


# Terra-i+ webtool

## Simplifying Agroforestry Sustainability Monitoring

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In an ever-evolving landscape of regulations and commitments to net-zero emission commodity chains, Terra-i+ offers a satellite-based solution for agroforestry supply chain sustainability management. At its core, Terra-i+ functions as an integrated platform to access critical information about the sustainability status of coffee supply chains. With Terra-i+, stakeholders gain access to essential metrics and insights, empowering them to make informed decisions that drive adoption of sustainable practices.

 **Find new areas for low-risk investment in certification:** Terra-i+ equips users with the tools to identify untapped opportunities for low-risk investments in certification. By analyzing comprehensive data sets, Terra-i+ pinpoints regions with high potential for sustainable agroforestry practices and low risk of deforestation. This strategic insight allows users to optimize their investments and contribute to the growth of sustainability assurances around their supply chains.

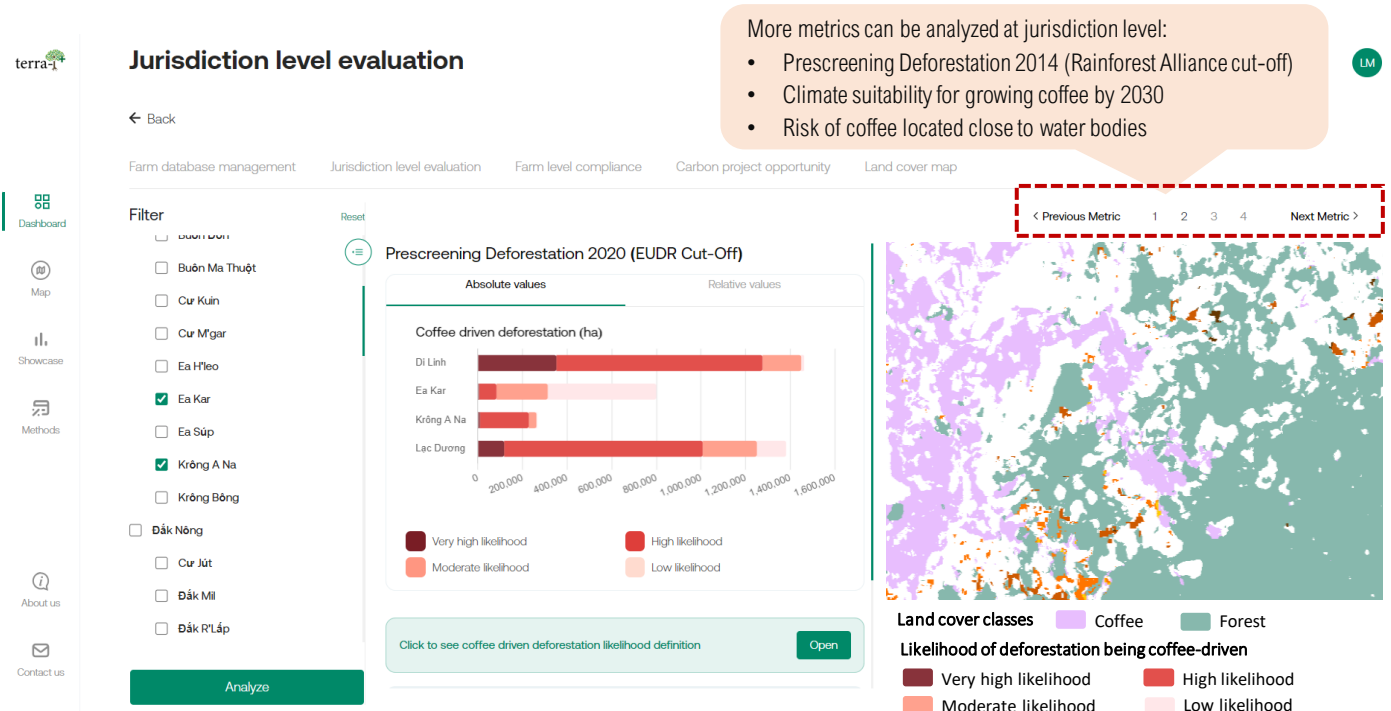



Figure 1: Screenshot of Terra-i+ website presenting metric “Prescreening Deforestation 2020 (EUDR Cut-Off)”. Jurisdictions can be compared with each other to help companies benchmark potential areas against each other for certification

