LANDGRIFFON

LANDGRIFFON METHODOLOGY. EXECUTIVE SUMMARY

Agricultural supply chain impact and risk assessment

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INTRODUCTION

LandGriffon is a software service that helps companies assess risks and impacts from agricultural production in their supply chains and analyze possible futures.

LandGriffon uses earth observation data and modeling approaches to spatialize company supply chain information to enable companies to take action now with the information they have. LandGriffon provides a holistic picture of company agricultural supply chain impacts so companies can answer questions such as:

- What materials, business units, regions or suppliers are the largest sources of impacts and risks?
- Where are the greatest opportunities to reduce impacts and risks?
- Are we making progress against our targets and is this progress likely to be sufficient to achieve those targets?

Every company has unique aspirations, environmental reporting needs, and supply chain visibility. LandGriffon provides a flexible framework with a set of indicators that align with key voluntary reporting guidelines[1] and that can be customized for individual companies and can evolve over time.

Though LandGriffon is a commercial service, the LandGriffon methodology and software source code are published openly in order to foster trust, collaboration, and continued innovation. This version 0.2 update focuses on providing water, land, carbon, and biodiversity indicators in alignment with the Science Based Targets Network guidance for 2023.

[1]Science Based Targets Network (**SBTN**), Science Based Targets Initiative (**SBTI**) and Taskforce for Nature Related Financial Disclosure (**TNFD**)

CONTENTS

WHAT COMPANY SUPPLY CHAIN INFORMATION DOES LANDGRIFFON USE?

LandGriffon users import company data on the agricultural materials they use in order to estimate their impacts. At a minimum, LandGriffon requires data on the amount of each material. More precise information about where materials are sourced from, such as the country, administrative region, or the point of production, enable LandGriffon to generate more accurate estimates of environmental impacts. Users can also include information about business units and other relevant company data to enhance their analysis (**Figure 1**).

When exact production locations are not known, LandGriffon models the likely locations using maps of agricultural crops and livestock production. Providing more detailed location information increases the accuracy of the model. For example, if a company knows the country its crop is grown in, LandGriffon only looks at crop-producing areas in that country. If they know the country in which they received delivery, LandGriffon uses international trade data to estimate the likely source (**Figure 2**).

The LandGriffon software can be deployed within corporate infrastructure so that sensitive data does not leave the corporate network.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**Material**	**Business unit**	**Suppliers**		**Sourcing location**						**Tonnage**					
2	Material	The business unit for which these materials were supplied	The company from which the materials were purchased	The company that produced the raw materials. (farm, cooperative, local aggregator etc.)	The level on information you have on where the raw materials were produced. One of: - Point of production (farm, ranch, plantation, etc.) - Production aggregation point (warehouse, silo, mill etc.) - Administrative region of production - Country of production - Country of delivery - Unknown	The country where the material was produced. If unknown, enter the country where the material was delivered.	Location of the producer. If administrative region of production, enter the administrative region where the material was produced.	Location of the producer. State, province, county, district, city, town, address etc. Leave blank if GPS coordinates are known. This will be geocoded with Google Maps.	GPS coordinates of producer, if known	GPS coordinates of producer, if known	Metric tonnes of the material purchased each year					
3	**Required**	**Required**	**Required**	**Required**	**Required**	**Required**	**Required for "Administrative r**	**Required for "Aggregation point" and "Point of production"**			**Required**					
4	**Material**	**Business unit**	**Tier 1 Supplier**	**Producer**	**Location Type**	**Country**	**Admin region**	**Address**	**Latitude (ºI**	**Longitude (**	**2012 t**	**2013 t**	**2014 t**	**2015 t**	**2016 t**	**2017 t**
5	40 Rubber and	Accessories	Cargill	Moll	Unknown	Lebanon					7746	1716	2199	9539	23	682
6	40 Rubber and	Accessories	Unknown	Moll	Unknown	Malaysia					3801	619	3718	2986	5967	258
7	40 Rubber and	Accessories	Unknown	Moll	Unknown	United States					1472	6018	2804	9261	4241	761
8	40 Rubber and	Accessories	Unknown	Moll	Unknown	Japan					651	36	4767	3805	8988	953
9	40 Rubber and	Accessories	Unknown	Moll	Unknown	India					1500	1382	8372	6700	4297	702
10	40 Rubber and	Accessories	Unknown	Moll	Country of production	Thailand					6965	3166	8316	5971	8195	489
11	40 Rubber and	Accessories	Unknown	Moll	Country of production	Indonesia					9526	3361	9099	2967	628	218
12	40 Rubber and	Accessories	Unknown	Moll	Country of production	Côte d'Ivoire					1274	2610	3630	2879	6260	19
13	40 Rubber and	Accessories	Unknown	Moll	Country of production	Vietnam					8808	3671	4208	8370	5682	707
14	40 Rubber and	Accessories	Unknown	Moll	Country of production	Malaysia					1056	220	6932	4206	8883	850
15	40 Rubber and	Accessories	Unknown	Unknown	Production aggregation point (w	Liberia		Margibi			5487	9236	2871	6941	3576	493
16	40 Rubber and	Accessories	Unknown	Unknown	Production aggregation point (w	India		Kerala			3794	4861	7933	197	6471	455
17	40 Rubber and	Accessories	Unknown	Unknown	Production aggregation point (w	Thailand		Nakhon Si Thammarat			1963	9665	3169	6452	8923	966
18	40 Rubber and	Accessories	Unknown	Unknown	Production aggregation point (w	Thailand		Ang Thong			3124	5967	3225	9532	7842	471

