Assessment of deforestation and forest degradation and related direct drivers using SEPAL

Final Report

March, 2025

TABLE OF CONTENTS

Executive summary IV
1. Project Overview 6
1.1 Project Profile 6
List of Abbreviations 6
Key project information 7
2. Summary of progress 8
3. Key Challenges 8
4. Performance evaluation of the project 11
5. Project Results 16
Socio-economic surveys 20
6. Communications and Visibility 23
7. Financial execution 32

EXECUTIVE SUMMARY

Deforestation and forest degradation are complex, transboundary and intricate processes that have many direct and underlying causes. A good understanding of forest conversion to other land uses and anthropic activities leading to forest disturbances is instrumental for the development of policies and actions aiming to reduce the loss of forests and its associated carbon emission. A better understanding of recurring patterns and correlations can therefore help countries tailor their efforts towards reducing forest loss.

In the recent years, access to a wealth of public datasets and satellite imagery resources, together with the exponential development of online tools and mobile applications to process this data have significantly changed the way land cover and land uses changes are assessed and monitored. However, these data and methods are still targeting specialist and expert end-users and need to be made available to a broader audience, in particular at various government levels.

Agriculture is estimated to be responsible for around 70-80% of the worldwide deforestation and in Africa, it is estimated that 84% of forest disturbance area (both as deforestation and degradation) is due to small-scale, non-mechanized forest clearing for agriculture. However, these global and regional estimations are based on the current global scientific literature with data acquired up to 2015 only, excluding the recent upward trend observed in tree cover loss. They also tend to omit the role played by degradation induced by forest exploitation, timber extraction and other commercial activities. Finally, there are growing signs of increasing pressure to Congo Basin forests, including mineral extraction, road development, agribusiness, commercial logging and biofuels, in addition to the traditional subsistence agricultural expansion and charcoal collection.

The difficulty in handling cloud-computing tools to analyse the numerous global datasets, the trends in forest disturbances, the need for updated studies and the lack of historical national perspectives result in the absence of a consensus on the main direct drivers and agents of deforestation and forest degradation in the Central African region.

In this context, FAO has developed a global, standard, large-scale methodology to assess forest dynamics using cloud-computing solutions and open-source tools to map disturbances and quantify direct drivers of deforestation and forest degradation. The methodology has been tested to assess deforestation and forest degradation trends and their associated current and historical direct drivers in six Central Africa countries. The project builds on a collaborative approach, in which national experts, global research institutes and civil society will work together and join resources and data to provide technical evidence and reach a common view on the direct drivers of forest disturbances.

The planned project outputs are: an agreed methodology to assess the direct drivers of deforestation and degradation, a forest change map, a quantification of the direct drivers, a geospatial module to inform land use planning, and knowledge and outreach materials to disseminate results and lessons learned.

The project applies state-of-the-art global tools and expertise; it includes a capacity development focus; it builds on using free and open-source solutions for Earth observation.

The proposed methodology benefits from powerful processing global tools available through public cloud-computing platforms to generate geospatial products of deforestation, forest degradation and associated direct drivers (maps, sampling-based schemes). The program has collaborated with national and international partners in each country on the assessment, design and played a significant role in the spatial analysis of direct drivers, providing useful data on co-located land cover and land use activities (commercial logging, mining, agribusiness, infrastructures but also protected areas or community forestry).

Gallery forests under pressure in Democratic Republic of the Congo

1. PROJECT OVERVIEW

1.1 PROJECT PROFILE

Title of the project :	Assessment of deforestation and forest degradation and related direct drivers using SEPAL
MPTF project reference :[2]	UNJP/GLO/103/UNJ
Implementing agency :	FAO
Report submitted by:	Name : Tiina Vähänen Title : Deputy Director, NFO Organisation : FAO email : tiina.vahanen@fao.org
Contact in case of need of clarification :	Name : Rémi d'Annunzio Title : Forestry Officer Organisation : FAO email : remi.dannunzio@fao.org

Was this report approved by the steering committee: NO

LIST OF ABBREVIATIONS

COTECH – technical committee

COPIL – Steering committee

DIAF – Division des Inventaires et Aménagement Forestiers (RDC)

MINFOF – Ministère des Forêts et de la Faune (Cameroon)

SBAE – Sample Based Area Estimation

SEPAL - System for earth observation, data access, processing, analysis for land monitoring

KEY PROJECT INFORMATION

Project Title :	Estimation de la déforestation et de la dégradation des forêts et des facteurs directs actuels et historiques associés à ces processus à l'aide de SEPAL
Numéro de référence MPTF du projet	UNJP/GLO/103/UNJ
Hyperlien du document de projet[1]	https://drive.google.com/drive/folders/1x2xgnfTXg0AdY7l6yiy6oiR8xaFsn8HQ?usp=drive_link
Zone(s) d'intervention(s) du projet	Cameroun, Guinée Equatoriale, Gabon, République Centrafricaine, République du Congo, République Démocratique du Congo
Institutions ou ministères de tutelle	
Organisations partenaires participantes de niveau 1 [2]	FAO
Budget total du projet (USD)	2,442,000
Durée totale du projet (mois)	33 months
Date d'approbation du projet par le Conseil d'administration de CAFI ou le Comité de pilotage du FONAREDD	23.06.2020
Date de réception des premiers fonds du MPTF	27.08.2020
Date d'approbation du 1er Plan de Travail Budgétisé Annuel par le comité de pilotage du projet	23.06.2020
Date de clôture initiale	22.02.2020
Date de clôture révisée le cas échéant	30.03.2025
Dépenses du 01/01 au 31/6 de l'année de rapportage	
Dépenses globales cumulatives (USD) au 31/12 de l'année de rapportage	2,435,187
Taux de consommation sur l'ensemble des tranches reçues	99.7%
Date et lien de l'évaluation à mi-parcours le cas échéant	Click or tap to enter a date. Insérer hyperlien si l'évaluation est publique

[1] L'ensemble des documents de projet se trouve sur le Drive CAFI https://drive.google.com/drive/folders/1RhAT_Hc5jycgw40xr7YZM57jV4zQFadQ. Sélectionner Country documents / Le pays ou regional / programming / active portfolio / numéro et nom du projet

[2] Il s'agit des organisations qui ont reçu un financement direct du Bureau MPTF dans le cadre du projet.

2. SUMMARY OF PROGRESS

Summary of progress 2024	Cumulative results since the beginning of the project
Forest management and governance is improved thanks to the application of global knowledge to mitigate climate change, with a focus on reducing poverty and contributing to sustainable development.	
Impact indicator 1 : Outcome: Standardized methodology agreed, tested and applied to assess the trends of deforestation and forest degradation and quantify current and historical direct drivers using cloud-computing solutions and free and open-source tools for forest monitoring	
▪ The creation of a public FAO project website and SEPAL documentation for the methodological approach in three languages; ▪ ensemble Sample Based Area Estimates (sSBAE) approach to estimating area and confidence intervals of deforestation and degradation, with customized approaches for the CAFI region; ▪ Capacity development with online webinar series in French and Spanish ▪ Peer-reviewed scientific publication on the drivers analysis and webinar; ▪ Interactive Story Map in English, French and Spanish summarizing methods and results from second phase of the project (2015-2023) ▪ Socio-economic data collection in two pilot sites ; ▪ Publication of a peer-reviewed literature review paper on the methodological approaches and analytical scales of deforestation drivers studies ▪ TNT (Tree/Not Tree) approach developed to update area estimates for 2023 – with methodological guidance document ▪ Area estimation workshop and templates for automatic calculations and statistics from sample based area estimation ▪ Regional workshop and Side Event at CBFP MoP 20 ▪ Regional workshop on emissions calculation with template sheet for automatic calculations based on IPCC Tier 1 data (Tier 2 can be added when available)	▪ Design and pilot of a new global methodology to assess forest cover change over time, and the associated direct drivers using an ensemble analysis approach ; ▪ Development of a robust approach to visually interpret deforestation, degradation and associated drivers using open-source tools (Collect Earth Online) ; ▪ Development of a comprehensive, regularly updated online database with data available for download ; ▪ Dissemination of the methodology, results, accessible data and bibliography online ; ▪ Sharing of regional data and methods for use in other applications and landscapes (ECOWAS); ▪ Design of a replicable methodology to collect relevant socio-economic information and perspectives through discussion group and household surveys ; ▪ Development of a machine learning model to identify risk of degradation and deforestation from direct drivers (for input into GEO4LUP land use planning support) ▪ Area estimates of deforestation and degradation for 2015-2023 for all countries via automated Google Sheets ▪ Interactive dashboard of area estimates with comparisons to global products ▪ Drivers assessment for 2015-2023 for all countries ▪ Emissions calculations from area estimates for all countries

3. KEY CHALLENGES

3.1. Challenges at national level

The main issues facing the project implementation at the national level are summarized by country.

Gabon: the project in Gabon was mainly affected by the lack of clarity regarding the national consultant. After the first consultant left her post at the end of her contract and did not wish to return, vacancy announcement was posted, but there were insufficient candidates with the minimum requirements to meet

the internal criteria to establish a full-time contract. Thus, the selected candidate was limited to 100-day contracts, which did not provide the level of support needed for the project. It was then determined to include the consultant staff costs in the LOA with AGEOS – but at the last minute AGEOS refused this amendment. Thus, only the activities limited to the scope of LOA could be conducted, with minimal direct support or staff in the FAO office in Libreville.

Central African Republic: there was long period of communication with the Ministère des Eaux, Forêts, Chasse et Pêche concerning the control of the management of funds in each Ministry. The country has put in place a lengthy process to obtain the required documentation needed to open a dedicated bank account to receive funds, which is a requirement for FAO LOAs. This was further hindered by the bank's complicated and bureaucratic processes, which severely delayed the signature of the only LOA in CAR. This limited the activities in the country, and in addition to security and logistical issues, the collection of socio-economic data in Bangassou was not possible.

DRC: there were constant difficulties in working with the DIAF which included inconsistent participation and presence or refusal to collaborate. Ultimately, they placed undue pressure to have an LOA with a very short validity period of 1 month. This was in part due to a project extension that was not yet formally approved but as a result, the activities within the timeline were completely realistic; and after the end of the LOA DIAF did not contribute to any other work packages – although they seem very interested in using the project methods to update their national emissions reference level.

Congo: The SNYA-MNV project was established in parallel to the CAFI DDD project and provided advanced support and expertise for providing robust results. However, we could not influence the timelines of their activities, and some of their requirements and objectives differed from the regional activities. This meant that some data were collected with slightly different approaches and were not directly comparable in terms of the time period of the analysis, and differences in the drivers assessment.

