Trajectories of Cocoa Production in Tshopo Province: Potential for Climate-Change Mitigation

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Abstract

The global demand for cocoa has increased. As a result, the area used for cocoa production rapidly increased. Africa alone produces over 70% of the cocoa in the world, with Ghana and Côte d'Ivoire being the main producers. Although listed as a crop that drives deforestation and forest degradation, cocoa farming has the potential to actively contribute to forest restoration. If practised in agroforestry and fallow or degraded areas, it can considerably contribute to biodiversity conservation, climate change mitigation, poverty mitigation, and other services. The Democratic Republic of Congo (DRC), which features a large forest in the Congo Basin (60%), has become a new hotspot for this cash crop. As one of the areas suitable for the development of this crop, which has been grown since colonial times, Tshopo province, DRC, is experiencing rapid increases in its cocoa-growing area. As such, our objective in this study was to track the trajectories of cocoa farming in Tshopo and determine their contributions to climate change mitigation through the restoration of degraded ecosystems. We described all cocoa development initiatives in the Tshopo province, along with their potential responses to climate change.

Keywords: climate change, carbon storage, cocoa agroforests, MRV, Tshopo, DRC

1. Introduction

The medium-term growth in global cocoa consumption has been projected at 3% per year, with new markets (China, India, and eastern Europe) 'discovering' chocolate, with demand increasing compared with that of traditional markets (Europe and the United States of America). Therefore, new emerging countries producing cocoa must be identified to meet this global demand (Huart *et al.* 2011). The Democratic Republic of Congo (DRC), with its suitable climatic and soil conditions, is an area where African cocoa production is expanding. As cocoa production increases in the DRC, the country can learn from its West African counterparts to avoid mistakes and to prioritise sustainable and climate-smart practices, good governance, innovation, and value addition (Downie 2018).

As a developing-world organic cocoa producer and one of the main European Union organic cocoa bean suppliers, supplying 8.6% of the total, the organic cocoa areas in the DRC have substantially expanded in recent years (Le Douarin 2020). The DRC is a unique country with land that is suitable for this crop in 16 of its 26 provinces, and is therefore extremely favourable for the development of cocoa production (Huart *et al.* 2011).

The production systems in the DRC are mostly mixed, with industrial and semi-industrial plantations surrounded by village plantations. This production system favours the rapid development of village production, allowing smallholders to access not only markets but also the technologies and services they need, which cannot yet be offered by public services on a daily basis (Huart *et al.* 2011).

DRC soils are generally deep, well-aerated, and more fertile than those of West African countries, where fertiliser use has become essential to achieve satisfactory yields. In the DRC, where the agro-climatic conditions are appropriate, high yields can be obtained through the application of environmentally friendly farming practices, such as the use of cover plants, organic waste, or compost (Huart 2016). However, until now, cocoa has been cultivated to the disadvantage of forests (Kibambe and Madibi 2022). Cocoa, instead, should be grown in savannahs or areas that were formerly forests that have become fallow (Huart 2016).

In the DRC province of Tshopo, the National Institute for Agronomic Research and Studies (INERA) station in Yangambi has selected elite cocoa clones that produce of 2 tonnes/ha of cocoa. However, in practice, the yield produced by old cocoa farms is around 500 kg/ha (Huart 2016). Generally cultivated under diversified shade in Tshopo, cocoa farming could constitute one method to store more aboveground carbon than other agricultural systems (Batsi *et al*. 2021).

Given the current revival of cocoa crops in Tshopo, especially by people with the financial means to open up large areas of land (>50 ha) (Windey 2020), vigilance is required. Land grabbing deprives local communities of their land commonly used for cash crops, and some forest land is being converted to agricultural lands to produce cocoa, thus contributing to increases in the rate of deforestation and forest degradation. The growing interest in cocoa production in Tshopo is also explained by the rampant

insecurity in the cocoa-producing areas of North Kivu (Beni Territory) and Ituri (Mambasa Territory).

