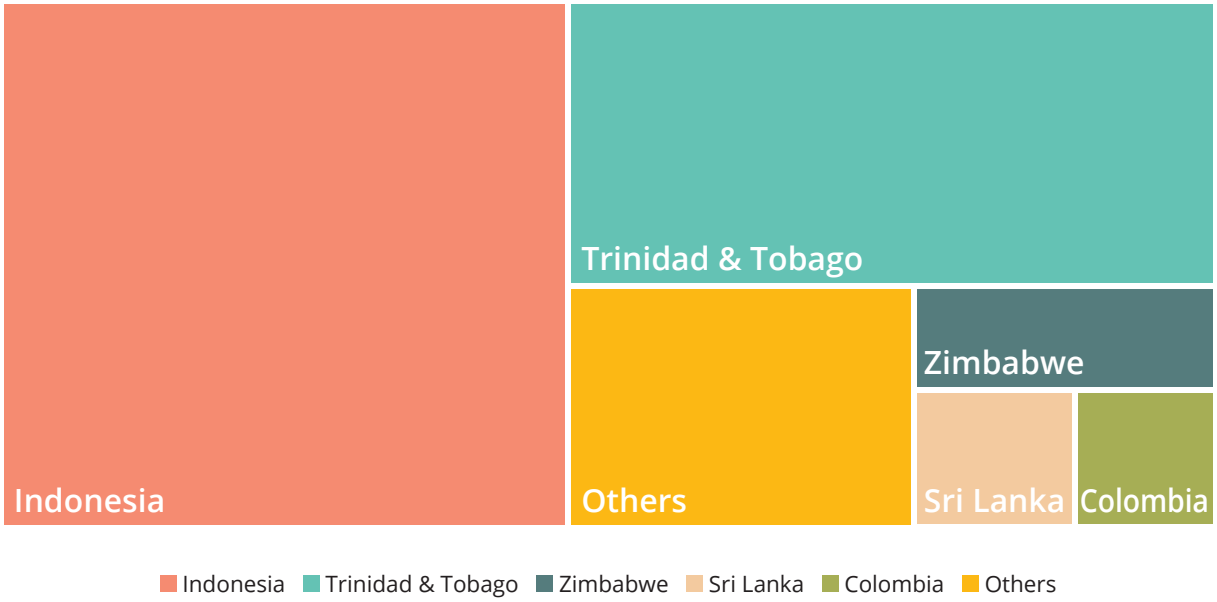


Figure 18: Countries with the highest deforestation footprint per unit of fresh milk produced. Source: Planet Tracker, Vizzuality.

This further highlights the severe threat dairy production poses on tropical and subtropical forests, ecosystems which are not only biodiversity rich, but have also been proven to be removing more atmospheric carbon than temperate and boreal equivalents (Harris et al, 2021).[19]

Turning to emissions from farming, Indonesia has the highest intensity. Nevertheless, it is Iran which presents the most interesting case.

