



## Tropical forest patches under pressure

### Dynamics, functions, and sustainable management in agricultural landscapes of the West African forest and savannah zones

Forest patches in the fragmented agricultural landscapes of West Africa provide key ecosystem services and are crucial for the local population's well-being. However, these forest patches are under heavy pressure and prone to further degradation. Yet, the forest patches have received little research attention. The SUSTAINFORESTS project analyses the interactive roles of forest patches in the agricultural landscapes in Togo, Benin, Nigeria, and Cameroon (see Fig. 1). In addition, it investigates the conditions under which various biophysical, socio-cultural, economic, and institutional factors, including decision-making and land users' behaviour, interact with and affect forest patches and their sustainable use, management, and governance.

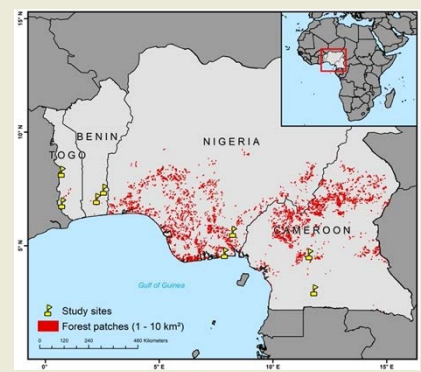


Fig. 1: Wingate et al., 2022

The SUSTAINFORESTS project is structured into four work packages. Since its inception, the project has made substantial progress including mapping and inventorying of forest patches in West and Central Africa through remote sensing technologies, fieldwork, and collaborations with partner institutions. In our upcoming stakeholders conference, we hope to engage actors from policy, practice, and research to discuss emerging findings and policy strategies for sustainable forest management and livelihood improvement in West and Central Africa.

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Institute of Geography (GIUB)



# Impressions from fieldwork in Western Africa

(September 2022 to March 2023)

## CONTEXT

From the 26<sup>th</sup> of September 2022 to the 19<sup>th</sup> of March 2023, we conducted fieldwork in four Western African countries together with our local partners. Our social-ecological research approach required that we collect data on both biophysical and socio-economic aspects of the forests. We worked in nine forest patches situated in agricultural landscapes (see a sample forest patch in Fig. 2), three in Togo, and two forests each in Benin, Nigeria, and Cameroon. The fieldwork comprised ecological, spatial, and socio-economic dimensions. The sections below provide some details of these dimensions.



Fig. 2: Orthomosaic of Koui Sacred Forest

## ECOLOGICAL



Fig. 3: Georges A. Agonvonon assessing natural regeneration in a sample plot in Ewè-Adakplamè forest. Benin

An ecological assessment of tropical African forest patches was undertaken, including tree species composition assessment, forest structural characterization, litter fall, and soil nutrient assessment and forest biomass quantification. Methods included manual measurements and terrestrial laser scanning.



Fig. 4: Samuel Hepner using terrestrial laser scanner in Lokoli swamp forest, Benin.

## SPATIAL

Multispectral and Lidar drones were used to map the forest patches. The methodology involved forest patch selection, flight planning, mission execution, and data management. After initial drone flight planning and ground reconnaissance, final flight plans were developed and executed. The captured images and point clouds were downloaded and stored daily in the field. These datasets allowed for the analysis of forest structures and conditions and informed us of the fragmentation impacts on the ecosystems.



Fig. 5: Chima Iheaturu setting up the Lidar drone in Koui Sacred Forest, Togo.

## SOCIO-ECONOMICS



Fig 6: Focus group discussion with men by Pamela Tabi Ekebil, Apegame, Togo

Through household surveys, gender-differentiated focus group discussions, oral history, and key informant interviews, we were able to integrate communities' perspectives. Discussions were focused on ecosystem services, livelihoods, and governance. Various stakeholders such as farmers, hunters, local leaders, traditional priests, local researchers, officers from government, and non-governmental organisations were involved.



Fig 7: Focus group discussion with women by Frank Mintah, Iko Ekperem, Nigeria.

Conducting fieldwork is tasking but enriching. As the team leader, **Chinwe Ifejika Speranza** engaged in various aspects - discussions and arrangements with research partners and authorities, obtaining the research authorizations, and supervising the various fieldwork components. She conducted fieldwork with the various teams on a rotating basis, enabling her to engage in all fieldwork dimensions. Other support was provided by the Land Systems and Sustainable Land Management research team at the GIUB and by other GIUB colleagues.

The SUSTAINFORESTS team members have engaged in various conferences, workshops, summer schools and scientific publications. More details are below.