Equatorial Guinea: There were actually few issues confronted in Equatorial Guinea – a small country with an efficient national FAO office made for simple and straightforward administrative processes. The enthusiasm and commitment of INDEFOR meant that the country led all others in the work packages. The only challenges are known issues of decentralized institutions on the mainland and persistent problems with internet connectivity.

Cameroon: A ministerial turnover changed the active and engaged focal points which created issues for continuity. It took time for replacements to be identified, and the engagement process had to start anew, along with the recruitment of a new national consultant to accompany the process. FAO Cameroun prepared background materials and information on the project to share with MINFOF and actively sought meetings and collaboration but the process was slow. This was later hindered by MINFOF requesting to change the legal language in the standard FAO LOA draft which requires a long clearance and approval process. However, once the focal point was identified and positively engaged, the national activities were condensed into a short timeline and were still underway the last week of March.

3.2 Challenges inherent to the project

The main issues with the project set up and implementation included the LOA processes of FAO, which are recognized as bureaucratic, slow, inflexible and problematic for long term partnership with national institutions. Feedback on these issues have been raised at FAO but there is unfortunately no alternative, transparent method to directly engage with partners in country.

The program extensions were also issues as they took their time and came a bit too late to keep the activities running smoothly. The first extension required re-hiring of all the national consultants, which took several months of effort during which no analysis or scientific activities could be conducted - which necessitated a second extension. When the DRC consultant left during the first pause, and a lengthy hiring process followed, which took so long that the consultant was ultimately only onboard for 4 months. Without national consultants, the engagement with the national institutions were limited, and compounded by turnover of focal points, and inconsistent interest and commitment from some national institutions.

The evolution of data, algorithms and approaches which ultimately proved successful and necessary – were a significant hurdle through the project. The pivots in approaches were necessary to respond to the increasing interest and importance of the accurate estimation of annual forest cover change – which in the original program document were simply a step in the process to assess drivers. But with the objective of developing innovative and state-of-the-art tools which can be replicated elsewhere, there is a downside in that methods -and results- are constantly evolving. The CAFI project presented an invaluable opportunity to test and massively scale up methods over an enormous study area, testing the limits of processing capacities. This helped FAO learn a great deal however, and helped refine and improve the processing steps. But for the project it often meant discovering processing bugs and issues which had to be addressed and updated as they were being implemented. The evolution of methods produced different estimates for change for the 2015-2020 time period. The differences in approaches and the impacts on the estimates were reviewed in this technical note.

Finally, all these approaches for area estimation require a substantial amount of validation for statistical robustness which can only be achieved through tedious visual interpretation. In order to meet the expected accuracy targets, a significant amount of validation data needs to be produced, and the project recognized how monotonous and time consuming this process is. The visual interpretation approach validates data specifically for the study region and for the specific time period considered, but it is a constant challenge to engage the partners to conduct this assessment, and when undertaken over long time periods the quality of data decreases with user fatigue. The expected solutions include advocating for larger confidence intervals or lower accuracy to manage expectations and to use model-assisted approaches to reduce the dependency on potentially flawed visual interpreted data.

3.3. Comments

Overall, an extremely ambitious scope and extent of the project in multiple countries proved challenging. Ultimately, a 3-4 year project with ample time for institutional set-up would have been an improvement over a short project with multiple extensions.

4. PERFORMANCE EVALUATION OF THE PROJECT

4.1 Assessment of project performance based on logical framework indicators

		Targets		Results					
Products	**Indicators**	**Baseline**	**Target**	**Status for the reporting period**	**2021**	**2022**	**2023**	**Final**	**Comments**
Output 1. Standardized methodology agreed, tested and applied to assess the trends of deforestation and forest degradation and quantify current and historical direct drivers using cloud-computing solutions and free and open-source tools for forest monitoring	methodology agreed on to produce information on direct drivers	0 methods	1 piloted method	100%	50	75	100	100	An improved methodology was developed in 2023 and fully documented here.
	Systematized information available to facilitate strategic planning and decision making of institutions	0 information available	Methods readily available	100%	25	50	75	100	Project websites, data page, updated story map, GitHub, interactive maps and data
Output 2. Forest Change Map 2015-2023	Number of dense time series processed by administrations and institutions to monitor forest changes between 2015 and 2023	0	6	6	6	6	6	6	Time series have been re-processed every year for new time periods and with new methods
	Percentage of women actively participating in each national working session	0	30%	30%	32%	32%	32%	30%	Gender ratio is 40% in core project team (chief technical advisor and 4 national consultants); COTECH gender ratio was generally around 30%

	A forest change map (2015-2023) produced by each recipient country	0	100%	50%	50%	75%	100%	100%	Statistically robust estimates of change using SBAE have been produced for each country based on sample estimation. These are alternatives to producing maps, although probabilities of forest change have been mapped for all six countries.
Output 3. Current and historical direct drivers of deforestation and forest degradation in Central Africa identified, quantified, discussed and agreed on with the different partners	Number of sets of Standard operating procedures (SOP) ensuring the quality of the assessments of forest changes and direct drivers of deforestation and forest degradation developed by national administrations and institutions	0	6	6	6	6	6	6	The methodology has been developed and consistently applied throughout the project in all six countries
	Percentage of women actively participating in each national working session	0	>30%	40%	32%	32%	32%	32%	for the technical teams, there is a 50% gender ratio in DRC; 25% in Gabon
	A report on forest changes and current and historical direct drivers of deforestation and degradation is published and validated by each member of the Technical Committee	0	2	1	0	1	1	2	1 peer-reviewed article in prep, and 1 draft FAO white paper
Output 4. Geospatial module to inform land use planning developed in SEPAL and tested in two pilot areas	Indicator 4.1: Number of socio-economic field surveys conducted in the pilot areas to collect additional information to that provided by technical partners	0	6	7	0	2	0	7	Socio-economic data was collected in a total of 7 pilot sites in 5 countries.

	Indicator 4.2: Percentage of women actively participating in each team in charge of a field survey	0	>30%	33%	0	30%	32%	33%	Gender ratio was 50% in Gabon; data being compiled for other countries
	Indicator 4.3: A module in SEPAL (Geo4LUP) generating geospatial information to support land use planning is developed and tested in the pilot areas	0	2 desk studies	2	0	0	2	2	a peer-reviewed manuscript was developed applying the model to 2 trans-boundary landscapes in the study region; an online assessment and planning tool in EarthMap being developed for the CAFI region
	Indicator 4.4: Number of assessments of the impacts of past land use policies and plans using Geo4LUP conducted	0	2 (at least 1 per pilot zone)	0	0	0	0	0	Past policies were not consistently available or in enough detail for analysis within pilot sites
Output 5. Project results and lessons learnt disseminated for global knowledge, and potential for scaling up at global level defined	Indicator 5.1: Number of regional consultations where the multi-stakeholder audience will receive additional information on the use of spatial data in the process of designing land use planning	0	At least 1	2	0	0	2	2	CAFI DDD data and methods shared being shared with Cameroun stakeholders (multiple ministries and NGOs) in the context of cocoa sector EUDR readiness. Approaches and data also being used for the new INFORBIO project with WWF-Germany
	Indicator 5.2: Number of presentations of the project's outputs in fora and in Global and South-South exchanges	0	>3	7	3	5	3	18	Innovation and Climate talk about TU Delft; GFOI, CBFP MoP
	Indicator 5.3: Number of knowledge materials presenting the projects findings, results and best practices published	0	>6	2	0	2	5	6	Story Map updated with final results; 3 peer-reviewed publications in prep; 1 FAO Report and Tableau Dashboards

	Indicator 5.4: Percentage of best practice case studies focusing on achievements of women published	0	>1	0.75	0	0	0.5	0.75	There is a draft case study featuring Josefina from Equatorial Guinea that is in prep but not yet published

4.2 Progress in implementing project activities for the reporting period

Implemented Activity	**Product**	**Target**	**Expected time period for the activity**	**Target achieved**	**Status at the end of the reporting period**	**Progress or challenges expected**
1. Methodology and institutional setup	1.1	Signed LOAs with each country	**From** Jan, 2024 -Mar, 2025	LOAs with DRC,EQG,GAB, CMR, CAR	100%	Unwillingness of ministries to undertake the necessary steps to sign LOAs
2. Forest Change Map	2.1	Time series analysis 2015-2022	**From** Jan, 2024-Dec, 2024	TNT processed for all countries	100%	A revised methodology has been developed and documented
	2.2	Land use map for 2023	**From** Jan,2024-Dec, 2024	Mosaics and training data prepared	50%	Not all countries were able to complete accurate maps for 2023 (CAR, DRC, GAB)
	2.3	Time series analysis for 2023	**From** Jan,2024-Dec, 2024	SEPAL scripts developed	100%	Probability change maps developed for each country
	2.4	National change statistics (2015-2023)	**From** Jan,2024-Dec, 2024	Estimates derived for all countries	100%	Area calculations are online. All countries have conducted validation workshops.
3. Drivers and data analysis	3,1	Design of a sampling system for calibration and validation	**From** Jan,2024-Dec, 2024	samples extracted and validated for all countries	100%	Random samples of validation data have been re-evaluated

	3.2	Production of calibration/validation of direct drivers and disturbances	**From** Jan, 2024 -Jun, 2024	Samples validated in DRC, COG, GAB, EQG, CAR, CMR	100%	Over 54,000 points evaluated throughout the project
4. Geospatial module to inform land use planning developed in SEPAL and tested in two pilot areas	4.1	Sites selected and LOAs with partners	**From** Jan,2024-Dec, 2024	Updated survey tools integrating feedback available in Open Foris Arena	100%	Tools and technical guides complete. Data collected in Gabon, Congo, DRC, EQG. Survey approaches being implemented in West Africa.
	4.2	Data Collection	**From** Jan, 2024 -Mar, 2025	Data collected in 5 more pilot sites	120%	Finalization of methodology, tools and technical guidelines, data collection, analysis and peer review publications
5. Project results and lessons learnt disseminated for global knowledge, and potential for scaling up at global level defined	5.1	Diffusion of results and trainings	**From** Jan, 2024 -Jun, 2024	Webinars, trainings, COTECH, Google Classroom	100%	Methodological guidance document complete
	5.4	Knowledge management, data portal and online products	**From** Jan, 2024 -Jun, 2024	Website, story map, infographics, database, SEPAL docs, GitHub	100%	Data page, Story Map updated (same link),new tableau Dashboards, GitHub

5. PROJECT RESULTS

The regional land cover defined by the project technical committee using the Land Cover Classification System and used in all mapping and visual interpretation has been published in the FAO Land Cover Legend Registry for future applications in the region.

