Forest Policy and Economics 177 (2025) 103533

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Cocoa driven deforestation in Cameroon: Practices and policy

Verina Ingram [a,b,*], Valerie Janssen [a], Victorine Akenji Neh [c], Arun Kumar Pratihast [d]

[a] Wageningen Economic Research, Wageningen University & Research (WUR), Droevendaalsesteeg 4, 6708 PB Wageningen, the Netherlands
[b] Forest & Nature Conservation Policy Group, Wageningen University & Research (WUR), Droevendaalsesteeg 4, 6708 PB Wageningen, the Netherlands
[c] University of Buea, PO Box 63, Buea, South West Province, Cameroon
[d] Wageningen Environmental Research, Wageningen University and Research, 6708 PB Wageningen, the Netherlands

ARTICLE INFO

Keywords:
Zero and deforestation-free cocoa
Forest policy
Agricultural commodities
Value chain governance

ABSTRACT

Cocoa production has increased in Cameroon since the 2000s, supported by policies to enhance productivity, yields, farmer incomes and state revenues. Other policies incentivize zero-deforestation production and forest protection. However cocoa farming practices cause deforestation and degradation. Scientific evidence of practice-policy interactions is lacking. Given this context we identified perceptions, farming practices and their on-ground impacts, policies and initiatives addressing deforestation and cocoa. A practice-based conceptual approach guided 67 interviews, 8 focus group discussions and remote sensing analysis of land cover and ground validation in 557 locations around Ntui. Increasing, small-scale cocoa-driven deforestation, totalling 4599 ha over the past decade was found. Maps show 64 % of observed cocoa farms as forest. Farmers do not perceive themselves as responsible, attributing deforestation to poverty, low yields, land unavailability, migration, population growth, and high land and labour prices. Apart from sustainability certification, farmers were unaware of zero-deforestation initiatives and policies. Policies appear ineffective in halting cocoa-related deforestation or increasing yields, but modestly effective in expanding production. Opportunities to reduce deforestation include yield improvement, information, law enforcement, and land planning. However productivity increases could drive further deforestation. Paradoxically, farmers perceive no trade-offs between livelihoods and forest use, contrary to other value-chain stakeholders. These results lead to recommendations for coherent forest and agricultural policies, pragmatic forest and agroforestry definitions, accurate (agro)forest mapping, and evidence-based reframing of discourses on cocoa, agriculture and forests. Incongruent perceptions, practices and policies challenge implementation of the EU Deforestation Regulation.

1. Introduction

Cocoa agroforestry systems can provide economic and ecological benefits (de Sousa et al., 2019; Franzen and Borgerhoff Mulder, 2007). Ironically, the *Theobroma cacao* L. tree which originated in the understory of humid tropical forests in the Amazon and Orinoco basins and Guiana shield (Somarriba and Lachenaud, 2013) has also been coupled with economic and ecological costs. One of the major costs is deforestation and forest degradation across the tropics (Ruf and Varlet, 2017; Wessel and Quist-Wessel, 2015), and since its introduction to Africa in the 1870s, cocoa has been associated with deforestation (Aleman et al., 2018; Gbetnkom, 2005; Wessel and Quist-Wessel, 2015). Deforestation refers to forest areas cleared or converted to other land uses, often used in reference to deforestation free, zero-net deforestation, zero-gross deforestation and no/zero illegal deforestation (Brown and Zarin, 2013; FAO, 2018). Cocoa production has gradually increased since the mid-1940s, particularly in West and Central Africa where it was introduced in colonial times as an pioneer export commodity cash crop on fertile, converted forested lands (Ruf and Varlet, 2017; Wessel and Quist-Wessel, 2015). Most cocoa worldwide (76 %) is still produced in Africa, with Ivory Coast leading followed by Ghana and Cameroon (290,000 tons, 16 % of global production) in 2020/2021 (ICCO, 2021). Between 2000 and 2020 cocoa production expanded in Ivory Coast by 175 %, Ghana by 177 %, and in Cameroon by 242 % (ICCO, 2021; Ruf and Varlet, 2017). National policies have promoted increases in productivity, yield and production area rather than price incentives, and periods of global oversupply have led to price decreases (Essegbey and Ofori-Gyamfi, 2012; Grumiller et al., 2018; Vigneri and Kolavalli, 2017; Wessel and Quist-Wessel, 2015). For example, Cameroon's 2011 Support Program for the Improvement of Agricultural Productivity,

* Corresponding author
E-mail address: verina.ingram@wur.nl (V. Ingram).

https://doi.org/10.1016/j.forpol.2025.103533
Received 30 August 2024; Received in revised form 15 April 2025; Accepted 19 May 2025
Available online 30 May 2025

National Indicative Program 2014–2020, and the 2014 "Horizon 2020 Recovery and Development Plan for Cocoa and Coffee Value Chains" aim to double national production to 600,000 tons of cocoa annually by 2020 (Beule et al., 2014). This objective was not achieved and was postponed to 2030.

An estimated 2 to 3 million hectares of forest have been converted to cocoa production globally in the period 1988–2008 (Kroeger et al., 2017). Ivory Coast and Ghana are now largely deforested with 8 % and 33 % forest cover respectively remaining in 2020 (FAO, 2020), a 83 % and 80 % decrease respectively relative to estimates in 1900 (Cleaver, 1992; FAO, 2016; Ruf and Varlet, 2017). Cocoa continues to be a driver of forest loss in countries which had high forest cover such as Ghana and Ivory Coast, and in countries with still high forest cover such as Colombia, Ecuador, Peru, Congo and DR Congo (Beule et al., 2014; Feintrenie, 2014; Newton et al., 2013). Also in Cameroon, about half of the tropical humid forest area has become degraded since 1900 (Aleman et al., 2018), resulting in 42 % of land area still covered by forest in 2020 (FAO, 2020). From 2001 to 2015, over a quarter of forest loss in Cameroon has been permanent, caused by commodity-driven agriculture, such that these areas unlikely to be forested again (Curtis et al., 2018). From 2001 to 2020 forest cover decreased by 5 %, with the Central and East regions experiencing highest losses (Global Forest Watch, 2022). A major driver of deforestation in Cameroon is agricultural expansion, including cocoa production (Vancutsem et al., 2021).

In this history of cocoa-related deforestation, paradoxes exist. Firstly, "chocolate forests" have been recognised since the 1950s as traditional, biodiverse, shaded cocoa agroforestry cropping systems in Latin American and Africa (Johns, 1999; Michel et al., 2024; Ruf and Schroth, 2004). Such cocoa agroforestry systems generate ecosystem services and support high plant and animal biodiversity, carbon sequestration and soil protection, like secondary forests (Schroth and Harvey, 2007; Sonwa et al., 2007). Secondly, despite this history, in the last two decades agroforestry practices have been proposed as 'new' pathways to decrease deforestation and stimulate reforestation, to mitigate climate change by enhancing forest carbon stocks, to diversify and increase incomes and reduce farmer risks (Alemagi et al., 2014; Jagoret et al., 2012a; Ruf and Zadi, 1998). Thirdly, despite cocoa being only one of multiple products (Anglaaere et al., 2011; Bymolt et al., 2018; Jagoret et al., 2014; Jagoret et al., 2011; Johns, 1999) from mixed crop production systems (Somarriba and Lachenaud, 2013), it has taken centre-stage in consumer, civil society and political deforestation-free commodity discourses since the early 2000s (Garrett et al., 2019; Taylor and Streck, 2018).

Policies to address deforestation have emerged from global to local levels. Internationally, a raft of legal and voluntary policy developments include the 2010 World Economic Forum agenda on deforestation, 2010 commitment of 400 Consumer Goods Forum companies to zero net deforestation within their supply chains by 2020; 2014 New York Declaration of Forests, 2015 Amsterdam Declaration on Deforestation by seven European governments; 2019 EU Action Plan and Communication on Stepping-up EU Action to Tackle Deforestation and subsequent 2021 EC and European Parliament proposals setting mandatory due diligence rules for operators placing commodities (including cocoa) associated with deforestation and degradation on the EU market and resulting 2023 EU Deforestation Regulation (2023/1115). To be labelled as 'deforestation-free' and eligible for import into the EU, cocoa must be sourced from farmland that has not been deforested since 31st December 2020. The EU Corporate Sustainability Due Diligence Directive also has implications companies importing cocoa into Europe. Private-public partnerships such as the World Cocoa Foundation's Cocoa & Forest Initiative and consumer country public-private-civil society sustainable cocoa actions in Germany (GISCO), Belgium (Beyond Chocolate), the Netherlands (DISCO) and Swiss Platform for Sustainable Cocoa (SWISSCO), all address cocoa-related deforestation, coupled with commitments and financial pledges by governments and companies as part of the COP26 (Climate Champions, 2021; UK Government, 2021, UK Government and UNCC, 2021) to end deforestation by 2030. As Cameroon exported 65 % of its cocoa to the EU in 2020 (EFI, 2023), these international regulations and policies are pertinent nationally.

Market-based, voluntary governance also operates globally, such as voluntary sustainability certification. In West Africa, uncertified cocoa farmers tend to have lower environmental performance than certified and supported farmers (COSA, 2012; Ingram et al., 2018b), suggesting that uncertified and organised farmers present a higher deforestation risk. In 2019, 23 % of cocoa exported from Cameroon was certified by voluntary, third-party sustainability certification standards (Lescuyer et al., 2020) up from 3 % in 2016 (Nkott et al., 2017). Certified cocoa is produced by around 25,000 certified farmers, an estimated 7 % of the total in Cameroon (Ndoping, 2016). As there are an estimated 300,000 farmers nationally, the majority are not certified or registered in groups, and act independently rather than selling collectively (Sanial et al., 2019). Rainforest Alliance, Organic and Fairtrade standards all require farmers, as part of a group, to not convert forests after specific cut off dates, to maintain native shade trees, prevent and or remediate deforestation, and protect water sources and biodiversity off-farm in corridors and high conservation areas. The effectiveness of these statutory and market-based governance measures is mixed and has been questioned (Ingram et al., 2018b; Jackson and Balema, 2020; Ruf et al., 2013; Waarts et al., 2019).

Regional policies also exist (de Steenhuijsen Pieters et al., 2021; Waarts et al., 2021a): the 1999 Central African Forests Commission (COMIFAC) and 2013 Economic Community of West African States (ECOWAS) Convergence Plan for the Sustainable Management and Utilization of Forest Ecosystems in West Africa. Both aim for the conservation, sustainable and concerted management of forest ecosystems. On a national level, Cameroon's has had a succession of forest protection, reforestation and restoration policies, underpinned by the 2024 Forestry Law and 2019 plantation forests development programme (Minisitry of Forestry and Wildlife, 2019). These are implemented by the Ministry of Forestry and Wildlife (MINFOF) and National Forestry Development Agency (ANAFOR). In 2011 Cameroon signed the Bonn Challenge commitment to restore 150 million hectares of degraded lands by 2020 and 350 million hectares by 2030 (Business in Cameroon, 2021). Forest and landscape restoration is provided for in the 2024 Forest Law, and in 2017 Cameroon pledged to restore 12,062,768 ha of forests and degraded lands by 2030 as part of the African Forest Landscape Restoration Initiative (AFR 100) (Atyi and Mbonayem, 2018). The Roadmap to Deforestation free cocoa places forest restoration as part one of its three main pillars (IDH, 2021).