 **Monitor deforestation-related risks and compliance with certification standards and regulations:** Terra-i+ enables its users to be leaders in supply chain risk management. Through real-time monitoring and analysis, the platform helps users track deforestation-related risks and assess compliance with industry certification standards as well as the European Union Due Diligence Regulation (EUDR). By proactively addressing these challenges, Terra-i+ ensures the integrity and sustainability of its users’ supply chains.

### Acknowledgments

This work is funded by the Nordic Climate Facility and carried out with support from the University of Copenhagen, Ecom, and the Rainforest Alliance.

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**Export data and report about risk management:** Effortlessly generate Excel and geospatial data for internal assessment; as well as and detailed reports for auditors, management, and other stakeholders. Terra-i+ facilitates quick actions and streamlines the reporting process, providing a comprehensive overview of its users' risk management strategies. This feature not only facilitates transparency but also showcases commitment to responsible sourcing.

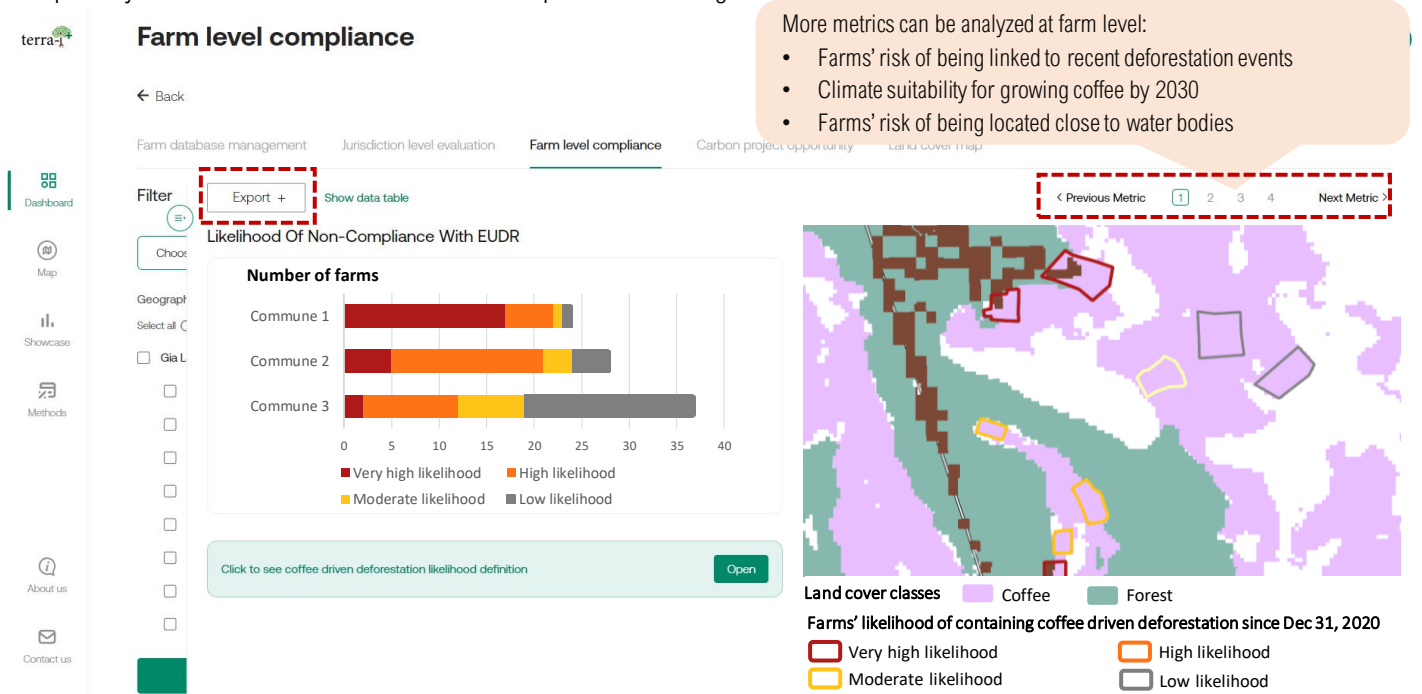


Figure 2: The farm level metric “Likelihood of Non-Compliance With EUDR” highlights farm polygons at risk of being non-compliant with EDUR in term of deforestation after 31 Dec 2020. Data can be exported in pdf, excel, shapefile, or kml formats.

**Quickly identify opportunities for carbon sequestration within agroforestry systems and assess progress toward net-zero emissions:** In the era of climate change mitigation, Terra-i+ empowers users to identify carbon sequestration opportunities within agroforestry systems. With this platform, stakeholders can assess the current status of their efforts toward achieving net-zero emissions.