Identifying opportunities and challenges for cocoa production in Tshopo Province was our main objective with the current literature review. We aimed to analyse its development trajectories to determine its sustainability based on climate-smart cocoa production practices for an effective response to climate change.

2. Geographical context

Tshopo, located between 2°0' N and 2°0' S and 21°24' W and 28°2 E, is approximately 87% covered by rainforest. Agricultural areas (~10%) are located mainly along roads, waterways, and large agglomerations, such as in the city of Kisangani. Forests predominate owing to the geo-climatic conditions in the region (Omasombo 2020). Covering an area (including the city of Kisangani) of 199,567 km², representing 8.5% of the national territory, Tshopo is the largest province in the DRC (Figure 1). Kisangani is the capital of this province.

Currently, Tshopo has 17.6 million ha of mature forests (Masson 2022). From 2002 to 2021, Tshopo lost 661,000 ha of primary rainforest[1] at an average rate of 1.5% per year (Masson 2022), mainly due to urbanisation and agricultural expansion. In the immediate vicinity of Kisangani (<1 h), these disturbances are the most serious.

3. Temporal analysis of cocoa farming in Tshopo

Cocoa cultivation has undergone three major periods in this region. It was first introduced by INERA in Yangambi during the colonial period. During this period, several agronomic experiments were conducted, including the selection of different shade-tolerant species. However, this crop was not popularised in rural areas at that time. In 1979, the Bengamisa cocoa plantation Cacaoyère de Bengamisa (CABEN) was set up in the country. CABEN was managed by a South African company with the aim of developing more than 2000 ha of farmers' plantations in addition to an industrial plantation. Three farmer stations supervised by CABEN agronomists were created: Kisangani, Kapalata, and Yangambi. Several peasant farms were established between 1986 and 1988. However, CABEN went bankrupt, and the farmers supervised by CABEN lacked a market to sell their cocoa. At the time, CABEN was the exclusive buyer. Consequently, many farmers' plantations were either abandoned or converted to food crops. A few farmers were able to maintain their plantations owing to the advice provided by the former agronomists of the company who had settled in the community.

More recently, with the arrival of some communities from the eastern DRC, particularly from North Kivu, old cocoa plantations are being revived. This is due to the discovery of a new market in the east

[1] https://www.globalforestwatch.org, Accessed on 23 November 2022

and Uganda, and the presence of new buyers at the local level from North Kivu. Abandoned plantations have been taken over and rejuvenated. This market recovery has led to the creation of new plantations by other farmers. Thus, several plantations have been and are continuing to be established. Notably, this new expansion of cocoa farming is the work of migrants and local traders who have the opportunity to acquire large tracts of land at the expense of the village community.

In addition to the expansion mainly by migrants, initiatives by REDD+ projects provide support to local communities in cocoa farming. However, the process is still basic and limited to a few small villages and farmer associations that are not fully supervised due to the lack of leadership, technical capabilities, and human resources within the Ministries of Agriculture and Rural Development.

4. Varietal and genetic potential of cocoa plants in Tshopo

Tshopo, which hosts INERA, has a collection of 62 genetic materials in a trial cocoa plantation at the Centre de Recherche de Yangambi (CRY). The current germplasm collection in Yangambi has resulted from selection experiments involving diverse accessions from various introductions. The INERA research station in Yangambi still harbours old cacao trees, derived from crossings between the best local selections and the Upper Amazon introductions in 1934. These old trees were probably genetically related to the trees introduced during the Belgian Congo period. Genetically, the Yangambi collection is composed of two groups: a hybrid population, originating mainly from Amelonado and/or Criollo–Trinitario, and, to a lesser extent, from Marañón and Nanay; and a population predominantly assigned to Amelonado, but also to Nanay, Contamana, and Nacional.