These diverse drivers on international regional and national scales seek to increase cocoa production practices to augment individual farmer incomes and state revenues, but also incentivize zero-deforestation commodity production, forest protection, agroforestry, reforestation and afforestation. However, there is still relatively little consensus on how coherent these policies are with perceptions and practices on the ground, and on whether these policies are effective in halting cocoa related deforestation. The aim of this study is therefore to identify drivers of farmers' practices concerning cocoa related deforestation, their effects on the ground, and the policies, actions and initiatives seeking to tackle drivers of deforestation and improve cocoa production. This concerns Sustainable Development Goal (SDG) 1 on poverty, SDG 15 regarding life on land and SDG 12 on responsible production and consumption.

Given this lack of scientific evidence on how practices and policy interact in a context of relatively high forest cover, economically important cocoa production and with an expansionist cocoa policy, this study focuses on Cameroon and seeks to understand cocoa driven deforestation, specifically:

1. Who are the key stakeholders in the cocoa sector, and what practices, initiatives and policies do they enact concerning (zero) deforestation?

2. What has been the extent of deforestation in Ntui in the past 10 years?
3. How do cocoa farmers perceive and define deforestation?
4. What are the main drivers and barriers to deforestation for cocoa farmers?
5. What are the major trade-offs regarding cocoa and deforestation?

To conceptually frame these questions, a practice-based approach (PBA) to forest governance (Beule et al., 2014) and value chain governance (Ingram et al., 2018a) is taken, looking at the dynamic interactions that make practices of cocoa production, the active role of actors along the value chain from farm to consumer in these practices, and the way policies, ideas, and knowledge emerge. Social practices and policies are thus key units of analysis. Practices are enacted by diverse stakeholders and practitioners, in this case ranging from cocoa farmers, community chiefs, and forest authorities to policy makers at the Cameroon, Europe and global level, who work with cocoa, trees, forests and biodiversity, and act upon forest, agricultural, trade and development policies, discourses, voluntary sustainability certification, traditional and local knowledge and scientific insights. Thus, a PBA is also about how individuals, communities, NGOs, stakeholders in the cocoa value chain, and citizens get involved in farm, value chain and forest governance (Behagel et al., 2019). This paper contributes empirical data on practices and policies on cocoa and forest governance, and its results speak to the plea to connect different governance structures and policy measures situated in specific conditions to enhance sustainability, given the multiple statutory, market-based and project governance arrangements in the two sectors (Ingram et al., 2018a; Vellema et al., 2016).

2. Materials and methods

2.1. Study area

Informed by work on cocoa production areas and deforestation patterns in Cameroon (Armathé et al., 2013; Gbetnkom, 2005; Jagoret et al., 2012a; Mertens et al., 2000; Beule et al., 2014; Pédelahore, 2014a, 2014b), the area around Ntui, Mbam and Kim administrative division, Centre Region was chosen – shown in Fig. 1 – from where between 37 and 58 % of national cocoa production originates (ONCC, 2023) (Pédelahore, 2014a). In 2010, Mbam et Kim division had 1.93 mha of tree cover on 74 % of its land, down to 70 % in 2022 (GFW, 2023). This department demonstrates a continuum from degraded forest and agricultural mosaics predominately of cocoa, to humid tropical lowland forest (Ngang et al., 2020), suitable for cocoa (Schroth et al., 2016). Based on field reconnaissance in January 2019 and May 2020 and a literature review, a continuum of 22 km was identified from degraded forest cover and cocoa farms north of Obala and Nachtigal on the Sanaga River, along the N15 road through Ntui, to forested areas northwards towards Yoko.

At the southern "degraded forest" end of the continuum, the cocoa-producing zone has a high population density of with 111 inhabitants/km2 in 2010 (Pédelahore et al., 2020). From Obala to the Sanaga river crossing, severe anthropogenic disturbances have created a highly degraded humid semi-deciduous landscape. A bridge over the river at Nachtigal and tarmacked road to Ntui was finalised in 2020. Previously the poorly maintained, untarred road and car ferry limited the quantity and vehicle access from Obala to Ntui and further north, and access to forested lands. Cocoa plantation agroecosystems of approximately 30–60 years in age are generally close to villages located along the N15 road to Ntui and from Ntui to Bafia. Native forest trees have been felled and replaced by a generally low diversity of cultivated species. Plantations are weeded and treated with pesticides in varying degrees of regularity (Pédelahore et al., 2020; Tadu et al., 2009). Cocoa agroforests occur in mosaics with manioc (*Manihot esculenta*), plantain (*Musa* spp.), maize (*Zea mays*), macabo (*Xanthosoma sagittifolium Schott*), oil palm (*Elaeis guineensis*) and timber fallows (IDH/WWF/ICRAF, 2020) and are often 'planted shade', with the shade trees a mixture of forest and planted domesticated species, in mosaics with degraded forests (Lionelle, 2021; Pédelahore et al., 2023). Both certified and conventional traders, cooperatives and farmers operate here (ibid).

At the northern "forested" area of the continuum are higher levels of humid forest cover, suitable for cocoa cultivation, with decreases in forest cover in the last 5 to 10 years (Pédelahore, 2014a). There is a lower population density and villages tend to be smaller and more dispersed. Towards Yoko is the transition zone from humid to humid-savannah forest with patches of gallery-forests and human-made agroforests (Armathé et al., 2013; Nijmeijer et al., 2019). Cocoa plantations generally have a diversity of shade trees, are generally well shaded, and contain mostly remnant forest trees with some cultivated trees (Lionelle, 2021). These agroforests are extensively managed, with a mix of new and up to 60-year-old small-holdings and high plant diversity (Lionelle, 2021; Pédelahore et al., 2023). The same crops are grown as in the southern end continuum. Plantations are less frequently sprayed and weeded, due to generally more limited access and longer distances to

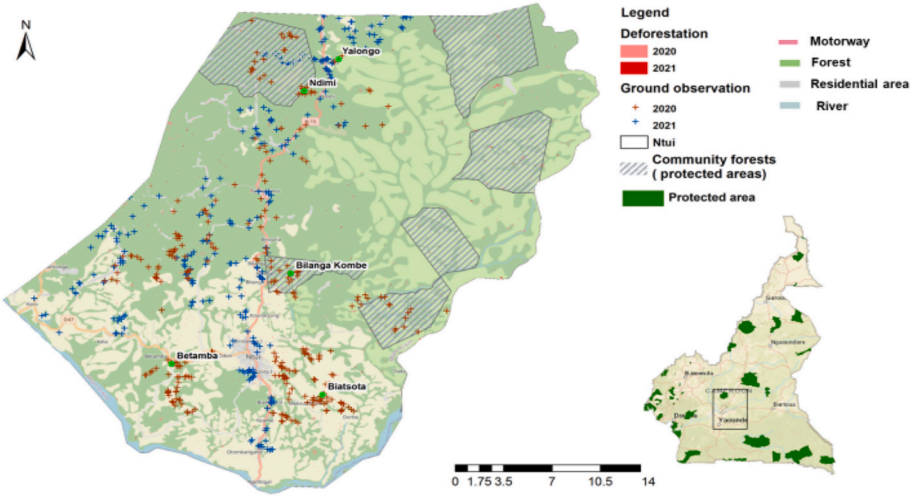

Fig. 1. Study area Ntui and neighbouring villages.
Legend: Ground observations in 2020 (red crosses) and 2021 (blue crosses). Deforestation 2020 (Light red) and 2021 (Red). Community forests and protected areas (hashed), on a OpenStreetMap layer background with dark green for forests, mid-green for grasslands, and beige for farmland.
Source: Openstreet map layers.

obtain to agricultural inputs. This is a frontier area where agricultural colonization is taking place with increasing crop cultivation by converting forest or fallows, generally undertaken by migrants mainly from the north (Pédelahore, 2018) and the North West. It is also a climate frontier, where climatic changes may make the area less suitable for cocoa (Alemagi et al., 2015; Schroth et al., 2016). More conventional than certified traders, cooperatives and farmers operate here (Pédelahore et al., 2023).

2.2. Sampling

Within this continuum five cocoa producing villages were identified, with two in the forested area and two in the degraded forest area, shown in Fig. 1 and Table 1. They are all close to the main Obala-Yoko road, reachable by unpaved roads.

To prepare for Focus Group Discussions (FGD) in the selected communities a meeting was held with the customary village chief to explain the study and obtain permission to hold the FGD, identify a suitable location and date. Further meetings with local chiefs, cooperative managers, cocoa traders and authorities helped to identify up to 15 potential participants per FGD based on the criteria that (a) at least 8 of the cocoa farmers are from the selected community (i.e. they have a history there); (b) at least two women are involved in cocoa farming and: (c) at least half of the participants have had more than five years' experience in cocoa farming. The potential participants were then invited to join the FGD in their village. For the key informant interviews, stakeholders in Ntui, Yaoundé and Douala were identified and purposely selected according to their roles as being active in the cocoa and forestry practices or policies, jurisdiction, influence and interest in cocoa and forests, land use management and governance.

2.3. Data collection and analysis

2.3.1.1. Focus group discussions. Before the start of the FGD, free, prior and informed consent to participate in the study was obtained and information about participating farmers was collected using a questionnaire covering the age of the cocoa farmer, the region where they grew up, cocoa yields, cocoa plot sizes, length of time they cultivated the plots, and previous land uses of the plots. The data was analysed and aggregated per village. In each village a FGD with between 9 and 12 people per group was conducted in a mix of English, French and pidgin by a facilitator-moderator, with discussions noted by a reporter. Eight FGDs (one in each village) with a total 84 people were conducted in July and August 2020. These discussions were guided by a semi structured question guide which covered the topics of main enablers and barriers to deforestation related to cocoa; extent that cocoa farmers and stakeholders are aware of deforestation initiatives (policies, projects, interventions), restoration, forest protection and cocoa productivity and discrepancies between practices on the ground and policies. Data was transcribed into excel, coded and analysed according to the above topics per village and then aggregated for the forested and degraded areas. Quotes are presented to contextualize the results.

Table 1
Study area villages, Ntui, Cameroon.