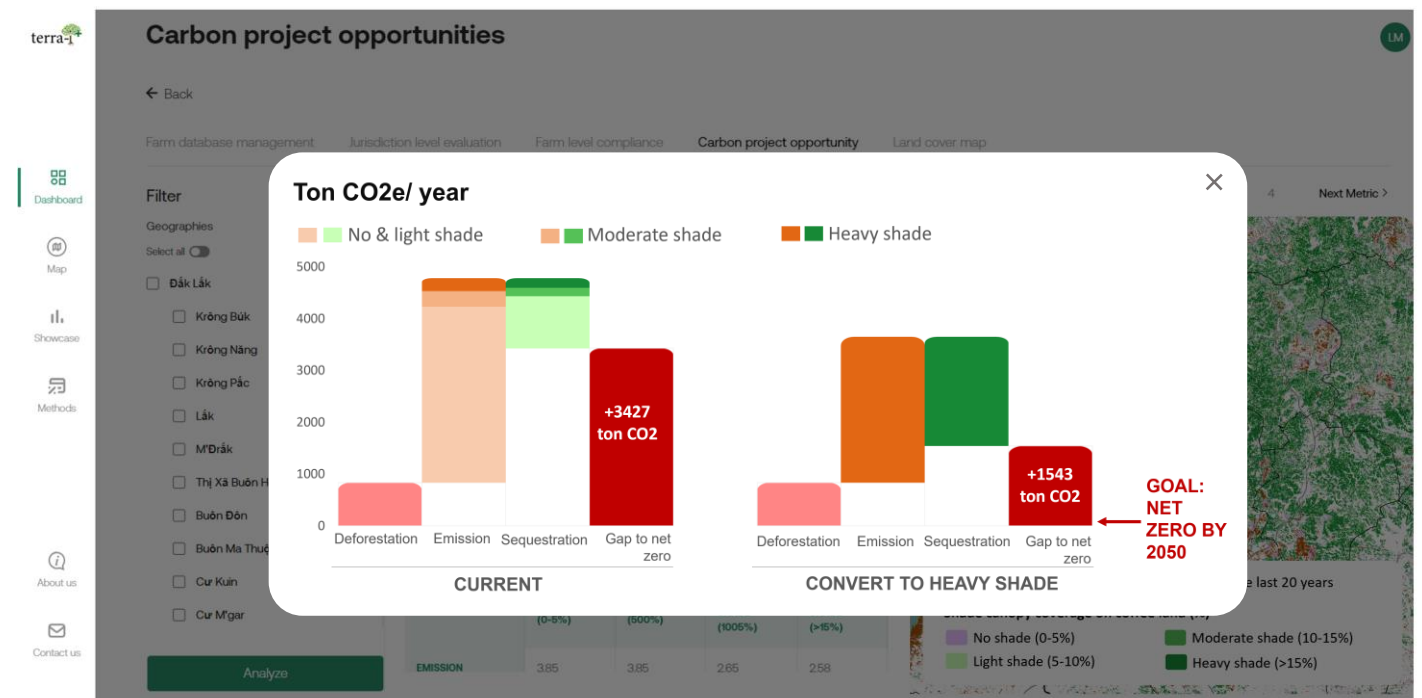


Figure 3: The carbon metric allows users to benchmark coffee farms' net carbon gain potential when moving from the business-as-usual scenario toward higher-shade systems. Comparison can be made at different levels: jurisdiction, certification label, and farmer group.

## The problem



The coffee industry faces increasing pressure from regulatory bodies, such as EUDR, and evolving environmental commitments toward carbon-neutral supply chains. These demands place a significant burden on coffee traders to provide accurate, timely, and transparent reporting on zero deforestation supply chains and emissions status. Furthermore, coffee traders, often operating in complex, geographically dispersed supply chains, struggle with limited geospatial analysis capacities. This inherent constraint slows their progress in responding to the growing demand for traceability and sustainability assurances. Finally, a significant gap exists between the industry's obligation to report and the availability of actionable, globally standardized, locally relevant data regarding coffee-driven deforestation.

Locally accurate and up-to-date information on deforestation risks and compliance with sustainability standards is essential for stakeholders throughout the coffee supply chain, especially traders. These stakeholders require accessible, user-friendly solutions that empower them to navigate the complexity of their supply chains effectively.

## The solution



Terra-i+ emerges as an innovative solution to the complex challenges faced by the coffee industry in its pursuit of sustainable supply chains. Terra-i+ was uniquely designed in collaboration with the coffee industry and serves as a pioneering satellite-based platform that centralizes the monitoring of agroforestry supply chain sustainability. The tool was designed around four main functionalities:

- **Identifying Sustainable Opportunities:** Terra-i+ analyzes data to reveal low-risk areas for certification investments, fostering certified supply chain growth.
- **Deforestation Risk Monitoring:** Real-time tracking and compliance assessment ensure supply chain integrity.
