

Multidisciplinary Workshop

Green Transition & Biodiversity



8 DECENT WORK AND
ECONOMIC GROWTH



15 LIFE
ON LAND



PROGRAMME

Brussels, Monday 4 December 2023

Venue

Palais des Académies — Paleis der Academiën
Rue Ducale 1 — Hertogsstraat 1
1000 Brussels

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CONTENTS

Contents	1
Programme	2
Communications by young researchers	6
Session I	7
Session II	12
Session III	19
Posters	26
Index	41

PROGRAMME

08.30 - 09.00 Registration & Poster installation

09.00 - 09.10 Welcome Address

09.10 - 09.35 **KEYNOTE LECTURE**

Benoît LEGRAND, Enabel Belgian development agency

09.35 - 09.45 Questions & Answers

09.45 - 10.45 **COMMUNICATIONS BY YOUNG RESEARCHERS – SESSION I**

Chair: Pierre MEERTS, Université Libre de Bruxelles & RAOS Member, Belgium

Do large dams contribute to the green transition? A systematic review of their hydrogeomorphological impact in Africa

Sofie ANNYS, Department of Geography, Ghent University (Belgium)

High phenotypic plasticity and growth performance in outcrossed seedlings of *Pericopsis elata* (Fabaceae)

Jean Pierre NGONGO, Faculty of Sciences. Evolutionary Biology and Ecology, Université Libre de Bruxelles (Belgium) & Faculty of Agronomic Sciences, Department of Natural and Renewable Resources Management. University of Kindu (Democratic Republic of Congo)

Empowering women to achieve sustainable development goals: Bangladesh's "whole of society" approach and CARE's role

Krishna Kumar SAHA, Department of Conflict and Development Studies, Ghent University (Belgium) & Assistant Professor, Department of Public Administration, Comilla University (Bangladesh)

Water scarcity as a crisis of reproduction: A case study of climate change adaptation to water scarcity and droughts in eastern India

Nairita ROY CHAUDHURI, Tilburg Law School, Tilburg University (Netherlands)

10.45 - 11.15 Coffee break & Poster session

POSTERS

Habitat fragmentation and alien species impacts on biodiversity condition of Ikogosi Ekiti, Southwestern, Nigeria

SAMUEL ANIRAMU, Space Application and Environmental Science Laboratory, Obafemi Awolowo University, Ile-Ife (Nigeria)

Pratiques et rendements de carbonisation dans la zone rurale de Lubumbashi en RDC

Nathan KASANDA MUKENDI, Faculté des Sciences Agronomiques, Unité de Recherche en Economie et Développement Agricole, Université de Lubumbashi (République Démocratique du Congo) & Gembloux-Agro Biotech, Unité Biodiversité et Paysage, Université de Liège (Belgium)

Quantification de la déforestation et de la dégradation du miombo dans le bassin de production du charbon de bois (BPCB) à Lubumbashi (RD Congo): ampleur et changement spatiaux entre 1990 et 2022

Héritier KHOJI MUTEYA, Unité Ecologie, Restauration Ecologique et Paysage, Faculté des Sciences Agronomiques, Université de Lubumbashi (Democratic Republic of the Congo) & Unité Biodiversité et Paysage, Université de Liège—Gembloux Agro-BioTech (Belgium)

“Mother Nature, where have I hurt you and why do I feel your anger in my being?”

Ecofeminist issues

Christelle BALEGAMIRE KARUTA, Center of Expertise in Environmental and Mining Management, Catholic University of Bukavu (CEGEMI-UCB) (Democratic Republic of the Congo) & Kalehe Higher Institute of Development Techniques (ISTD-Kalehe) (Democratic Republic of the Congo)

Aquifer structure and hydraulic parameters assessment of Jimma area, Ethiopia

Wagari Mosisa KITESSA, Laboratory for Applied Geology and Hydrogeology, Department of Geology, Ghent University (Belgium) & Faculty of Civil and Environmental Engineering, Jimma Institute of Technology, Jimma University (Ethiopia)

11.45 - 12.45

COMMUNICATIONS BY YOUNG RESEARCHERS – SESSION II

Chair: Christine COCQUYT, Meise Botanic Garden & RAOS Member, Belgium

Traditional health practices and biodiversity in Africa: A systematic review

Léa FOURCHAULT, Royal Belgian Institute of Natural Sciences (Belgium)

Hydro-geophysical study of the Bou Omrane-Sabkhet Naouel region (Tunisian Southern Atlas)

Marwa GHAIB, Faculty of Sciences of Tunis & Sedimentary Basins and Petroleum Geology Research Laboratory (BS&GP), University of Tunis El Manar (Tunisia), Laboratory for Applied Geology and Hydrogeology, Department of Geology, Ghent University (Belgium)

Assessing catchment connectivity dynamics in the Gumara and Rib catchments of the Ethiopian Highland

Anik Juli Dwi ASTUTI, Department of Geography, Ghent University (Belgium)

Sustainability of mangrove silviculture in Malaysia: New insights from deep soil carbon

Giovanna WOLSWIJK, Systems Ecology and Resource Management, Department of Organism Biology, Faculté des Sciences, Université Libre de Bruxelles (Belgium) & Mangrove Research Unit (MARU), Institute of Oceanography and Environment (INOS), Universiti Malaysia Terengganu (Malaysia)

Groundwater pollution vulnerability analysis using the DRASTIC model a case of the Jimma area, Southwestern Ethiopia

Beekan Gurmessa GUDETA, Laboratory for Applied Geology and Hydrogeology, Department of Geology, Ghent University (Belgium) & Jimma Institute of Technology, Faculty of Civil and Environmental Engineering, Jimma University (Ethiopia)

The quality potential of Robusta coffee accessions from DR Congo

Robrecht BOLLEN, Meise Botanic Garden, Meise (Belgium), Flanders Research Institute for Agriculture, Fisheries and Food (Belgium) & University of Leuven, Leuven (Belgium)

12.45 - 13.45

Lunch + Poster session

POSTERS

Exploring perceptions of Wetland Ecosystem Services (WES) in Africa, methods and tools: A scoping review

Géant CHUMA, Faculty of Agricultural and Environment Sciences, Université Evangélique en Afrique (UEA), Bukavu (Democratic Republic of Congo) & 2UR Spheres-Laplec, Department of Geography, University of Liège (Belgium)

Mapping small inland wetlands in the South-Kivu province by integrating optical and SAR data with statistical models for accurate distribution assessment

Géant CHUMA, Faculty of Agricultural and Environment Sciences, Université Evangélique en Afrique (UEA), Bukavu (Democratic Republic of Congo) & 2UR Spheres-Laplec, Department of Geography, University of Liège (Belgium)

Effects of preceding upland rice and manuring on soil properties and cotton yield in the South Sudan area of Burkina Faso

Arthur DIESSANA, Ministère de l'Agriculture, des Aménagements Hydro-agricoles et de la Mécanisation (Burkina Faso) & Département des sciences et gestion de l'environnement, University of Liège (Belgium)

Mapping the pollution risk of the Mouhoun sub-watershed in Boromo in Burkina Faso

Harouna KABORE, Department of Environmental Sciences and Management, University of Liège (Belgium)

Assessment of spring water resource in Jimma zone, Southwestern Ethiopia

Adisu Befekadu KEBEDE, Laboratory for Applied Geology and Hydrogeology, Department of Geology, Ghent University (Belgium) & Faculty of Civil and Environmental Engineering, Jimma Institute of Technology, Jimma University (Ethiopia)

13.45 - 15.15

COMMUNICATIONS BY YOUNG RESEARCHERS – SESSION III

Chair: Matthieu KERVYN, Vrije Universiteit Brussel & RAOS Member, Belgium

Exploring the biodiversity of Polynesian lower mesophotic reefs: A thrilling crime scene investigation

Xavier RAICK, Functional and Evolutionary Morphology Laboratory, University of Liège (Belgium)

Land cover change in the Afro-alpine Mt. Guna: Implications on sustainable socio-economic and environmental management

Adugnaw BIRHANU, Guna Tana Integrated Field Research and Development Center; Department of Natural Resource Management, (Ethiopia), Laboratory for Applied Geology and Hydrogeology, Department of Geology, Ghent University (Belgium) & Department of Geography, Ghent University (Belgium)

Assessing conservation strategy impact: Forest cover change and carbon balance in protected vs. unprotected areas in Benin, West Africa

Ibitoyé BIAH, Laboratory of Applied Ecology, Faculty of Agricultural Sciences, University of Abomey-Calavi (Benin)

Estimation of groundwater recharge in the volcanic Aquifer of Gilgel Gibe catchment, Ethiopia

Fayera Gudu TUFA, Laboratory for Applied Geology and Hydrogeology, Ghent University (Belgium) & Faculty of Civil and Environmental Engineering, Jimma University (Ethiopia)

Geophysics at the frontlines of climate-induced water scarcity

Khaoula CHARREK, Faculty of Sciences of Tunis, Georesources Laboratory, Centre for Water Research and Technologies (Tunisia) & Ghent University (Belgium)

Human-edible products from Acacias: Overlooked treasures in the arid tropics — A plea for their valorization

Moustapha Soungalo DRABO, Research Unit VEG-i-TEC, Faculty of Bioscience Engineering, Ghent University (Belgium) & Laboratoire de Biochimie et Immunologie Appliquées, Unité de formation en Science de la Vie et de la Terre, Université Joseph Ki-Zerbo (Burkina Faso)

15.15 - 15.45

Coffee break & Poster session

POSTERS

Influence of temperature on acute and chronic toxicity of marine algal toxins — A case study with copepod *Nitokra spinipes*

Wenxin LIU, Blue Growth Research Lab, Ghent University (Belgium)

A South Africa biodiversity data pipeline for wetlands and waterbirds

Francis STROBBE, Operational Directorate Natural Environment, Royal Belgian Institute of Natural Sciences, Brussels (Belgium)

Equity on the distribution and composition of street trees in the city of San Luis Potosí, México

Luis Emir RAMÍREZ-CASTILLO, Instituto Potosino de Investigación Científica y Tecnológica (México)

Unravelling the diversity and roles of plant volatile organic compounds in the Annonaceae family

Jannat-E-TAJKIA, Department of Biology, Faculty of Science, Ghent University, (Belgium) & Department of Crop Botany, Faculty of Agriculture, Bangladesh Agricultural University (Bangladesh)

15.45 – 16.15

General discussion and closing remarks

Philippe GOYENS, RAOS Honorary Permanent Secretary, Belgium

Best poster award

Cecile BAETEMAN, Royal Belgian Institute of Natural Sciences & RAOS Member, Belgium

Thierry SMITH, Royal Belgian Institute of Natural Sciences & RAOS Member, Belgium

**COMMUNICATIONS BY
YOUNG RESEARCHERS**

Session I

Do large dams contribute to the green transition? A systematic review of their hydrogeomorphological impact in Africa

Sofie Annys^{1,*} & Amaury Frankl¹

KEYWORDS. — Hydrologic alteration; Sediment trapping; Riverbed; Planform morphology.