Map products

Table 1. Regional classification scheme. Classes and descriptions are also accessible online

Code DDD	FNF	Nom	Nom Espanol	Name English	Description
1	Forêt	Forêt Dense	Bosque denso	Dense Forest	Forêt dense humide primaire sur terre ferme, >60% arborée
2	Forêt	Forêt Dense Sèche	Bosque denso seco	Dense Dry Forest	Forêt dense, >60% couverture arborée avec des saisons sèches
3	Forêt	Forêt Secondaire	Bosque secundario	Secondary Forest	Forêt ouvert 30-60% couverture arborée, dégradée ou secondaire
4	Forêt	Forêt Claire Sèche	Bosque claro Seco	Dry Open Forest	Forêt claire sèche 30-60% couverture arborée, avec des saisons sèches
5	Forêt	Forêt Sub-Montagnarde	Bosque sub-montañoso	Sub-Montane Forest	Forêt >30% de couverture arborée, 1100-1750m en altitude
6	Forêt	Forêt Montagnarde	Bosque montañoso	Montane Forest	Forêt >30% de couverture arborée, >1750m en altitude
7	Forêt	Mangrove	Manglar	Mangrove	Forêt >30% de couverture arborée, sol hydromorphe
8	Forêt	Forêt Marécageuse	Bosque pantanoso	Swamp Forest	Forêt marécageuse mixte >30% couverture arborée, sol inondée >9 mois
9	Forêt	Forêt Galérie	Bosque en galería	Gallery Forest	Foret ripicole en fond de vallée ou en bordure de rivière
10	Forêt	Plantation Forestière Mature	Plantación forestal madura	Mature Forest Plantation	Couverture arborée >15% végétation cultivée/gérée
11	Forêt	Savane Arborée	Sabana arbórea	Woodland Savanna	Savane boisée 15-30% arboré
12	Non-Forêt	Savane Arbustive	Sabana arbustiva	Shrubland Savanna	Savane >15% arbustive
13	Non-Forêt	Savane Herbacée	Sabana herbácea	Grassland Savanna	Savanne herbacée <15% arbustive ou arborée
14	Non-Forêt	Prairie Aquatique	Pradera acuática	Aquatic Grassland	Couverture herbacée aquatique ou régulièrement inondée
15	Non-Forêt	Sols Nus - Végétation Éparse	Suelo desnudo-Vegetación escasa	Bare Land and Sparse Vegetation	<15% végétation
16	Non-Forêt	Terres Cultivées	Tierras cultivadas	Cultivated Areas	Couverture arbustive cultivée >15% arbustif/herbacée/arborée
17	Non-Forêt	Zones Bâties	Zonas edifiadas	Built-up Areas	Présence humaine
18	Non-Forêt	Eau	Agua	Water	Eau > 50%

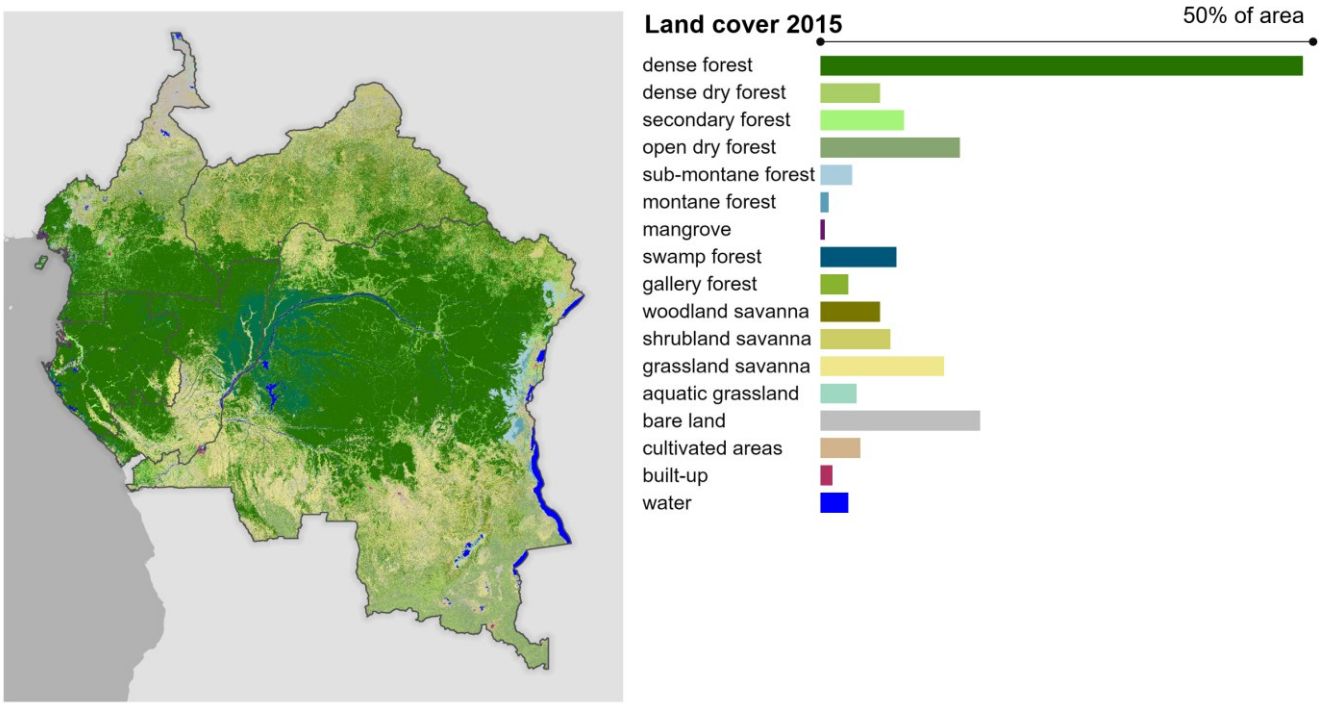

Figure 1. Regional land cover map for the study area, 2015

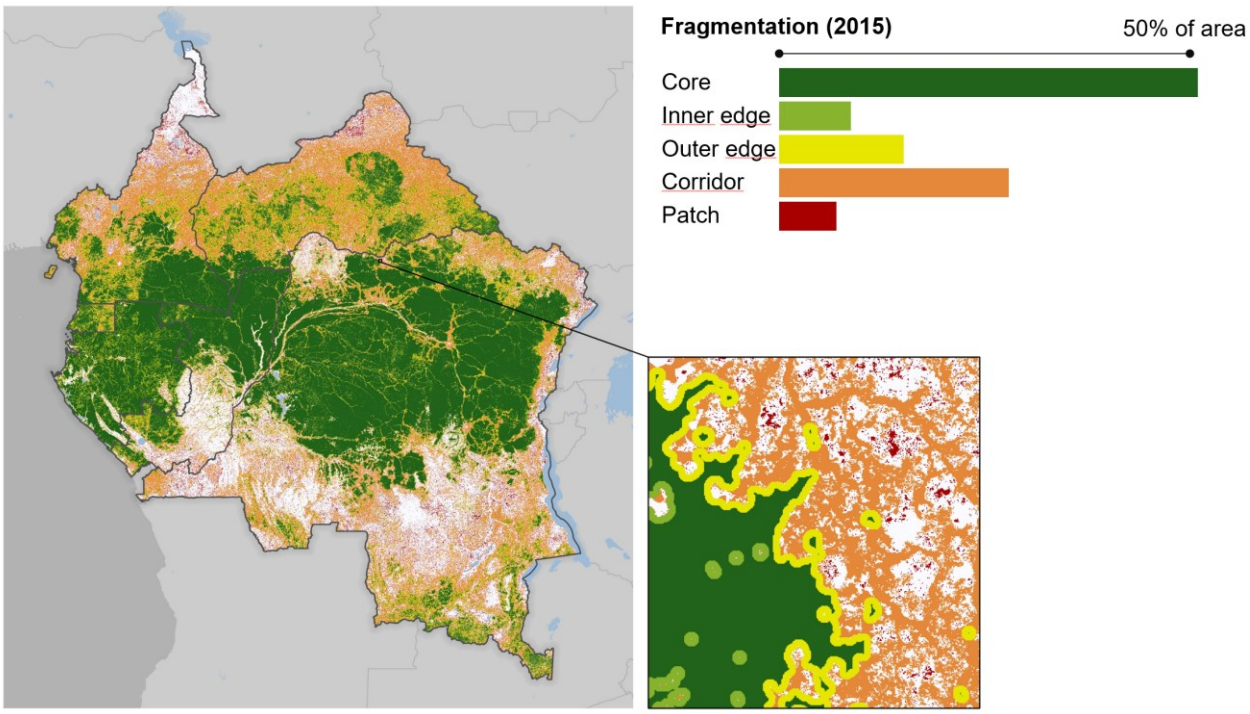

Figure 2.Forest fragmentation assessment for the study area, 2015.

All datasets produced by the project are available on the data page: https://congo.dddafrica.info/ as well as in this interactive map: https://faocongo.users.earthengine.app/view/cafi-data

All scripts and codes are accessible and can be cloned and run from the GitHub page: https://github.com/aurelgrooves/CAFI_DDD

Forest Change Estimates

Annual estimates of change were assessed at national and sub-national levels for all countries using sample-based area estimation from statistically sampled points. Google sheets with integrated calculations automatically extract estimates and calculate confidence intervals at national scale, sub-administrative level and forest type.

Figure 3. Sample-based area estimates of annual change for CAFI study countries 2015-2023. The dashboard is accessible here.

Using the reference land cover data from the interpreted points, we can estimate the proportion of changes coming from each forest type.

Figure 4. Changes by forest type over the study period. Dashboard and data available here.

Figure 5. Comparison of annual estimates generated by the project, and readily available global datasets. The different shades of blue represent the six countries of the study. Dashboard and data available here.

The area estimates were compared with global datasets (which do not have any systematic validation) and estimates are generally below Global Forest Change estimates, as expected, and greater than areas detected by the Tropical Moist Forests (TMF) product which only covers the tropical moist forest ecoregion.

Greenhouse Gas Emissions

The methodological guide has compiled the approach implemented by the project in a complete manner. It explains each step in the process of estimating deforestation and degradation using best practices and is now an accepted approach for National Emissions Reference Levels. The approach has been used by the Republic of Congo in their latest submissions and all six countries of the study area have understood and are able to replicate the approach. This means that all six countries are in a good position to update their reference levels as needed, in particular Cameroun and DRC. Although it should be noted that CMR and DRC do not have recently updated emissions factors.