- **Effortless Reporting:** Terra-i+ simplifies reporting, promoting transparency and responsible sourcing.
- **Carbon Sequestration:** Users identify carbon sequestration prospects, measuring progress towards net-zero emissions.

## The innovation



Terra-i+ stands as the cutting-edge of geospatial innovations, derived from satellite imagery with **30 cm resolution** and blending advanced deep learning techniques with remote sensing data from the Copernicus missions Sentinel 1 and Sentinel 2. These sophisticated models are not only trained on large datasets but also enriched with local reference data sourced from key areas tied to collaborating companies. These models provide essential components, including precise land cover data and shade tree density assessments within agroforestry systems, which serve as the building blocks required to construct more complex metrics. This unique approach ensures that Terra-i+ delivers actionable, industry-specific metrics while adhering to global standards. Users without any location data can still utilize the tool, thanks to its ability to identify coffee and forest land cover with true positive and true negative rates falling within the range of [82% to 91%](#) accuracy. Furthermore, Terra-i+ was meticulously crafted with the coffee industry, for the coffee industry. Placing users at the center of its development process, this tool provides metrics finely tuned to meet the specific needs of the industry, ultimately revolutionizing sustainability management in agroforestry supply chains.

# Methods

## 1 Dataset creation: deforestation detection; land cover mapping; climate modeling

Deforestation hotspots were detected from 10m resolution analysis using a semi-automated procedure to automatically acquire and analyzed the latest available Sentinel 1 images.

Land cover maps were created using a deep learning model based on Sentinel 1 and 2 input data, combined with geo-located land cover data and human interpretation of high-resolution imagery. Accuracy checks, optical checks, and validation rounds were performed.