ABSTRACT. — Despite the fact that large dams exert a significant environmental impact on the rivers they impound, a renewed 21st century interest in these hydraulic structures exists, mainly driven by the premise to make the agricultural and energy sectors climate-resilient. This study focuses on the often underexposed large dams in Africa and entails an examination of their spatial distribution and characteristics, and downstream impacts. To this end, we have created a comprehensive spatial database of 1047 large dams, which can be considered the most complete database for Africa. Together, these dams impound 949 km³ of water for irrigation (50 % of dams), urban and industrial water supply (31 % of dams), hydropower generation (16 % of dams, with a total installed capacity of 43,567 MW) and other purposes (< 3 % of dams). The findings of our systematic literature review of the hydrological and geomorphological impact of these large dams reveal a consistent augmentation in low flows, a pronounced reduction in high flows, and often, a decrease in average river flows. Furthermore, sediment trapping efficiencies within the range of 60 % to 99 % are documented. Although these trends exhibit broad consistency across the continent, the associated geomorphological changes frequently exhibit localized variations. Common alterations encompass riverbed incision and a narrowing of the active riverbed. Coastal erosion and the permanent opening or closing of estuaries are also recurrently observed. Additionally, a spectrum of ecological impacts is identified, ranging from thermal and hypoxia pollution to shifts in riparian woody vegetation distribution, often favouring non-native species. Although there is no one-size-fits-all solution to address these environmental externalities, our study highlights the importance of environmental impact assessments, monitoring of dam-induced impacts and environmental justice. Furthermore, the study offers insights into potential forthcoming challenges in the context of a changing climate (32 % / 44 % of dams expect significant precipitation increases / decreases by 2050) and ever-high sediment yields (at 73 % of the dam locations, sediment yields > 10 Mg km⁻² yr⁻¹ occur). These challenges necessitate adaptive dam operation strategies and transboundary management, and additional research on technological solutions for reservoir sedimentation.

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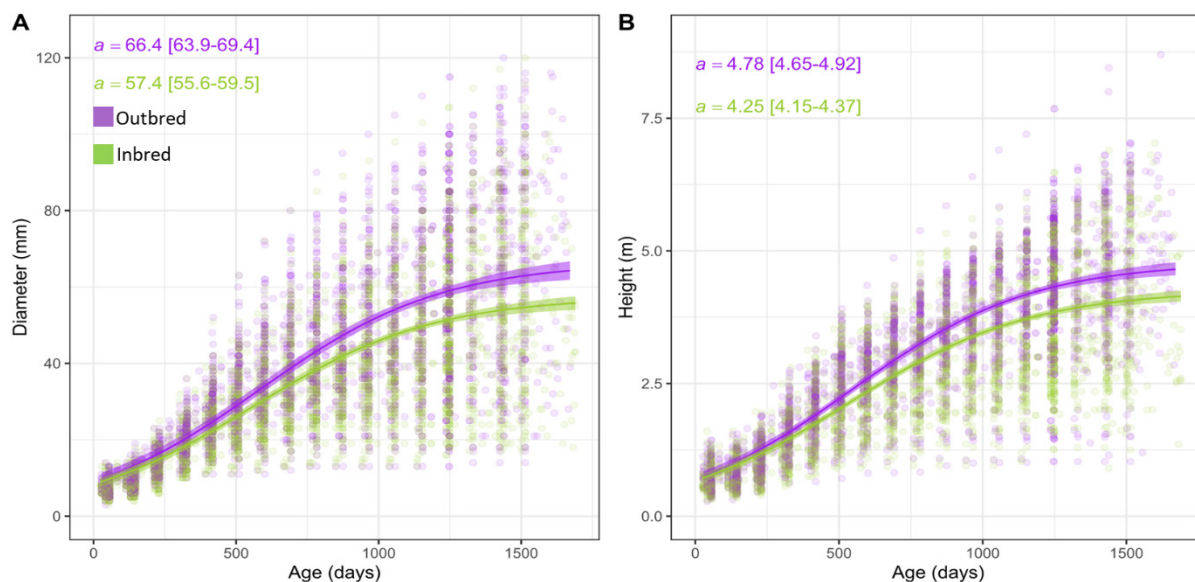
High phenotypic plasticity and growth performance in outcrossed seedlings of *Pericopsis elata* (Fabaceae)

Jean Pierre Ngongo^{1,2,*}, Chadrack Kafuti³, Hans Beeckman⁴, Olivier J. Hardy¹
& Nils Bourland⁴

KEYWORDS. — Biodiversity; Silviculture; Functional Traits; Central Africa; Population Genetics.

ABSTRACT. — Logging in the Congo Basin is geared towards selecting a minority of species with a high commercial value. The long-term conservation of these species has become a major challenge for ecologists and forest managers. The silvicultural approach is one of the best ways of promoting the long-term conservation of these species. This study focused on *Pericopsis elata*, a heliophilous species found in the semi-deciduous humid forests of tropical Africa, which is deficient in natural regeneration. Highly exploited for its high-quality timber, it is listed in CITES appendix II (CoP18 #17) and is recorded as Endangered A2cd on the IUCN Red List. With a selfing rate of 54 %, it may be affected by inbreeding depression and loss potential to adapt to changing environmental conditions. Several studies have assessed the impact of inbreeding in terms of fecundity and survival. However, little is known about the effect of inbreeding on growth potential and phenotypic plasticity. A silvicultural trial of 648 *P. elata* seedlings was carried out in the DR. Congo for 4 years cultivated in a density gradient. Paternity analyses using microsatellite markers were carried out to identify the matrimonial origin of the seedlings. We found a significant difference between the growth of inbred and outbred plants (fig. 1). Analysis of leaf characteristics revealed a higher level of phenotypic plasticity in outbred seedlings than inbred seedlings, reflecting their possible better adaptation to environmental conditions.

Our presentation will show how controlling planting density and selecting outbred seeds can improve the growth and adaptation of *P. elata* seedlings to changing environmental conditions.



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Empowering women to achieve sustainable development goals: Bangladesh’s “whole of society” approach and CARE’s role

Krishna Kumar Saha^{1,2,*}

KEYWORDS. — Bangladesh; SDGs; Women’s Empowerment; CARE; Whole of Society Approach.

ABSTRACT. — Bangladesh is making efforts to achieve Sustainable Development Goals (SDGs) by empowering women and reducing inequality. The government has adopted a “Whole of Society” approach, which involves the participation of various stakeholders such as NGOs, development partners, private sectors, media, and CSOs. The SDGs Implementation and Monitoring Committee was formed to spearhead the process. CARE, an organization dedicated to women’s empowerment, has been operating in Bangladesh since its inception with a goal of bringing change to marginalized women and girls’ lives. CARE’s approach includes contextual analysis, employment of the women’s empowerment framework, and integration of the resulting knowledge into various sectors’ projects.

Secondary data from the CARE project documents and reporting from the M&E section of the organization has provided the necessary empirical data needed for the study. Also, the necessary theoretical literature and important body of research from the South Asian context have been used to conduct the study on women’s empowerment. This brings us to explore the question on, how women can advocate themselves against gender-based norms and achieving women’s empowerment? Based on the literature, the findings show that by making women stronger and more confident on their rights will lead to non-traditional life choices and income generating activities. This will provide them with education, proper marriage, career, life inspiration, and more as the women for women is the only solution for the women’s empowerment.

Through economic empowerment, the organization has helped women secure their entitlements to health, education, and other basic rights. The women’s empowerment impact statement consists of three domains of change, namely exercise of a superb choice of decisions affecting their lives, reduced violence against women, and strong social movements built on women’s solidarity and participation of men. The three levers of women’s empowerment identified are agency, structures, and relations, which are discussed in detail in Kabeer’s (1999) conceptual framework for women’s empowerment. In the study, the same author has expressed that ability to choose is the empowerment and in this case the organization is providing certain support for the marginalized population for availing their choice. To exercise the choice depends on three interrelated terms: resources (pre-condition), agency (process), and achievements (outcomes). This paper provides insight into Bangladesh’s approach to achieving SDGs and CARE’s successful efforts towards women’s empowerment in the country.

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Water scarcity as a crisis of reproduction: A case study of climate change adaptation to water scarcity and droughts in eastern India

Nairita Roy Chaudhuri^{1,*}

KEYWORDS. — Law and Development; Qualitative Research; Gender; Water; India.