The project designed an automated Google Sheet, similar to the SBAE estimates to calculate emissions, based on the FAO EX-ACT greenhouse has accounting tool, which can use Tier 1 (global) biomass estimates and emissions factors with high uncertainties, or more specific tier 2 data where available. For EQG, COG, GAB the emissions factors from their previous reference levels were used. For other countries, above and below ground estimates were calculated from ESA Biomass data. Individual tables and summary table are available here.

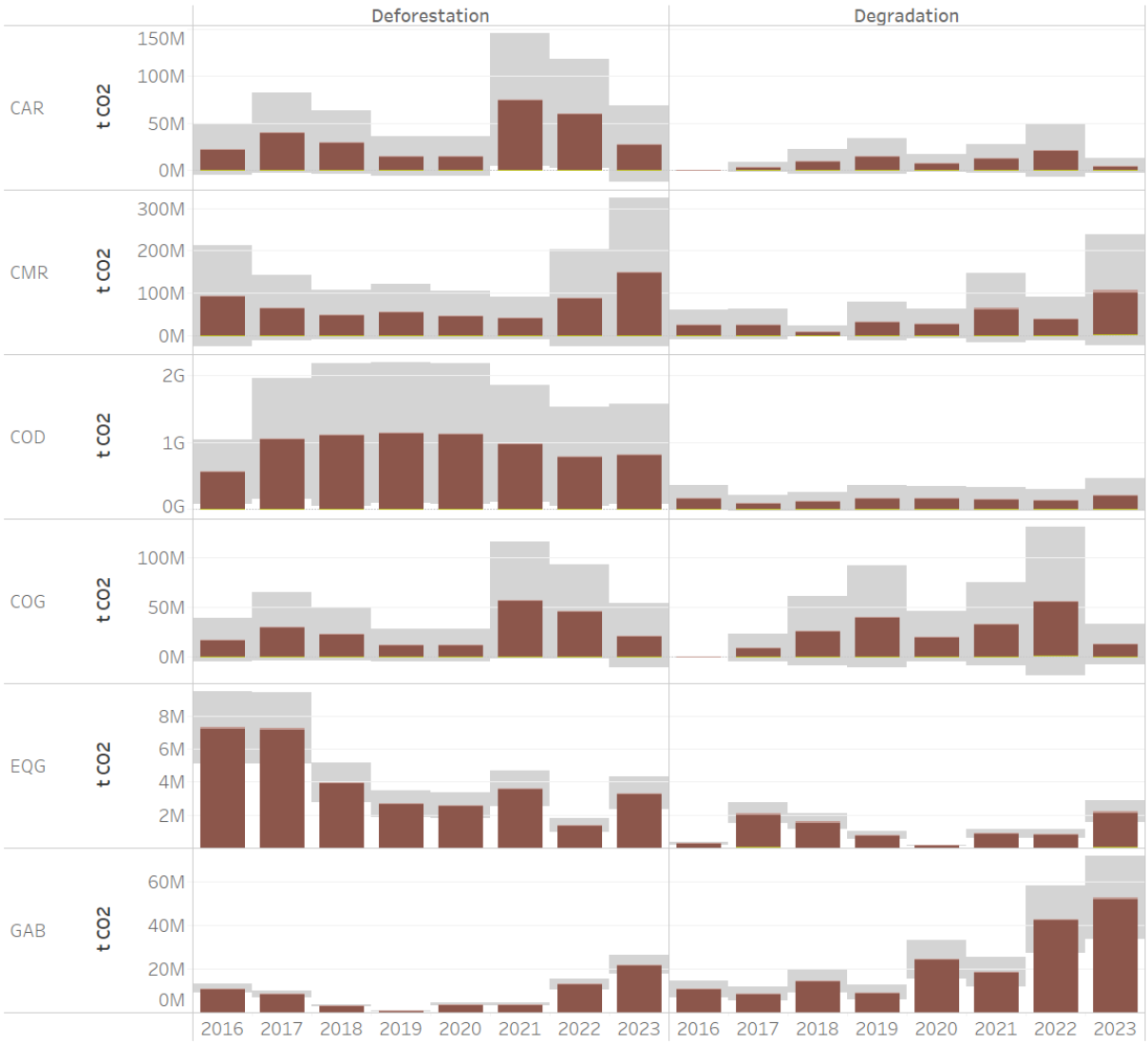

Figure 6. Annual greenhouse gas emissions calculated per country, with uncertainties. Dashboard and data available here.

Socio-economic surveys

Two campaigns to collect information from local communities on perspectives on deforestation and degradation drivers were conducted. First, in 2022 to develop and pilot the methods. Then, the methods were applied in the selected landscapes in 4 more countries in Central Africa, and seven countries in West Africa for a parallel project on drivers.

Table 2. Six pilot sites were selected by the project and approved by the Steering Committee. Some countries were able to collect data in two pilot sites.

COUNTRY	LANDSCAPE NAME	DESCRIPTION OF DRIVERS
Cameroun	Dja	Agro-industry and infrastructure that connects deforestation fronts and development of rubber plantations
Democratic Republic of the Congo	Sud Kivu/Mwenga	A long history of armed conflict, refugee flows, urbanization, shifting agriculture and conflicts over natural resources

Democratic Republic of the Congo	Tshopo Territoire de Isangi	Small scale agriculture, cocoa plantations, fishing activities, timber to supply Kisangani and cross border demand
Central African Republic	Bangassou	Mining concessions and small-scale agriculture, lack of land-use planning, heavily deforested. Very degraded and little studied ecosystems. Unfortunately, logistics and security prevented data collection in this landscape.
Equatorial Guinea	Rio Campo	New road development and transboundary conservation area with Campo Ma'an, Cameroun
Gabon	Ivindo	Local and industrial activities, mining and forestry concessions in a cross-border zone
Gabon	Zadie	Congo cross-border zone, increase in mining and forestry activities and agriculture

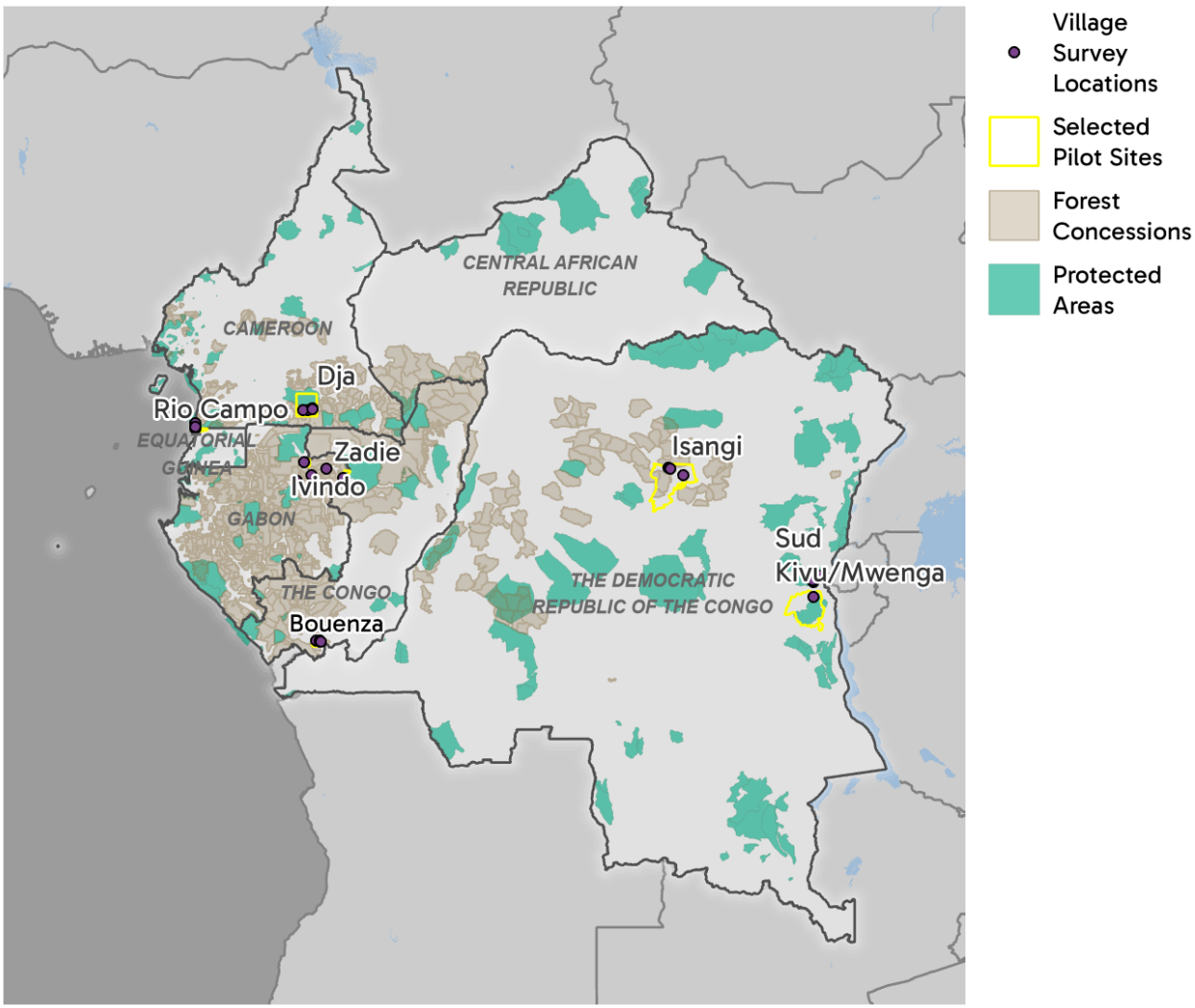

Figure 7. Locations of all socio-economic data collection in the selected landscapes in five countries of Central Africa.

