

Leibniz Centre for **Agricultural Landscape Research** (ZALF)



Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH



Analyzing land use and land cover dynamics (LULC) in a cocoa landscape context (Côte d'Ivoire)

Bonna Antoinette Tokou^{1,2}, Kueshi Semanou Dahan^{2,3}, Constant Yves Adou Yao^{1,6}, Stefan Sieber^{2,4}, Katharina Löhr^{2,5}

¹UFR Biosciences, University Félix Houphouët-Boigny, Cocody, Abidjan, Côte d'Ivoire

²Leibniz Centre for Agricultural Landscape Research (ZALF), Eberswalder Straße 84, 15374

Müncheberg, Germany

³Department of Environment and Sustainability Sciences, Faculty of Natural Resources and Environment, University for Development Studies, Tamale, Ghana

⁴Humboldt Universität zu Berlin, Resource Economics, Unter den Linden 6, 10099 Berlin, Germany

⁵ Humboldt-Universität zu Berlin, Urban Plant Ecophysiology, Unter den Linden 6, 10099 Berlin, Germany

⁶Switzer Centre of Scientific Research (CSRS), Abidjan, Route de Dabou, Côte d'Ivoire





Introduction

Research Design

- The dynamics of land use change (LUC) in cocoa landscapes is a complex, multidimensional phenomenon that raises major issues for the sustainability of cocoa production.
- Over the past three decades, cocoa production has increased in the country due to the intensification and expansion of cocoa production.
- The expansion and non-sustainable cocoa production have led to increased deforestation and loss of biodiversity.
- This study assesses the spatial pattern of LULC in the cocoa production Analysis area to inform policies and decision-makers for sustainable cocoa production.
- The results of this study contribute to a better understanding of Ivorian agricultural tendencies.
- **Objectives**
- Identify the different types of land use
- Examines transformative trends of change land use transitions

Results

In 10 years, the main areas decreased in Aboisso (Table 1) are forests (7%), fallow (5%) cocoa

Data collection

area.

- Satellite image acquisition, USGS Landsat 7 Collection 1 Tier 2 TOA Reflectance, USGS Landsat 8 Collection 1 Tier 2 TOA Reflectance.
- Global Positioning System (GPS) datasets of the
- different LULC systems (February March 2024) in Aboisso, Abengourou (First loops of cocoa), and Divo (second loop of cocoa).
- Ramdon forest algorithm: was used as a machine learning technique for classifying different LULC types (which offers a robust alternative).
- **Descriptive analysis:** was used for different LULC

egional delegation Abengourou 🔲 Regional delegation Divo

Figure 1: Area study

Table 2: LULC area Div

				Changes 2012-
Classes Divo	LULC	Area (% 2012	Area (% 2023	2023 Divo
0	Cocoa full-sun	6.06	7.78	1.72
1	Cacao agroforestry	22.85	14.96	-7.89
2	Rubber tree	0.28	2.45	2.17
3	Oil palm	36.68	29.62	-7.06
4	Coffee	1.23	0.91	-0.32
5	Cropland	8.47	19.82	11.35
6	Fallow	5.03	4.96	-0.07
7	Forests	9.54	6.70	-2.84
8	Water and wetland	1.35	1.39	0.04
9	Settlment	4.57	4.15	-0.42
10	Other	3.94	7.27	3.33
Total Area		100	100	

full-sun area (2%), and rubber (2%). In Divo (Table 2), there are cocoa agroforestry (8%), oil palm (7%), and forests (3%). In Abengourou (Table 3), there are forest (17%), and cocoa agroforestry (16%).

Crops with a significant increase in the area are oil palm (8%) and cocoa agroforestry (3%) in Aboisso; cropland (11%) and rubber tree (2%) in Divo and oil palm (9%), and cashew (7%) in Abengourou.





Photo. 1: Mosaic landscapes in Abengourou, Cocoa full-sun (A), Cocoa Agroforestry (B), Rubber tree (C), Google Earth, 2024

Table 3: LULC area Abengourou

Classes				Changes 2012-
Abengourou	LULC	Area (% 2012	Area (% 2023	2023 Abengourou
C	Cocoa full-sun	0.14	0.88	0.74
	Сосоа			
1	agroforestry	24.77	8.96	-15.81
2	Rubber tree	1.85	2.14	0.29
3	Oil palm	2.93	11.49	8.56
4	Cashew	2.19	9.38	7.19
5	Coffee	3.90	3.30	-0.60
6	Cropland	11.54	15.12	3.58
7	Fallow	2.65	7.89	5.24
8	Forests	45.17	28.33	-16.84
	Water and			
g	wetland	1.88	1.91	0.03
10	Settlment	2.70	7.86	5.16
11	Other	0.27	2.74	2.47
Total Area		100	100	

(2) Abe	engouro	u 2012		•			(2) Ak	bengo	ourou 20	23		V	
(3) Aboisso 2012						(3) A	boiss	o 2023					
(1)	0	1	2	3	4	5		6	7	8	9	10	
(2)	0	1	2	3	4	5	6		7	8	9	10	ŕ
(3)	0	1	2	3	4	5		6	7	8	9	10	

\mathbf{A}		Table 1: LULC area Aboisso						
					Changes 2012-			
		Classes Aboisso LULC	Area (% 2012	Area (%) 2023	2023 Aboisso			
		0Cocoa full-sun	3.69	1.69	-2.00			
		Сосоа						
		1 agroforestry	8.76	12.14	. 3.38			
		2 Rubber tree	4.15	2.26	-1.89			
		3 Forests	30.12	23.21	-6.90			
	(3) Aboisso 2023	4Coffee	13.31	14.66	1.35			
(3) Aboisso 2012	(3) ADDI330 2023	5 Fallow	20.58	15.75	-4.83			
(1) 0 1 2 3 4	5 6 7 8 9 10	6Oil palm	11.71	18.38	6.67			
(2) 0 1 2 3 4	5 6 7 8 9 10 11	7Cropland	2.56	1.44	-1.12			
(3) 0 1 2 3 4	5 6 7 8 9 10	Water and						
		8wetland	3.38	4.75	1.37			
Figure 2 . []] (dynamics i	n Diva Abangaurau and	9 Settlment	0.99	1.66	0.67			
rigure 2. LULC dynamics i	n Divo, Abengourou, and	10Other	0.75	5.41	4.66			
Aboisso in 2012 and 2023		Total Area	100	100				

Conclusion

- Our study reveal an imbalance in land use in cocoa landscapes, marked by a significant decline in agroforestry systems and forests in favor of oil palm cultivation.
- This dynamic threatens biodiversity and compromises the livelihoods of local populations.
- Valuable indications for political decision-makers, for the

implementation of land regulation mechanisms and the application

of more concrete and continuous agroforestry practice strategies.



Supported by the

Federal Ministry for Economic Cooperation and Development

Contact person:

Leibniz Centre for Agricultural Landscape Research (ZALF) · Eberswalder Straße 84 · 15374 Müncheberg, Germany, BonnaAntoinette.Tokou@zalf.de