Most of the CRY cultivars are scattered between the Forastero and Trinitario reference accessions, indicating the hybrid nature of the African collection. Belgium introduced various cacao varieties from Brazil, Trinidad, Ecuador, and Venezuela, all of which were tested in Brazil. The diverse foreign introductions and the substantial number of hybridisation events that have occurred in the DRC have caused an admixed ancestry of most of the CRY cultivars, as observed. Only a small amount is associated with one reference group: Forastero or Trinitario. The Yangambi collection has some agronomically interesting hydrides, including CRY1424 and CRY15, which are resistant to several cacao diseases, such as witches' broom and black pod rot; and cultivars CRY14 and CRY12, which are known for their high organoleptic quality and floral aroma (Rottiers *et al.* 2018).

5. Main cocoa production areas in Tshopo

Formerly cultivated only in the area influenced by the CABEN (on the Kisangani–Banalia road) and at the INERA-YANGAMBI Research Centre, cocoa farming has now intensified mainly in diverse locations: (1) along the Kisangani–Alibuku–Ngeno road in the Industrie Forestière du Congo (IFCO) forest concession in Alibuku (36 km from the town of Kisangani on the old Banalia road) (Windey 2020,

Vyawahare 2022), (2) the Kisangani–Bafwasende axis, and (3) the Kisangani–Lubutu road. The intensification of cocoa farming has resulted from the growing use of allochthones, mainly from the Nandé tribe originating from North Kivu, as well as some local elites and notables living in Kisangani and elsewhere, and some politico-military authorities (Windey 2020). In addition to these initiatives the distribution of cocoa trees and some shade-tolerant species to local communities by REDD+ projects (including PIREDD-MBKIS, mainly on the Kisangani–Banalia axis (Banalia territory) and PIREDD-ORIENTAL (Bafwasende, Ubundu, and Isangi territories) have also contributed to the expansion of cocoa production in the region (Figure 1).