ABSTRACT. — Over-extraction of groundwater in the agricultural sector exacerbated water stress in rural India (Taylor, 2013). Climate change is compounding the stress by increasing the frequency, severity and extent of droughts, thereby threatening crop production and rural livelihoods (IPCC, 2014). Adapting to scarce water and droughts is vital for sustainable transition in rural societies. Despite women being primarily responsible for ensuring water security and care, little is known about the sustainability potential of local adaptation practices from a gender perspective. Therefore, the research question is, how do gender relations shape local knowledge of sustainable adaptation to water scarcity in rural parts of eastern India. The aim is to explore gendered and situated understanding of sustainable adaptation. A grounded theory and qualitative approach was adopted to collect data from the semi-arid belts in eastern (West Bengal and Odisha) India. The findings show that rural communities especially women, are suffering from interlinked crises of water, fuelwood, food, biodiversity, health, time, and income. Therefore, water crisis is as part of a bigger crisis of reproduction of holistic ‘Nature’, covering ecological commons, livelihoods, and gendered labour. Expanding upon the social reproduction theory, it is demonstrated that adaptation practices in agrarian contexts involve struggles over fictitious boundaries between productive agricultural work and reproductive work, which prioritize production and market imperatives, over reproduction and non-economic values. Climate change aggravates these ‘boundary struggles’ (Fraser, 2017), rendering especially Dalit, Adivasi and poorest rural women intersectionally vulnerable to the vanishing water and ecological commons. Consequently, women are severely overburdened with reproductive labour, while water and other commons continue to be instrumentalized for increasing agricultural production. In order to sustainably transform these boundary struggles, the paper argues for integrating adaptation endeavors within the notion of ‘sustainable reproduction’ that takes gender justice seriously and promotes situated and non-economic knowledges that reproduce life.

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Session II

Traditional health practices and biodiversity in Africa: A systematic review

Léa Fourchault^{1,*}, Dimitri Romaric Nguinwa Mbakop², Abdallah Lamane³,
Ganiyat Temidayo Saliu¹, Erik Verheyen^{1,4}, Sophie Gryseels^{1,4} & Katharina Kreppel⁵

KEYWORDS. — Traditional Medicine; Wildlife Conservation; Zootherapy; PRISMA; Africa.

ABSTRACT. — In 2023, the World Health Organisation held its first global summit on Traditional Medicine, which is currently the primary type of healthcare for five billion people. While Traditional Health Practices are an important part of Sustainable Development Goals 3 and 12, several of these practices involve animal parts (*e.g.*, feces, bones, blood) from wildlife. This review thus aims to analyze the impact of zootherapeutic practices on African biodiversity. We conducted a systematic literature search to characterize temporal and spatial trends of the impact of zootherapeutic practices on African biodiversity. We included 53 studies reporting the use of 540 animal species in over 2,000 zootherapeutic practices. Half of these studies were published in the last three years, indicating a recent surge of interest. Nigerian, Ethiopian and South African practices were comparatively well documented, unlike practices in the Sahara region. We found that the most frequently recorded practices involved both wild (genus *Smutsia*, *Loxodonta*, *Crocuta*) and domestic species (genus *Bos*, *Gallus*, *Capra*). Further, while some practices required animal parts that imply harm to the animal (internal organs, blood, bones), other practices were harmless (*e.g.*, using feces, milk, or feathers). Importantly, zootherapeutic practices disproportionately harmed endangered wildlife compared to domestic animal: the odds of a practice being harmless to individual animals significantly decreased when the species was listed as Near Threatened, Vulnerable, Endangered, or Critically Endangered ($e^{-1.976} = 0.138$, $z = -11$, $p(z) = 3.927e-28 < 0.05$). This highlights that zootherapeutic practices negatively impact endangered wildlife specifically. Nonetheless, several studies were taxonomically biased, indicating a need to record practices that span the animal kingdom. This review acts as a first step to highlight the impact of traditional medicine on African biodiversity and spark conversations regarding sustainable alternatives that align healthcare demands rooted in traditional methods and global conservation objectives.

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Hydro-geophysical study of the Bou Omrane-Sabkhet Naouel region (Tunisian Southern Atlas)

Marwa Ghaib^{1,3,5}, Dorra Tanfous^{1,3}, Ferid Dhahri^{2,4}, Mouez Gouasmia^{2,3}, Kristine Walraevens⁵
& Mouhamed Soussi^{1,3}

KEYWORDS. — Bou Omrane-Sabkhet Naouel; Aquifer System; Hydrogeological; Geophysical.

ABSTRACT. — The Bou Omrane-Sabkhet Naouel area, located in the southern Tunisian Atlas, including the elongated E–W synclinal basin of Bou Omrane to the west, and the wide plain of Talh-Sabkhet Naouel, to the east. This area is restricted between the anticlinal ranges of Orbata-Tyouna-Bouhedma to the north, and Chemsî-Benkhir, to the south. Sebkheth Naouel constitutes its outlet. The hydrographic network is relatively dense. The study area faces severe aridity and lack of water resources. Groundwaters are the main source of water for drinking-domestic and agricultural uses. Population access to groundwater by artisanal well is limited because of the seasonal lowering of the water table and the increase of salinity toward Sebkheth Naouel borders. However, deep Miocene-Cretaceous aquifers are abstracted by means of 48 wells (in 2016). In the last decade, the number of wells increased dramatically around Sebkheth Naouel to more than 260 and led to the establishment of a cultivated perimeter. This work aims to evaluate the groundwater potential for the region based on a hydrogeological and geophysical approach. Also, it raises awareness for the local population to the increased concerns on the sustainable use of water resources in the region that faces overexploitation and climatic change. In fact, the basin is filled with Meso-Cenozoic sediments that developed some aquifer systems within the Cretaceous, Miocene and Mio-Pliocene-Quaternary sequences. In this survey, geological and geoelectrical data, calibrated with outcropping series and available hydraulic and petroleum wells were used to delineate the geometry of the shallow to semi-deep aquifer system in the region and to propose its conceptual hydrogeological model. The structural background of the region is complex, and the Meso-Cenozoic strata are strongly dislocated by folding, and faulting which largely controlled the development of the aquifer's units. This issue needs further investigation to endeavor comprehensive hydrogeological exploration of the region.

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Assessing catchment connectivity dynamics in the Gumara and Rib catchments of the Ethiopian Highland

Anik Juli Dwi Astuti^{1,*}, Sofie Annys¹, Hanibal Lemma², Jan Nyssen¹, Stefaan Dondeyne¹
& Amaury Frankl¹

KEYWORDS. — Catchment Management; Connectivity Index; Satellite data; Gumara and Rib Catchments; Water and Sediment Connectivity.

ABSTRACT. — In the past three decades, the Gumara and Rib catchments in the Ethiopian Highland have witnessed substantial changes in sediment dynamics. These changes are primarily driven by alterations in land cover and variation in rainfall patterns. Understanding the mechanisms behind these shifts and their implications for environmental sustainability is important. This study aimed to investigate the dynamics of water and sediment connectivity in two adjacent Gumara and Rib catchments, both suffering from severe land degradation.

Water and sediment connectivity was assessed using the modified index of connectivity (*MIC*) and the SedIn-Connect 2.3. Satellite data sources, including the Shuttle Radar Topographic Mission (SRTM), were utilized to determine slope gradient and roughness index, while Landsat 8 and Landsat 5 data were employed to identify land cover. Additionally, remotely sensed rainfall estimates, such as TAMSAT, were used to estimate annual rainfall erosivity in the catchments. The mapping of land cover was carried out using Google Earth Engine, which was then leveraged to estimate both the crop (*C*) factor and surface runoff. The finding indicates an increasing trend in water and sediment connectivity from 1995 to 2015 in both catchments. The highest water and sediment connectivity was observed in 2010, while the lowest occurred in 1997. The Gumara catchment exhibited higher water and sediment connectivity compared to the Rib catchment, primarily due to differences in rainfall.

Analyzing water and sediment connectivity on an annual basis offers valuable insight into how these dynamics correlate with rainfall variations and changes in land cover. This temporal and spatial analysis of water and sediment connectivity gives an understanding for land managers and policymakers to develop effective strategies for erosion control and sustainable land use planning within the catchment.

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Sustainability of mangrove silviculture in Malaysia: New insights from deep soil carbon

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Che Abdullah Mohd Kamarul Anuar², Ali Ahmad Nazila², Wolswijk Louise⁴,
Hami Hamzah Mohamad Khalies² & Dahdouh-Guebas Farid^{1,3,5,6}

KEYWORDS. — Blue Carbon; Carbon Stock; Charcoal Production; Matang Mangrove Forest Reserve.

ABSTRACT. — Mangroves are among the most carbon dense forests in the tropics thanks to anaerobic soil conditions that limit the losses of CO₂ via respiration and allow for carbon accumulation in the soil (Donato *et al.*, 2011). However, there is only limited information on the influence of soil depth on carbon pool estimates perhaps due to practical difficulties to work in mangrove environments and/or limited facilities available. In this study, for the first time, soil cores collected from a depth of 10 m at the Matang Mangrove Forest Reserve (MMFR), Malaysia, were analyzed together with the other important ecosystem components of vegetation biomass, leaf litter and dead wood. The MMFR is managed for pole and charcoal production from the species *Rhizophora apiculata* and *R. mucronata* with a rotation cycle of thirty years that includes two thinnings and a final clear-felling (Ariffin & Mustafa, 2013), allowing us to compare carbon pools across different forest ages as well as evaluating the loss of carbon caused by the silvicultural activities. Compared to previous studies that only considered 1 m of soil, our results show a five times higher carbon stock in the soil, highlighting the importance of soil depth in blue carbon studies. Although most of the carbon was stored in the top 3-4 m, even at lower depth the average carbon pool was still around 100 Mg C ha⁻¹. Importantly, the forest stands exempted from greenwood exploitation (protective forest) contained a deeper peat layer and higher soil carbon pool compared to the managed areas (3,200 Mg C ha⁻¹ vs 2,000-2,800 Mg C ha⁻¹). The overall loss of carbon through clear-felling and thinning activities, especially in the top 3 m of soil, was found to be 457 and 285 Mg C ha⁻¹ respectively. Other ecosystem components had overall lower carbon pools with the biomass being the most relevant and reaching values of 200 Mg C ha⁻¹ in protective forest and 120 Mg C ha⁻¹ in a 25-year-old managed forest. As the protected mangroves remain crucial for balancing carbon stock as well as sustainability of the ongoing management, we would recommend increasing the extent of unmanaged forest in the MMFR for a better resilience against climate change.