Area	Villages	Protected areas within 10 km	Proximity to main road
Forested area	Yalongo	Ascokyb Community Forest	Adjacent
	Ndimi		Adjacent
	Bilanga Kombe A & B	Paysanne Bilanga Kombe Community Forest	Adjacent
Degraded forest area	Biatsota 1 & II		Adjacent
	Betamba A & B		Adjacent

2.3.1.2. Key informant interviews. A total of 67 key informant interviews were conducted: 25 from January to March 2020 and 40 from July 2021 to June 2023. Participants included 9 local chiefs, 9 government officials (Ministries of Agriculture and Rural Development, Commerce, Forestry & Wildlife, Environment, Nature Protection and Sustainable Development, the National Forest Support & Development Office (ANAFOR) and the National Office of Cocoa and Coffee (ONCC), 9 traders, 4 non-governmental and development organisations, 13 certified cocoa farmers, 7 buyers and coxeurs, 11 cocoa cooperative staff and 3 researchers. Participants were engaged with during the multiparty EU-Cameroon 'Cocoa Talks' about sustainable cocoa and the EUDR from November 2021 to June 2023. The interviews were guided by semi-structured questions about: Definitions of forest, deforestation, zero deforestation and sustainability; Awareness of deforestation/forest conversation and productivity interventions; Drivers, incentives and influences to engage in deforestation/restoration/productivity improvements, corporate and government interventions; What could prevent farmers from opening new farms causing deforestation?; Which stakeholders are involved and interact in forest protection/deforestation/restoration?; Which policies and interventions occurred in cocoa productivity and avoiding deforestation; Discrepancies between practices on the ground and policies; If the government or other parties are monitoring deforestation; and visions on deforestation in Cameroon. Transcripts of the interviews were coded according to these topics and aggregated by stakeholder type and analysed. They were used to verify and triangulate the findings of the FGDs, understand about cocoa, forest use and deforestation and answer the research questions. The interview results were also used to verify and triangulate the findings of the FGDs. Quotes are presented to contextualize the results.

Documents (corporate policies, standards, laws and websites) relevant to the study and referred to in interviews were accessed and coded in line with the research questions.

2.3.1.3. Spatial analysis. The AVOCADO (Anomaly Vegetation Change Detection) Monitor method was used to identify deforestation and regrowth as cocoa plantation area in Landsat NDVI time-series images (Decuyper et al., 2022). RADD alerts (Radar for Detecting Deforestation) were gathered from World Resources Institute's Global Forest Watch. These satellite alerts were purposely sampled (based on road accessibility) for ground validation. The ground validation team were twice given 287 randomly generated locations to investigate and instructed to travel on foot to around 33 % of these data points to within 100 m or the closest point within 500 to 1000 m if the terrain was difficult or a river needed to be traversed. Ground validation was conducted between July and August 2020 and in June 2021. In total, 557 ground validation points were collected. The validation process utilized a decision-based data collection form (Fig. 2) to record geolocation, location, size, time, drivers and photographs of change made at each cardinal compass point, and observations of landuse cover (using the classification shown in Table 2). If a farmer or labourer was at the site, they were asked about drivers of change, date of land use change, previous land use cover. The data collection form using XLSForm (an Excel-based form) was deployed on mobile phones using the Open Data Kit (ODK) Collect application. Data were collected offline and transferred to data servers via Wi-Fi when available. An online database management system based on ODK Aggregate, was used for storage, analysis and visualization of the collected data. Details of the data collection method can be found in Pratihast et al. (2013). Maps were created using a SPOTs Open Street Map (OSM) as the basemap. OSM maps include categories of forest, farmland, meadow, residential, and scrub.

3. Results and discussion

Drawing on the data collected, this section presents and discusses the stakeholders in the cocoa and forest sector in Ntui, landcover changes,

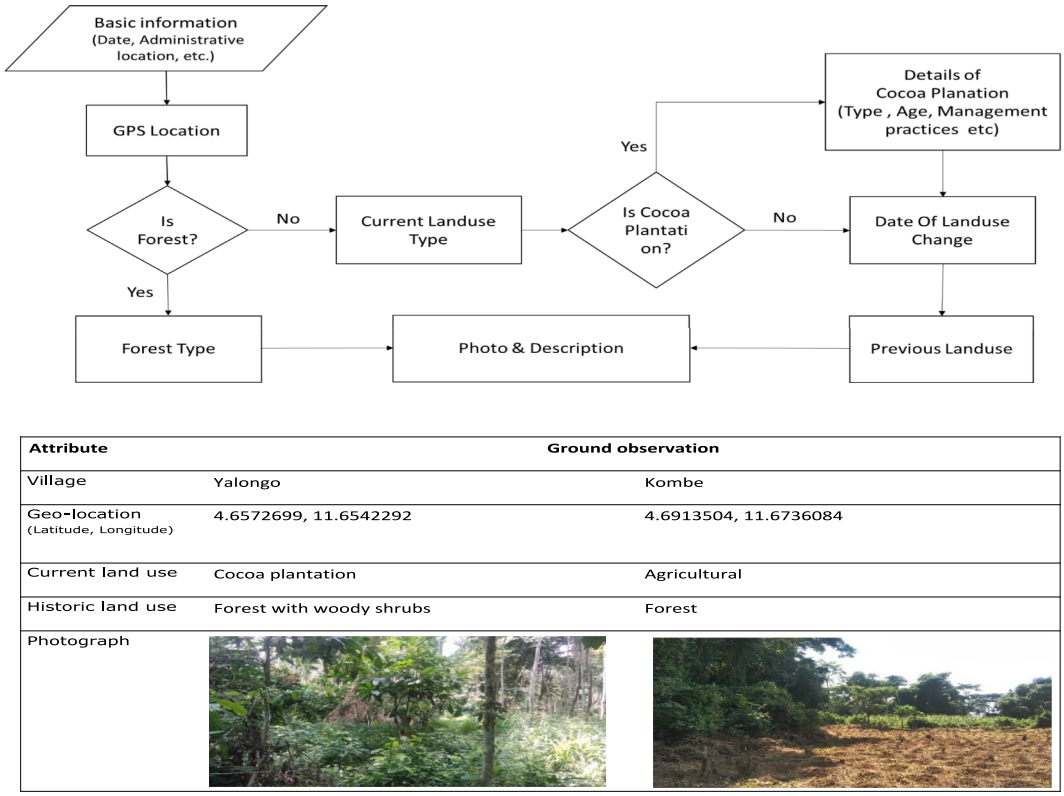

Fig. 2. Decision-based data acquisition form using ODK software on mobile phones for ground validation of landuse.

Table 2
Classifications of land use cover.

Current landuse		Previous land use
Forest	Natural forest vegetation Degraded forest Tree planation	Forest
Cocoa plantation		Agriculture Tree plantation Fallow
Agricultural (farmland)		
Grassland/grazing area (no trees)		
Residential		
Commercial		
Transport (road, rail etc)		
Water body		
Industrial		
Religious		

their definitions and awareness of deforestation, perceptions of drivers and barriers to deforestation and trade-offs between cocoa production and deforestation.

3.1. Key stakeholders, policies, initiatives, practices in the cocoa sector in Ntui

3.1.1. Government stakeholders in cocoa and forest policies

In Cameroon, five government ministries influence cocoa and forests, each with their own policies, which are briefly described. The Ministry of Economy, Planning and Land Planning (MINEPAT) is responsible for landuse planning, including land titles. However, the majority of cocoa fields, in Centre region and nationally, are under customary land rights and not formalised (Folefack and Darr, 2021). The Ministry of Agriculture and Rural Development (MINADER) aims to double national cocoa production from 300,000 to 600,000 tons by 2030 via 'sustainable farm expansion', improving cocoa yields by providing improved hybrid cocoa seedling to registered farmers, providing fertilizers and pesticides and training farmers on good agricultural practices (Office of the Prime Minister, 2014). These activities are implemented by Société de Développement du Cacao (SODECAO), reporting to MINADER, a parastatal promoting cocoa production, and the PAD-CACAO program, via farmer groups, such as cooperatives and Common Initiative Groups. MINADER recommends planting 1200 cocoa trees per hectare, although they recognise famers often plant more, and to practice selective tree felling before planting. The National Agricultural Investment Plan 2020–2030 sees cocoa as the future, allocating 40.000 million CFA of investment, although the Fonds de Développement des Filières Cacao et Café, allocated the PAD CACAO program only 569 million CFA in 2021 (FODECC, 2021). The Ministry of Forestry and Wildlife (MINFOF) is responsible for the management and protection of forests. Under the 1994 Forest Law, farmers should obtain permission from MINFOF before cutting trees of economic value in their farms, and slash and burn is not permitted. MINFOF indicated that many farmers do not obtain permission before cutting trees but burning is more respected although some livestock and cocoa farmers engage in bush burning to open new fields or convert fallow. This practice was observed and confirmed by other stakeholders, including MINDADER. The Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) collaborates with MINFOF concerning bush burning and tree felling (Ministère de l'Environnement de la Protection de la Nature et du Développement Durable, 2018) and regarding the 2018 national emissions reduction strategy that addresses deforestation and degradation (Ministère de l'Environnement de la Protection de la Nature et du Développement Durable, 2018) They promote agriculture without agrochemicals or in small quantities. Cameroon has a list of chemicals approved by MINEPDED and MINADER, although in practice, non-authorised farm inputs can be found in the market and many farmers are not aware of the regulations or are unable to follow application guidelines on some imported chemicals due to low literacy or due to instructions provided on inputs being in foreign languages. An environmental impact assessment (EIA) is required for large farms (>100 ha); however, no cocoa farms of

this size were known in the area. The average farm size is around 4 ha, although some larger farms up to 20 ha exist. The Ministry of Commerce (MINCommerce), under which the National Cocoa and Coffee Board (ONCC) has operated since 1991, publish daily trading prices for cocoa and perform post-harvest quality checks of cocoa sold by traders. The tax of 25,000 F CFA/ton on exported cocoa is used to fund this work, as well as supporting the cocoa sector platform, the Conseil Interprofessionnel du Cacao et du Café (CICC) and providing development funds through the Fonds de Développement des Filières Cacao – Café (FODECC). Recently funded projects in collaboration with Ministry of Research and Innovation (MINRESI) and the Agricultural Research Institute for Development (IRAD) have focused on increasing the quantity and quality of cocoa production pre- and post-harvest. In February 2023 the first session of the multi-stakeholder consultation platform "Sustainable Cocoa Committee in Cameroon" between MINADER and MINCommerce and public and private sector, civil society, and research representatives, aiming to implement the "Roadmap to deforestation free cocoa", an initiative financed and supported by the I Sustainable Trade Initiative (IDH) (IDH, 2021, 2023). This has been a turning point from the situation at the start of the study, when none of the government stakeholders had policies which explicitly addressed forests and cocoa. Most farmers were not aware of the different government roles and policies, except for MINADER and ONCC, and often their information was outdated.