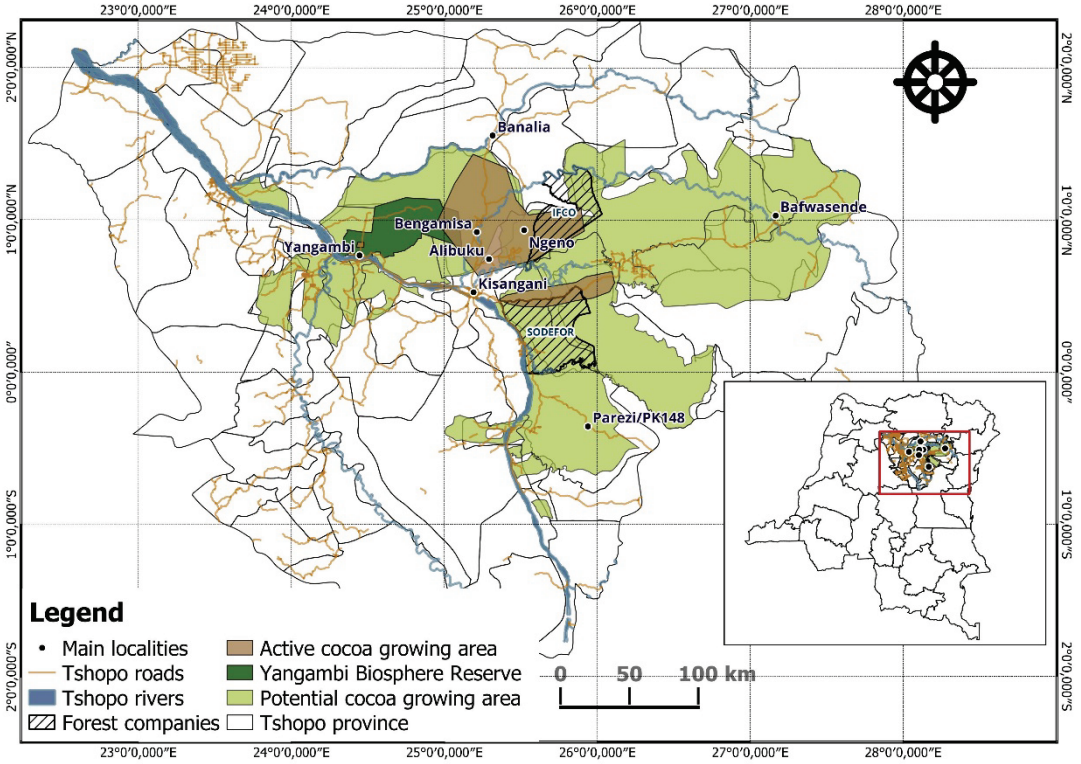

Figure 1. Potential and active cocoa production areas in Tshopo province, Democratic Republic of the Congo

Source: Authors

6. Cocoa production statistics in Tshopo

Currently, evaluating the exact quantity of cocoa producers in Tshopo is difficult because of the inefficiency of public services. However, many producers likely do not accurately declare their production to avoid harassment by various types of public services and the collection of taxes. We obtained the data (Figure 2) from the National Office of Agricultural Products of Congo (ONAPAC), which is a state-owned company that controls exports, uses end buyers to declare annual production, and sends a report to the Central Bank of Congo (BCC). Based on the data obtained from ONAPAC-Tshopo and the BCC report, we found that the annual growth in cocoa production at the national level

and in Tshopo Province has been exceptional, mainly since 2017. At the national level, production rose from 5995 tonnes in 2013 to 58,238 tons in 2021; in Tshopo, it rose from 12.3 tonnes in 2016 to 202.24 tonnes in 2021.

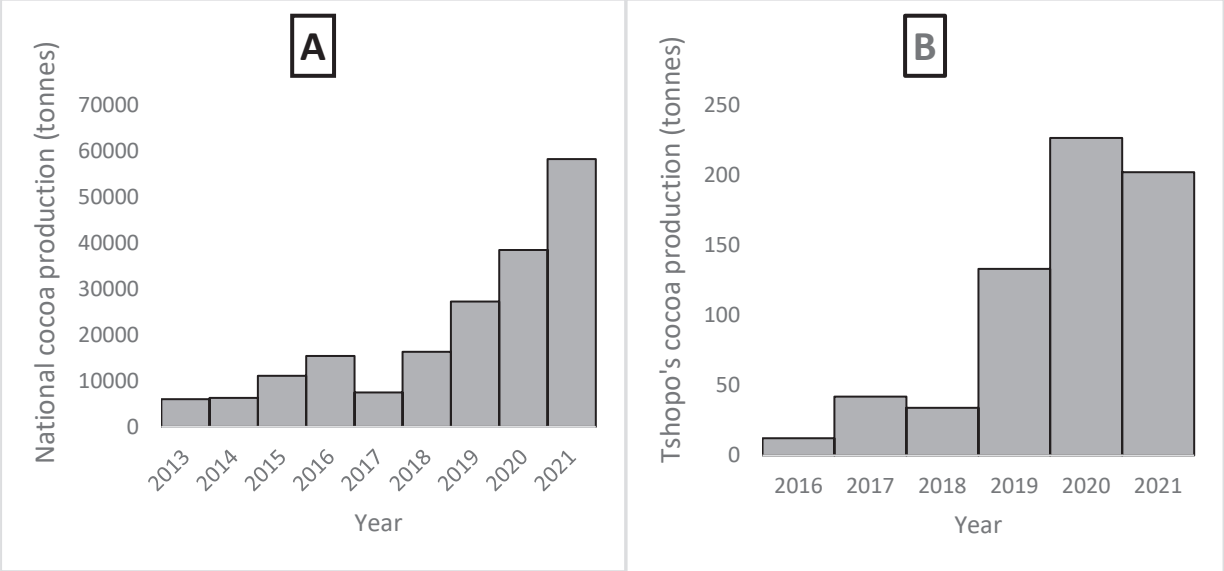

Figure 2. Cocoa production evolution at national (A) and Tshopo province (B) level
Source: Figures developed from the ONAPAC Tshopo (A) and BCC 2022 statistics reports (B).