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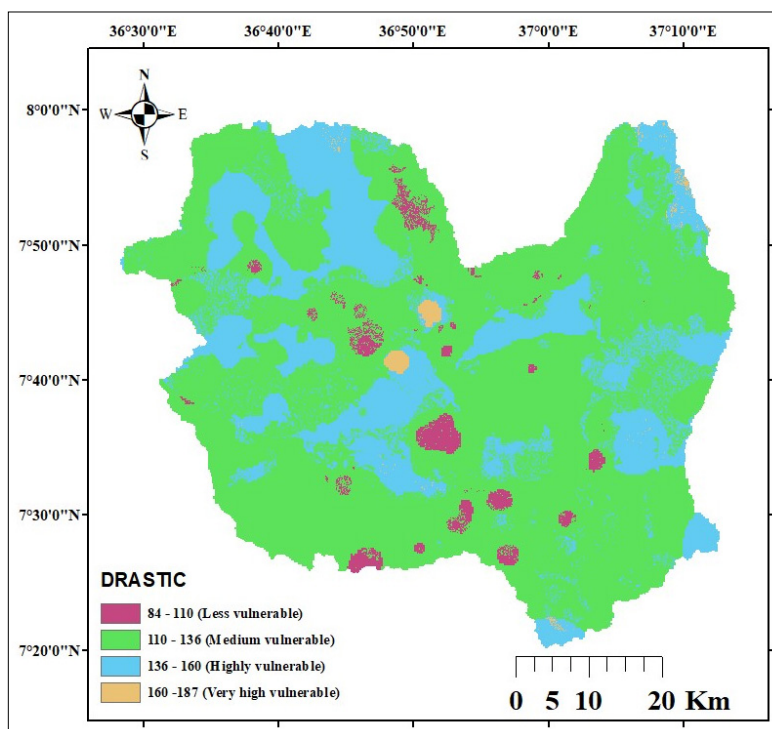
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Groundwater pollution vulnerability analysis using the DRASTIC model a case of the Jimma area, Southwestern Ethiopia

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KEYWORDS. — DRASTIC; Groundwater; Jimma; Sensitivity; Pollution; Vulnerability.

ABSTRACT. — Nowadays, there are various anthropogenic activities that have the potential to pollute groundwater resources. Therefore monitoring the quality of groundwater resources quality and identifying vulnerable areas to pollution are important. However, there are few studies and minimal worries about regulating groundwater quality in developing countries like Ethiopia. This research is aimed to evaluate the vulnerability of groundwater in the Jimma area using the DRASTIC model. The seven DRASTIC parameters. The DRASTIC model uses seven layers of hydrogeological data: the depth to the water table, the recharge, the aquifer media, the soil media, the topography, the impact of the vadose zone, and the hydraulic conductivity of the aquifer. The sample of water was analyzed to measure nitrate concentration that used to check the validity of the model. The DRASTIC vulnerability index was calculated in ArcGIS as a weighted sum. The DRASTIC vulnerability index in the region varies from 84 to 187, depending on the location. 3, 70, 26, and 1 percent of the area, respectively, are at low, medium, high very high vulnerability. The DRASTIC index indicated a moderate correlation with nitrate, with a value of 0.571. Sensitivity analysis was performed to measure the influence of each parameter in the DRASTIC index calculation. In the single parameter sensitivity analysis, the depth to the water table, the net recharge, and the impact of the vadose zone have higher mean effective weights than the other parameters. In a parameter removal sensitivity analysis, a high variation of the vulnerability index was observed due to the removal of depth to the water table. The research findings should be used as a reference to protect and monitor the quality of the groundwater in the Jimma area since the less vulnerable areas and highly vulnerable areas to pollution were identified.



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The quality potential of Robusta coffee accessions from DR Congo

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KEYWORDS. — Plant Science; Coffee Quality; Accessions; DR Congo.

ABSTRACT. — The ex-situ Robusta coffee (*C. canephora*) collection of INERA Yangambi (DR Congo) contains a considerable yet underexplored diversity of genetic resources, including wild accessions and local varieties. To explore the agronomic potential of the collection, we performed genetic screening and a detailed organoleptic evaluation of the accessions. The Robusta collection was fully genotyped using Genotyping-by-Sequencing and Amplicon sequencing (Verleysen *et al.*, 2023). The Fine Robusta cupping protocol (Coffee Quality Institute, 2019) was extended to allow for qualitative descriptive cupping in order to evaluate 70 genotypes and 20 post-harvest processing samples.

The genotyping of the accessions revealed considerable hybridization of the genetic resources and separation of the wild material. A large spread in cupping quality was discovered, with the highest-scoring samples having unique flavor profiles. The flavor profiles were not correlated with the genetic origin of the accessions, as we found unique profiles among the different origins. Post-harvest processing significantly impacted the quality score, and we found descriptors correlated with the processing. A considerable commercial potential was found for the INERA Yangambi collection. The use of sensory descriptors allowed for the discovery of unique flavor profiles as well as the differentiation of post-harvest processing methods. Conservation of the Robusta genetic resources of DR Congo are of importance to the global coffee sector.

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Session III

Exploring the biodiversity of Polynesian lower mesophotic reefs: A thrilling crime scene investigation

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KEYWORDS. — Marine Biology; Bioacoustics; Passive Acoustic Monitoring; Fish Morphology; French Polynesia.

ABSTRACT. — Mesophotic coral reefs are known for their distinct fish communities and a remarkably diverse biophony. However, a significant portion of the sound-producing sources in these reefs remains elusive. This scientific study aims to unravel the secrets of this intriguing soundscape through the following objectives:

1. Identification of vocal fish species inhabiting the deep regions of mesophotic coral reefs in French Polynesia, based on a review of existing literature.

2. Interpretation of the sounds produced by these species to establish connections with previously recorded acoustic samples.

3. Examination of the sonic structures utilized by fish species within these families to generate their sounds.

Our findings suggest the possible presence of 42 vocal families at 120 m depth. Notably, the most prevalent vocal families include Serranidae, Lutjanidae, and Scorpaenidae. Certain Scorpaenidae species are characterized by the absence of a swimbladder. Instead, they possess a prominent sonic muscle configuration comprising bundles inserted into the skull, separated by Baudelot's ligament, and extending via tendons attached to the vertebrae. This distinctive anatomical arrangement closely resembles that observed in temperate species known to produce sounds resembling the dominant acoustic profiles recorded within mesophotic reefs. Furthermore, our investigation reveals that the studied Serranidae species possess intercostal sonic muscles and swimbladders closely associated with the ribs, suggesting their potential to generate sounds such as downsweeps and tonal calls.

These research outcomes provide insights into the potential fish taxa responsible for the recorded sounds within mesophotic reefs, shedding light on the intricate sonic mechanisms employed by these fish. Our scientific endeavor delves into the depths of this enigmatic soundscape, unraveling mysteries of sound production in mesophotic coral reefs, enhancing our understanding of their unique acoustic ecology.

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Land cover change in the Afro-alpine Mt. Guna: Implications on sustainable socio-economic and environmental management

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KEYWORDS. — Land Cover Change; Drivers; Afro-alpine; GWR; Mount Guna.

ABSTRACT. — The study investigates land cover change and its drivers in Mt. Guna. The recent land cover map was generated from 2018 Google Earth imagery, while historical land cover maps were generated from aerial photos of 1957 and 1980.

Multi-scale Geographically Weighted Regression (GWR) and Ordinary Least Squares (OLS) methods were used to analyze land cover changes between three periods and the factors driving these changes. The analysis revealed that dynamic land cover change observed in Mt. Guna between 1957 and 2018, is primarily characterized by the conversion of land cover into cropland. Only 31 % of land cover remained unchanged over the period of 61 years, while 69 % of land cover shows alteration in the form of gains or losses from its initial state. The spatial relationship between land cover change and its drivers in Mt. Guna revealed that population density, slope gradient and clustered homestead density are major drivers of land cover change.

The observed changes in land cover in Mt. Guna have significant implications at both the local and national levels, affecting socio-economic and environmental development. This expansion has led to a decrease in available fodder and has put the remaining grassland, especially in the higher Afro-alpine zones of the mountain (fig. 1), at a high risk of degradation due to overgrazing. This implies the importance of integrating socio-economic and livelihood considerations into environmental management, with the aim of achieving a sustainable balance in human-environment interactions. Therefore, it is crucial to adopt protected area management strategies based on the ecosystem services approach to mitigate further land cover change in Mt. Guna. By employing the ecosystem services approach, it is possible to achieve conservation objectives while also recognizing and incorporating the social, economic, and cultural values associated with nature.

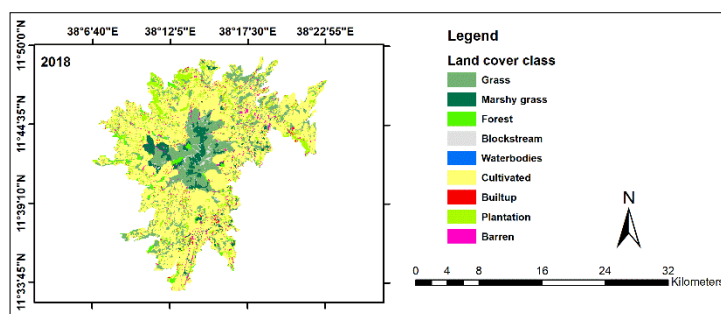


Figure 1: Land cover map of Mt. Guna in 1957, 1980 and 2018.

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Assessing conservation strategy impact: Forest cover change and carbon balance in protected vs. unprotected areas in Benin, West Africa

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KEYWORDS. — Forest reserve; Community forest; Sustainable management; Carbon sequestration.