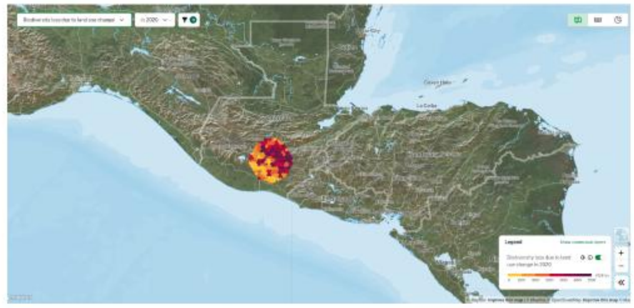
Figure 1. Example spreadsheet of company sourcing data for LandGriffon. Users may choose to include materials, suppliers, the information they have about where materials are produced, and the volume of materials sourced each year.

[2]MapSPAM 2010 v2 (IFPRI 2019); Gridded Livestock of the World v3, 2010 (Gilbert et al. 2018)
[3]resourcetrade.earth (Chatham House, 2021); FAOSTAT (FAO, 2022)

Sourcing location type	Modeled likely production areas

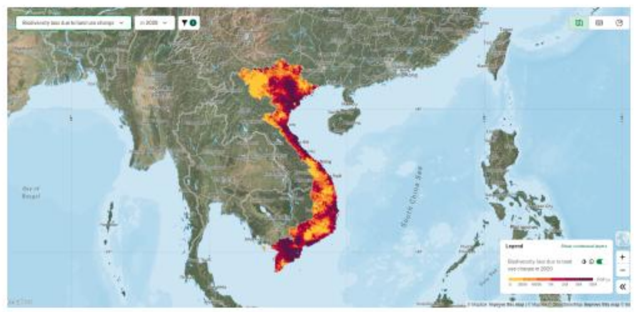
Aggregation point

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

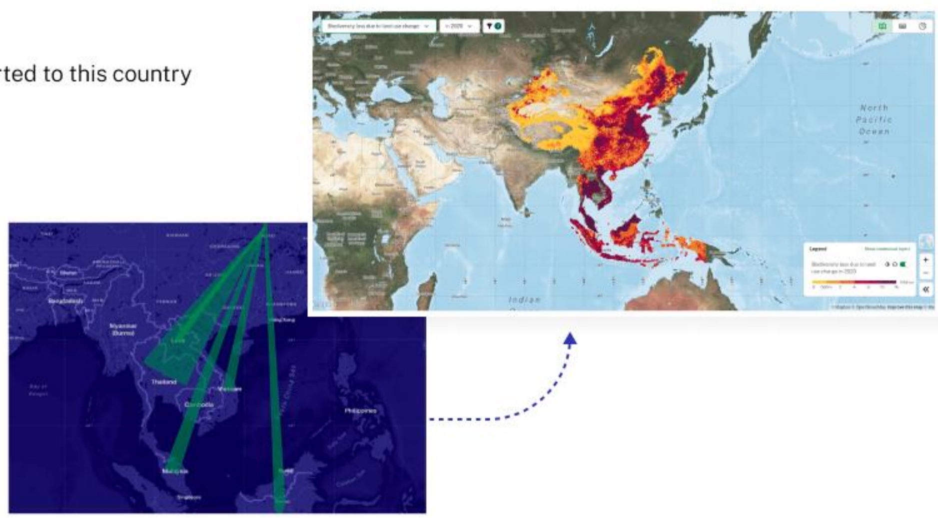


Figure 2. Company supply chain location information is turned into heat maps of where materials are most likely to have been produced. The method used for mapping these locations depends on the type of location provided by users.