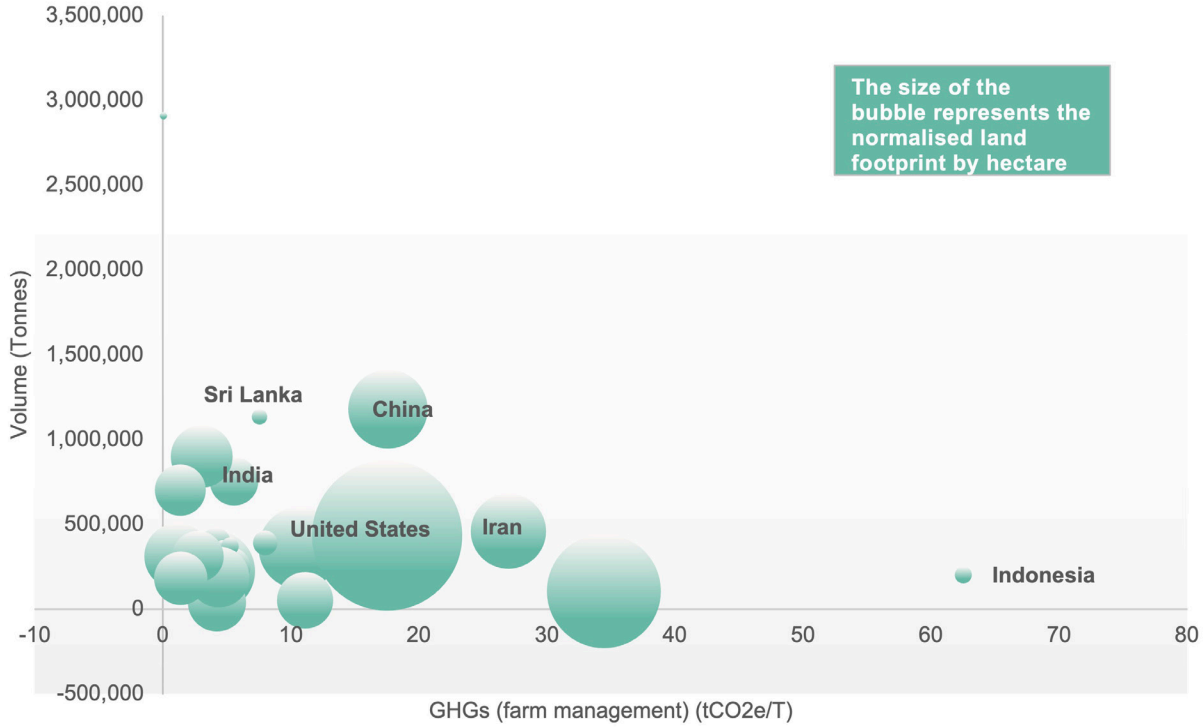


Figure 19: Nestlé's estimated GhG emissions from farm management in 2022, normalised by sourced volumes. The number assigned to the countries (the size of the bubble) represents the hectares required for each ton of milk produced. Source: Planet Tracker, Vizzuality.

As shown in Figure 19, Iran is associated not only with relatively high emissions per unit of fresh milk produced; the country also has a high volume-normalised land footprint, suggesting lower-than-average land use efficiency. In Iran's case, the overgrazing and the potential degradation of its rangelands may impact overall productivity. The situation could create a vicious cycle, pushing farmers to convert more of the land into cropland in a bid to keep production levels afloat. In contrast, the United States, with its significant land footprint driven by maize and alfalfa production for feed, exhibits a notably high normalised land footprint. The extensive land requirement for feed components significantly contribute to the overall high impact, highlighting the substantial demands of dairy production in these regions.

Conclusion

Using the company's public documentation, Planet Tracker was able to conduct an environmental assessment of Nestlé's supply chain covering four of the company's key commodities:

- Coffee
- Cocoa
- Fresh Milk
- Palm Oil

The study was made possible through the use of Vizzuality's traceability software, LandGriffon, which uses procurement data to compute a series of environmental impact metrics connected to the commodities involved.

The study found that coffee and dairy exhibit some of the highest environmental impacts across most indicators, particularly in deforestation footprint, GhG emissions, and farm management. Coffee has the highest deforestation footprint in absolute terms (6,838 hectares/year), but when normalised by volume, cocoa shows a higher deforestation intensity per tonne sourced (0.02 hectares/tonne).

Other insights suggest that water usage is likely to pose increasing concerns across the coffee value chain over time, with some areas already under stress. Coffee has the largest total water use both on an absolute (143 Mm^3/year)and per tonne (0.000167 Mm^3/tonne) basis, indicating its water-intensive nature.

Fresh milk production, notably in China, shows the highest GhG emissions from farm management (104,860,821 tCO_2e/year), even when normalised. Additionally, dairy farming in India shows significant unsustainable water use (16.80 Mm^3) due to its concentration in water-stress regions.