Climate suitability maps for Robusta coffee until 2030 were created by analyzing 19 crop suitability bioclimatic variables and averaging 19 climate scenarios.



## 2 Industry outreach and prototyping metrics

The Terra-i+ team interviewed representatives from 12 coffee companies operating in Vietnam to assess their level of interest as potential users, and shortlist the top 3 most important Terra-i+ metrics from an initial list of 18 potential metrics.

We conducted in-depth user research with two primary users, co-creating and prototyping the Terra-i+ metrics in an iterative process with them over 2 years.



## 3 Implementing webtool metrics at jurisdiction and farm level

By intersecting deforestation with the relevant land cover and shade cover, the system created metrics that identifies hotspots of coffee driven deforestation; risks of non-compliance with EUDR; future climate risks; water risks; shade tree coverage; carbon gain potential.

These metrics were implemented into webtool to be analyzed at jurisdiction level, as well as at farm polygon level.



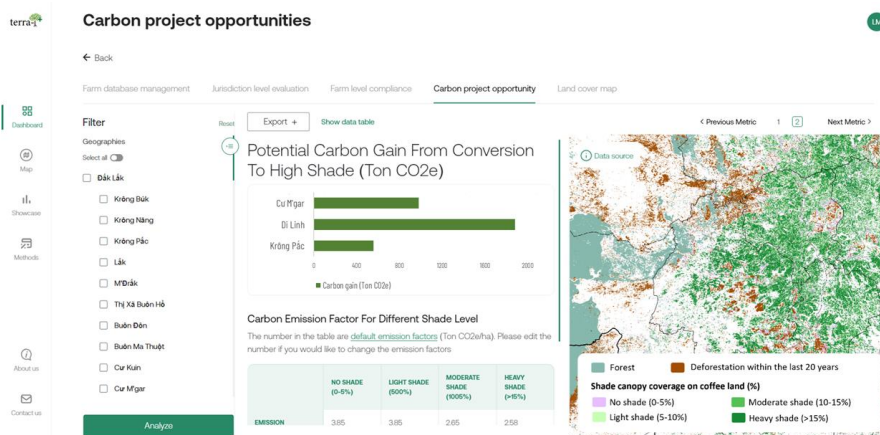
# Results

I. Terra-i+ contributes to closing the geospatial data gap in the coffee industry by producing the following high resolution datasets:

- ✓ Land cover map with >82% accuracy for coffee, agroforestry, tree crops and forests
- ✓ Deforestation events updated every 12 days
- ✓ Climate suitability for coffee until 2030
- ✓ Shade trees and visible soil coverage in 2020

II. Terra-i+ lowers the capacity barrier to use geospatial data by extracting and summarizing the key information from these data layers to make a simple-to-use platform for agribusinesses.

III. Until 2030, Terra-i+ will have enabled the sequestration of **at least 4375 tonnes CO2 equivalent<sup>1</sup>** above-ground biomass. This is achieved through the planting of more than 150,000 trees in the coffee agroforestry project of Terra-i+ first registered industry user, ECOM SMS Vietnam.



<sup>1</sup>Assuming newly planted trees mortality rate of 44% (Banin et al, 2022). The calculation reflects the most conservative scenario, as it was calculated based on the species with the lowest wood density among the list of species grown by the project (Soursop - Annona muricata). Above ground carbon estimation method is based on the study by Chave et al (2014).

### Reference:

Banin, L. F., Raine, E. H., Rowland, L. M., Chazdon, R. L., Smith, S. W., Rahman, N. E. B., ... Burslem, D. F. (2022). The road to recovery: a synthesis of outcomes from ecosystem restoration in tropical and sub-tropical Asian forests. *Philosophical Transactions of the Royal Society B*, 378(1867), 20210090. doi:10.1098/rstb.2021.0090

Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E. N., Colgan, M. S., Delitti, W. B. C., ... & Vieilledent, G. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. *Global Change Biology*, 20(10), 3177-3190. https://doi.org/10.1111/gcb.12629

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