3.1.2. Cocoa buyers, traders, and cooperatives

Farmers sell dried, fermented cocoa beans to cooperatives (Union de Producteurs de Kousse (UGicPABKousse), Société Cooperative de Ntui (SOCONTUI), Société Cooperative des Entrepreneur de Cacao, Ntui (SOCOOPEC), SOCOOPAME and Société Coopérative de Ndimi (NADAFCOOP-NDIMI), approved Licensed Buying Agents, and coxeurs who purchase cocoa from farmers and sell to cocoa traders. Traders export to cocoa and chocolate manufacturers such as Mars, Nestle, Hershey and Ferraro. Major traders operating in the area are Telcar (selling to Cargill), SicCacao (selling to Barry Callebaut) and OlamCam (selling to Olam). These traders also purchase from approved agents, cooperatives and coxeurs. Intense competition was reported between buyers, and increase in the production of certified cocoa in the study area, reflecting the situation in Cameroon (Nkouedjo et al., 2020). For Rainforest Alliance/UTZ and Fairtrade certified cocoa, a premium of 50 to 150 CFA/per kg is generally paid to the cooperative, a proportion of which is paid to farmers. These cocoa certification standards all include requirements for farmers to conduct good agricultural practices, maintain shade trees, protect (existing) protected forests and maintain traceability schemes. Cooperatives buy cocoa from farmers and sell direct to traders, with many cooperatives in the area selling certified cocoa to traders. A proportion of the premium cooperatives receive from the traders is used by cooperatives to cover running costs, management, training and bulk purchase inputs, and a part goes to the farmers. Traders and the certifiers reported that certification does not permit farms to be certified if they have been created from a forest since before 2014 (Rainforest Alliance) and 2018 (Fairtrade) or are located in a protected area (Fairtrade International, 2022; Rainforest Alliance, 2022). This was not mentioned by farmers in the FGDs. All the traders, generally in collaboration with their approved buyers and civil society actors such as NGOs, had corporate programs for sustainable cocoa – shown in Table 3. A common strategy of all three programs is to improve yields (and thus incomes and thus reduce poverty) through the application of Good Agricultural Practices and technical support, which was stated as also being a way of avoiding deforestation. This is based on the impact logic that increasing yields allows farmers to earn more from the same or smaller area of land, and as cocoa and shade tree planting increases tree and 'forest' cover. All the corporate programs are largely delivered through third party certified cooperatives (see Table 3). None of the coxeurs were certified or have sustainability programs, although most provide access to farm inputs and direct payment upon delivery of cocoa beans and/or credit. Most farmers knew about the sustainability activities of the cooperatives, traders and coxuers they sell too. However, they have little knowledge of other buyers, particularly prices, trade conditions, and sustainability programs, although they are often aware of Cameroon export prices and world market prices via media. Confusion concerning the implementers and financers of sustainability and training programs was common.

IDH started a multi-stakeholder initiative bringing together state, private, CSOs and NGOs, and researchers to develop the Roadmap for Sustainable Cocoa in 2020. In 2022 with assistance from the German Development Cooperation (GIZ) and IDH, stakeholders were invited to a series of Cocoa Talks with EU Delegation about how to align Cameroonian policies and practices with the emerging EUDR (European Parliament, 2020) on the import of free- deforestation and forest-degradation commodities. Although the Talks were presented as dialogues to bring together regulatory, policy, industry and civil society stakeholders, several participants described them as monologues.

Table 3
Trader's corporate sustainability programs relating to cocoa production and forests in the Ntui area.

Trader	Program	Core elements	Third party certification	% cocoa volumes georeferenced and traced 2021/2022
Barry Callebaut	Forever Chocolate	• Prospering farmers – via farm business plans and support • Eradicate child labour from supply chain • Become carbon and forest positive reduction of land use change from cocoa due to traceability (certification) and sourcing, reduce carbon footprint, plant cocoa and shade trees • Sustainable product sourcing	Rainforest Alliance (formerly UTZ)	+/− 45 %
Cargill	Cocoa Promise/ Farmforce	• Farmer livelihoods – professional farming practices and resilient livelihoods • Community Wellbeing – safety & wellbeing children and cocoa families • Protect Our Planet – environmental best practices in cocoa farming • Consumer Confidence – help consumers choose sustainable products (labelling, certification) • Transformation together – partnerships for sector transformation	Rainforest Alliance (formerly UTZ)	+/− 35 %
Olam	Cocoa Compass	• Prospering farmers • Traceability at source • Cocoa farmers in supply network achieve a living income • Eliminate child la–our - child labour monitoring, cocoa farmers children have access to education • Investing in nature - protect forests, increase tree carbon stock, deforestation monitoring • Forest loss risk index	Rainforest Alliance (formerly UTZ) Fairtrade	±27 %

Sources: Interviews, trader's corporate websites, (Fabre et al., 2022).

Despite negotiations and consultations, some stakeholders believed that the wording of the regulation means that Cameroon's high percentage of forest cover, and differing EU and Cameroon definitions of forest, practices of cocoa agroforestry, mean expansion using the shaded, cocoa forest production systems believed to dominate in Cameroon is perceived as liability for continued exports to the EU, with no possibilities under the EUDR for expansion into degraded forests and no incentive for chocolate agroforests. The impact of the EUDR in reaching farmer living incomes; ability to map plots; the costs of developing, implementing and monitoring traceability systems, including integration into existing certification standards and corporate systems, were also major issues of dispute mentioned by participants. References to national sovereignty and (de)colonization of trade policy were made by some stakeholders.

3.1.3. Cocoa farmers

The majority (89 %) of cocoa farmers in FGD were male in both areas. Women were reported as not being directly engaged in cocoa farming, and are generally not farm owners, but they do conduct activities such as harvesting and drying beans. This is in line with other sources, reporting that 98 % of the cocoa farmers in the study areas are male [2], and 77 % on a national level [3]. Most farmers (81 %) grew up in the central region, with the exception of farmers in Yalongo and Ndimi where respectively 67 % and 23 % grew up in the North East region. The average household size was out of 7.27 members on average, which is higher compared to the national average of 5.2 members (United Nations, 2017). Farmers own 4.46 ha of land on average, out of which 93 % is for cocoa production. Farmers within the forested area have larger farm sizes (5.31 ha compared to 3.53 ha). This is within a similar range to studies showing average farm size in the study area as 4.5 (Pédelahore, 2014a) to 5.5 ha (Kumase et al., 2010). The yields of farmers reported in FGDs are lower in the forested area ($n = 44$, average 462 kg hectare) than in the degraded forest area ($n = 40$ average 582 kg hectare). For both areas, these yields are higher than the range of 214 to 524 kg/ha reported in the study area [4], and 300 kg/ha on average in Cameroon (Kumase et al., 2010). The average farm age is 16 years. Farmers reported previous land use of their cocoa farms as being forest (90 %), especially in the forest area (95 % compared to 84 % in the degraded area). Practices relating to deforestation and degradation occur when forested or fallow land is cleared to plant cocoa, or when plots with old trees are cleared for replanting or rehabilitation. Clearing forested land involves leaving several selected, large tree species, due to their value for timber, fruits, nuts or medicinal barks, and providing shade for cocoa or because they are too large to fell. Shade trees also increase natural composting and maintain soil fertility and moisture. Farmers reported planting a variety of trees, both exotic and indigenous species of economic and food value, such as mango, avocado, citrus, safou (*Dacryodes edulis*), oil palm (*Elaeis guineensis)* and cola *(Garcina cola, Cola nitida, Cola acuminata),* njangsang *(Ricinodendron heudelotii)* and cassamangue *(Sponythereaherea S.)*. The shade function was stressed as important by farmers in the degraded forest and savannah areas. Apart from shade trees, generally, all other vegetation is cleared when new farms are opened, and farmers clear undergrowth between one to three times a year. When cocoa trees are young farmers often plant banana, plantain and cassava, and after five to six years, produce shade tolerant crops under the canopy such as pineapple, macabo and chili pepper, similar to findings of other studies (IDH/WWF/ICRAF, 2020; Lionelle, 2021; Pédelahore et al., 2023). Farmers and cooperatives did not report being involved in forest protection, afforestation, or restoration programmes.

3.1.4. Incoherent, unaligned forest and cocoa policies and practices

The key stakeholders and state and private sector policies, at national, regional and international scales, are not well aligned. A coalescence of government and market-based stakeholder's forest and (agroforestry) cocoa policies and programs are now slowly emerging because of international pressure, notably the Roadmap and Cocoa Talks as part of the EUDR. However, only few stakeholders (NGOs, government, academia, development organisations) interviewed indicated they have been engaged in discussions on how to actively protect remaining forests and to align policies and practices on how to achieve this. At cooperative and farmer level there was little awareness of the upcoming EU legislation, deforestation was not a topic, and an expansion in area planted with cocoa was expected, with an assumption that any increases in cocoa productivity would not prevent deforestation. The EU Cocoa Talks did not tackle how to reach farmers that are not certified or not selling to cooperatives, which make up the largest proportion of farmers in the area.

Other studies have similar findings about incoherences and incongruences between stakeholders, their practices, initiatives, and policies concerning (zero)deforestation. Vogel et al. (2020) found that perceptions towards future transitions are not actively coordinated in Cameroon. Mithöfer et al. (2024) compared Cameroon, Peru, and Indonesia, finding that policies and development programs focus on expansion and productivity increases, irrespective of smallholder needs for economically viable farming systems and market structures resulting in little farmer bargaining power. Sustainability standards are spread unevenly, and competing interests and interdependencies between different actors' responses to concerns are not openly acknowledged by public and private sectors. The lack of power, with voices of smallholders largely unheard (Mithöfer et al., 2024), especially women and youth (Amon-Armah et al., 2023), has been noted in the cocoa sector globally (Fountain and Hütz-Adams, 2020).

3.2. Extent of deforestation in Ntui in the past decade

Of the sample of 557 field observations, the majority (52 %) of the land cover observed consisted of cocoa plantations, shown in Fig. 3. The spatial analysis and ground verification shows the extent of deforestation in the Ntui study area in the 10 years from 2010 to 2020 is 4599 ha. Using satellite imaging data and the field validation observations, land cover differences were confirmed between the villages in the forested and degraded forest areas. In the degraded forest area, the largest share of locations sampled were occupied by agricultural land (39 %), followed by residential areas (22 %) and cocoa plantations (17 %). Of these cocoa plantations, three-quarters were observed as poorly maintained. In forested area, half of the observed locations were occupied by cocoa farms. These farms were relatively young, with an average cocoa tree age of 13 years and three-quarters of these farms were well-maintained.

The analysis of land cover changes shown in Fig. 4 shows increasing conversion of forest to cocoa farms from 2010 to 2020, and illustrates gradual deforestation, the very local, plot and farm level of deforestation and changes, resulting in the current mosaic nature of the landscape, with forest and cocoa dominating, interspersed with agriculture and grasslands. Observations near villages in degraded forest area show larger areas of agricultural crops other than cocoa, whereas near villages in the forested area, cocoa was the predominant crop.

Sources: Satellite images and ground verification.

Fig. 5 provides an example of the level of detail of forest cover and photographic evidence, showing how deforestation occurs on a small, plot level scale. The results of the satellite analysis supported by the ground verification clearly show that most subsequent land use changes after deforestation closely coincide with the growth of cocoa plantations. The ground validation datasets, FGDs and interviews further support this finding.

A) Forest cover change with ground observation photograph of a forested area near Ndimi village.

B) Forest cover change in degraded area with ground observation photograph near Betamba village.

C) Forest cover change in degraded area near Biatsota village.

Sources: OSM, historical satellite images and ground verification.