ABSTRACT. — Beyond the primary goals of biodiversity conservation, ecosystem protection, and restoration, one of the specific goals of an integral reserve is climate change mitigation. Integral reserves play a crucial role in sequestering carbon and regulating greenhouse gases by implementing strategies to preserve and manage natural ecosystems. However, their effectiveness can vary significantly, needing a thorough impact assessment to guide future management decisions. This study aimed to evaluate the efficiency of management strategies employed in protected areas in Benin. We assessed changes in forest cover and their corresponding impact on the carbon balance. We use the Lama Forest Reserve as a case study, a 4,777-hectare semi-deciduous forest that has been under full protection since 1987 (Nagel *et al.* 2004). The reserve comprises three different vegetation types: undisturbed semi-deciduous forest, disturbed semi-deciduous forest and fallow (Goussanou *et al.* 2018). We compare this protected area with an unprotected one, such as the Lokoli community swamp forest, which spans 3,033 hectares and encompasses three vegetation types: typical swamp forest, disturbed swamp forest, and degraded swamp forest (Adomou *et al.* 2009).

The methodology combines remote sensing and fieldwork methods. Landsat imageries were used for supervised classification to detect changes in land cover through a transition matrix. Forest inventories were carried out for both the moist semi-deciduous forest and swamp forest, involving 45 and 36 square plots (50 m x 50 m), respectively which were distributed proportionally to the area of each vegetation type. Biomass calculations employed allometric models, biomass expansion factors, and root-to-shoot ratios. Within the protected Lama Forest Reserve, a notable trend emerges, where the fallow and degraded forest transitions into typical semi-deciduous forest at an annual rate of 3 %. This gain results in carbon sequestration benefits of 16 tCO₂eq.yr⁻¹.ha⁻¹. In contrast, 42 % of the typical swamp forest has experienced carbon loss, releasing -63 tCO₂eq.yr⁻¹.ha⁻¹.

These findings underscore the success and challenges of conservation and land management efforts, which ultimately contribute to enhance forest preservation and reducing carbon emissions.

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Estimation of groundwater recharge in the volcanic Aquifer of Gilgel Gibe catchment, Ethiopia

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KEYWORDS. — Baseflow Separation; Groundwater Recharge; Soil Moisture Balance; Sustainability.

ABSTRACT. — Understanding the aquifer recharge-discharge system of a catchment is a fundament for the efficient use and effective management of groundwater resources. The present study focuses on the estimation of groundwater recharge using Soil Moisture Balance (SMB) and Base Flow Separation (BFS) methods in the Gilgel Gibe catchment where groundwater demand for irrigation, domestic and industrial purposes is dramatically increasing. The demand for groundwater and the existing ambitious plans to respond to it shall put a strain on the groundwater resource in the catchment unless prompt intervention is undertaken to ensure its sustainability. Ground-based hydrometeorological 36 years' data from 17 stations and satellite products from CHIRPS and NASA/POWER were used for the SMB method. These data include rainfall, temperature, wind speed, relative humidity, and solar radiation. Using the graphical, Eckhardt, BFLOW, and PART techniques of BFS through the main catchment and sub-catchments, the groundwater recharge was estimated. The input data for BFS, streamflow, were obtained from the Ministry of Water and Energy. The average annual recharge of groundwater was estimated to be 313 mm by SMB for the years 1985 to 2020 and 314 mm by BFS for the years 1986 to 2003. The result from the SMB method revealed geographical heterogeneity in annual groundwater recharge, varying from 209 to 442 mm. Significant spatial variation is also observed in the estimated annual groundwater recharge using the BFS method, which varies from 181 to 411 mm for sub-catchments. Hydrogeological conditions and the yielding capacity of existing wells across the catchment were assessed to evaluate the validity of the results. The recharge estimated by SMB and BFS methods are comparable and hydrologically reasonable. The findings remarkably provide insightful information for decision-makers to develop effective groundwater management strategies and to prioritize the sub-catchments for immediate intervention to ensure the sustainability of groundwater.

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Geophysics at the frontlines of climate-induced water scarcity

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KEYWORDS. — Climate Change; Hydrogeology; Gravity; Structure; Tunisia.

ABSTRACT. — In the Sahel region of Tunisia, the convergence of water scarcity and climate change is triggering a crisis. Climate change, marked by altered precipitation patterns and rising temperatures, has heightened water scarcity, impacting ecosystems and societies.

The knowledge of the groundwater hydrodynamics in the Sahel region (North-eastern Tunisia) depends on understanding the structural framework under the Quaternary deposits. Thus, a geophysical study was carried out, using an advanced gravity analysis and well logs in this area were applied to outline edges of structural elements. These structures play an important role in the groundwater flow direction.

Processing the data with different filters and using Euler's solutions allowed us to separate the regional - residual parts of the anomalies and to calculate the horizontal gravity gradient. This advanced and in-depth analysis of gravity data and their geological setting has helped to reveal the presence of different structural blocks separated by a set of deep faults of different direction (NE-SW, NW-SE, E-W and N-S). Studying the peculiarities of these revealed geological structures can be a key factor in identifying deep groundwater targets.

The obtained results illustrate the complexity of hydrogeological structures and open up opportunities to assess the impact of fault zones on the regional distribution of aquifers and their recharge processes.

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Human-edible products from Acacias: Overlooked treasures in the arid tropics — A plea for their valorization

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KEYWORDS. — Biodiversity; Drought-Prone Tropics; Ethnobotany; Food Security; Traditional Knowledge;

ABSTRACT. — The arid and semi-arid tropics are ecological security barriers between the deserts and the humid climate areas. They are located in Aridoamerica, outback Australia, South America, Southern Asia, and sub-Saharan Africa, dominated by grasses and shrubs, and characterized by hot weather (mean annual temperature ca. 18°C), short rainy periods (2-4 months/year), and low precipitations (<800 mm/year). People living in those areas are the most vulnerable to climate change and the poorest and most susceptible to food insecurity, representing more than 80 % of undernourished people globally (FAO/IFAD/UNICEF/WFP/WHO, 2023). Amidst the climate crisis, it is crucial to closely limit the expansion of the arid and semi-arid areas and support the livelihood of people living in those regions.

Acacia s.l., a big group of approximately 1500 species and 7 newly refined genera of leguminous plants, have thrived as one of the most dominant components of the vegetation in the arid and semi-arid tropics. They grow as deciduous or evergreen shrubs or trees, are resistant to drought, and have high nitrogen fixation and soil protection capacity, making them the backbone of arid and semi-arid landscapes and privileged plants in agroforestry systems. In addition to their essential ecological functions, they are manifestly potential sources of medicinal and health-promoting food products, which have been overlooked, poorly disseminated, underexplored, and underexploited for a long time. A comprehensive literature review (Drabo *et al.*, 2022) and our research summary (Drabo, 2023) have allowed us to identify several potential food products, including gums or resins, honey, seeds (promising protein alternatives), and feathery shoots (promising healthy vegetables) from native and widespread *Acacia* s.l. plants in the arid and semi-arid tropics. In fact, the dissemination of the food products from Acacias and their nutritional and health benefits could help underpin better environmental stewardship, improve human livelihoods, and foster several Sustainable Development Goals in the arid tropics. Therefore, the purpose of this communication or plea is to highlight the food potential (*i.e.*, food safety, productivity, accessibility, sustainability, economic value, and nutritional and culinary properties) of human-edible products from native Acacias in the arid tropics, hoping to stimulate a concerted research incentive. Besides, this plea also warns against the risks associated with the expansion of exotic species of Acacias.

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Posters

Habitat fragmentation and alien species impacts on biodiversity condition of Ikogosi Ekiti, Southwestern, Nigeria

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KEYWORDS. — Land Management; Biodiversity; Invasive Species; Geospatial Analysis; Tourist Centre.

ABSTRACT. — Ikogosi Ekiti, Ekiti State, Nigeria, is a unique land area of 366 km² characterised by rain-forest vegetation, wildlife resources, warm spring that attract both settlers and tourism industry. The development of Ikogosi Warm Spring has led to biodiversity degradation since the State' creation in 1996. The study assessed land-use/landcover change, habitat fragmentation impacts and exotic species within the Ikogosi environs. Geospatial technique was employed to estimate landcover modification, habitat fragmentation and mosaic configuration. The 30-meter Landsat imageries of TM 1991, ETH+ 2002 and OLI 2015 were digitally processed using Supervised Classification within ArcGis 10.3 environment while Fragstat 4.0 analysed habitat and diversity matrices by creating codes for each cell in the patch-mosaic imageries. Plot-by-Plot of 25 m² dimension was demarcated in-which thirteen sampling plots were inventoried. Also, qualitative survey was conducted on the pattern of biodiversity disturbances and management; 264 copies of questionnaire were successfully retrieved and statistically analysed.

The findings revealed that human-induced activities has resulted in 26 % increase in non-vegetated surface between the periods of 1991 and 2015 with a substantial loss (30 %) of forest cover. The fragmentation metric showed that the Number of Mosaic Patches (NMP) increased in frequency for the years: 1991 (**257**), 2002 (**268**) and 2015 (**281**) while Shannon Diversity Index (SHIDI) decreased by **0.54**, **0.47** and **0.21** for species diversity respectively. Respondents (76 %) affirmed that inhabitants engaged in bush burning and poaching. Respondents (70 %) affirmed that inadequacies in biodiversity conservation policies triggered animal species migration (*e.g. Scotophilus dinganii, Chlorocebus pygerythrus, Epixerus ebii*). Plant inventory identified several exotic plants (*e.g. Ixora coccinea, Heliopsis helianthoides, Pinus sp.*) which have spread in the area.

The tourism developmental processes has triggered deforestation, extinction and exotic plants invasions in Ikogosi. The study concluded that unmonitored anthropogenic activities has adverse effects on species diversity, mosaic connectivity and habitat loss. The study highlighted ecotourism, strict legislation and biodiversity protection as tools for ecological sustainability.