7. Main public and private actors in cocoa production in Tshopo

The cocoa sector in Tshopo (Figure3) is organised into three categories of actors: nongovernmental organisations, public organisations (public services), and private actors (farmers, buyers, and cooperatives). The cocoa farming sector in Tshopo is driven more by private actors (elites and the political and military authorities, but, to a large extent, non-natives, including the Nandés); the Belgian Development Agency (ENABEL) through the Agricultural Development Program in the Tshopo District (PRODAT); United Nations Development Programme (UNDP) and Tropenbos-DRC (nongovernmental organisation) through the Eastern Integrated Program for Reducing Emissions from Deforestation and Forest Degradation (PIREDD-Oriental); Environment and Sustainable Development Ministry (MEDD) of the DRC through the Integrated REDD+ Project in the Mbuji-Mayi/Kananga and Kisangani basins (PIREDD/MBKIS), which is locally implemented by a nongovernmental organisation consortium: Congolese Organization of Ecologists and Friends of Nature (OCEAN), Pygmies Support and Accompaniment Organization (OSAPY), and Association for the Integrated Development of Kisangani (ADIKIS).

The cocoa trade in Tshopo is largely centralised around the company Kivu Agricultural Cooperative Society (SCAK) in Kisangani, which exports cocoa via its headquarters in North Kivu. It is also centred around certain buyers and wholesalers, such as OMER, who take their cocoa to Edm Schluter &

Company (ESCO), Kivu, and other companies in North Kivu, or transport it themselves to Uganda. Figure 3 shows the organisational model of cocoa farming in Tshopo.

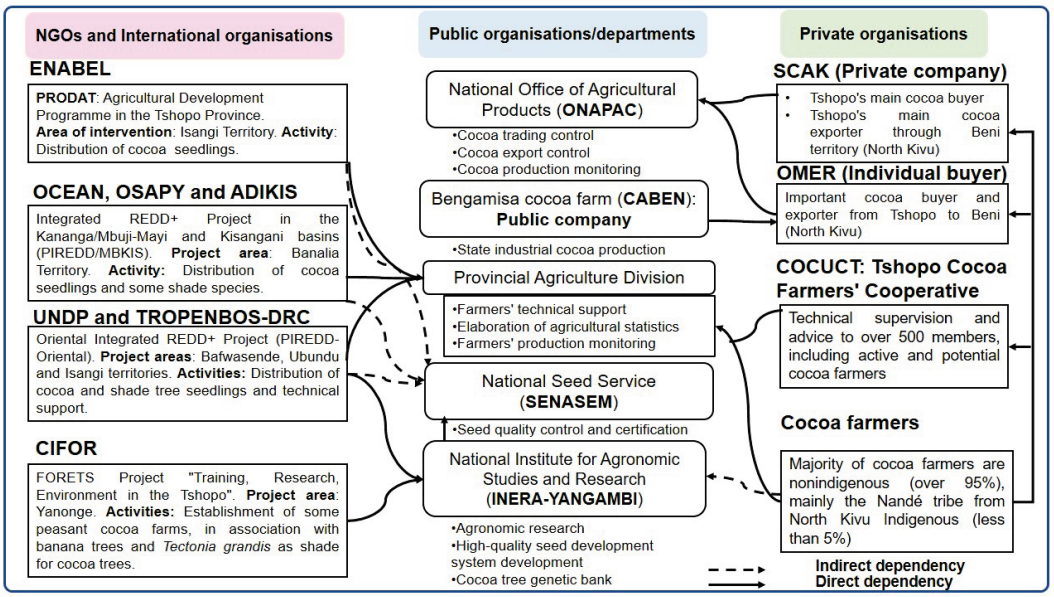

Figure 3. Organisational model of cocoa sector in Tshopo, based on field information