Deforestation and farm management emissions are topics not to be overlooked. Cocoa cultivation in Côte d'Ivoire and coffee production in Vietnam further illustrate the environmental challenges associated with each commodity, with cocoa requiring extensive land (287,494.44 hectares) and coffee causing substantial land conversion and deforestation-related GhG emissions in Vietnam (613,693.80 tCO_2e). While palm oil generally shows lower impacts across most categories, these findings highlight the urgent need for sustainable practices and improvements in managing the environmental trade-offs associated with these commodities. The detailed impacts for coffee and dairy in particular underscore the necessity of targeted interventions to mitigate their environmental footprint.

Ultimately, the most actionable takeaways are found in the cross-country comparisons, looking at individual commodities.

Although the study relies on a series of assumptions and estimated volumes, this type of analysis provides an example of what external organisations can determine about a corporation's supply chains and the impact of management decisions. The results from traceability softwares like LandGriffon allow corporations to identify areas of concern and levers of environmental pressure, as can external organisations.

As such Planet Tracker urges:

- **Corporations** to engage with traceability tools, in a bid to quantify, locate and track their impact on Nature over time
- **Investors** to encourage corporations to invest in their traceability systems,
- **Lenders** to facilitate the transition towards a transparent and traceable value chain, supporting local suppliers with their financing needs

Ultimately, if corporate management teams do not invest in traceability systems, external parties may start highlighting their vulnerabilities, in turn exposing investors and lenders to potential regulation and reputational risks.

Appendix A

Analysis Methodology & Limitations

The analysis relies on Nestlé's 2022 and 2023 supply chain disclosures covering coffee, cocoa, fresh milk and palm oil.[20] [21] [22] [23] As part of the company's traceability efforts, Nestlé provides a list of Tier 1 and 2 suppliers (and up to Tier 4 for palm oil) for each commodity except for fresh milk (where instead sourcing regions are the most granular level provided), alongside a total volume sourced for the year.

Planet Tracker went further to estimate each country's procurement volume by commodity, averaging data between 2019 and 2020. For fresh milk only, procurement volume percentages were estimated through proxy 2023 data on revenues segments. Lastly, country procurement volumes were equally split and allocated among the suppliers in the same country.

The data was then ingested by Vizzuality's LandGriffon software. In order to compute accurate impact results, LandGriffon employs a hierarchical approach to estimate the environmental impacts based on the available geographic precision of the data. When information is limited, LandGriffon uses a probabilistic approach to identify likely sourcing regions and estimate impacts. When companies know more about their suppliers and sourcing regions, this information is used to improve the quality and accuracy of estimates. This would ideally come in the form of physical coordinates for each supplier. However, while Nestlé provides supplier names, their locations are not generally disclosed. The tool therefore follows the following approach when estimating impacts from production for this particular analysis:

- Calculation computed at point of production or aggregation
- Calculation computed according to the average found for the administrative region of production
- Calculation computed according to the country of production's average

For cocoa, coffee, and palm oil, LandGriffon utilised this hierarchy to estimate impacts such as deforestation and GhG emissions from farm management. In cases where exact production locations were unavailable, the tool assumed that raw materials were sourced from all producing locations within the country or administrative region. This methodology assumes that higher production areas have a greater likelihood of sourcing and therefore, a higher probability of impact, which could potentially lead to an overestimation of associated impacts.

Estimations at the point of production were only available for palm oil suppliers, making use of the Universal Mill List as of May 2024 and matching suppliers' names.[e] For palm oil exclusively, 84% of suppliers were mapped to geographic coordinates. In contrast, for coffee and cocoa, the absence of exact supplier locations meant that the tool had to rely exclusively on administrative regions and countries' averages, which introduces a degree of uncertainty into the analysis.

e The Universal Mill List is a collection of palm oil mill locations across the world based on data contributed from processors, traders and consumer goods manufacturers, the Roundtable on Sustainable Palm Oil (RSPO), and FoodReg. It is maintained by WRI and Rainforest Alliance. Accessible here