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Pratiques et rendements de carbonisation dans la zone rurale de Lubumbashi en RDC

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MOTS-CLÉS. — Ressources naturelles; Charbon de bois; Monitoring; Lubumbashi.

RÉSUMÉ. — La carbonisation consiste à produire le charbon de bois qui est un combustible solide, à partir d'une matière première qui est le bois. Le rendement de carbonisation est l'appréciation de l'efficacité de ce processus (Schenkel *et al.*, 1997; Louppe, 2014). Le charbon de bois constitue le combustible le plus utilisé par les ménages de la ville de Lubumbashi suite aux problèmes liés à l'approvisionnement en électricité. Il est issu du bassin d'approvisionnement situé aux environs de la ville et qui ne cesse de s'éloigner suite à la déforestation. Ainsi, la présente étude analyse les pratiques des charbonniers de la zone rurale de Lubumbashi et détermine le rendement des meules construites par ces derniers. Un total de 20 producteurs de charbon de bois professionnels ont été enquêtés et suivis à différentes étapes de la production. Il ressort des résultats qu'en moyenne la superficie exploitée par charbonnier durant 1,6 années est de 0,9 ha. Au total, 19 espèces d'arbres ont été utilisées et celles qui constituaient le plus les meules sont le *Julbernardia paniculata*, *Brachystegia spiciformis* et *Brachystegia microphyla*. Ils ont présenté un diamètre de $72,2 \pm 7,0$ cm en moyenne et un taux d'humidité de 25,1 % pour le bois de gros diamètre soit ≥ 96 cm. Les meules construites contenaient $33808,5 \pm 15518,8$ kg de bois pour $3464,6 \pm 1775,1$ kg de charbon de bois produit par meule. Cela montre que les pratiques sont moins efficaces car le rendement est faible (10,2 %). Ces pratiques ne permettent pas une utilisation rationnelle de la ressource bois, et accentuent la déforestation. Enfin, il est nécessaire d'approfondir des recherches sur les techniques améliorées de carbonisation, promouvoir ainsi leur diffusion auprès des charbonniers par des échanges, lors de nos descentes sur terrain. Ce qui va induire le maintien de la forêt ainsi que l'amélioration des revenus des charbonniers.

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Quantification de la déforestation et de la dégradation du miombo dans le bassin de production du charbon de bois (BPCB) à Lubumbashi (RD Congo): ampleur et changement spatiaux entre 1990 et 2022

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MOTS-CLÉS. — Dégradation des forêts; Forêt claire; Charbon du bois; Changement d'occupation du sol.

RÉSUMÉ. — La croissance démographique que connaît Lubumbashi au Sud-Est de la RD Congo entraîne une augmentation des besoins énergétiques menaçant l'équilibre de la forêt claire de *miombo* dans la zone rurale adjacente à la ville. Cette étude quantifie la déforestation du *miombo* dans le BPCB de Lubumbashi à travers la télédétection et l'analyse paysagère. Ainsi, l'analyse des images Landsat de 1990, 1998, 2008, 2015 et 2022, appuyée par l'algorithme du *Random Forest* a montré que le BPCB de Lubumbashi a perdu plus de la moitié de sa couverture forestière entre 1990 (77,90 %) et 2022 (39,92 %), qui a été convertie principalement en savanes boisées (21,68 %), prairies (37,26 %), agriculture (2,03 %) et sol nu - bâti (0,19). La prairie est devenue la nouvelle classe dominante en 2022 (40 %). Par conséquent, le taux de déforestation (-1,51 %) est presque six fois plus élevé que la moyenne nationale (-0,26 %). Cependant, la surface des grandes taches du *miombo* ainsi que la complexité de la forme de ses taches ont été réduites à travers le temps. En raison des activités humaines, la dynamique paysagère est caractérisée par la suppression du *miombo* et la création de savanes boisées, de prairies, des taches d'agriculture, et de sol nu et bâti. Pour inverser la tendance de ces dynamiques, il s'avère urgent de concevoir un plan d'aménagement forestier, qui n'existe pas pour la forêt claire; de développer des alternatives quant aux besoins énergétiques, notamment l'utilisation de l'hydroélectricité et le biogaz produit sur place; et de lutter contre l'agriculture itinérante en appuyant les paysans avec les engrais et les semences améliorées ainsi qu'à l'éducation des communautés locales. Enfin, des études doivent être menées sur l'amélioration génétiques des espèces du *miombo* afin de faciliter leur croissance pour les introduire dans les projets de reboisement.

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“Mother Nature, where have I hurt you and why do I feel your anger in my being?” Ecofeminist issues

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KEYWORDS. — Agronomy; drawing; gender; Uvira; Gatumba.

ABSTRACT. — This research is part of the FluidBorders project, which uses decolonial feminist perspectives, border thinking as well as drawing as a research methodology in the border areas between DR Congo (Uvira) and Burundi (Gatumba) through decolonial feminist perspectives. Uvira and Gatumba regularly experience massive flooding due to overflowing rivers and Lake Tanganyika (Nibigira, 2019). The research question focuses on an ecofeminist analysis of the situation of disaster victims in this area affected by flooding, armed conflict and insecurity. Wambui (2018) considers that there are similarities and common causes between systems of domination and oppression of women, as well as between the system of overexploitation of nature by modern man. Patriarchal ideologies impose themselves to maintain the monopoly of management. Ecofeminism allows us to closely observe the link between nature and the phenomenon of instrumentalization of the colonial gender system and modernism, which subject women and men to the categorization of roles and responsibilities (Hudson, 2016). Preserving “mother nature” however, requires us to rethink relations between genders, as well as between humans and nature. In this crisis management against the “wrath of the waters” in Uvira and Gatumba, our field interviews with evacuees noted that during the last flood of April 2023 gender differences were not brought to the fore, although they still exist in the division of labor that emanates from a capitalist link opposite the gender question.

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Aquifer structure and hydraulic parameters assessment of Jimma area, Ethiopia

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KEYWORDS. — Aquifer Characterization; Jimma Area; Pumping Test; Volcanic Aquifer System.

ABSTRACT. — Jimma area is found in the Oromia regional state of Ethiopia, and is covered by tertiary volcanic rocks. The area is a fast-expanding capital city, which requires a significant water resources potential for water supply. However, still limited studies have been conducted concerning the groundwater potential and its characteristics. The objective of this study is to assess hydraulic parameters and the identification of the structure of the volcanic aquifer system of the Jimma area. In this study, primary and secondary data were used to study the aquifer of the area. Primary data are the collected borehole water levels. While secondary data were used to identify the aquifer structure and hydraulic parameters. Thus, the transmissivity of the aquifer rocks was estimated with the pumping test method using analytical solutions of Theis and Cooper-Jacob for confined aquifers, Neuman for unconfined aquifer systems, and Hantush and Jacob for leaky aquifers. In the study area, hydro-geologically three aquifer types are identified: basaltic; quaternary alluvial deposits; and pyroclastic aquifer system. The pumping test and lithologic borehole log data confirm that the aquifer system is dominantly confined. Leaky and unconfined aquifers were also identified. Detailed investigation of the lithologic borehole data shows that this volcanic aquifer system is a multi-layer aquifer system. The transmissivity T was found to range between $0.25 \text{ m}^2/\text{d}$ and $139 \text{ m}^2/\text{d}$, while the specific capacity Q/s was estimated to range between $0.71 \text{ m}^2/\text{d}$ and $158 \text{ m}^2/\text{d}$. The borehole yield and the calculated transmissivity values indicate that this aquifer system is strongly heterogeneous. With each borehole's specific capacity, the empirical relationship of transmissivity and specific capacity among aquifer parameters is $T = 0.88(Q/s)^{0.98}$ with a correlation coefficient of 0.88. These results could be used as a reference for further investigation for any study of groundwater in the Jimma area.

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Exploring perceptions of Wetland Ecosystem Services (WES) in Africa, methods and tools: A scoping review

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KEYWORDS. — Ecosystem Services (ES); Wetland; Research Method; Africa.

ABSTRACT. — Gaining a comprehensive understanding of the methods and tools employed in studying the perception of ecosystem services (ES) in African wetlands is crucial for identifying the strengths and limitations of various approaches and advancing methodological development. This paper examines scientific literature to explore perceptions of wetland ecosystem services (WES) in Africa. Through analysis and synthesis of existing research, we investigate the factors influencing wetland perceptions of ESs, methodologies employed, and the tools utilized. Our findings reveal commonalities and methodological approaches utilized across diverse African wetland contexts, although no universal tools and parameters exist among all studies. Mixed methods are predominantly employed (85 %) to assess perceptions of WES, including directive approaches and focus group discussions (FGDs). Approximately 33 % of studies evaluate all recognized WES, with provisioning services being the most frequently assessed. These WES evaluations primarily focus on swamps (27 %), palustrines (14 %), and Dambos (9 %), compared to other wetland types. Different target individuals participate in these studies depending on the method employed, with a dominant presence of community members and leaders. Spatial analyses and survey tools are also utilized. Around thirty parameters encompassing socioeconomic and biophysical factors, cultural values, knowledge systems, and ecological indicators are identified as significant influencers of WES perceptions. Interdisciplinary approaches and community engagement are highlighted in most studies. Despite a diversity of contexts, constraints, and weaknesses in approach selection, this paper underscores the necessity for context-specific investigations and provides insights for future research, robust methodologies, and informed wetland management decisions. This work contributes to understanding perceptions of WES in Africa, promoting sustainable management approaches aligned with community needs and values. Notably, the reviewed studies indicate a wide usage of mixed methods (survey-FGD-field observations), with ambiguity regarding the number of individuals involved, duration, and sampling.

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Mapping small inland wetlands in the South-Kivu province by integrating optical and SAR data with statistical models for accurate distribution assessment

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KEYWORDS. — Wetlands; Machine Learning; GIS; Remote Sensing; Kivu Highland.