To contextualize, similar trends of forest and tree cover loss occurred

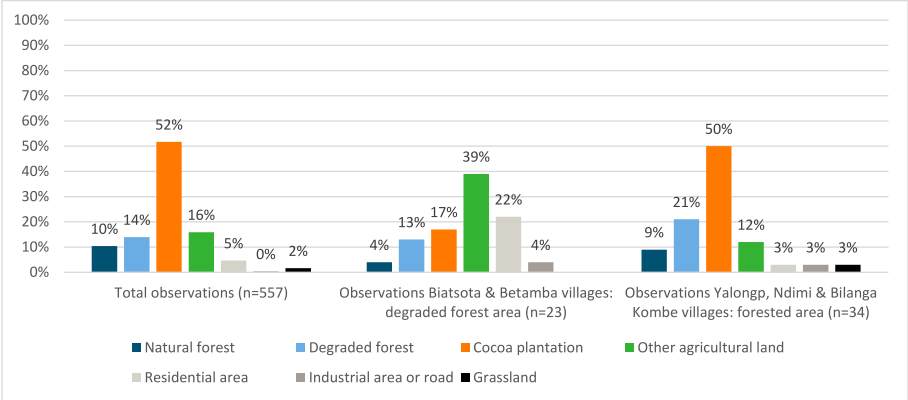

Fig. 3. Land cover ground validated observation locations in forest and degraded forest areas, Ntui.

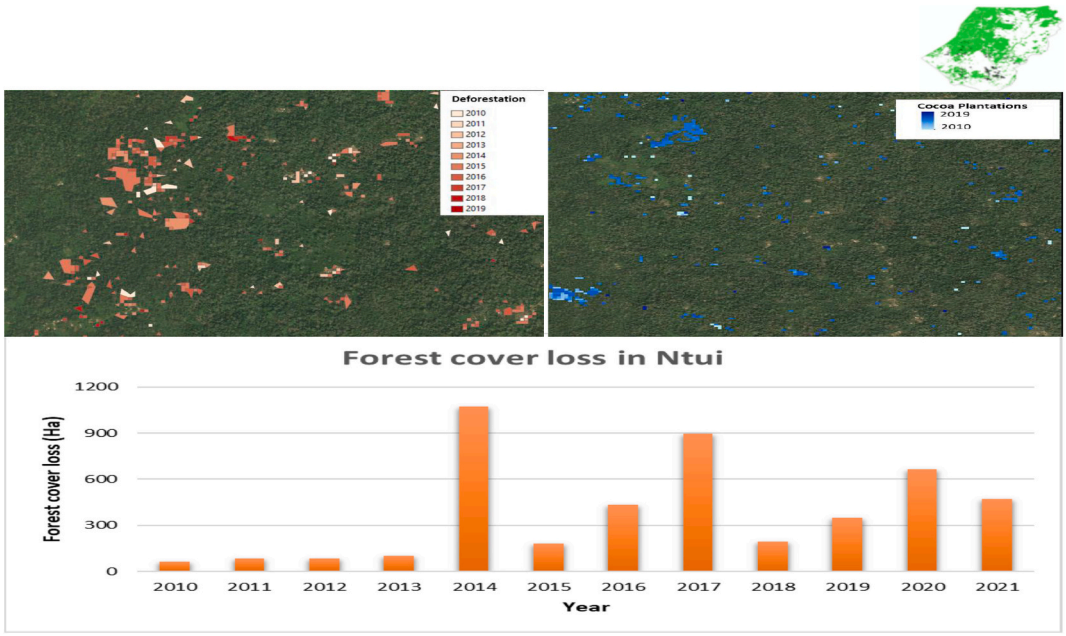

Fig. 4. Progression of changes in forest cover and cocoa farms 2010–2020 Ntui Cameroon.

from 2002 to 2022 in Mbam et Kim department (shown in Fig. 6) with a 54 % of total tree cover loss, and decrease in the total area of humid primary forest of 4.0 %, a 4 % decrease in tree cover since 2000 (GFW, 2023). Similar national and regional Congo Basin trends are attributed to economic growth, population pressure and agricultural conversion, with otherwise a general increasing trend in primary forest and tree cover loss peak in 2014 is attributed to changes in measurement methods (Dalimier et al., 2022). The ground validation observations emphasised the unreliability of landuse cover maps for the categories of forest, natural forest vegetation, degraded forest, and tree and cocoa plantations. The percentage overlap between ground observation data and the OSM land use classes for forest was 32 %, farmland 17 % and residential 2 %. Of the 557 observations, 64 % that were shown indicated in the OSM as forest, were in fact cocoa farms; 3 % that were shown as agricultural farmland were cocoa farms and 3 % indicated as residential areas were also cocoa farms. The field observations suggest that detecting differences between mature, shaded chocolate forests and forests, and young, unshaded cocoa plantations in grasslands and agriculture according to non-ground verified map, makes for unsuitable and unreliable decision making. Such difficulties in distinguishing cocoa agroforestry from forest, degraded forest and fallows has been recognised (Critchley et al., 2021; Kanmegne Tamga et al., 2023; Niether et al., 2019). This finding has significant implications for Cameroon and EU policymakers implementing the EUDR.

3.3. Definitions and awareness of deforestation

According to key informants, forests were defined as a group(s) of trees with a given density or forest cover, some distinguishing between primary forests, using terms such as "*natural, virgin or untouched or unexploited*", and secondary forests as "*degraded or exploited forest areas*". Farmers generally defined forest as "*unlogged and unfarmed land*". Traders, NGOs and researchers mainly defined forests from a legality perspective, citing the 1994 Law on forests, wildlife, and fisheries (République du Cameroun, 1994), adding in whether it is primary or secondary. IDH, WWF, Rainforest Alliance and researchers also defined forests according to land use cover, using the FAO inspired definition of "*land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use*". The EUDR (Art.2) (European Union, 2023) defines "forest' as "*land spanning more than 0,5 hectares with trees higher than 5 metres and a canopy cover of more than 10 %, or trees able to reach those thresholds in situ, excluding land that is predominantly under agricultural or*

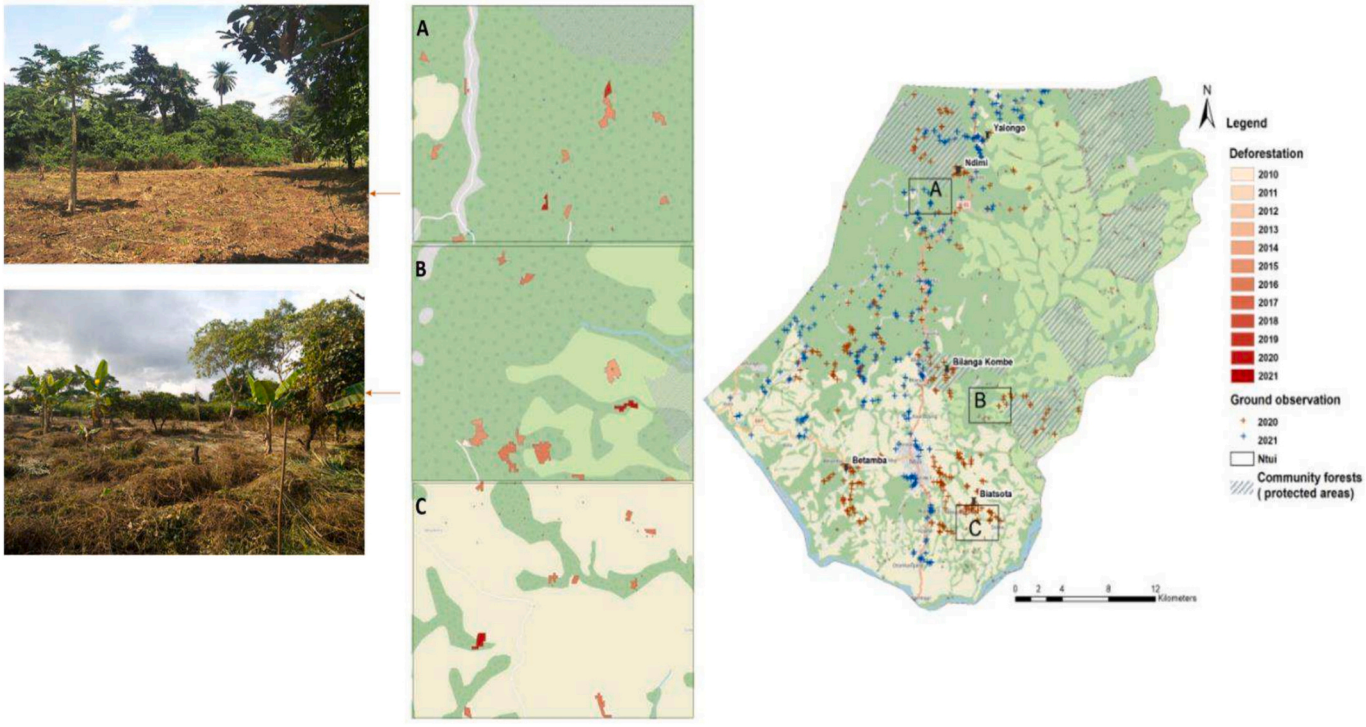

Fig. 5. Detail of forest cover changes 2010–2020 Ntui Cameroon.

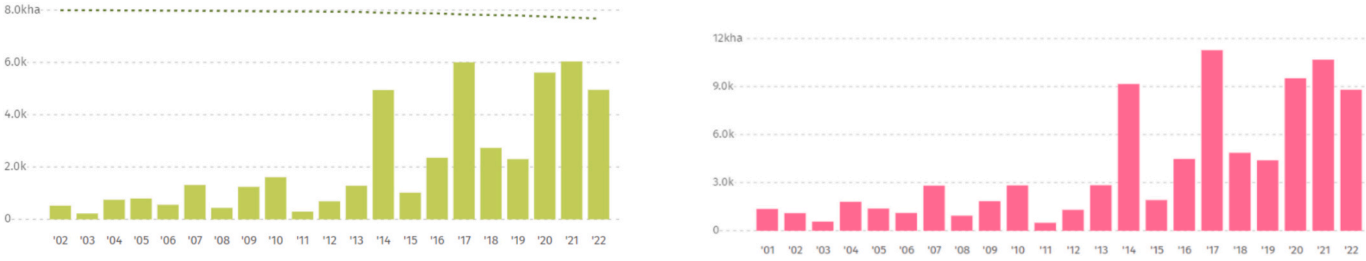

Fig. 6. Primary forest and tree cover loss in Mbam and Kim, Centre region, Cameroon 2002–2022.
Source (GFW, 2023).

urban land use", agricultural use as "*the use of land for the purpose of agriculture*", and in line with FAO definitions, "*agroforestry systems including where crops are grown under tree cover, as well as agrisilvicultural, silvopastoral and agrosilvopastoral systems, should not be considered forests, but as constituting agricultural use*". The Cameroon 1994 Forest Law distinguishes between national forest estate which comprises permanent and non-permanent forests domains, with permanent forests being lands used solely for forestry and/or as "wildlife" habitat (and including state and council forests) and non-permanent forests as forest lands that may be used for other purposes than forestry and include communal forests; community forests and forests belonging to private individuals and includes communal forests, community forests and forests belonging to private individuals. There is no biophysical definition of forests, deforestation, or plantations. The Framework for Action underling the Roadmap seeks to comply with the 1994 law to prevent activities in the cocoa sector that cause or contribute to any form of deforestation or forest degradation in the permanent forest domain (IDH, 2021).