8. Cocoa farming in response to climate change in Tshopo

Cocoa plantations are among the perennial crops that the DRC has integrated into its response to deforestation, forest degradation, and climate change mitigation since the REDD pilot project. Two main REDD+ programs focusing on smallholder-cocoa-based agroforestry are currently underway in Tshopo. The first is the Oriental REDD+ program (Bafwasende, Ubundu, and Isangi territories), and the second is the Integrated REDD+ Project in the Mbuji-Mayi, Kananga, and Kisangani basins (PIREDD/MBKIS).

Cocoa in Tshopo is largely produced within agroforestry systems. These systems substantially contribute to carbon sequestration and storage. However, several differences exist between the diverse cocoa-based agroforestry systems in terms of environmental services, such as carbon sequestration and storage. Three main systems, defined by the type of shade plants, are more prevalent in Tshopo: under palm trees, under the shade of forest trees only, and under a mixed shade composed of some palm and forest trees (Batsi *et al*. 2020). The carbon storage in Tshopo cocoa farms (Batsi *et al.* 2021, Mangaza *et al.* 2022) depends on three parameters: (1) shade tree density (especially large trees), (2) wood density of the shade species, and (3) basal area. Therefore, the higher the tree density, wood density, or base area in the system, the greater the carbon storage (Table 1). The carbon stock is mainly maintained by cocoa-associated plants (more than 80%) and large trees (more than 60%). Thus, to increase the carbon stock in agricultural plots, the planting of tree species in pre-existing cocoa farms should be encouraged and to shaded cocoa production under forest trees should be popularised. The cocoa farms using forest tree shade have a multistory structure and, therefore, have considerable potential to provide several

environmental services. This multistory structure is also important for creating a continuum to connect forest mosaics in degraded areas (Batsi *et al.* 2021).

Table 1. Aboveground biomass carbon storage and associated attributes of cocoa farms in Tshopo

Type of system	Associated plant density (no. ha^{-1})	Cocoa tree density (no. ha^{-1})	Basal area (m²/ha)	Biomass (Mg ha^{-1})	Carbon (Mg ha^{-1})	Reference
INERA-Yangambi cocoa farms	88±52	916±120	23.7±10.3	197.1±119.2	93.62±56,62	Mangaza *et al*. 2022
Smallholder cocoa farms–forest shade tree	162±77.98	984±200.55	22.99±3.86	125.12±52.76	59.43±25.06	Batsi *et al*. 2020, Batsi *et al*. 2021
Smallholder cocoa farms–mixed shade	182.4±113.3	824±109.8	16.22±2.77	72.59±26.04	34.48±12.37	Batsi *et al.* 2020, Batsi *et al*. 2021
Smallholder cocoa farms–palm tree shade	145.2±38.69	826±114.53	12.1±2.85	71.12±47.41	33.78±22.52	Batsi *et al.* 2020, Batsi *et al.* 2021

Source: Built from information compiled by Batsi *et al.* 2020, Batsi *et al*. 2021, and Mangaza *et al*. 2022.

In deforested and/or degraded areas, cocoa farming is a viable option because it can maintain up to approximately 50% of the aboveground biomass (carbon stock) and forest diversity as a perennial crop. However, new cocoa plantations should not be established at the cost of mature forests (Mangaza *et al*. 2022) to avoid the massive deforestation that decimated Ivorian and Ghanaian forests. Therefore, the Zero Deforestation[2] Cocoa Roadmap can be a useful tool for addressing deforestation from cocoa farming from a REDD+ perspective (Pirker and Carodenuto 2021).