Table 3. Summary of data collection in Cameroon & DRC in 2022

Country	Village name	No. of Household surveys	No. of village surveys	No. of FGDs		No. of participatory maps	
				Male	Female	Male	Female
Cameroon	Mbouma	18	1	1	1	1	1
	Zoebefam	31	1	1	1	1	1
	Bi	18	1	1	1	1	1
	Assok	18	1	1	1	1	1
	Total	**85**	**4**	**4**	**4**	**4**	**4**
DRC	Buyungule	34	1	1	1	1	1
	Kikogo	20	1	1	1	1	1
	Total	**54**	**2**	**2**	**2**	**2**	**2**
GRAND	**TOTAL**	**139**	**6**	**6**	**6**	**6**	**6**

Table 4. Summary of data collection in Central African countries, 2024-2025 (data from Equatorial Guinea and Republic of Congo still in analysis phase)

Country	Village name	No. of Household surveys	No. of village surveys	No. of FGDs (including participatory mapping exercises)		
				Male	Female	Mixed
Gabon Site 1	Mayibouth	31	1	0	1	1
	Ntsenkele	30	1	1	1	0
	Nze vatican	30	1	1	1	0
	Sub-Total	**91**	**3**	**2**	**3**	**1**
Gabon Site 2	Ekata	30	1	1	1	0
	Ntolo	30	1	1	1	0
	Zamba kangaka	30	1	1	1	0
	Sub-Total	**90**	**3**	**3**	**3**	**0**
EQG	*tbd*	30	*tbd*	*tbd*	*tbd*	*tbd*
	tbd	30	*tbd*	*tbd*	*tbd*	*tbd*
	tbd	30	*tbd*	*tbd*	*tbd*	*tbd*
	Sub-Total	**90**	**3**	*tbd*	*tbd*	*tbd*
DRC Site 1 (Nindja)	Mushaka	36	1	1	1	0
	Kabuye	34	1	1	1	0
	Kabona	36	1	1	1	0
	Sub-Total	**106**	**3**	**3**	**3**	**0**
DRC Site 2 (Tshopo)	Nakarhwa	*tbd*	1	*tbd*	*tbd*	0
	Cikendje	*tbd*	1	*tbd*	*tbd*	0
	tbd	*tbd*	*tbd*	*tbd*	*tbd*	*tbd*
	Sub-Total	**105**	3	*tbd*	*tbd*	*tbd*
RoC	Kingoye-Modoko	*tbd*	*tbd*	*tbd*	*tbd*	*tbd*
	Kinsimba	*tbd*	*tbd*	*tbd*	*tbd*	*tbd*
	Mbinda	*tbd*	*tbd*	*tbd*	*tbd*	*tbd*
	Mayanama	*tbd*	*tbd*	*tbd*	*tbd*	*tbd*
GRAND	**TOTAL**	**482**	**15**	*tbd*	*tbd*	*tbd*

The report provided by AGEOS on the data collection in two sites is available here.
Two manuscripts outlining the methods and results of the socio-economic surveys are in preparation for publication.

6. COMMUNICATIONS AND VISIBILITY

6.1. Highlighted Narrative

An important event in the project was the presentation of the project approach and results at the CPFP Meeting of Parties #20 in Kinshasa, DRC. At this even we were able to convene all national consultants (with the exception of DRC – who had not been hired at that time) and focal points from all countries, with the exception of Congo, who joined remotely – overcoming several planning and logistical hurdles.

The side event was well attended was followed by a lively discussion –summarized in this report. This was a crucial opportunity to present the fundamental scientific components of this project: transparent, statistically validated, repeatable approaches for robust forest cover change estimation which has enabled six countries of Central Africa to simultaneously produce and report on area of deforestation and forest degradation. The important distinction of the CAFI project was repeatedly raised to the audience: that statistically robust area estimation is the only accurate approach to estimate areas, and that we cannot continue to rely on error prone global maps and pixels counts. This is important to counter the common, repeated narrative that seems not to be based on reliable data or trends, for example, from this post from November, 2022 :

“Authors of the first chapter of the [State of the Forests] report led by Juliette Dalimier indicate that there has been a significant increase in the annual rate of disturbance of the rainforest between 2015 and 2020”

Yet on page 16 of said report, the following figure is shown:

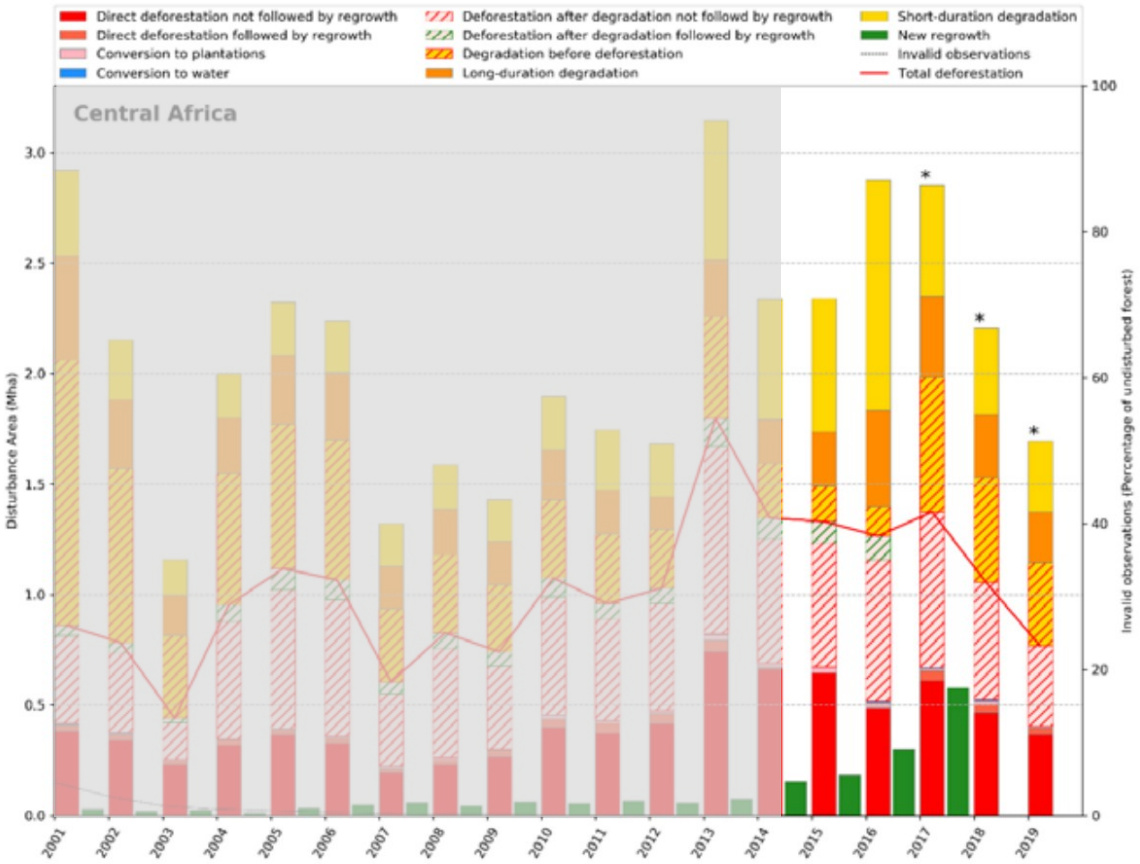

Figure 1.13: Annual change in deforestation (red bar) and degradation (yellow bar) in Central African tropical moist forests, 2001–2019.

Source: Vancutsem et al. 2020

Figure 8. From page 16 of the State of the Forests of the Congo Basin. The red line represents annual total deforestation.

Does this red line appear to be “significantly increasing?”

The Global Forest Watch estimates for the same time period are also shown below.

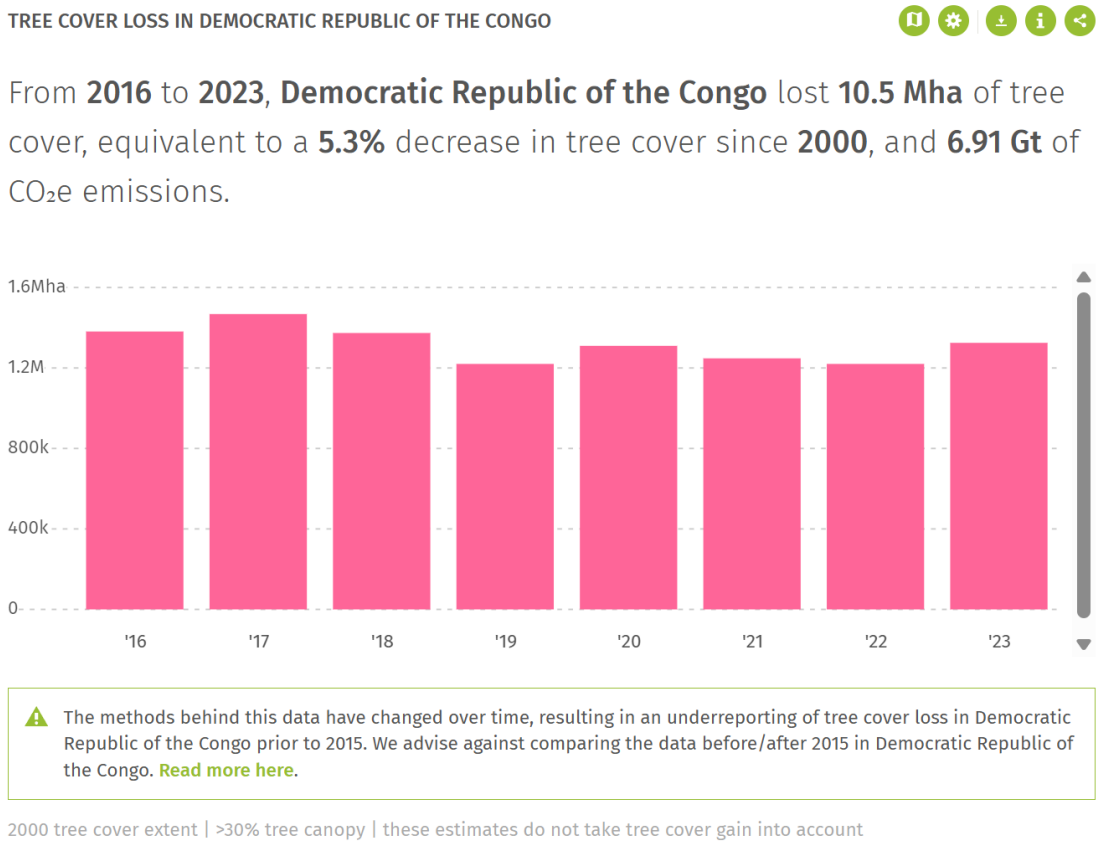

Figure 9. Global Forest Watch estimates from DRC for 2016-2023

Yet this negative message is still amplified in the news: "*Forests in the Democratic Republic of Congo (DRC) have been disappearing at increasing speed*." These interpretation of trends inspired the COTECH Kahoot! "Ça monte ou ça descend?" to discuss the caveats and best practices of interpretation of trends in visual diagrams.