HOW DOES LANDGRIFFON MEASURE ENVIRONMENTAL IMPACTS?

LandGriffon calculates indicators of environmental impacts for water use, water quality, land use, deforestation, greenhouse gas emissions, and biodiversity loss associated with agricultural production. These are in alignment with guidance from the Science Based Targets Network (**SBTN**), Science Based Targets Initiative (**SBTI**) and Taskforce for Nature Related Financial Disclosure (**TNFD**).

These indicators are calculated by combining company sourcing data with global environmental datasets (Table 1). LandGriffon calculates indicators per ton, and then multiplies by the total tonnage of each material sourced from each location across the entire company supply chain. 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 gate (farm level impacts) or across the wider landscape as a result of land use change (land use impacts).

To calculate farm-level indicators

If the exact point of production is provided, the indicator is based on the value of the indicator dataset(s) at that point. If the location information is less precise, LandGriffon calculates an average indicator value across the modeled likely areas of production (**Figure 2**).

More material is assumed to be sourced from locations with higher production, so impacts or risks in those areas are considered to be greater.

To calculate land use change impact indicators

LandGriffon additionally includes the risk of impacts to local areas when calculating land use change impact indicators, using a spatial adaptation of the statistical land use change (sLUC) proportional allocation based on land occupation approach. This accounts for deforestation or habitat conversion in areas nearby to producing regions that may be caused by demand for materials and associated land pressure. For example, if a company sources soy beans from a farm in the Mato Grosso municipality in Brazil, the deforestation footprint would be based on the area of forest loss occurring within a 50km radius of the plantation location.

HOW CAN USERS BENEFIT FROM LANDGRIFFON'S ANALYSIS AND FORECASTING FUNCTIONALITIES?

LandGriffon performs impact calculations automatically on imported data. We provide tools for visual and quantitative analysis, to export data, and to create forecasts or future scenarios simulating changes in procurement and impacts (**Figure 3**).

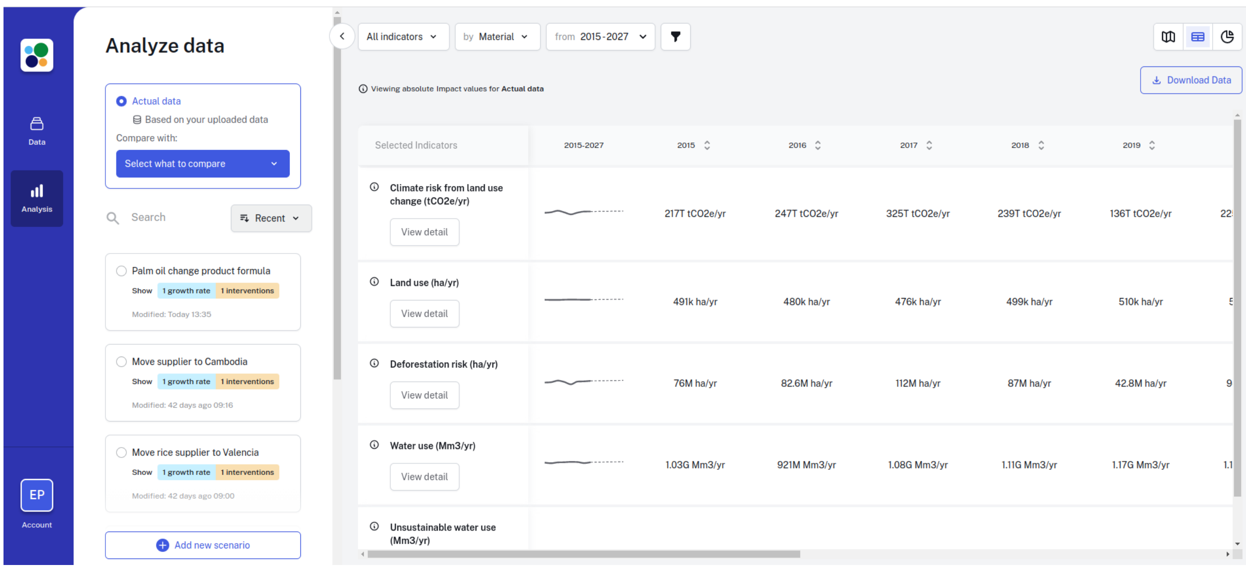


Figure 3. Example table showing historical and forecasted impacts by region. Maps, charts, and data can be customized, filtered, and exported for further analysis.