## Scientific publications

### Published

Wingate, V. R., Akinyemi, F. O., & Ifejika Speranza, C. (2023) **Archetypes of remnant West African forest patches allow identifying common underlying social-ecological characteristics and change pressures**. *Applied Geography* 158, 103024. doi: 10.1016/j.apgeog.2023.103024

Ifejika Speranza C., Akinyemi F. O., Baratoux D., Benveniste J., Ceperley N., Driouech F., Helmschrot J. (2022) **Enhancing the Uptake of Earth Observation Products and Services in Africa Through a Multi-level Transdisciplinary Approach**. *Surveys in Geophysics*. 23:1-35. doi: 10.1007/s10712-022-09724-1

Wingate V. R., Akinyemi F. O, Iheaturu C. J., Ifejika Speranza C. (2022) **A Remote Sensing-Based Inventory of West Africa Tropical Forest Patches: A Basis for Enhancing Their Conservation and Sustainable Use**. *Remote Sensing of Environment*. 14, 6251. <https://doi.org/10.3390/rs14246251>

### Submitted

Hepner S., Agonvonon G., Ehbrecht M., Iheaturu C., Azihou F. A., Ifejika Speranza C. (under review) **Degradation and Fragmentation Effects on Structural Complexity in West-African Forest Patches**. *Biotropica*. Manuscript ID: BITR-24-022

Iheaturu C. J., Wingate V. R., Akinyemi F. O., Ifejika Speranza C. (under review) **An integrated object-based sampling approach for validating the accuracy of non-contiguous tropical forest cover data**. *Remote Sensing of Environment*. Manuscript Number: RSE-D-23-03178.

Mintah F., Tabi E. P. P., Oberlack C., Ifejika Speranza C. (under review) **Why do forests persist and re-emerge amidst tropical deforestation pressures? Archetypes of governance and impact pathways**. *Global Environmental Change*. Manuscript ID: GEC-D-24-00094.

Wingate V. R., Curatola Fernández G., Ifejika Speranza C. (under review) **Small forest patches in West Africa: mapping how they are changing to better inform their conservation**. *Environmental Conservation*. Manuscript ID EC-24-01-03.

## Sustainability Day 2023 of Bern's Institutions of Higher Education

The SUSTAINFORESTS group participated in the Sustainability Day of Bern's higher education institutions on the 3<sup>rd</sup> of November 2023. The interactive stand on "Forest patches in West Africa – Forest structure, biomass and management" attracted many visitors throughout the day, and they expressed great interest in the project by asking many questions and networking with us.



**Fig. 6:** Part of the SUSTAINFORESTS team at the Sustainability Day, from left to right: Pamela Tabi Ekebil, Georges Agonvonon, Phydias Agossou, Frank Mintah, Samuel Hepner & Giulia Curatola.

## Conferences & Workshops

### Organised Conference Sessions

#### 2023

Ifejika Speranza, C., Akinyemi, F. O., Mintah, F., Sonwa, D., Sinsin, B. (Hybrid) Sustaining forests in mosaic landscapes. **The International Association for Landscape Ecology (IALE) 2023 World Congress**, 12/07/2023, Nairobi Kenya.

Ifejika Speranza, C., Bisong, F., (Hybrid) Reconstituting institutions and norms for forest commons in contexts of multiple transitions. Conference Session, **The XIX Biennial International Association for the Study of the Commons (IASC)**, 21/06/2023, Nairobi, Kenya.

### Presentations in Conferences and Workshops

#### 2023

Iheaturu, C.J., Wingate, V., Akinyemi, F.O., Ifejika Speranza, C., Monitoring Tropical Forests in West Africa with Deep Learning and Satellite Data Fusion. Poster presentation, **American Geophysical Union Meeting** (11 – 15 Dec.), San Francisco, USA.

Hepner, S., Tabi Ekeobil, P.P., Agonvonon, G.A., Mintah, F., Iheaturu, C., Ifejika Speranza, C., Video documentation and insights from field research in forest-agricultural landscapes of West Africa. Oral presentation, **Swiss Geoscience Meeting**. (17-19 Nov.), Mendrisio, Switzerland.

Wingate, V.R., Curatola Fernandez, G., Ifejika Speranza, C., Small forest patches in West Africa: mapping how they are changing to better inform their conservation. **Swiss Geoscience meeting** (17 Nov.), Mendrisio, Switzerland.

Iheaturu, C.J., Wingate, V.R., Akinyemi, F.O., Ifejika Speranza, C., Integrating UAV Lidar and Multispectral Data to Assess West African Tropical Forest Condition and Structure. Poster presentation, **The ISPRS Geospatial Week** (2-7 Sept.), Cairo, Egypt.

Mintah, F., Tabi Ekeobil, P.P., Oberlack, C., Ifejika Speranza, C., Analysis of Forest Governance Arrangements and their Impacts on the Persistence and Re-emergence of forest in the Tropics. Oral presentation, **IALE 2023 WORLD CONGRESS** (10-15 July), Nairobi, Kenya.

Tabi Ekeobil, P.P., Bürgi M., Akinyemi, O.F., Sonwa, D., Ifejika Speranza, C., Ecosystem services assessment of forest patches in mosaic agricultural landscapes in Cameroon and Benin. Oral presentation, **IALE 2023 WORLD CONGRESS** (10-15 July), Nairobi, Kenya.