It is debated that the area of forest loss in Central Africa is large and remains a staggering problem, fuelled by poor governance, population growth, lack of infrastructure and poverty. But for countries to engage, and be properly compensated for successful efforts in reducing emissions, or to be encouraged through payments for ecosystem services and international investments, a robust baseline developed with clear, statistically robust methods must be established. The CAFI DDD project used the CBFP as a relevant regional platform to promote this message and the importance of open, accessible, nationally developed transparent data for forest monitoring, and this will be the theme of a new peer-reviewed article in preparation showcasing the comparable methods executed in 6 countries of the Congo Basin.

Figure 10. Group photo from CBFP MoP #20 side event in Kinshasa

6.2. Communication plan and strategy

Name of project	CAFI DDD		
Start Date	01.01.2024	**End Date**	30.03.2025
Communication project objectives (how does this communication project fit in with overall objectives and strategy?) :	Promote and share program methodology and results		
Audience	**Result in terms of communication (including communication for social and behavioral change)**	**Link to communication tools (e.g. publications, workshops, radio spots, web pages)**	
Project Partners	Active Whatsapp groups (1 for each country) interacting on project results; sharing news and relevant initiatives and successes		
Public	Permanent FAO Drivers web page with links to the curated	Drivers FAO website FAO web story on trainings	

	project library, Story Map, Dashboards, interactive maps	
Public	A public summary of methods and results in three languages	Interactive Story Map
Scientific and research audience	Peer-reviewed publications; online and associated infographic, public webinar and FAO web story; online interactive dashboards; Area estimates tables for each country; Emissions estimates for each country	LinkedIn post on drivers article, webinar FAO web story Interactive infographic Tableau forest change dashboard Drivers Dashboard SBAE Google Sheets
SEPAL users and researchers	SEPAL documentation on the methodology in 3 languages and regularly updated scripts in Github.	SEPAL docs ; GitHub; CEO blog post
Public	Visibility on LinkedIn with references to CAFI project (Bluesky replaces Twitter)	https://www.linkedin.com/in/aurelie-shapiro/recent-activity/all/ with reposts by OpenForis account

The FAO drivers webpages in EN and FR are in the top ten most viewed pages on the FAO SEPAL website:

Page Views

	Page path + query string	Views	Total users	Views per active user
	Totals	5,275	2,034	2.59
1	/in-action/sepal/en	1,381	579	2.39
2	/in-action/sepal/activities/cocoa/en	591	327	1.81
3	/in-action/sepal/resources/certified-course/en	550	274	2.01
4	/in-action/sepal/activities/drivers/en	391	172	2.27
5	/in-action/sepal/activities/seplan/en	269	129	2.09
6	/in-action/sepal/es	177	76	2.33
7	/in-action/sepal/overview/sepal-a-powerful-open-source-platform-for-forest-and-land-monitoring/en	173	151	1.15
8	/in-action/sepal/overview/en	167	78	2.14
9	/in-action/sepal/resources/certified-course/es	159	92	1.73
10	/in-action/sepal/activities/drivers/fr	144	35	4.11

Figure 11. Page view ranking of FAO SEPAL website https://www.fao.org/in-action/sepal/en

FAO Drivers website (https://www.fao.org/in-action/sepal/activities/drivers/en) analytics are as follows:

	Country	Total users	Views
	Totals	226	596
1	Italy	38	133
2	Singapore	24	28
3	Germany	23	73
4	United States	22	36
5	France	14	23
6	United Kingdom	11	16
7	Congo - Kinshasa	9	34
8	Cameroon	8	20
9	Nigeria	6	8
10	Mozambique	5	8

Figure 12. Geographical distribution of page views.

	Page path + query string	Views	Total users	Views per active user
	Totals	594	226	2.63
1	/in-action/sepal/activities/drivers/en	412	183	2.25
2	/in-action/sepal/activities/drivers/fr	143	35	4.09
3	/in-action/sepal/activities/drivers/es	19	10	1.9

Figure 13. Page views of different translations of the drivres website.

Regular posts on LinkedIn, with reposts from Open Foris accounts has increased visibility of the CAFI project:

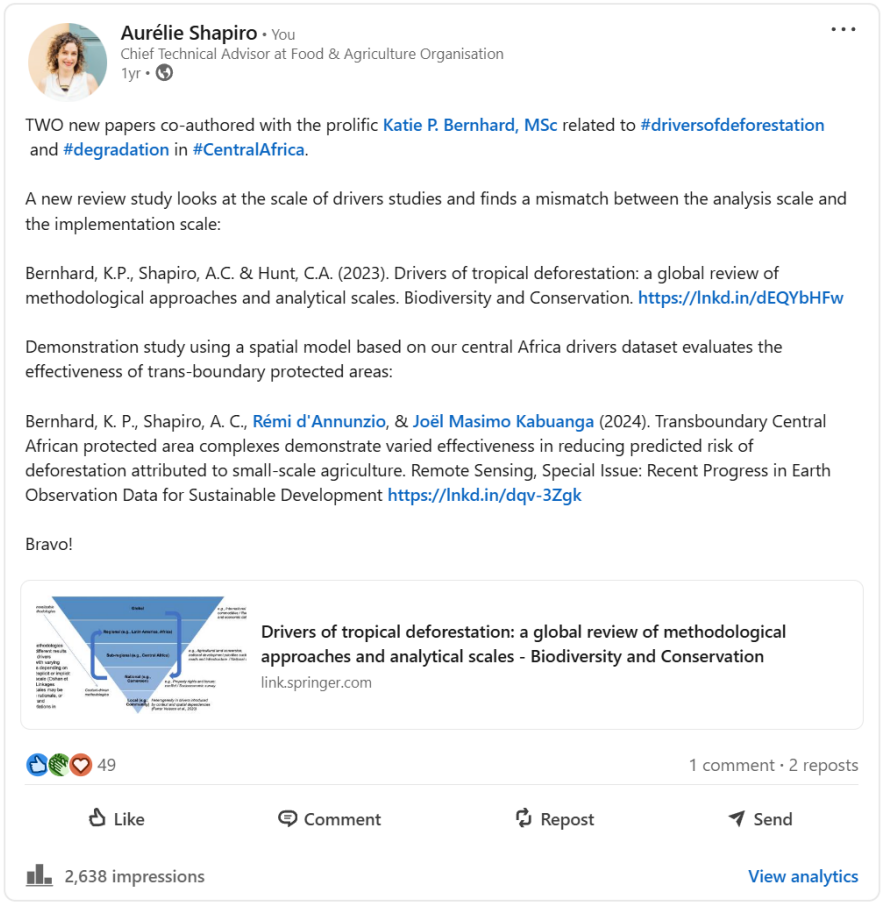

Figure 14. LinkedIn post promoting CAFI related publications

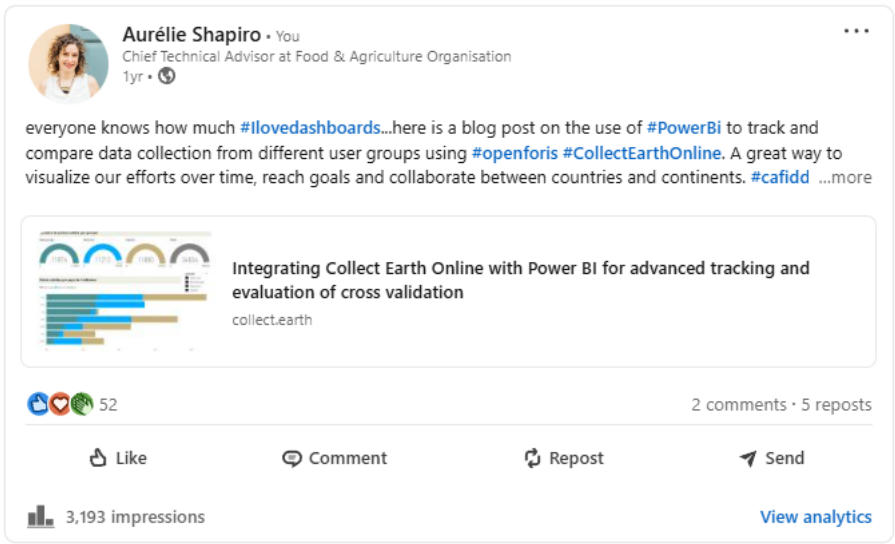

Figure 15. LinkedIn post on the Collect Earth Online blog entry about how we track and evaluate visual interpretation using automated Power Bi dashboards. Read the blog post here.

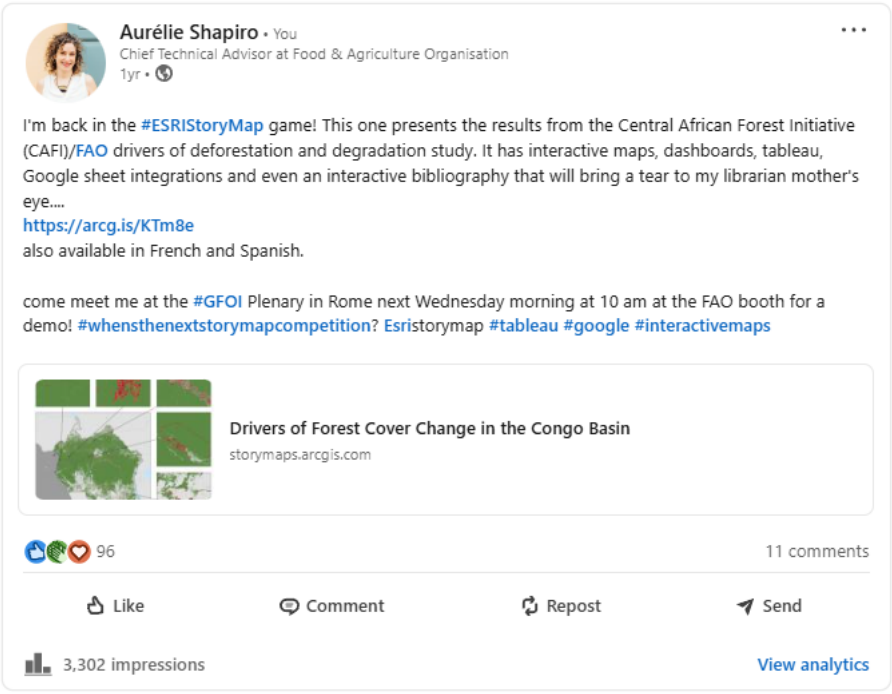

Figure 16. LinkedIn post presenting the CAFI DDD interactive Story Map

Literature and publications

The literature review is available as a searchable database in this online tool. Several publications have been produced throughout the project.