Regarding fresh milk, impacts were estimated based on a mixed production system assumption, meaning that the dairy estimates were distributed across the country's production areas. LandGriffon estimates the direct environmental impact associated with dairy feed components by converting the volume of fresh milk produced into the local feed requirement using feed conversion efficiency (FCE). This approach allows for the calculation of quantities of individual feed components, such as palm, corn and wheat, necessary for dairy production across different regions. However, the methodology assumes uniform FCE values and consistent feed composition across locations, potentially oversimplifying the complex dynamics of feed conversion and ingredient sourcing. Additionally, regional variations and differences in on-farm versus off-farm feed production are not fully captured, which may impact the accuracy of the estimated environmental impact. This approach could result in overestimation of impacts depending on the actual distribution of the dairy farms. More accurate impact estimates could be achieved with more precise data on farm locations and feed components.

These are well-known limitations of the analysis, one which would dissipate should exact suppliers' locations and production volumes be known. However, in absence of such granularity, these results represent the best possible estimates derived from a collection of publicly available sources and reasonable assumptions. LandGriffon, even with these limitations, helps in identifying potential environmental hotspots and guiding corporate sustainability efforts.

Overall, a summary of the collected datapoints is provided by the table below.

Table 1: Summary of suppliers' breadth of information. Source: Planet Tracker.

Commodity	Unique Suppliers	Suppliers with geographical coordinates	Unique Sourcing Regions	Unique Sourcing Countries
Coffee	151	-	1	27
Cocoa	91	-	6	6
Palm Oil	1,568	1,323	1	25
Dairy (Fresh Milk)	-		140	27

Further, it is worthwhile providing more context as to the approach used by LandGriffon in computing land use change impacts.

LandGriffon uses a statistical land use change (sLUC) approach. This methodology involves two steps: first, mapping the spatial extent of nature ecosystem conversion and/or consequent impacts, and second, distributing these impacts across land using a spatial adaptation of the sLUC proportional allocation approach. The sLUC method allocates greater responsibility for impacts to areas immediately adjacent to land use change, recognizing that land pressures in a near forest boundary significantly contributes to subsequent land conversion. This approach may result in deforestation estimates that are likely to differ from Nestlé's publicly disclosed sustainability targets, as the company may use a different model for assessing land impacts.

In the context of the EU Deforestation Regulation (EUDR) and the push for full commodities' traceability, it is important to consider how these different methodologies align. The EUDR requires companies to ensure that products entering the EU are not linked to deforestation, effectively requiring companies to achieve near-full traceability within their supply chains. While traceability allows for more precise tracking of direct land use change (dLUC) metrics, it may not fully capture the broader, indirect impacts that sLUC accounts for. In some situations, actions to reduce dLUC emissions can lead to increased land use change outside of a company's sourcing boundary. For example, a large-scale shift to alternative grazing practices might increase soil carbon sequestration but could also reduce fresh milk output per hectare, potentially leading to additional land clearing elsewhere (GhG Protocol, 2022).

As companies like Nestlé progress on their traceability journey, they might report low or zero deforestation footprints based on the dLUC metrics, which focus on specific, known areas of land use. However, the sLUC approach offers a complementary perspective by accounting for land pressures and deforestation risk in surrounding landscapes, pressure points that are not fully addressed by dLUC alone. This highlights the importance of integrating both approaches to ensure a comprehensive understanding of land use impacts.

Furthermore, it is also important to note a limitation surrounding the calculation of farm-related emissions. In this instance, the absence of detailed farm management GhG data for coffee may understate the commodity's overall environmental impact. Incorporating more granular data on coffee's GhG emissions from farm management would likely provide a more accurate and potentially higher estimate of its contribution to climate change. In turn, palm oil's generally lower impact compared to cocoa and coffee might be partly attributed to the more detailed supplier information available. Ultimately, the detailed mill-level data for palm oil contributes to more accurate modelling, whereas the coarser estimates for cocoa and coffee result are likely to lower the overall precision.