Users can define future scenarios through a combination of growth rates and interventions. Growth rates set the rate in which material purchases and associated impacts are expected to increase across the company or per business unit. Interventions allow users to simulate changes and alternatives in sourcing, including:

- working with farmers to reduce environmental impact and increase yield
- changing product recipes or fiber types and content.
- sourcing the same materials from producers with lower environmental footprints.

Users can compare scenarios to historical data, to each other, and to company targets. This enables users to evaluate the tradeoffs between different pathways and identify the actions needed to meet their environmental goals.

TABLE 1. IMPACT INDICATORS (V0.2)

LandGriffon's impact indicators are focused on the impacts of agricultural production. The LandGriffon software and framework are designed to readily integrate additional indicators.

Impact type category	Indicator	Short description	Source dataset(s)
Water quantity	Water use	The volume of surface or groundwater that is consumed in the production of the raw material sourced.	Mekonnen, M.M. & Hoekstra, A.Y. (2010) The green, blue and grey water footprint of farm crops and derived crop products. Value of Water, 47. Mekonnen, M.M. & Hoekstra, A.Y. (2010) The green, blue and grey water footprint of farm animals and animal products. Value of Water, 48.
	Unsustainable water use	The volume by which the water consumption associated with the production of the raw material sourced must be decreased to reduce pressure on nature.	Water use indicator Kuzma, S., M.F.P. Bierkens, S.Lakshman, T. Luo, L. Saccoccia, E. H. Sutanudjaja, and R. Van Beek. 2023. "Aqueduct 4.0: Updated decision-relevant global water risk indicators." Technical Note. Washington, DC: World Resources Institute. Available online at: doi.org/10.46830/writn.23.00061.
Water quality	Nutrient load	The annual average water volume required to assimilate the nutrient load added by the raw material sourced.	Mekonnen, M.M. & Hoekstra, A.Y. (2010) The green, blue and grey water footprint of farm crops and derived crop products. Value of Water, 47. Mekonnen, M.M. & Hoekstra, A.Y. (2010) The green, blue and grey water footprint of farm animals and animal products. Value of Water, 48.

	Excess nutrient load	The volume by which nutrient load associated with the raw material sourced must be decreased to achieve the desired instream nutrient concentration.	Nutrient load indicator McDowell, R. W., A. Noble, P. Pletnyakov, B. E. Haggard, and L. M. Mosley. 2020. 'Global Mapping of Freshwater Nutrient Enrichment and Periphyton Growth Potential'. Scientific Reports 10 (1): 3568. https://doi.org/10.1038/s41598-020-60279-w. McDowell, R. W., Alasdair Noble, Peter Pletnyakov, and Luke M. Mosley. 2020. 'Global Database of Diffuse Riverine Nitrogen and Phosphorus Loads and Yields'. Geoscience Data Journal 8 (2): 132–43. https://doi.org/10.1002/gdj3.111.
Land use	Land footprint	The total land area required to produce the raw material sourced.	International Food Policy Research Institute. 2019. 'Global Spatially-Disaggregated Crop Production Statistics Data for 2010 Version 2.0'. Harvard Dataverse. https://doi.org/10.7910/DVN/PRFF8V.
Climate	GHGs (farm management)	The amount of greenhouse gas (GHG) emissions, including CO2, N2O and CH4, arising from farm-management of the raw material sourced.	Halpern, Benjamin S., Melanie Frazier, Juliette Verstaen, Paul-Eric Rayner, Gage Clawson, Julia L. Blanchard, Richard S. Cottrell, et al. 2022. 'The Environmental Footprint of Global Food Production'. Nature Sustainability 5 (12): 1027–39. https://doi.org/10.1038/s41893-022-00965-x.
	GHGs (deforestation, sLUC)	The annual average greenhouse gas (GHG) emissions associated with deforestation within a 50km radius attributable to the raw material sourced.	Land footprint indicator Deforestation footprint (sLUC) indicator Noon, Monica L., Allie Goldstein, Juan Carlos Ledezma, Patrick R. Roehrdanz, Susan C. Cook-Patton, Seth A. Spawn-Lee, Timothy Maxwell Wright, et al. 2021. 'Mapping the Irrecoverable Carbon in Earth's Ecosystems'. Nature Sustainability 5 (1): 37–46. https://doi.org/10.1038/s41893-021-00803-6. ESA. 2017. 'Land Cover CCI Product User Guide Version 2. Technical Report'. maps.elie.ucl.ac.be/CCI/viewer/download/ESACCI-LC-Ph2-PUGv2_2.0.pdf.