All participants in the key informant interviews and focus group discussions indicated being aware of the concept of deforestation. Deforestation was generally defined in the FGDs in both high and degraded areas as "the removal of trees for sale or use of land for other purposes". Most farmers did not see their own cocoa farming activities as causing deforestation or cocoa production as one of the causes. Instead, in degraded forest area, farmers indicate that the dam construction along the River Sanaga and private oil palm plantations are major causes. In forest area, logging companies are seen as the major cause. A village chief explained that farmers do not see selective felling of trees and replacement with (other) trees as deforestation. Deforestation in key informant interviews was defined as the loss of trees and forests, using terms such as destruction, loss, killing and threat. Cocoa traders did not use the term 'deforestation-free cocoa'. Barry Callebaut has committed to reducing its carbon footprint which implies no land use change to achieve zero-net-deforestation (Callebaut, 2016), and that forests can be cleared if they are replanted. Barry Callebaut's objective of being "carbon and forest positive" by 2025 implies regenerating more forest than is degraded. Olam wants to "both reduce and reverse deforestation". Cargill has committed "to reducing [their] environmental impact, including ending deforestation in [their] cocoa supply chain". Olam wants to reduce and eventually reverse deforestation, and monitors deforestation, taking account of the amount of land used for cocoa farming and the amount of forest in their supply chain, the quality of the trees and agroforestry systems and relationship to carbon capture and biodiversity (Olam Cocoa, 2020, 2021). Most definitions thus use concepts of land use change and forest exploitation to define deforestation. This is similar to the EUDR (Art.2) (European Union, 2023) which defines "forest degradation' as "structural changes to forest cover, taking

the form of the conversion of: (a) primary forests or naturally regenerating forests into plantation forests or into other wooded land; or (b) primary forests into planted forests".

Most cocoa farmers reported not having heard of the term sustainability. However, when asked what they think it meant, defined it in terms of quality and as old cocoa plantations that still produce. Traders and certification organisations defined sustainability as addressing social-economic (well-being, livelihoods and human rights) and environmental protection, stressing that protection includes cocoa plantations not encroaching protected areas, shade tree cover on farms and on avoiding pollution. The Roadmap defines sustainable cocoa as "cocoa that is produced in accordance with economic, ecological and social requirements, which means that its production is economical, environmentally friendly and socially responsible, without compromising the ability of future generations to satisfy their own needs" quoting a GIZ 2019 definition (IDH, 2021). Sustainability and sustainable cocoa is mentioned but not defined in the Horizon 2020 strategy (Beule et al., 2014).

Common themes can be seen between stakeholder's definitions, particularly international and private sector. Wider disparities are evident between farmers and stakeholders in the project area, and between stakeholders where cocoa is their primary objective with forestry, environment, and conservation focused stakeholders. There are also incongruities between definitions, particularly definitions of cocoa agroforests, primary forest, permanent forest domain, drivers of deforestation and incentives for protection and restoration. The incongruence of definitions and perceptions was prominent at the end of the EU-Cameroon Cocoa Talks, resulting in unaligned national and international policies at odds with common cocoa farming practices in the Ntui study area. The spatial analysis emphasises that policies based on conventional land cover classifications[1] which illustrate changes from primary to secondary forest and other landcover, are unaligned with practices. Particularly the practice of conversion of natural forest to cocoa farms, chocolate forests or tree plantations (using EUDR terminology) found in Ntui is not clear on maps. Cartography does not accurately detect cocoa agroforests, nor do they show this as deforestation once a cocoa agroforestry site has canopy cover.

These findings have implications for monitoring reforestation of grasslands and savannah, particularly due to expanding cocoa in the savannah area, a point raised by Harmand et al. (2020). These findings also have significant implications for commonly used statistics of deforestation and degradation (e.g. FAO, GFI/WRI as used in Congo Basin State of Forest (Dalimier et al., 2022) national and regional forest monitoring). This is due firstly to discrepancies between land cover classifications used and the different reality of agroforestry cocoa practices and difficulties in detecting, monitoring, reporting and verification of cocoa agroforestry. This finding resonates with work by Lescuyer et al. (2024) to define agroforestry cocoa for Cameroon and Central Africa. Secondly, confusion is multiplied due to the multiple and different definitions used in Cameroon and internationally: for example, forest conversion is not considered as deforestation according to FAO definition where planted forests fall under the category of "forest". Again, this has been a critique of the EUDR (Lescuyer et al., 2024; van Noordwijk et al., 2024). Thirdly, the implications for monitoring and traceability, particularly in relation to EUDR, show the difficulties to be overcome when using low level granularity maps for traceability and risk assessment, resonating with Gallemore (2023) and European Commission et al. (2024). This study provides evidence from Cameroon how this is particularly relevant for small scale cocoa farms under 4 ha and confirms the need and value of ground validation.

[1] For example, the CORINE land use classes used in this study, see Table 2.

3.4. Drivers and barriers of deforestation and degradation

The interviews and focus group discussions indicated motivations and actions related to cocoa farming and forests, asking what farmers would do in different scenarios of changes in income, cocoa prices, yields, costs of land, costs of labour and fertiliser which could drive farmers to start new cocoa farms or not. Other stakeholder's perceptions of drivers of deforestation were also assessed, recounted in the next section.

3.4.1. Deforestation drivers

3.4.1.1. Financial pressures and high cost of living. The main reason farmers and stakeholders gave in both areas for opening new cocoa farms is financial pressure "*a lack of capital to develop new farms and manage old ones*" and to meet increasing living costs, especially when their families are growing. Specifically, school fees were mentioned as a regularly occurring high cost. Increasing cocoa prices are expected to help farmers achieve a decent standard of living, but not to prevent deforestation. Farmers indicated that if they had money or if cocoa prices increase, they open new cocoa farms to generate revenue to increase farm production and improve their standard of living. Some village chiefs indicated that it is difficult to stop farmers from deforesting, as it is their culture and larger farm sizes are a sign of a higher socio-economic status.

3.4.1.2. Cocoa farming. Many cocoa farmers did not consider their own activities as deforestation. One of the village chiefs indicated that "*farmers do not see the selective felling of trees and replacement with (other) trees as deforestation*". Farmers mentioned that other actors were the primary cause of deforestation, this indicates that farmers may not consider their own activities as such. Farmers in degraded forest cover indicate that dam construction on the River Sanaga is an important cause of deforestation, and private oil palm plantations. In forested areas, farmers indicate that logging companies are the major cause of deforestation.

3.4.1.3. Low and high yields. Many farmers perceived "*low cocoa yields as the result of farming on degraded land* (i.e. less fertile soils), *high prevalence of diseases, and climate shocks*". Farmers indicated that if their yields per hectare would decrease, they would open new cocoa farms as a way of mitigating the losses in income. Almost all interviews and in FGDs indicated that yields in the area have been steadily increasing in the past 10 years. Two village chiefs however indicated strong decreases in the past 10 years because of old and degraded farms. Yields were seen as very low 10 years ago due to low knowledge and application of good agricultural practices. Yields were generally stated as having doubled in the past 10 years. Most stakeholders mentioned that 2020 was an exception with a decline in yields because of drought and pest attacks. Yield increases were predicted to possibly stall in the future due to declining soil fertility and climate changes, which are expected to become more frequent occurrences. Some farmers also mentioned the opposite, that "*improving yield per hectare will cause opening more farms since they need more money to take care of their needs*."

3.4.1.4. Migration. Farmers in FGD and other stakeholders indicated that "*migrants and internally displaced people engage more because they seek survival*" are most responsible for deforestation. These migrants originate mostly from the anglophone Northwest and Southwest regions, the North and Yaoundé. Migration has occurred in the last fifteen years and increased since 2017 due to the anglophone conflict. Migrants generally obtain land under customary authority, opening new farms and working for existing farmers as "cheap" labour which helps them to open new cocoa farms, as particularly forested (and to a lesser extent secondary or fallow) land clearance is seen as one of the most labour-intensive tasks in

cocoa production. More migrants have settled in the forested area. The degraded area was seen as less attractive as there is less forest left to buy, land that is available is less fertile, and village chiefs prevent newcomers from settling by only selling land to people who have been living in the area for a long or who are well known in the village.

3.4.1.5. Population growth. Besides migration, local population increases have driven demand for land for cocoa production. Cocoa farmers and their children who inherit farms generally were seen to stay in cocoa production, in part as they have no other income sources and because "*cocoa farming is a way of life*" and "*it's our culture*". Cocoa is seen as challenging due to low yields on older farms, with many adapting by creating new fields from natural forests. As a result of the growing population, and as children generally stay in the same area as they are born, plus an increasing number of migrants coming into the area, more farmland is needed, resulting in smaller farm sizes, an increased number of plots and distances from village to farm plots increasing. When farmers have little capital to invest, natural forests are preferred as being easier to farm and more fertile than unfertile, savannah and degraded lands.

3.4.2. Land and labour prices

Farmers stated that the availability (and prices) of labour also influence decision-making about opening new cocoa farms, and that "*the price for labour has changed drastically*". When f the availability of labour increases or price decreases, this encourages new cocoa farms, as the preparation of forest areas is labour intensive. Despite the influx of migrants, farmers and stakeholders indicated that labour prices have increased in the past 10 years. Payment for labour has changed from being mostly cash wages to a percentage of the yield.

For land, farmers indicated that decreasing land prices would encourage opening new cocoa farms. Prices for land however have strongly increased over the years, up to 10 times higher than 10 years ago and between 3 and 10 times higher in the last 5 years. In some regions, land was free 10 years ago and given away by chiefs upon stating the intended activity on the land. The current value of land ranges between 150,000 XFA (€229) per hectare to 500,000 XFA (€763) per hectare, depending on the location. Village chiefs reported receiving cash in return for giving out customary land rights, as well as receiving commodities (food or wine), services (work on their land) and daughters.

Forest land is attractive for newcomers and valued by the local population. The farmers in the forest area considered forests a "*natural bank*" for future development and many families and individuals have claimed and appropriated natural forests for their own use, in anticipation expanding their cocoa farms or for their children when they come of age. For this reason, in forests around Ndimi, Yalongo and Bilanga-Kombe communities, cocoa trees have been planted and forest trees felled to signify occupancy, even when the families are not otherwise cultivating the land.

3.4.2.1. Accessibility of land. Improved accessibility to both areas due to improved infrastructure (the tarred road and bridge) "*gives farmers the access to new areas to open new farms*" was also perceived to lead to increased deforestation. The degraded forest area has better accessibility and thus is more attractive, according to all stakeholders. This is confirmed by the spatial data.