9. Climate-change-adapted CAFS models of Tshopo and central and west African cocoa-producing countries

Carbon stocks depend on the systems adopted by farmers to manage cocoa farming (Sonwa *et al*. 2018, Batsi *et al.* 2021). Central African cocoa agroforest systems (CAFS) store more carbon than west African CAFS. In west Africa, particularly in Ghana (the global leading cocoa producer), carbon stocks

[2] Collective commitment signed by the global chocolate industry in 2017 for full supply chain traceability to end deforestation in cocoa-growing regions.

in CAFS hardly reach 30% of that in mature rainforest, and in Central Africa, they can exceed 75% (Cameroon). This contrast is owing to in the systems adopted by the farmers in these two regions. In Cameroon, cocoa farms are established under a thinned forest overstory; conversely, in Côte d'Ivoire and Ghana, cocoa farms are most typically established by slashing and burning the forest (Gockowski and Sonwa 2010) (Table 2).

Table 2. Aboveground biomass carbon storage and associated attributes of cocoa farms in Tshopo

Country	CAFS' AGC (Mg ha^{-1})	Reference	Foress AGC (Mg ha^{-1})	Reference
Cameroon	170	Sonwa *et al*. 2017	227	Gockowski and Sonwa 2010
Cameroon	70	Saj *et al*. 2013	174.8	Djomo *et al*. 2018
Cameroon	125.3	Madountsap *et al*. 2018		
Ghana	26	Mohammed *et al*. 2016	173	Brown *et al*. 2020
Ghana	36.21	Afele *et al.* 2021	229.4	Adu-Bredu *et al*. 2008
Ghana	41.3	Asigbaase *et al.* 2020		
DRC/Yangambi	93.62	Mangaza *et al.* 2022	185.73	Mangaza *et al.* 2022

CAFS**:** cocoa agroforest systems**,** AGC**:** Aboveground carbon.

Source: Built from information compiled by Adu-Bredu *et al.* 2008, Gockowski and Sonwa 2010, Djomo *et al*. 2018, Brown *et al*. 2020, and Mangaza *et al*. 2022.

The CAFS of Tshopo (DRC) lags that of Cameroon in terms of aboveground carbon storage. Although the country is too young for cocoa production compared with Cameroon and west African countries, the DRC should take the necessary steps to avoid the environmental disasters that have occurred in west African cocoa-producing countries. To be well-positioned in the zero-deforestation process and to increase the value of Congolese cocoa and ensure the ecological transition, the systems adopted by INERA-Yangambi (DRC) and Cameroon (regarding their level of carbon storage) must be popularised. In general, the intensification of cocoa agroforestry systems offers considerable potential for advancing the REDD+ mechanism (Alemagi *et al*. 2015). Shaded cocoa systems are important for climate change mitigation and adaptation given the ability of these systems to capture atmospheric carbon dioxide (CO_2) and store carbon in shade and cocoa (*Theobroma cacao*) trees and soil compared with other agricultural practices (Acheampong *et al.* 2014).

Conclusions

Most of the newer cocoa farms in Tshopo, DRC, have been developed on forest land, either by directly clearing the existing forest or by first establishing food crops and cocoa farms. Therefore, regardless of the size, the development of cocoa farming in this province has contributes to forest degradation and deforestation This observed deforestation and forest degradation driven by cocoa farming has mainly been the consequence of the failure of the Congolese state to supervise this sector through the relevant services. Some communities, particularly the Nandé community from North Kivu, where this crop is highly developed, have migrated in large numbers to Tshopo either for commercial reasons or to escape insecurity. Because of the lack of remaining arable land in the densely populated North Kivu, these migrants have purchased vast tracts of forest, either from a land acquisition process via provincial authorities or in agreement with local chiefs, resulting in less diversified cocoa production.

The areas used for cocoa production must be carefully chosen to avoid any form of deforestation or forest degradation associated with cocoa production. Consequently, the choice of zero-deforestation cocoa farming, different from cocoa-based agroforestry, is essential in Tshopo specifically and in the DRC generally. This requires a coherent agricultural policy and strong coordination between the sectors involved (the environment, rural development, and agriculture).

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