Lastly, the estimates available are top-down in nature, meaning that these are inherently uncertain. The included indicators serve primarily as a prioritisation, planning tool for macro-scale analysis, which can and should be supplemented by local engagement and analysis. Data gathered from such exercise and use cases can be incorporated back into the tool, feeding a cycle of progress and continuous improvement.

Ultimately, more precise data on supplier locations and production volumes would enhance the accuracy of impact assessments and provide a clearer understanding of environmental pressures across the supply chain.

Appendix B

LandGriffon Methodology

LandGriffon tackles the complexities surrounding agricultural supply chains' traceability and environmental impact assessment. By integrating procurement data with geospatial sources, LandGriffon provides accurate impact estimates and supports a fully traceable global view across a diverse set of agricultural commodities.

The LandGriffon methodology aligns with the guidelines proposed by the Science Based Targets Network (SBTN), the Science Based Targets Initiative (SBTI) and the Taskforce of Natural Related Financial Disclosure (TNFD), enabling companies to explore pathways for reducing environmental impacts and representing a practical tool for managing and enhancing sustainability across the supply chain. The software carries out the following sequential steps (Figure 1):

1. Importing supply chain procurement data
2. Modelling spatial sourcing
3. Evaluating impacts
4. Exploring pathways to reduce impacts

LandGriffon uses these elements to structure the methodological description portrayed below, described in further detail in the below sections.