Table 5. List of publications

Title	Authors	Description	Status
Small scale agriculture continues to drive deforestation and degradation in fragmented forests in the Congo Basin (2015–2020)	Aurélie Shapiro, Rémi d'Annunzio, Baudouin Desclée, Quentin Jungers, Héritier Koy Kondjo, Josefina Mbulito Iyanga, Francis Inicko Gangyo, Tatiana Nana, Conan Vassily Obame, Carine Milandou, Pierrick Rambaud, Denis Jean Sonwa, Benoît Mertens, Elisée Tchana,Damase Khasa, Clément Bourgoin,Chérubins Brice Ouissika, Daddy D. Kipute	Spatio-temporal analysis of drivers of deforestation and degradation for 2015-2020	Published November 2023, available online (open access)
Drivers of tropical deforestation: A global review of methodological approaches and analytical scales	Katie Bernhard, Aurélie Shapiro, Carter Hunt	This study clarifies common themes in driver identification and what is needed for drawing contextualized, scale-appropriate conclusions relevant to forest conservation policy	Published December 2023; available online (restricted access) PDF available here

		and sustainable land use planning	
Transboundary Central African Protected Area Complexes Demonstrate Varied Effectiveness in Reducing Predicted Risk of Deforestation Attributed to Small-Scale Agriculture.	Katie Bernhard, Aurélie Shapiro, Rémi d'Annunzio, Joel Massimo Kabuanga.	An assessment of deforestation risk from small-scale agriculture in transboundary areas using the GEO4LUP model	Published January 2024, available online (open access)
Measuring the drivers of deforestation and forest degradation: Testing scalable local-level socioeconomic methods and tools in the Congo Basin	Nicholas J. Hogarth, Aida Cuni-Sanchez, Aurélie Shapiro; Katie P. Bernhard	Development of standardized methods for determining perspectives, trends and information on drivers at local scales	In prep
Revisiting the drivers of deforestation in the Congo Basin: Insights from local perceptions	Aida Cuni-Sanchez, Gerard Imani, Erick Bahati, Rémi d'Annunzio, Hermilie Bindang, Bienfait Birindwa, Juvencio Eko, Nick Hogarth, Ruben Ivina, John Kalume, Vilma Konkoen, Ana Leite, Francis Manfoumbi, Michel Mbadinga, Jean N.M. Mengue, Francisco Mitogo, Delicia Molongua, Archange T. Mouagui, Marco Mouilliom, Modesta Ndoho, Tania Ngompaza, Conan V. Omabe, Vanessa Ovono, Laetitia Rogombe, Eloisa Sales, Aurelie Shapiro, Elise Tchana,	Synthesis of socio-economic data collected in the Congo Basin using the CAFI DDD methodology	In prep
A Global Methodology for the assessment of direct drivers associated with deforestation and degradation. Using Open Foris Solutions for informed decisions	Shapiro, A.C., d'Annunzio, R., Merle, C. & Bernhard, K.	A methodological guide for the direct drivers methodology with results from Central Africa	Expected publication date: April 2025
To what extent does charcoal threaten Central Africa's Congo Basin forests? A synthesis of English and French literature	Katie P. Bernhard, Aurélie C. Shapiro, Rémi D'A nnunzio	A literature review to understand the demand, supply of charcoail; how much production is affecting forests in different countries in Central America.	Submitted March 24, 2025 to the Journal of Sustainable Forestry

An interactive infographic was created to present the major findings from the drivers publication:

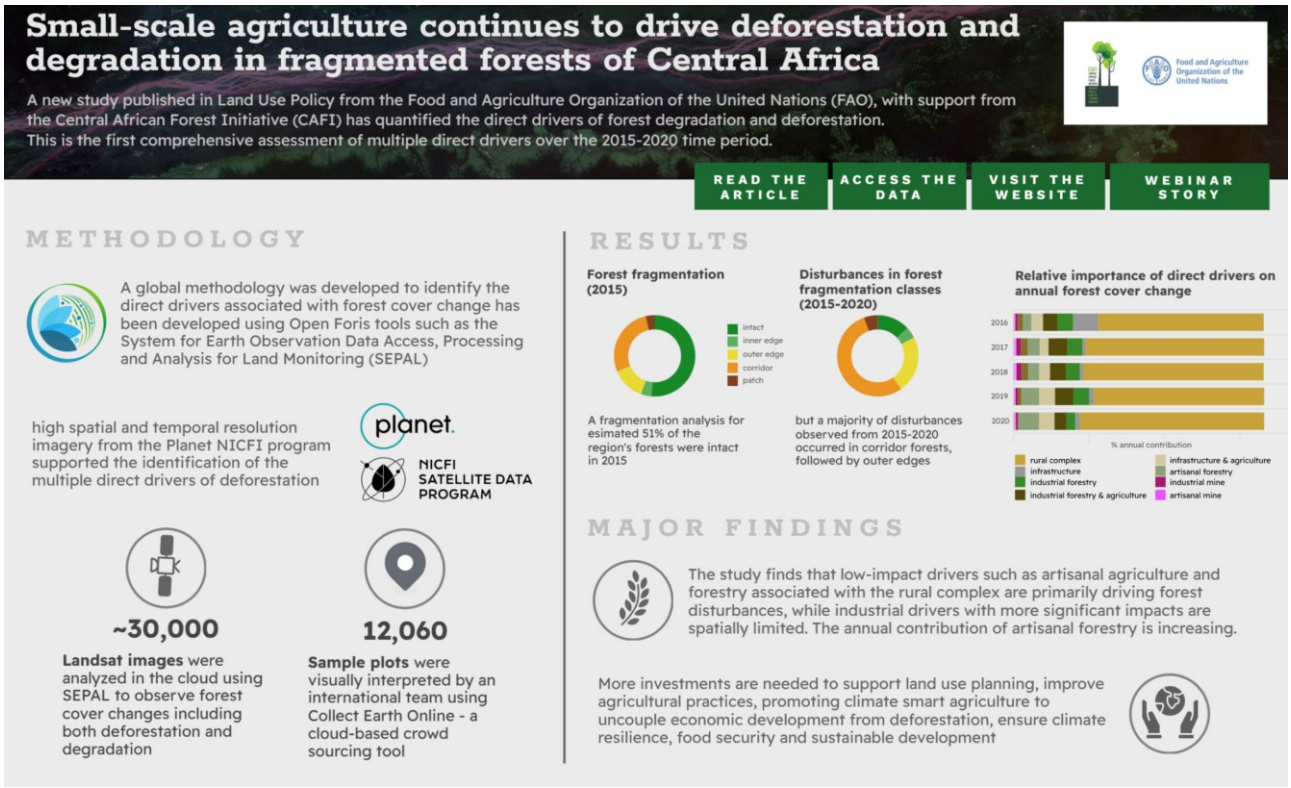

Figure 17. Interactive infographic to accompany the Drivers article

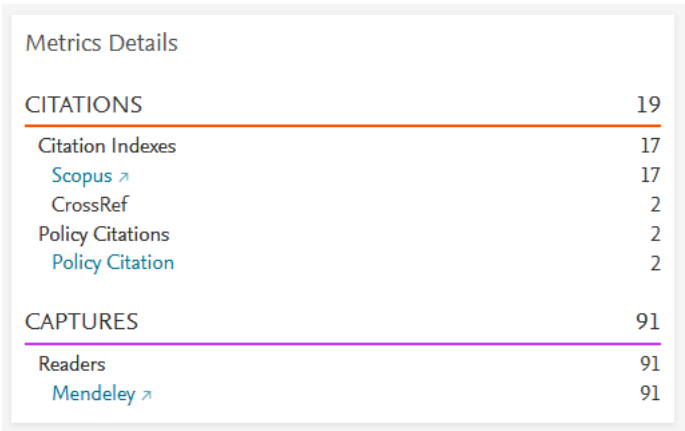

Figure 18. Citation metrics from Shapiro et al., 2023

7. FINANCIAL EXECUTION

TBD after financial reporting is finalized

8. MONITORING, EVALUATION AND LEARNING FROM THE PROJECT

8.1. Status of the monitoring plan

Monitoring and evaluation activity	Expected	Actual	Date(s)	yperlinked minutes (must include follow-up on decisions taken by poroject decision-making bodies)
Steering Commitee meeting (COPIL)	1	1	March 28, 2024	COPIL 7 presentation, report
Technical Commitee meetings (COTECH)	8	9	Monthly from January 2024 to November, 2024	COTECH reports COTECH presentations Kahoot Course
Field Missions	2	5	January, 2024 to March, 2025	5 pilot sites visited in 2024/5

COTECH – project technical committee

The COTECH was a central component of the project execution with monthly meetings well attended by a wide range of participants from CAFI countries and international institutions, with engaging discussions, interaction among participants and animated Kahoot! games and quizzes.