That low productivity, cocoa prices and farm incomes in cocoa production countries worldwide and in Cameroon drive deforestation has long been recognised (Jagoret et al., 2012b; Jagoret et al., 2018; Manga Essouma et al., 2021; Ruf and Zadi, 1998; Sassen et al., 2022). This study adds more nuance and detail that population growth, including from migration, is a driver in Cameroon, similar to Ivory Coast (Sabas et al., 2020). A new facet is that many farmers do not perceive their farming practices to constitute deforestation. An understanding of perceptions has been shown (Kenfack Essougong et al., 2020) as critical to understand practices.

3.4.3. Barriers to deforestation

In the focus group discussions and interviews, the following barriers to deforestation were identified:

3.4.3.1. Improving yields. To prevent farmers from settling in forested areas, alternatives to increase their production were encouraged by researchers, NGOs and traders. This is due to "*farmers who are unable to implore GAPs, realise land exhaustion and low yields, thus seeking new more fertile lands*". Increased yield is also a focus of certification standards. Stakeholders see increased productivity as an alternative to helping farmers cope with their perceived increased costs of living. Their expectation is that earning more money on the same piece of land will prevent opening new farms. Farmers also indicated that generally the most important way to increase their incomes without expanding their farms is to improve their yields, via the application of good agricultural practices, or using more inputs (i.e. fertilizers, pesticides and labour). Additionally, farmers themselves also mentioned the use of mixed cropping to improve their incomes without expanding their farms. However, some traders and farmers mentioned that improving the productivity will encourage farmers to open new fields as they have more money which they can invest in more land. Financial pressures mean farmers yearn to improve their standard of living at all costs. Increases in income because of higher yields per hectare may therefore not prevent further deforestation but enable it.

3.4.3.2. Awareness. The majority of the interviewed government officials, traders and cooperative managers indicate that raising awareness, "*trainings and sensitization to farmers through the cooperatives*" about the need and benefits of preserving forests could help reduce deforestation. However, they indicate that it will be difficult for farmers to stop deforesting with awareness raising alone, as the need for cash is a strong driver, combined with the culture of growing cocoa in the area.

3.4.3.3. Restricting land sales. All the chiefs stated that restricting land sales may discourage newcomers from settling in forested areas, "*thus making it less accessible by migrants and new settlers*". For instance, in Betamba, a new settler cannot buy land until he has resided permanently in the community for upwards of ten years, and land sales are restricted in some villages. The chiefs of villages in both areas indicated such restrictions, with land now only sold to well-known people in the community. In Betamba, living in the village for around 10 years is a prerequisite to buy land. In general, farmers and chiefs gave the main reason for not selling land to safeguard it for future generations, because they don't know or trust people and out of fear of conflicting interests.

3.4.3.4. Enforcing regulations on protected areas. All stakeholders except the Ministry of Forestry reported that few regulations exist regarding deforestation. The laws reported as relevant concern protected areas in the form of forest reserves, national parks and community forests,[2] shown in Figure 1Table 4, were little known and seen as weakly implemented. NGOs stated that "*Conservation groups should advocate for the effective enforcement of the management of community forests, protected forests and reserved areas*". The low level of knowledge and law enforcement and perceived absence of protected areas in the Ntui area presents few barriers to farm expansion in the forested area. Exceptions were in Ndimi-Yalongo where the chief and council have defined a

[2] Community forests provide rights to a defined community to manage and exploit a forest area according to a simple management plan agreed with the government and can include logging, non-timber forest product exploitation, agriculture and recreation. The use of heavy-duty machines for logging is forbidden.

conservation area (referred to by some as community forest) comprising savannah, fallow field, natural and degraded forest where the community is not allowed to log or farm. Despite the community forest and customary regulation, some people, especially youths, notables and elders are farming, degrading, and deforesting the area. The other Community forests in the area (see Table 4) were not mentioned. The timber concession Forest Management Unit (UFA) was mentioned and reportedly replaces trees after logging, according to its legally required management plan. There was no known environmental impact assessment (EIA) for cocoa farming, as no farms over 100 ha were known in the area. A 200-ha cocoa farm in Bembegne near Yoko was reportedly not subject to an EIA as it has been gradually developed. All stakeholders indicated they expect deforestation to increase north, towards Yoko where there are less disturbed, primary forests, and many think that the Mpem Djim protected area and Mbam Djerem national park are at risk. All the cocoa traders intended to buy (more) from the forested area in the future.

Diving into literature, improving yields, and awareness, information and training combined with capacity to implement such knowledge, and enforcement of laws governing forest and protected areas have all been shown to act as barriers to deforestation and degradation, and incentivize or promote forest protection (Ingram et al., 2018b; Sassen et al., 2022; Waarts et al., 2019). Less prominent in the literature is the finding concerning customary control of land sales, albeit that the explicit aim of local control is not to avoid deforestation. The ability of statutory land tenure to act as barrier to deforestation is thus limited (Folefack and Darr, 2021), particularly given low levels and difficulties in land titling in Cameroon and across West Africa (Asaaga et al., 2020). Given the power inequities shown in the analysis of key stakeholders, equitable tenure reform that incentivises cocoa agroforestry adoption rather than deforestation is critical.

3.5. Trade-offs between cocoa and forest policies and practices

During the stakeholder interviews and FGDs in both areas, trade-offs between farmer livelihoods and forest use were not explicitly expressed. However, some stakeholders espoused paradoxical views, and different groups of stakeholders had the following contrary views.

3.5.1. Forests both benefit and hinder cocoa farming

For farmers, forests were seen as sources of productive, fertile land for cocoa farming thus benefitting livelihoods. The negative effects of deforestation noted by NGOs, MINFOF and academics were increasing greenhouse gas emissions and loss of biodiversity. Paradoxically, cocoa production was seen detrimental to biodiversity, but also the biodiversity within forests was seen as creating pests and diseases (eliminated by hunting, trapping or using insecticides and pesticides) which make farming challenging and decrease production. Stakeholders such as NGOs, development and government authorities did perceive major trade-offs, particularly over longer time scales, where environmental externalities (e.g., soil fertility decreasing after forest conversion, increases in pests and diseases in cocoa plantations over time, and loss of forest ecosystem services). The Cameroon Horizon 2020 for Cocoa (Beule et al., 2014) does not mention cocoa as driver of deforestation or discuss its relationship to forests. The EUDR however clearly states that cocoa is a driver of deforestation and sets a baseline that cocoa entering the EU market does not come from land deforested after 31 December 2020.

Table 4
Protected forest areas around Ntui.

Name & Code	Area ha	Date attribution	Status
Mpem et Djim National Park	97,480	2021	National Park IUCN II
Kevin 08–006	51,450	2005	Production forest UFA
ASCOKYB 08–04-284	4421	2008	Community forest
DAPSBI NTUI 08–04-161	4835	2002	Community forest
ITOC 08–04-160	3018	2004	Community forest
Paysanne De Bilanga Kombe 08–04-060	4796	2002	Community forest
ASS 08–01–794	4358	2019	Community forest

Source (Ministère de Forêts et de la Faune, 2022.).

3.5.2. Cocoa farming reduces forest biodiversity but may also increase it over time

Farmers explained the practices such as clearing forests for cocoa means that plant biodiversity is reduced when forested land is first cleared for cocoa but tends to increase as cocoa plantations mature as selected trees are maintained, combined with planting exotic and native trees, making floral biodiversity dynamic over time as farmers replace dying forest and cocoa trees with other species. Farmers noted that spontaneous generation occurs, and they generally consciously select which regenerating species are left, such as oil palms. Farmers perceived animal biodiversity generally as "pests" (insects, caterpillars, squirrels, monkeys, deer), particularly in the forested area, where there were more animals present and they caused more damage, than farmers in the degraded forest area. The gradual conversion of large areas of the landscape from forest to cocoa plantations was seen as contributing to provide less favourable habitats for pests and to lower faunal biodiversity. This trade-off is well recognised by scholars (Ruf and Schroth, 2004) but is not translated into Cameroonian policy and discourses.

3.5.3. Trade-offs between state policies to increase cocoa productivity and production against deforestation practices

For MINADER, cocoa traders, cooperatives, development organisations and consumer country quasi government organisations (such as IDH and GIZ) and farmers, increasing cocoa and other on-farm crop productivity is a goal, achieved through improving access to agricultural inputs and the application of improved agricultural practices. Most farmers indicated that if productivity increases were achieved, and if the same or higher yields of cocoa were produced on the same amount of land it would reduce the need to expand into fertile forest land. In practice however, farmers indicated that significant productivity increases for the majority have been elusive, and productivity gains were hard to achieve with their limited financial and labour resources, even when they had knowledge (from certification GAPs, government, and trader's corporate programs) about how to achieve this. Most farmers also indicated in the FGDs that increased incomes would incentivize them to open new farms as they want to optimize their incomes, so improved yields may even incentivize them to buy more land and open new cocoa farms.

3.5.4. Trade-offs between higher cocoa prices and deforestation

Increasing cocoa prices, through certification premiums or through associations into cooperatives with better bargaining power, are embedded in corporate, certification policies and programs that aim to help farmers towards achieving a decent standard of living. In practice, most farmers indicated that price increases from certification premiums were marginal. Such price increases have been shown not guarantee preventing deforestation (Waarts et al., 2019; Waarts et al., 2021b).

3.5.5. Trade-offs between policies promoting increased cocoa production and restoration

Restoration is a requirement in certification standards and is central Cameroon's forest policy. It is not mentioned in the Horizon 2020 strategy (Beule et al., 2014), but in practice was not reported as implemented in the Ntui area. No mention of restoration through REDD or carbon projects, certification requirements or corporate sustainability programs was made. The spatial analysis and stakeholders indicate historical and forest degradation and deforestation in the last two

decades, suggesting this area could be a restoration focus. The EUDR mentions restoration under partnerships and cooperation, without being specific, and whilst excluding cocoa agroforest plantations from its definition of forest restoration. In contrast, the expansionist national cocoa policy and farmers indicated few practices of forest protection, whilst recognising that forest loss and degradation had occurred, this was not attributed to their farming practices. The value of forests was seen mainly from a utilitarian perspective, for their its role in water provision, soil fertility and climate regulation. Whilst state policies to protect forests are enshrined in Laws, governed by MINFOF, ANAFOR and MINEPDED, customary governance offers some level of forest protection, in practice, there was little awareness or respect for state and customary practices, and low levels of enforcement. This was attributed to low state presence in the field, customary traditions being eroded by the influx of peoples into the area, and high demand for land.

3.5.6. Trade-offs berween increasing population growth and high demand for land and labour and ability to meet national policies to increase cocoa production, forest policies or the EUDR

The forested area tends to have more fertile, cheaper and available land, attracting migrants and local people to create farms. All stakeholders indicated that they expect deforestation for cocoa to continue expanding northwards towards the remaining primary forests, including the Mpem Djim protected area and the Mbam Djerem national park. To protect primary forests (as defined in the EU, but not in Cameroonian law), the existence of and protection of protected areas and community forests needs to be known locally, monitored and enforced. Many farmers were not aware of protected areas or the EUDR. Farmers also do not perceive cutting primary forest and planting cocoa trees in cocoa agroforestry systems as deforestation. Customary and formal land title is not aligned, and whilst some land sales are restricted to prevent new people from starting cocoa farms, leasing land for cocoa and annual crop farming was mentioned as common in three villages.