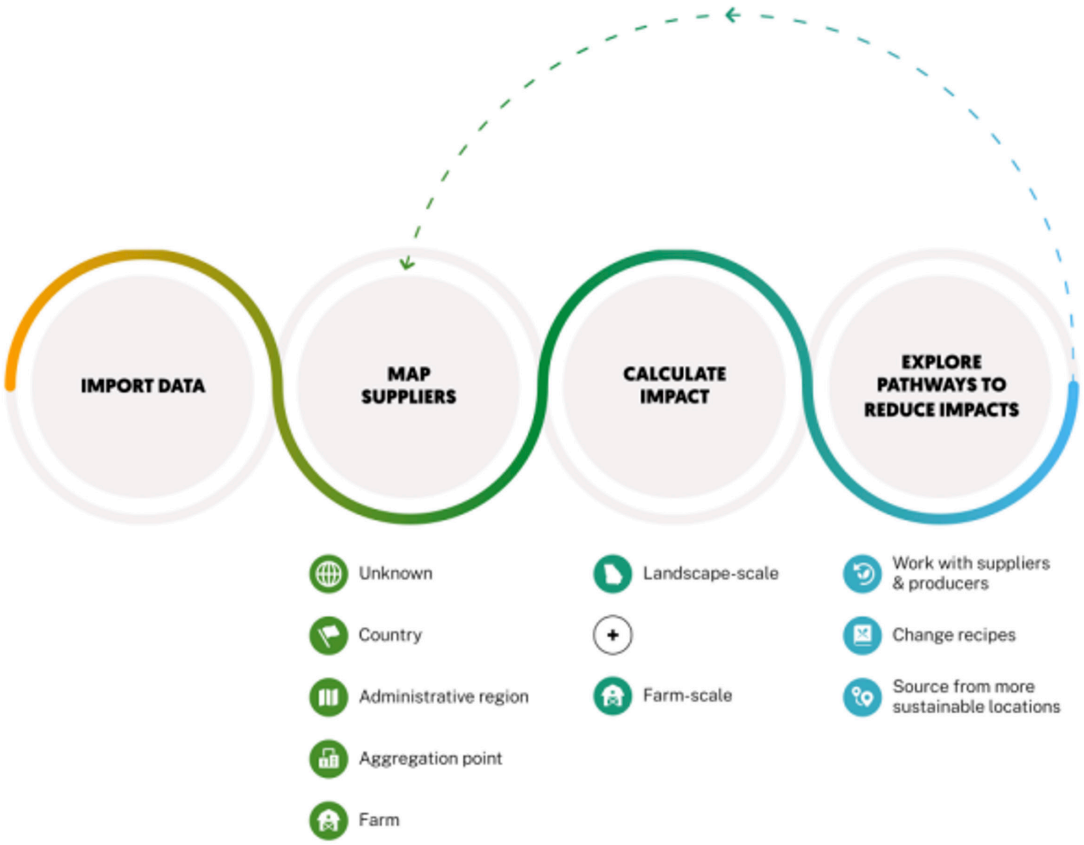


Figure 20: Schematic representation of the LandGriffon v0.2 methodology. Source: Vizzuality.

Importing supply chain data

LandGriffon users can import data on the agricultural raw materials they use in order to estimate their related natural impacts. At a minimum, companies are expected to provide annual volumes for each raw material sourced. Additional information about where materials are sourced from, such as the country, administrative region or point of production, enables LandGriffon to generate more accurate environmental impact estimates. Users can also include information about business units and/or other relevant company data to enhance their analysis.

The information companies have on the production of their raw materials is likely to vary significantly. Sometimes corporates know the exact farm location that grows a specific product, while other times, as reflected in this use case, companies are only aware of the country or administrative region producing the raw material. This in turn means varying degrees of precision as to where in the world each material is sourced from. LandGriffon analyses these data using a hierarchical structure to determine sourcing precision, ranging from unknown global sources to specific farms.

Raw materials ingested are identified using an extended Harmonized System (HS) code hierarchy, allowing for detailed or generic estimates based on data availability. In addition, open access data for major commodities (ie. Trase) helps to identify likely sourcing locations.

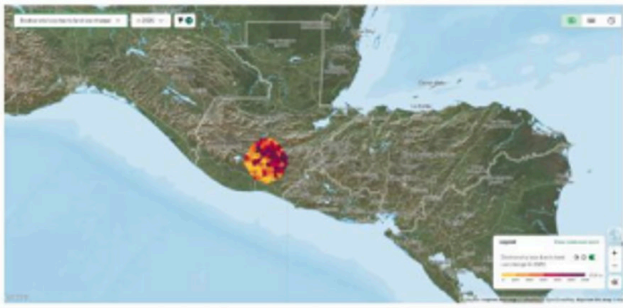
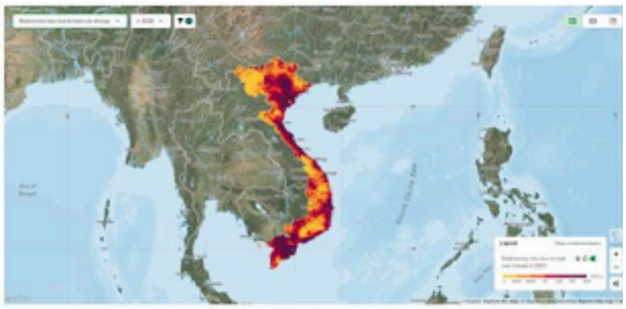
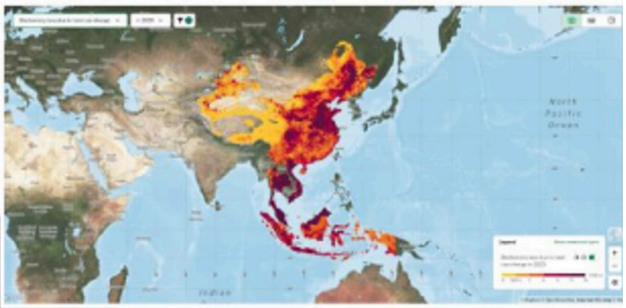
Sourcing location type	Modeled likely production areas
Aggregation point Produced within 50km of this location	
Producer country or jurisdiction Produced within this country or jurisdiction	
Delivery country Produced within or imported to this country	

Figure 21: Company supply chain location information is turned into heat maps of where materials are most likely to have been produced. The method used for mapping these locations depends on the type of location provided by users. Source: Vizzuality.