Natural ecosystem conversion	Deforestation footprint (sLUC)	The annual average area of deforestation within a 50km radius attributable to the raw material sourced.	Land footprint indicator Tyukavina, Alexandra, Peter Potapov, Matthew C. Hansen, Amy H. Pickens, Stephen V. Stehman, Svetlana Turubanova, Diana Parker, et al. 2022. 'Global Trends of Forest Loss Due to Fire From 2001 to 2019'. Frontiers in Remote Sensing 3. https://www.frontiersin.org/articles/10.3389/frsen.2022.825190 Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, et al. 2013. 'High-Resolution Global Maps of 21st-Century Forest Cover Change'. Science 342 (6160): 850–53. https://doi.org/10.1126/science.1244693 Mazur, Elise, Michelle Sims, Elizabeth Goldman, Martina Schneider, Fred Stolle, Marco Daldoss Pirri, and Craig Beatty. 2023. 'SBTN Natural Lands Map: Technical Documentation'. SBTN. https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Land-v0.3-Natural-Lands-Map.pdf. Potapov, Peter, Matthew C. Hansen, Lars Laestadius, Svetlana Turubanova, Alexey Yaroshenko, Christoph Thies, Wynet Smith, et al. 2017. 'The Last Frontiers of Wilderness: Tracking Loss of Intact Forest Landscapes from 2000 to 2013'. Science Advances 3 (1): e1600821. https://doi.org/10.1126/sciadv.1600821. Potapov, Peter, Matthew C. Hansen, Amy Pickens, Andres Hernandez-Serna, Alexandra Tyukavina, Svetlana Turubanova, Viviana Zalles, et al. 2022. 'The Global 2000-2020 Land Cover and Land Use Change Dataset Derived From the Landsat Archive: First Results'. Frontiers in Remote Sensing 3 (April): 856903. https://doi.org/10.3389/frsen.2022.856903. Turubanova, Svetlana, Peter V Potapov, Alexandra Tyukavina, and Matthew C Hansen. 2018. 'Ongoing Primary Forest Loss in Brazil, Democratic Republic of the Congo, and Indonesia'. Environmental Research Letters 13 (7): 074028. https://doi.org/10.1088/1748-9326/aacd1c.
	Net cropland expansion	The annual average net area of cropland expansion into natural ecosystems occuring within a 50km radius attributable to the raw material sourced.	Land footprint indicator Mazur, Elise, Michelle Sims, Elizabeth Goldman, Martina Schneider, Fred Stolle, Marco Daldoss Pirri, and Craig Beatty. 2023. 'SBTN Natural Lands Map: Technical Documentation'. SBTN. https://sciencebasedtargetsnetwork.org/wp-content/uploads/2023/05/Technical-Guidance-2023-Step3-Land-v0.3-Natural-Lands-Map.pdf. Karra, Krishna, Caitlin Kontgis, Zoe Statman-Weil, Joseph C. Mazzariello, Mark Mathis, and Steven P. Brumby. 2021. 'Global Land Use / Land Cover with Sentinel 2 and Deep Learning'. In 2021 IEEE International Geoscience and Remote Sensing Symposium IGARSS, 4704–7. Brussels, Belgium: IEEE. https://doi.org/10.1109/IGARSS47720.2021.9553499.

Biodiversity	Forest Landscape Integrity loss	The average forest landscape integrity score of natural ecosystems that have been converted to cropland within a 50km radius attributable to the raw material sourced.	Net cropland expansion indicator Grantham, H. S., A. Duncan, T. D. Evans, K. R. Jones, H. L. Beyer, R. Schuster, J. Walston, et al. 2020. 'Anthropogenic Modification of Forests Means Only 40% of Remaining Forests Have High Ecosystem Integrity'. Nature Communications 11 (1): 5978. https://doi.org/10.1038/s41467-020-19493-3.
	Forest Landscape Integrity loss	The average forest landscape integrity score of natural ecosystems that have been converted to cropland within a 50km radius attributable to the raw material sourced.	Net cropland expansion indicator Gassert, Francis, Joe Mazzarello, and Sam Hyde. 2022. 'Global 100m Projections of Biodiversity Intactness for the Years 2017 - 2020'. Technical White Paper. https://ai4edatasetspublicassets.blob.core.windows.net/assets/pdfs/io-biodiversity/Biodiversity_Intactness_whitepaper.pdf.

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