ABSTRACT. — There are several techniques for mapping wetlands. In this paper, we examined four statistical models to assess the potential distribution of wetlands in the South-Kivu province by combining optical and SAR images. The approach involved integrating topographic, hydrological, and vegetation indices into the four most used classifiers, namely Artificial Neural Network (ANN), Random Forest (RF), Boosted Regression Tree (BRT), and Maximum Entropy (MaxEnt). A wetland distribution map was generated and classified into ‘*wetland*’ and ‘*non-wetland*’. The results showed variations in predictions among the different models. RF exhibited the most accurate predictions, achieving an overall classification accuracy of 95.67 % and AUC and TSS values of 82.4 %. Integrating SAR data improved accuracy and precision, particularly for mapping small inland wetlands. Our estimations indicate that wetlands cover approximately 13.5 % (898,690 ha) of the entire province. BRT estimated wetland areas to be ~16 % (1,106,080 ha), while ANN estimated ~14 % (967,820 ha), MaxEnt ~ 15 % (1,036,950 ha), and RF approximately ~10 % (691,300 ha). The distribution of these areas varied across different territories, with higher values observed in Mwenga, Shabunda, and Fizi. Many of these areas are permanently flooded, while others experience seasonal inundation. Through digitization, the delineation process revealed variations in wetland areas, ranging from tens to thousands of hectares. The geographical distribution of wetlands generated in this study will serve as an essential reference for future investigations and pave the way for further research on characterizing and categorizing these areas. In the following, the aim is to characterize these areas and assess the communities’ perception of the ecosystem services provided.

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Effects of preceding upland rice and manuring on soil properties and cotton yield in the South Sudan area of Burkina Faso

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KEYWORDS. — Cotton; Upland Rice; Crop Rotation; Fertilizer; Acidity.

ABSTRACT. — Cotton is Burkina Faso's main cash crop. It supports around 20 % of the working population. In cotton production systems, the soils were characterised by a pronounced acidification and decline in soil fertility was cited as the main reason for the drop in crop yields. Therefore, the cotton crop sustainability relies on maintaining soil fertility. Improving soil chemical characteristics and obtaining better cotton yields are linked to the crop precedent and the types of manure applied. This study aimed to assess the effects of the preceding upland rice crop and some fertilizers on the cotton productivity. To this end, the test was carried out during the agricultural campaign of 2016 at the Farako-Bâ research station in a split-plot design implanted since 2011 on a tropical ferruginous soil and in a crop rotation system based on cotton. Thus, the main plots were assigned to two crop rotations while six levels of fertilizers were assigned to the subplots. Total rainfall was 917.8 mm received in 57 days during this campaign.

The results showed that soil organic matter and total N levels were respectively 16 % and 33 % higher in the “rice-cotton” rotation compared to the cotton monocropping. Soil acidity was higher (pH 5;58) in the plots fertilized with the recommended mineral fertilizer (14-18-18-6S-1B + urea). The “Burkina phosphate + compost” treatment reduced significantly soil acidity (pH 6;34). Moreover, the association “Burkina phosphate + compost + urea” increased the total P and available K content of the soil by 224 % and 33 % respectively compared with the recommended mineral fertilizer. About the growth and the cotton yield, there are no significant difference between rotations. Only the fertilizer effect was noticeable. The best seed cotton yield (1241 kg ha⁻¹) was obtained with the fertilizer “Burkina phosphate + compost + urea” corresponding to an increase of 9 % compared to the recommended mineral fertilizer. There were no significant interactions between rotations and fertilizers. The fertilizer “Burkina phosphate + compost + urea” could be considered as a cheaper option for correcting of soils acidity and soils nutrients deficiencies, especially phosphorus rate, and hence improving the cotton productivity.

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Mapping the pollution risk of the Mouhoun sub-watershed in Boromo in Burkina Faso

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KEYWORDS. — Cartography; Pollution; Mouhoun; Burkina Faso.

ABSTRACT. — The Mouhoun River sub-watershed at Boromo is strongly impacted by anthropogenic activities leading to intensive exploitation (irrigation, drinking water supply, processing of artisanal gold) of water resources (Kouanda, 2018). Thus, a diagnosis of the impacts of anthropogenic activities, notably gold panning, is necessary for optimal and sustainable management of water resources. This study aimed to gain better knowledge of the potential pollution zones of the Mouhoun River in order to establish a decision support tool for river water management strategies. Thus, GIS combined with runoff data served as methods of spatialization and assessment of the vulnerability of the Mouhoun River to pollution due to gold panning activities. Surveys and discussions with gold miners in the field made it possible to understand the procedures for extracting and processing artisanal gold. Each step of the gold mining and processing procedure has shown negative impacts on the environment in general, and on the water resources of the Mouhoun River in particular. A participatory action plan (religious and customary authorities, gold miners, stakeholders from the ministries concerned, etc.) has been established to better manage and protect the Mouhoun River and its tributaries. This action plan is accompanied by a vulnerability map made by crossing several parameters including slope, land use, runoff, soil type, drainage density using the AHP method. The assessment of the vulnerability map was satisfactory with a consistency index of assessments of 0.06 and a Coherence Ratio $R_c = 4\%$. It shows that 86 % of the basin is classified from very low to low vulnerability, which could be interesting for future pesticide-free agricultural projects. The operationalization of the action plan would make it possible to reduce the costs of treating drinking water at the level of the National Drinking Water Supply Office which supplies the large cities (Koudougou and Boromo) and will also raise the related economy fishing much practiced by the local population.

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Assessment of spring water resource in Jimma zone, Southwestern Ethiopia

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KEYWORDS. — Spring Water; Assessment; Field Campaign; Jimma Zone.

ABSTRACT. — In most African countries, including Ethiopia, spring water is the most reliable source of drinking water. It is insuring water demand for the community in the studied area. The study is important for the protection and sustainability of water resources. This study aimed at the assessment of spring water, spatial distribution, and its controlling factors in Jimma zone. Two seasons of field campaign were conducted to understand temporal and spatial variability of spring discharge. A total of 192 springs were inventoried and mapped, in altitude ranging from 1416m to 3010m. The discharge rate of springs varies from 0.01-7.5l/s. Springs show higher discharge during the rainy season indicating aquifer response to recharge from precipitation (Figure1). Out of the total, 151 springs are perennial and 41 are seasonal. Contact (53.57 %), depression (34.29 %), and fracture springs (12.14 %) are the major types of springs based on geologic condition. Bed rocks for springs' geology are basalt, ignimbrite, trachyte, and alluvial deposits. Springs with the highest discharge are in basaltic lithology followed by ignimbrite and trachyte. Various faults and joints, which are either parallel, perpendicular, or oblique compered to regional structures, were observed. Typical geomorphology set-ups for spring occurrences are slope breaks, valley bottoms, hill sides, flat areas, and riverbanks. The distribution of springs is also controlled by land use, slope gradient and drainage density. Interviews conducted revealed, there are springs which are not adequate during the dry season as the spring discharge decreases and there are water quality problems from old schemes. People's perceptions about the change of volume of spring water, change in rainfall and temperature indicate the local community has climate change awareness. Increasing number of population and decreasing precipitation pattern will cause failure to comply with water demand in future generations.

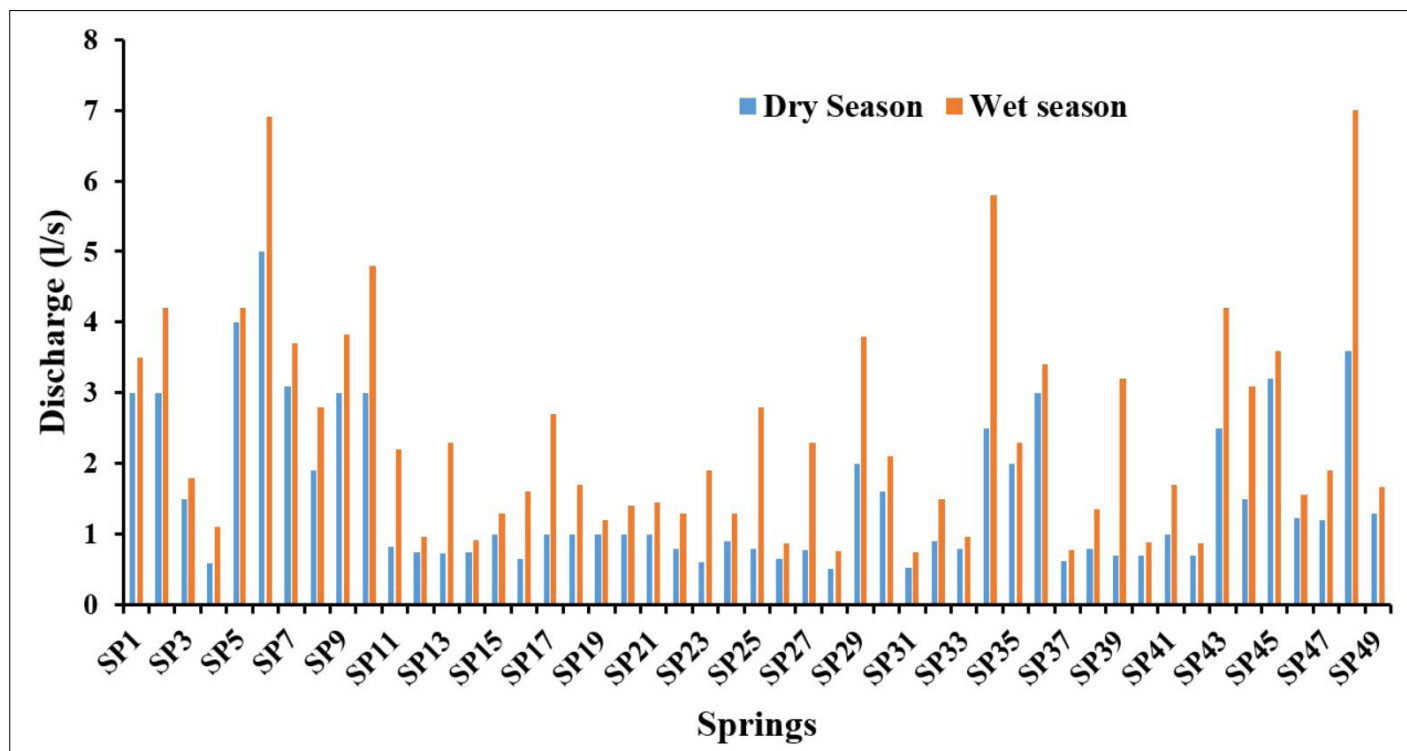


Fig. 1. — Hydrography of spring discharge in dry and wet season.