Modelling spatial sourcing

The spatial sourcing model in LandGriffon identifies likely sourcing areas for the ingested raw materials, attributing environmental impacts to these areas. When the exact location is known, the software assumes equal sourcing from all production areas within the region. Where the location type is the country of delivery, LandGriffon assumes that the material has been produced in that country or in any country exporting material to the given country. This is done using trading statistics.

During the data ingestion process, materials are matched using the HS commodity codes. More raw material is assumed to be sourced from locations with greater production. So, a higher probability of impact is associated with areas of high production. This approach can result in an under- or overestimation of the impacts associated with a raw material with this approach. Exact sourcing locations, when available, are therefore linked with much higher accuracy.

Evaluating impacts

LandGriffon measures environmental impacts for water use, water quality, land use, deforestation, greenhouse gas emissions and biodiversity loss. These are in alignment with standards from SBTN, SBTI and TNFD.

These indicators are calculated by combining company sourcing data with global environmental datasets. LandGriffon calculates indicators per ton and then multiplies by the total tonnage of raw material sourced from each location. The method used depends on the precision of the location data provided by the company, and whether the indicator measures impacts occurring within the farm itself (farm level impacts) or across the wider landscape as a result of land use change/ land expansion (land use change impacts).

LandGriffon includes the following set of impact indicators:

Water quantity:

- **Water use:** Volume of surface or groundwater that is consumed in the production of the raw material sourced.
- **Unsustainable water use:** Volume by which the water consumption associated with the production of a particular raw material sourced from a location suffering water stress must be decreased to reduce pressure on nature.

Water quality:

- **Nutrient load:** Annual average water volume required to assimilate the nutrient load added by the raw material sourced.
- **Excess nutrient load:** Volume by which nutrient load associated with the raw material sourced must be decreased to achieve the desired instream nutrient concentration.

Land use:

- **Land footprint:** The total land area required to produce the raw material sourced.

Climate:

- **GhG (farm management):** The amount of greenhouse gas (GhG) emissions arising from farm management of the raw material sourced.
- **GhG (deforestation sLUC):** Annual average emissions of greenhouse gas (GhG) associated with deforestation within a 50km radius attributable to the raw material sourced.

Natural ecosystem conversion:

- **Deforestation footprint (sLUC):** Annual average area of deforestation within a 50km radius attributable to the raw material sourced.
- **Net cropland expansion:** Annual average area of cropland expansion into natural ecosystems occurring within a 50km radius attributable to the raw material sourced.

Biodiversity:

- **Forest Landscape Integrity Loss:** Average foresta landscape integrity score of natural ecosystems that have been converted to cropland within a 50km radius attributable to the raw material sourced.
- **Biodiversity intactness loss:** Average biodiversity intactness score of natural ecosystems that have been converted to cropland within a 50km radius attributable to the raw material sourced.

Impact calculations are implemented in a modular way, so that new indicators can easily be added to the calculation framework as new recommendations or needs arise.

Exploring pathways to reduce impacts

LandGriffon computes automated impact calculation once data is imported. These impacts, once ingested and calculated, are shown on the main platform in the form of maps, tables and charts.

The tool also provides solutions for visual and quantitative analysis, exploring the data and creating forecast or future scenarios simulating changes in procurement impacts. For instance, the software allows users to understand how projected environmental impacts change when switching to other regions or alternative raw materials.

More detailed information can be found on the LandGriffon methodology v2.0 document that can be accessed through the following link.

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ABOUT PLANET TRACKER

Planet Tracker is an award-winning non-profit financial think tank aligning capital markets with planetary boundaries. Created with the vision of a financial system that is fully aligned with a net-zero, resilient, nature positive and just economy well before 2050, Planet Tracker generates break-through analytics that reveal both the role of capital markets in the degradation of our ecosystem and show the opportunities of transitioning to a zero-carbon, nature positive economy.

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