Mintah, F., Tabi Ekeobil, P. P., Oberlack, C., Ifejika Speranza, C., Institutions and impacts of forest governance on the persistence and re-emergence of forests in the tropics: An archetype approach. Oral presentation, **XIX Biennial International Association of the Study of Commons (IASC) Conference** (19-24 June), Nairobi, Kenya.

Agonvonon, G.A., Azihou, F., Ifejika Speranza, C., Tree communities' conservation in forest patches of Benin, West Africa. **Biodiversity convention: From science to implementation** (26-29 June), Ascona, Switzerland.

#### 2022

Agonvonon, G.A., & Ifejika Speranza, C., Challenges and opportunities for early career ecologists in Africa. Oral presentation, **International Association for Ecology** (28 Aug. to 02 Sep.), Geneva, Switzerland.

Hepner, S., & Ifejika Speranza, C., Social-ecological factors influencing the aboveground biomass of tropical forest patches. Oral presentation, **International Association for Ecology** (28 Aug. to 02 Sep.), Geneva, Switzerland.

Mintah, F., Oberlack, C., Ifejika Speranza, C., Governance of forest use and its impacts on the forest land use change in sub-Saharan Africa. Oral presentation, **The Netherlands Land Academy International Conference on Land Governance** (29 June –01 July), Utrecht, Netherlands.

Wingate, F. R., Akinyemi, F.O., Iheaturu, C.J., Ifejika Speranza, C., A remote sensing-based inventory of West-Africa tropical forest patches, **European Geoscience meeting EGU** (09 April), online.

### Guest Lectures and Invited Presentations

#### 2023

Ifejika Speranza C., Changing institutions and changing forests in West Africa? A historical examination. Guest lecture, **University of Neuchatel** (14 December), Switzerland

Wingate V.R., Small forest patches in West Africa: mapping how they are changing to better inform their conservation. Guest lecture, **University of Basel** (4 December), Switzerland.

Ifejika Speranza, C., Transdisciplinary approaches of “making hope possible” in social- ecological transformation - Two Illustrative Examples. **Lassalle-Institut, Edlibach, Zug** (28 August), Switzerland.

Ifejika Speranza, C., Sustaining forest patches in agricultural landscapes of West Africa – A research agenda. Guest lecture, **University of Göttingen** (6 June), Germany.

## Summer Schools

- **IGS North-South Summerschool, 2023, Nanyuki, Kenya** on “Common pool resources in a globalised world” (F. Mintah, P. Tabi Ekeobil)
- **Interdisciplinary summer school, 2023 Ljubljana, Slovenia** on “forest ecology and technology to measure forest characteristics” (S. Hepner)
- **IGS Summerschool 2022 in Tramelan, Bern** on “politics and natural resources from a conflict perspective” (G. Agonvonon, S. Hepner)

## Team

**Prof. Dr. Chinwe Ifejika Speranza**  
*Principal Investigator*

**Dr. Felicia O. Akinyemi**  
*Senior Researcher*

**Dr. Vladimir Ruslan Wingate**  
*Postdoc*

**Dr. Giulia Curatola Fernandez**  
*Postdoc*

**Dr. David Ellison**  
*Adjunct Researcher*

**Chima Iheaturu**  
*PhD Candidate,*  
Multi-scale modelling of Spatio-temporal dynamics of forest patches

**Samuel Hepner**  
*PhD Candidate,*  
Aboveground biomass of isolated forest patches in West Africa

**Georges Alex Agonvonon**  
*PhD Candidate,*  
Ecology and conservation of forest patches in West Africa

**Paule Pamela Tabi Ekebil**  
*PhD Candidate,*  
Livelihoods, biodiversity, and ecosystem health in forest patches in West Africa

**Frank Mintah**  
*PhD Candidate,*  
Governance arrangements that work for sustainable forest use and management in West Africa

**Phydias Agossou**  
*PhD Candidate*  
Identifying structural and functional connectivity underpinning effective forest and biodiversity conservation in the agricultural landscape of the Dahomey-Gap, West Africa.

**Juri Fitz, Robin Hartmann, Mariana Matthei Guzmàn, Flavia Bindschedler, Robin Heiserer, Janine Jung, Ingrid Kjelsen, Lea Sonnabend**  
*Research Assistants*

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## Upcoming Conferences & Events of SUSTAINFORESTS

14.02.2024: **SUSTAINFORESTS stakeholder conference, Berne, Switzerland**

16-18.04.2024: **13<sup>th</sup> Workshop on Imaging Spectroscopy, València, Spain**

16.-21.06.2024: **3<sup>rd</sup> World Biodiversity Forum, Davos, Switzerland**

12.-15.08.2024: **Welcome to Sustainability: Social-ecological resilience and transformation across multiple scales, Montreal, Canada**

## Partners



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University of Calabar

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