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Influence of temperature on acute and chronic toxicity of marine algal toxins — A case study with copepod *Nitokra spinipes*

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KEYWORDS. — Climate Change; Harmful Algae; Marine Toxins; Zooplankton.

ABSTRACT. — Harmful algal blooms (HABs) – proliferated algae densities with often a toxin producing ability – have been found increasingly in both northern and southern oceans. Recent studies have established that increasing temperatures contribute to HABs occurrence. But the broader influence of climate change on these outbreaks is less well quantified. Of particular concern is the limited research on HABs toxin effects under varying temperatures, especially concerning zooplankton, a crucial component of aquatic ecosystems. They do not only consume algae but also serve as prey for organisms at higher trophic levels, hence, are pivotal in energy transfer and nutrient cycles in aquatic food webs. Therefore, we examined the impact of marine toxins on marine zooplankton in the context of climate change. We designed a series of laboratory experiments using filtered seawater to assess the toxicity of four commonly occurring algal toxins, purified and sourced from CIFGA Laboratory, on a model organism for ecotoxicological studies, *Nitokra spinipes*, exposed to three different temperatures. We evaluated acute toxicity of domoic acid and yessotoxin, respectively. Adult females were exposed to these toxins at 15, 20, and 25 °C for 48 hours. EC50 values of domoic acid arranged from 11.08 ± 3.81 to 88.51 ± 164.89 µg/L, respectively. Also, juveniles, aged 48 to 72 hours, were exposed at 18, 20, and 22 °C for the same duration. The EC50 of domoic acid in this case arranged from 65.36 ± 10.66 to 102.76 ± 9.52 µg/L. Mortality rates across temperatures showed no significant difference. In chronic toxicity test, larval development ratio (LDR), brood size and inter-brood time of domoic acid, yessotoxin, saxitoxin, and microcystin-LR were examined at 18, 20, and 22 °C. We observed that with increasing temperatures, LDR for domoic acid increased, whereas brood size significantly decreased as toxin concentration rose. While these results are preliminary, they indicate a temperature dependent sensitivity of copepods towards toxins produced by HABs.

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A South Africa biodiversity data pipeline for wetlands and waterbirds

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KEYWORDS. — Freshwater Ecology; Citizen-Science Data; Statistical Analysis; Wetland Ecosystems; Waterbirds.

ABSTRACT. — With ever-increasing pressure globally on freshwater resources and, in particular, on wetlands, there is an urgent need to monitor the status of these ecosystems. In this context, waterbirds often serve as flagship and indicator species for the wetland ecosystems which support them. The South Africa Biodiversity Data Pipeline for Wetlands and Waterbirds (the BIRDIE project, <https://birdie.sanbi.org.za/>), emerges from a collaboration between government, academia, and conservation NGOs, with the overarching objective of serving as a link between South African nation-wide waterbird data collection programmes and conservation managers, researchers and other stakeholders. A key objective of the project is to support South Africa's reporting and implementation of Multilateral Environmental Agreements such as the Convention on Wetlands of International Importance (RAMSAR), the African-Eurasian Migratory Waterbirds Agreement (AEWA), and the Convention on Biological Diversity, in particular, contributing to Red-Listing assessments of waterbird species.

The project uses data from the Coordinated Waterbird Counts (CWAC) and the Southern African Bird Atlas Project (ABAP) to understand the distribution and population dynamics of waterbird species. These citizen-science data are processed with rigorous statistical analysis to gain insights about these processes that raw data might not reveal. CWAC collects abundance data for waterbird species at 688 wetland sites. Since 1992, counts have been done twice a year, in summer and winter, providing good long term records. This information is made available as reports and an interactive map component. This map viewer is also showing the ABAP occupancy models on 144 waterbird species for 16,220 geographical 'pentads'. Since 2007, more than 17 million records have been collected for ABAP with about 2 million more being added each year. The project also aims to support site management and decision making and, in the future, we hope to see the BIRDIE project expand to other regions and integrate with other biodiversity portals to promote a better understanding of the interactions between different taxonomic groups associated with wetlands.

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Equity on the distribution and composition of street trees in the city of San Luis Potosí, México

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KEYWORDS. — Environmental Justice; Urban Forestry; Georeferenced Data; Latin America.

ABSTRACT. — Accelerated urbanization often leads to environmental problems that proportionally affect vulnerable populations the most. This situation calls for the design of cities whose benefits are distributed equally among the entire population; a concept known as Environmental Justice. The ecosystem services provided by urban green spaces are critical to building this resilience. Within these urban green spaces, street trees are the component with which citizens most often come into contact. Despite this importance, street trees are a relatively understudied topic among urban planners and researchers. As a result, street trees are often poorly incorporated into urban planning, risking proportionally more street trees being planted in neighborhoods with higher socioeconomic status (“Luxury Effect”).

We investigated the relationship between socioeconomic characteristics and the distribution and composition of street trees in San Luis Potosí, a city in the semiarid region of Mexico with more than 1.25 million inhabitants. To this end, we identified and geopositioned 65,722 street trees and analyzed their relationship with socioeconomic indicators of each of the 218 Basic Geostatistical Areas (AGEB) in which they were planted. We found that the number of street trees per unit area was positively correlated with the average socioeconomic status of the AGEB. On the other hand, the richness of street trees per capita was highest in AGEBs with the lowest socioeconomic status, suggesting that fewer but more diverse street trees are planted in poor neighborhoods. AGEBs dominated by minority groups (afro descendants and indigenous) had lower street tree abundance and richness per capita, but not per area.

This study is the first in Latin America to confirm a lack of environmental justice and a luxury effect due to an unequal distribution of street trees. Incorporating equitable tree distribution into urban planning is necessary to achieve broader and inclusive environmental justice goals in urban areas.

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Unravelling the diversity and roles of plant volatile organic compounds in the Annonaceae family

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KEYWORDS. — Ecology; Floral Scents; Edible Fruit-Producing Species; Gas Chromatography-Mass Spectrometry (GC-MS); Tropical Rainforests.

ABSTRACT. — Plant volatile organic compounds (VOCs), categorised as secondary metabolites, are essential in ecology. The Annonaceae family of diverse flowering plants in tropical rainforests exhibits dynamic scents (Chatrou *et al.*, 2012; Goodrich, 2012). Focusing on edible fruit-producing species like *Annona glabra*, *Annona muricata*, *Annona reticulata*, and *Annona squamosa*, the research aims to identify unique volatile compounds in their flowers and leaves, uncover the specific compounds responsible for distinct scents, and understand their established roles in pollination and protection. In Bangladesh, a tropical country renowned for its abundant plant diversity, fragrance samples were collected at the full blooming stage using dynamic head-space sampling techniques. Three flowers and three leaves from each species were selected for sampling. The collected samples were then analysed using Gas Chromatography-Mass Spectrometry (GC-MS) at Ghent University. A total of 32 distinct volatile compounds were characterised based on their biosynthetic pathways, mainly esters, alkanes, aldehydes, and alcohols derived from fatty acids. A good number of terpenoid-derived monoterpenes and sesquiterpenes were also detected, along with benzenoid-derived compounds. Various *Annona* species, distinguished by their scents as perceived by humans, exhibited specific compound preferences: *A. reticulata*, *A. squamosa*, and *A. glabra* flowers emitted a sweet fruity aroma, dominated by fatty acid esters. *A. muricata* flowers, emitting a strong, sour fruity odour, were rich in terpenoids. In leaves, terpenoids were prominent in *A. reticulata* and *A. squamosa*, fatty acid esters in *A. glabra*, and benzenoid compounds in *A. muricata*. Fragrances containing fatty acids and benzenoids attract pollinators, supporting reproduction, while terpenoids in VOCs aid plants in resilience against drought, heat, and pests (Abbas *et al.*, 2022; Bae *et al.*, 2019). Thus, understanding the role and diversity of VOCs is vital for biodiversity conservation. This study paves the way for future research to unravel the precise roles of these unique compounds in individual plant species.

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INDEX

A

Aniramu, Opeyemi	27
Annys, Sofie	8
Astuti, Anik Juli Dwi	15

B

Balegamire Karuta, Christelle	30
Biah, Ibitoyé	22
Birhanu, Adugnaw	21
Bollen, Robrecht	18

C

Charrek, Khaoula	24
------------------	----

D

Diessana, Arthur	34
Drabo, Moustapha Soungalo	25

F

Fourchault, Léa	13
-----------------	----

G

Géant, Chuma B.	32, 33
Ghaib, Marwa	14
Gudeta, Beekan Gurmessa	17

J

Jannat-E-Tajkia	40
-----------------	----

K

Kabore, Harouna	35
Kasanda Mukendi, Nathan	28
Kedebe, Adisu Befekadu	36
Khoji Muteya, Héritier	29
Kitessa, Wagari Mosisa	31

L

Liu, Wenxin	37
-------------	----

N

Ngongo, Jean Pierre	9
---------------------	---

R

Raick, Xavier	20
Ramírez-Castillo, Luis Emir	39
Roy Chaudhuri, Nairita	11

S

Saha, Krishna Kumar	10
Strobbe, Francis	38

T

Tufa, Fayera Gudu	23
-------------------	----

W

Wolswijk, Giovanna	16
--------------------	----

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