3.5.7. Incongruence between farmers and areas with deforestation risks

The FGDs suggest that many farmers, (certified or not) have expanded into forested areas and will continue to do so if they have access and resources. Being a member of a cooperative, certified and engaged in corporate sustainability programs appears to decrease this risk, as farmers have increased awareness of deforestation and better access to means to increase productivity. However, monitoring, controls and enforcement in both cases are limited to the recent geo-mapping of farmers and their relation to forest and protected areas. In contrast, migrants into the Ntui study area, young farmers, those with access to labour to open new farms, “unsupported farmers” (i.e. not part of a group or participating in trader’s programs) and farmers in the forested area appear pose a greater deforestation risk. This corresponds with insights and recommendations for improving sustainable cocoa value chains in Cameroon (Lescuyer et al., 2020). As the spatial analysis shows, farmers in the already degraded and savannah areas, pose less risk in terms of EUDR requirements, as they are in an area largely deforested before 2020.

Contextualising these findings that there were few explicit, but many implicit trade-offs in practices mentioned by stakeholders. These incongruences have been widely recognised in academic literature (Ingram et al., 2018b; Ruf and Schroth, 2004; Schroth and Harvey, 2007; Waarts et al., 2019). As Waarts et al. (2021b) indicate, the trade-offs are not expressed and incorporated into the impact pathways underlying forest, deforesation and cocoa policies, with few conscious or cross-sectoral choices expressed about acceptable balances for the different stakeholders, particularly between forest conservation and livelihood aims underlying policies, this is relfected.

4. Conclusions and recommendations

This interdisciplinary study used interviews, focus group discussions, policy documents, spatial analysis and ground validation of satellite images to evidence land cover changes in the decade up to 2020, to explore the policies, perceptions and practices related to cocoa driven deforestation in one of the main cocoa growing areas in Central Cameroon with high but gradually decreasing levels of forest cover.

The findings of this study address global development goals espoused in the SDGs on poverty (SDG1), life on land (SDG 15) and sustainable production and consumption (SDG 12). They highlight that there are considerable trade-offs in reaching these three goals, which have generally not been explicitly considered in until recently sectoral policies i.e. on cocoa relating to SDGs 1 and 12 and on deforestation concerning SDG15, nor on individual versus collective practices of cocoa farmers and trading enterprises, a common governance challenge (Bowen et al., 2017).

To understand cocoa related deforestation means understanding the **diverse drivers and plural governance arrangements** as perceived by multiple **stakeholders in the value chain**. These include individuals, enterprises and organisations including farmers, cooperatives, cocoa traders and their associations, voluntary certification standards, civil society, NGOs and researchers in forestry and land use planning sectors the regulating local and national government organisations and traditional authorities. This study demonstrated that there are many national and international policies, statutory, customary/informal, as well as market-based arrangements governing cocoa production and forests, where many different actors from value chain from farm to consumer are involved, but only a few engage in more than one form of governance and different policies fields and sets of knowledge.

The strongly sectoral **policy approach** to cocoa and forests up until 2020 resulted in little alignment between stakeholders and policies. This has resulted in incongruences between national and international policies, practices, perceptions, and geographic maps. Cameroonian government policies that seek to increase cocoa production have been little aligned with internationally driven policies aiming to protect forest, avoid and reduce cocoa driven deforestation, particularly the EUDR. Incongruences remain due to siloed policies on cocoa, forest and landuse planning. Farming practices on the ground do not fit neatly into these categories, instead operating on a fluid continuum from agriculture to cocoa agroforestry to forest. Private sector policies and practices – due to the nature of the international value chain emerging from Cameroon – were more aligned, with cocoa production, deforestation and maintaining farm level shade tree cover addressed by cocoa buyers and cooperatives mainly through voluntary sustainability certification and corporate programs. However, international zero deforestation standards and practices were not well known by farmers in the fields and forests around Ntui. This has only just started to happen since 2022 with the politically laden Roadmap to Deforestation Free Cocoa and EU-Cameroon Cocoa Talks providing multistakeholder forums for exchange. However, these dialogues have not led to a consensus on definitions of chocolate (agro)forests, cocoa led deforestation or on how to address it. This situation is like the West African situation about five years ago, when the WCF Cocoa and Forest Initiative (World Cocoa Foundation, 2017) bringing governments, private sector and farmers organisations together to bridge and discuss deforestation in the protected area-forest-farm continuum. However, Cameroon has notable differences from West Africa, exemplified by the forest-rich Ntui study area with increasing deforestation and degradation, with forest-shaded cocoa agroforestry. Ghana and Cote d’Ivoire have much higher rates of historical deforestation, less forest and tree cover, such that the EUDR 2020 cut-off date constitutes a competitive advantage and creates few incentives for shaded cocoa agroforestry or restoration in practice. In **practice** there is nominal but scarce forest protection and little promotion of agroforestry, reforestation, or afforestation. The low reach of these policies to the ground in the Ntui area indicates little coherence between policies, perceptions and practices of farmers and other stakeholders on the ground.

The spatial analysis and ground verification indicate that the **extent**

of deforestation in Ntui in the past 10 years amounts to 4599 ha. Forest cover has decreased and degraded, replaced with mosaics of small-scale cocoa farms. The spatial data, interviews and discussions indicate that policies have been ineffective in halting cocoa related deforestation, have been modestly effective in expanding cocoa production, and not effective in increasing yields. The **significant unreliability of maps as a basis for decision making** given the difficulties of distinguishing cocoa agroforests from natural forests was highlighted, with 64 % of cocoa farms observed, shown as forested land on the open street map. This finding has significant implications for national and EU policy-makers, particularly concerning the EU Deforestation Regulation, regarding setting the 2020 deforestation baseline and the accuracy of the EU's benchmarking system which categorizes 'third countries' or regions within countries into low, standard, or high risk based on their overall deforestation risk associated with all products covered by the Regulation (European Union, 2023).

Diverse drivers at local, national and global scale scales have contributed to cocoa-led deforestation. These include policies seeking to increase cocoa production to augment individual farmer incomes and state revenues. Concurrently policies and practices incentivize zero deforestation and protect forests. Other drivers of deforestation include poverty, low cocoa yields, land availability, migration, population growth, land and labour prices. Stakeholders believe opportunities to counter deforestation include yield improvements (although this could conversely encourage further deforestation), awareness raising, statutory and customary law enforcement in protected areas, and restricting land sales.

Cocoa farmers do not perceive themselves as responsible for deforestation, however their practices indicate that cocoa farming is a driver of deforestation, in the past in the degraded area south of Ntui and in the last decade in the forest area to the north. Apart from voluntary sustainability certification, farmers are little involved in or aware of the plethora of initiatives to counter deforestation, such as restoration or afforestation or reduce deforestation. The practice of shaded, agroforestry cocoa systems are incentivised by certification but not explicitly through other policies.

Whilst farmers perceive few trade-offs between their practices and forest use, NGOs, development and government authorities do perceive major trade-offs. Major paradoxes and trade-offs were apparent in the different policy narratives and with farmer's practices. This context of incoherent national and international polices and incongruence with farm and forest practices on the ground in Ntui presents dilemmas if any of the cocoa, forest, landuse planning and development related government and private sector policies are to be effective. Alignment, particularly between the EUDR and Cameroonian national policies and stakeholders is critical. Whilst the Roadmap and Cocoa Talks started to address multi stakeholder and sectoral alignment – these are not apparent on the ground in farmers practices. Explicit, political choices about the trade-offs between cocoa production, the resulting impacts on farmer's livelihoods and forest conservation are lacking. Given the international, telecoupled nature of the cocoa value chain from Cameroon such trade-offs imply balancing state sovereignty on the related issues of landuse planning, forests, trade and development, alongside customary land use and governance practices, with international value chain governance. Another dilemma this study exposes is the contentious politics of cartography. Ground verification showed major discrepancies between land cover classifications of forests and fields. Given the upcoming importance of geo-mapping cocoa farms and chain of custody and traceability requirements towards European markets, map-based land use planning requires maps that accurately reflect different types of landuse cover in which cocoa production systems occur.

Actionable policy recommendations based on the empirical findings and these conclusions are that:

1. Landcover maps used to monitor the traceability of cocoa from forested areas in Cameroon as part of compliance with the EU Deforestation Regulation need to ground verification. If not, there is a high likelihood that they inaccurately show forest areas, rather than cocoa agroforestry.
2. National and international forest and cocoa polices need to recognise the contradictions and conflicts inherent in farming practices and policies. Forests both benefit and hinder cocoa farming, and cocoa farming can initially reduce biodiversity in forests but can also increase biodiversity over time. It may also protect forests from degradation and conversion to other land uses. Conversion depends on customary and statutory tree and land tenure, market-based governance such as sustainability certification standards, and economic costs and benefits of cocoa production, particularly buying prices.
3. Mechanisms that enable diverse farmer's voices, perspectives, framing of problems and solutions to be better heard and considered could counter the current misalignment of national and international policies with practices.
4. International and national discourses on the relations between cocoa, agriculture and forests can be reframed based on evidence. More and continued alignment is needed between policies concerning cocoa such as the Roadmap and Horizon 2020, and on forests and deforestation, such as the EU Deforestation Regulation, nationally and internationally. Implicit trade-offs in policies and discourses need to be made explicit, and aligned with the impact pathways underlying forest, deforestation and cocoa policies, and conscious, cross-sectoral choices made about equitable, acceptable balances for the different stakeholders between forest conservation and cocoa farming livelihoods.
5. Given farmer's low awareness of cocoa and forest policies, including the EUDR, better communication and support is essential for effective implementation or potential revision.

Funding

This study was part of the Knowledge base research programme, Data Driven & High Tech (KB-38), funded by the Dutch government (Ministry of Agriculture, Nature and Food Quality, LNV) "Community Management of Natural Resources using High Tech Mobile Technology and Connectivity Solutions in Small Holder Farming Context" is KB-38-001-009.

Ethics statement

This research was carried out in accordance with the Wageningen University Code of Conduct for scientific practice. Free prior informed consent was obtained from all participants before they participated in the study. Identities have been kept confidential and anonymous.

CRediT authorship contribution statement

Verina Ingram: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Valerie Janssen:** Writing – original draft, Methodology, Investigation, Conceptualization. **Victorine Akenji Neh:** Writing – original draft, Investigation, Formal analysis. **Arun Kumar Pratihast:** Writing – original draft, Visualization, Project administration, Funding acquisition, Formal analysis.

Declaration of competing interest

None declared.

Acknowledgments

We thank all participants in the study, the fieldwork enumerators Serge Nouadjep, Olive Happi, Victorine Akenyi Neh, Ekale Najembe and

Leslie N. Emeh in Cameroon, and Abidemi Elesho in Wageningen for assistance with the data collection app. Additionally, we thank Mathieu Decuyper for his contribution to the AVOCADO analysis using Landsat time series. We thank anonymous reviewers for their valuable feedback.

Data availability

Data will be made available on request.

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