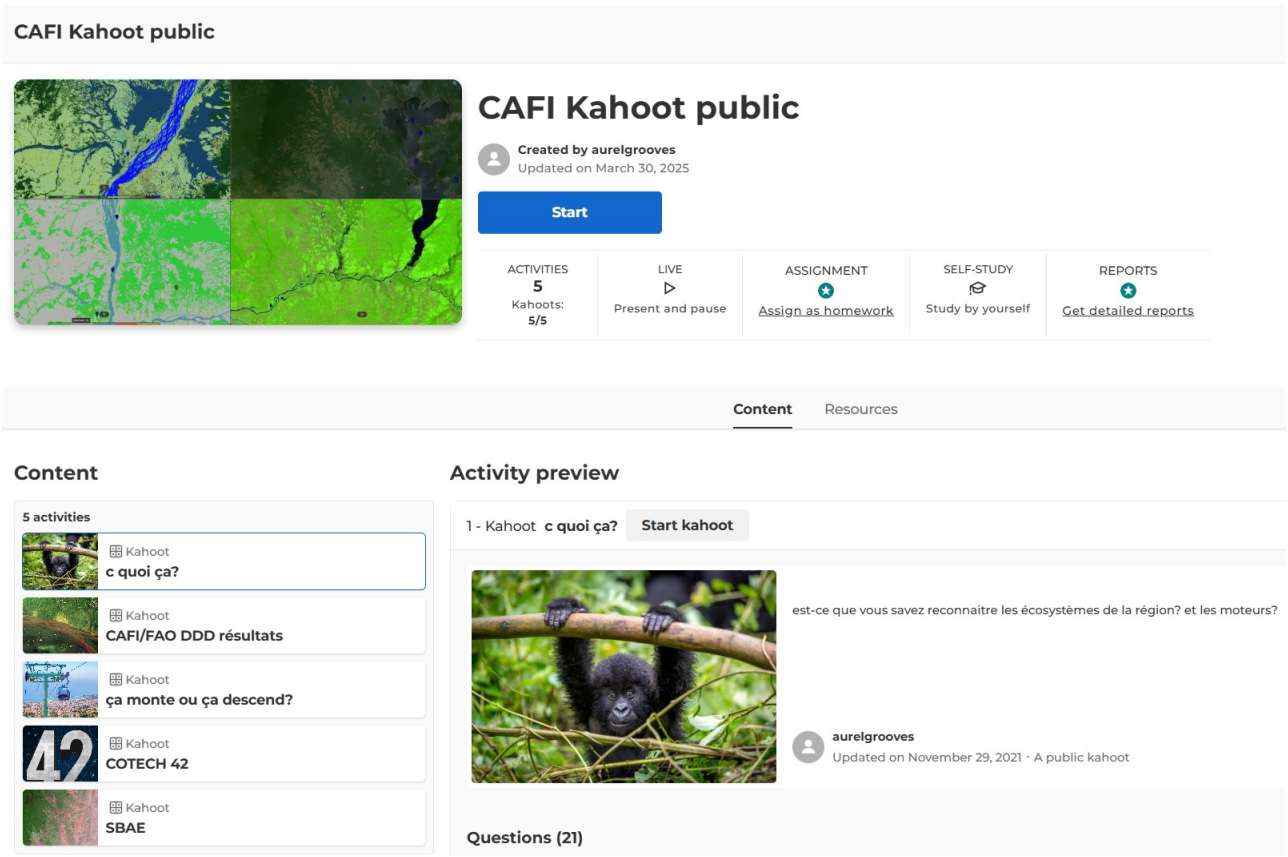

Figure 19. All Kahoot! Quizzes from the project are in a public course which can be accessed here.

The comprehensive list of COTECH participants for each meeting, along with the global summary is available here.

All COTECH reports can be accessed here (the Google Drive interface allows the searching of text within PDFs).

All COTECH presentations can be accessed here and can be similarly searched for terms and keywords.

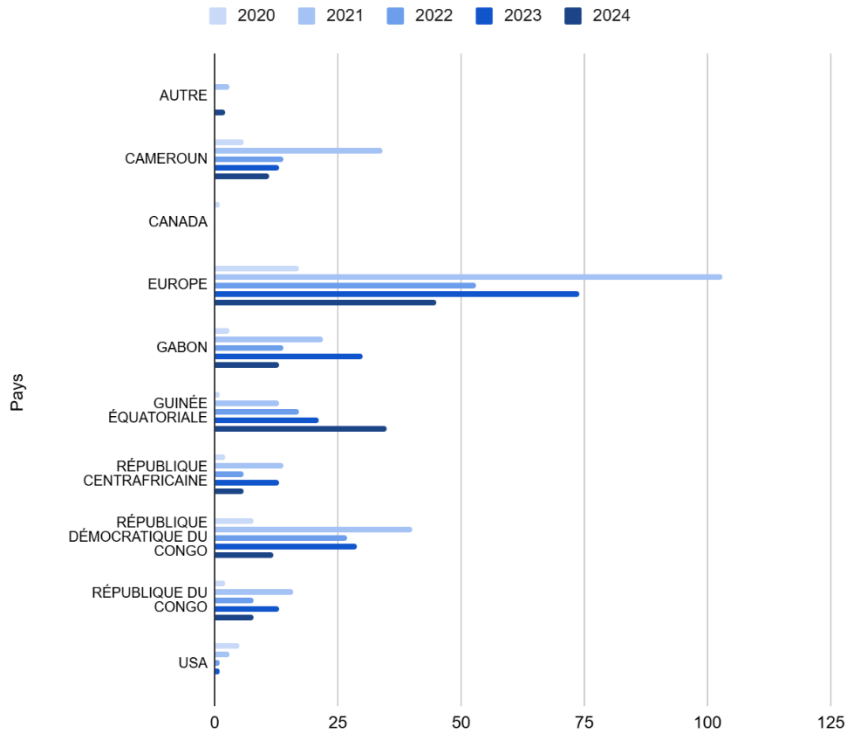

Figure 20. COTECH attendance by country and region 2020-2024

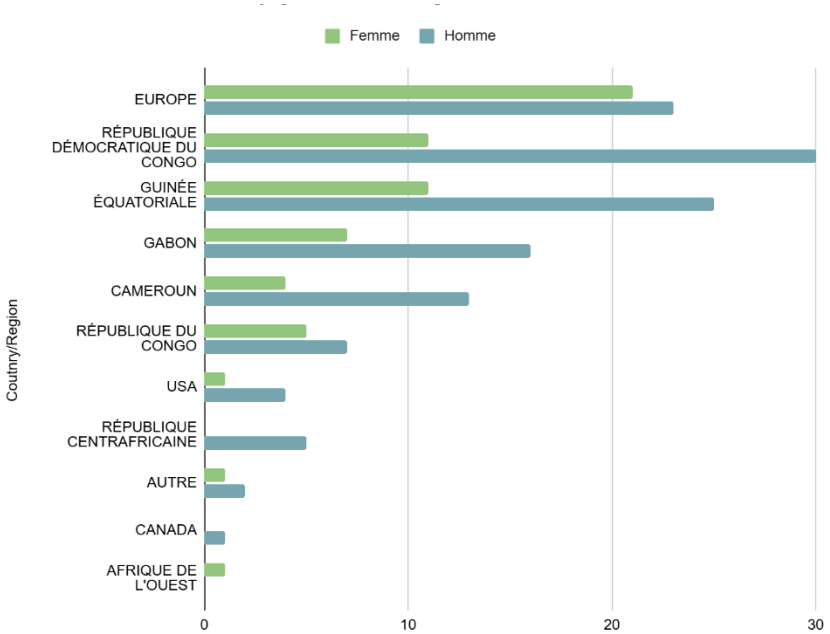

Figure 21. COTECH attendance by gender and region

Figure 22. group photo from last COTECH 42

8.3 Integration of lessons learned

Difficulty	Lesson learned
There were frequent problems with the LOAs which expired, needed to be extended and project extensions which took long to approve which disrupted some of the project activities	Feedback to FAO on problems with LOAs; all LOAs in 2024 had longer validity periods (with the exception of DRC which refused).
The online meetings of the COTECH and webinars were very useful and appreciated. These activities also reduced travel costs and emissions. The regional workshop did however enable more cohesion between partners and to align strategies	A regional workshop was held in 2024 which connected all hired consultants and focal points.
The countries wish to have more capacity development support to extract national data from the regional information, for sample-based area estimations and to better understand the results	There were more online trainings on emissions calculations and area estimations upon specific requests from countries.
The cross validation with so many points took much longer than expected and delayed many activities of the project. Some people did most of the work, others did less with lots of variation in quality.	In the final phase there was no cross validation, which enabled the production of many more points. Automated approaches were tested for stable dense forest points; and a random sample of points were re-assessed to determine user bias and error for each country.
Changing and evolving algorithms have disrupted the learning process.	The final methodology is explained from beginning to end in this online living document (people can add comments and questions and suggestions)

The updated methodology to improve efficiency and reduce biases has produced different results than BFAST	The updated methodology is preferred by the COTECH and differences were explained in a technical note

9. TRANSVERSAL THEMES

Criteria	Activities targeting the above-mentioned groups	Results	Challenges
Implementation/Activités	Project team, national technicians and COTECH include women	The project implementation team is composed of 1 international chief technical advisor (female), and 4 national consultants (1 female). Over all 42 COTECH meetings, the total gender ratio was 33% for participants; of 83 unique participants, 24 were female (28% ratio). In DRC the technical team had a gender ratio of 50% ; in Gabon 25%.	It is always a challenge to reach and engage women in scientific fields dominated by men. We tried to give everyone a chance to talk and engage in COTECHs and online trainings, rather than just attending, by encouraging use of the chat and whatsapp groups.

10. RISK MANAGEMENT

Identification of risk			Response to risk		
Description	**Category**	**Evaolution of risk (stable, increased, redused) throughout the reporting period**	**Principle action implemented, anticipated by the project**	**Responsibility**	**Deadline**
Ministry turnover and lack of engagement in Cameroun	Likely	Stable	Frequent communications were held with MINFOF in Cameroun to contact new focal points. A project document describing the benefits and synergies of the CAFI Program were produced for ministerial engagement.	FAO Cameroun	March 2024
Delays in signing LOAs	Likely	Stable	Hiring of consultants to implement activities before LOA	HQ	February 2024
Lack of engagement in DRC	likely	Stable	Appy a “build it and they will come” approach sharing outputs and tools via whatsapp, which are of interest to DIAF and their activities, notably the updating of the national emissions reference level, to pique their interest and keep them engaged	HQ	December 2024

11. SUMMARY OF DELIVERABLES

1. FAO website in 3 languages summarizing approach, results, bibliography and links to story maps, news items.
2. ESRI Story Map in 3 languages summarizing methods and updated results
3. Literature review and searchable project library compiles all the relevant literature and is updated throughout the project
4. Project Methodology Document developed and approved by the COTECH
5. Project workflow described in several languages in the SEPAL documentation
6. Description of the regional classification scheme with categories described in English, French and Spanish, including the LCML terminology and diagrams
7. Drivers identification manual (SOP for drivers identification)
8. Accessible, continually updated online database of relevant regional data from the project and auxiliary sources
9. Phase I maps products – land cover, fragmentation are visible, searchable and downloadable from ArcGIS Online
10. Drivers analysis interactive dashboard from all visually interpreted data
11. Google Classroom compiling resources from the French and Spanish webinar series, and associated web story
12. Peer- reviewed article on drivers study, including graphical abstract, interactive infographic and web story
13. Peer-reviewed literature review article on drivers study scales
14. All project scripts available on GitHub
15. Presentations featuring the CAFI drivers study at Forest & Elephants Symposium, South-South Degradation Exchange, International Conference for Conservation Biology (ICCB)
16. Side event at CBFP #20 in Kinshasa summary https://pfbc-cbfp.org/actualites-partenaires/CAFI-FAO-RDP20.html
17. Socio-economic survey methods and tools in Open Foris Arena and technical guidelines in 3 languages, compiled here.
18. Step-by-step methodology for mapping and updating change assessments (in French) including links to all scripts and tools
19. All area estimates in online interactive tableau dashboard and Google Drive.
20. Emissions calculations in these Google Sheets and dashboard

12. ANNEXES

CAFI Deforestation Drivers Final Report

Contact:
Aurélie Shapiro
E-mail:
Aurelie.shapiro@fao.org